INTERNATIONAL SOCIETY FOR
ISMRM
MAGNETIC RESONANCE IN MEDICINE

PROCEEDINGS

of the

International Society for Magnetic Resonance in Medicine

ELEVENTH SCIENTIFIC MEETING AND EXHIBITION
Toronto, Ontario, Canada
10-16 July 2003

ISSN NUMBER 1545-4428

OPENING SESSION

Hall F/G 07:45 – 08:20

07:45 **Welcome and Medal Presentations**
Richard L. Ehman, President

SEVENTH ANNUAL LAUTERBUR LECTURE

Hall F/G 08:20 – 09:00

08:20 **The Legacy of I.I. Rabi**
Norman F. Ramsey[1]
[1]Harvard University, Cambridge, Massachusetts, USA

The Toronto Keynote Lecture

Hall F/G 09:00 - 09:25

09:00 ***1***. **Future Directions in Funded Biomedical Imaging Research**
Roderic I. Pettigrew[1]
[1]National Institutes of Health, National Institute of Biomedical Imaging and Bioengineering, Bethesda, Maryland, USA

The landscape of biomedical research is undergoing a significant change consequent to the merger of technology and biomedicine. At the intersection of these scientific fields is the promise of new fundamental discoveries and significant progress in the understanding and management of disease. The recent creation of the National Institute of Biomedical Imaging and Bioengineering is in large part a response to this evolutionary landscape change toward technology enabled biomedical research and the promise of realizing a significant positive impact on the world's health care agenda.

PLENARY LECTURES
Imaging in Chronic Disease

Hall F/G 09:25 - 10:15 Chairs: Garry Gold and Clifford R. Jack

Educational Objectives
Upon completion of this session, participants should be able to:

- Recognize the role played by imaging in the treatment and monitoring of chronic diseases such as epilepsy, Alzheimer's, and arthritis;
- Evaluate the advances in MRI that allow for improved assessment of chronic disease;
- Recommend new MRI techniques for studying chronic disease at their institution;
- Interpret new techniques, such as spectroscopy and T_2-mapping, in the evaluation of chronic disease.

09:25 ***2.*** **MRI/MRS of Neurodegenerative Disease and Epilepsy**

Michael Weiner[1]
[1]University of California, San Francisco, California, USA

This talk will review MRI/S for diagnosis, prognosis, therapy monitoring, and investigation of neurodegeneration and epilepsy. Neurodegenerative diseases are characterized by loss of nerve cells including: Alzheimer's disease, vascular dementia, frontotemporal dementia, Lewy Body dementia, ALS, Parkinsons's disease, and other conditions. There are many types of epilepsy, all characterized by the common manifestation of seizures. Neurodegenerative diseases are frequently not detected by radiologists, because they often do not produce distinctive lesions or other obvious abnormalities. However, these conditions do produce changes of brain structure, perfusion, diffusion, and metabolites which are detected by a variety of MR techniques.

09:50 ***3.*** **The Burden of (Musculoskeletal) Disease: Challenges in Imaging**

Maarten Boers[1]
[1]VU University Medical Center, Amsterdam, Netherlands

Musculoskeletal disorders are the most common causes of severe long-term pain and physical disability affecting millions worldwide. Their impact on society and health care is large and not fully recognized. New imaging technologies such as MRI can play a pivotal role in improving this situation. However, applicability must be assessed in each setting by documenting truthfulness, discriminatory power and feasibility. In muscoloskeletal disorders the applicability of MRI in basic and applied research is quickly increasing, but still limited in routine patient care.

Physiology, Disease, and Drug Abuse

Room 718A 11:00 - 13:00 Chairs: Dorothée Auer and Linda Chang

11:00 ***4.*** **Imaging of Axonal Discharge in the Brain**

Chi Chen[1], *Robert R. Edelman*[1]
[1]Evanston Northwestern Healthcare & Northwestern University Feinberg School of Medicine, Evanston, Illinois, USA

Although several imaging methods are available to depict gray matter activation, the detection of activity in the white matter has proved elusive. Reported is the first demonstration of "white matter activation". The method is based on the hypothesis that membrane water permeability/transport changes associated with axonal depolarization wave propagation can be detected in altered diffusional anisotropy. The hypothesis was tested using a variation of diffusion tensor imaging in six volunteers with a block design paradigm. Task activation reduced diffusional anisotropy in the expected white matter locations, providing a direct imaging indicator of neuronal activation.

11:12 ***5.*** **Thalamo-Cortical Synchronization Across The Sleep-Wake Cycle**

Michael Czisch[1], *Renate Wehrle*[1], *Christian Kaufmann*[1], *Thomas C. Wetter*[1], *Florian Holsboer*[1], *Thomas Pollmächer*[1], *Dorothee P. Auer*[1]
[1]Max-Planck-Institute of Psychiatry, Munich, Germany

Upon acoustic stimulation, negative BOLD responses of varying extent and intensity can be observed in simultaneous EEG/fMRI experiments during sleep. During nonREM sleep this deactivation can be regarded as a sleep protective mechanism. For tonic and phasic REM sleep deviant (de-)activation patterns can be found which resemble wakeful-like activity during tonic REM and which show negative BOLD responses including thalamic deactivation during phasic REM. Functional connectivity maps show a highly synchronized thalamo-cortical network which can be exclusively been observed in REM episods.

11:24 ***6***. A Significant Effect of Fat Ingestion on Brain BOLD Response

Jeff Alfonsi[1], Sonya Bells[1], Michael D. Noseworthy[1]
[1]The Hospital for Sick Children, Toronto, Ontario, Canada

There is a considerable degree of between and within-subject heterogeneity in fMRI. One variability source is a subjects's physiologic state. We hypothesized that ingesting fat could alter BOLD signal due to vasoactive effects of certain fatty acids. Fasted subjects performed bilateral finger tapping before, 40 minutes, and 100 minutes following ingestion of a controlled fatty meal. A time and dose dependent decrease in the number of significantly activated motor cortex voxels was observed. We suggest a priori knowledge of a subject's physiologic state could help in reducing fMRI between subject heterogeneity.

11:36 ***7***. An fMRI Study of the Cortical Activity Associated With the Subliminal Domain of Visceral Stimulation

Mark Kern[1], Reza Shaker[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Brain activity during rectal distension at perceived and subliminal levels has received limited systematic evaluation. In the present study, fMRI was used to detect cortical activity over the range of rectal distension pressures that are not perceived but nonetheless elicit cortical activity. Along with defining the domain of subliminal distension pressures, the cortical activity associated with perceived distension was shown to significantly increase cortical recruitment after repeated subliminal distensions. These findings have relevance in dissecting peripheral and central influences on visceral stimulation in patients suffering from functional bowel disorders such as irritable bowel syndrome.

11:48 ***8***. Alcohol Intoxication Effects On A Visual Perception Task: An fMRI Study

Vince D. Calhoun[1], David Scott[2], David Altschul[2], Regina Shih[2], Godfrey D. Pearlson[1]
[1]Olin Neuropsychiatry Research Center/Yale University, Hartford, Connecticut, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

We studied the effects of two doses of alcohol on the neural correlates of a visual perception task. Analysis revealed robust activation in visual/visual association areas, frontal eye field/dorsolateral prefrontal cortex (DLPFC) and the supplemental motor area. EtOH resulted in a dose dependent activation amplitude decrease over much (but not all) of the visual perception network and resulted in a decrease in the maximum contrast-to-noise-ratio. Significant dose-dependent increases were observed in insula, DLPFC, and precentral regions whereas dose-dependent decreases were observed in cingulate, precuneus, and middle frontal areas. Alcohol thus appears to have both global and local effects.

12:00 ***9***. Acute Effects of Cocaine in Lower Human Brain: An fMRI Study

Peter Rae Kufahl[1], Zhu Li[1], Robert Risinger[1], Charles Rainey[1], Gaohong Wu[1], Shi-Jiang Li[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

This FMRI study used controlled doses of cocaine to induce BOLD signal changes in the human orbitofrontal cortex and other parts of the lower brain believed to be associated with chronic drug abuse. The MESBAC pulse sequence was used to compensate for signal distortion that had previously made pharmacological FMRI study of the orbitofrontal cortex unreliable. Nonparametric statistical tests showed significant cocaine-induced activation patterns across nine different subjects imaged at 1.5 Tesla.

12:12 ***10***. Decreased Brain Activation and Deactivation During Visual Attention in HIV Patients

Linda Chang[1], Sheeba Arnold[1], Dardo Tomasi[1], Elisabeth C. Caparelli[1], Dana Carasig[1], Lisa Zimmerman[1], Christine Cloak[1], Thomas Ernst[1]
[1]Brookhaven National Laboratory, Upton, New York, USA

HIV patients commonly have attention and concentration problems. Functional MRI was performed in 18 men [9 HIV and 9 seronegative controls] during visual attention tasks. Despite similar performance accuracies, HIV patients showed decreased parietal and cerebellum activation, and less dorsal frontal deactivation during visual attention tasks. These findings suggest HIV- associated brain injury may lead to less efficient allocation of neural resources, with reduced deactivation of the frontal brain regions, during attention-requiring tasks. In contrast, seronegative subjects were able to perform the tasks using brain regions optimized for visual processing (parietal cortex and cerebellum) and suppress dorsal frontal activation.

12:24 ***11***. Head Motion During fMRI in a Longitudinal Stroke Recovery Study

Fred Tam[1], Simon Graham[1], Sandra Black[1], Richard Staines[2], William McIlroy[3]
[1]Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada; [2]York University, Toronto, Ontario, Canada; [3]University of Toronto, Toronto, Ontario, Canada

Despite many advances, motion artifacts remain a serious problem in fMRI of some clinical populations. To characterize head motion in stroke patients, retrospective motion estimates were examined from the fMRI sessions of a large, ongoing longitudinal study of somatosensory and motor recovery. Preliminary results suggest age, low motor function, and fMRI inexperience may be associated with increased motion. A significant interaction was also observed between functional task type and the side of the body examined. As the longitudinal study unfolds, this analysis will be used to guide task design, monitor data quality, and select candidates for fMRI.

12:36 *12*. fMRI 'Deactivation' of the Posterior Cingulate during Generalized Spike and Wave

John S. Archer[1], David F. Abbott[1], Anthony B. Waites[1], Graeme D. Jackson[1]
[1]Brain Research Institute, Melbourne, Australia

Using spike triggered fMRI, we demonstrate regional Blood Oxygen Level Dependent (BOLD) signal changes associated with spontaneous generalised spike and wave discharges (S&W). Five adults with Idiopathic Generalised Epilepsy with frequent S&W were studied. EEG was recorded inside a three tesla MRI, allowing acquisition of single, whole brain fMRI images following S&W. Significant S&W related BOLD signal reductions were observed in the posterior cingulate. Some signal increases were seen in the depths of the pre-central sulci, but not in the thalamus. The posterior cingulate may have a special role in the electroclinical phenomenon of S&W and 'absence'.

12:48 *13*. Spinal fMRI of Spinal Cord Injury in Human Subjects

Patrick W. Stroman[1], Victoria Krause[1], Krisztina L. Malisza[1], Jennifer Kornelsen[2], Amanda Bergman[2], Jane Lawrence[2], Boguslaw Tomanek[1]
[1]Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]University of Manitoba, Winnipeg, Manitoba, Canada

The reliability of spinal fMRI methods for detecting areas of activity in spinal gray matter has been demonstrated. Here, spinal fMRI is applied to the first study of spinal cord injury. The lumbar spinal cord was studied inferior to the injury in order to investigate tissues that were undamaged by the original injury. Neuronal activity was consistently detected, and demonstrated diminished sensory activity but apparently enhanced activity related to motor reflexes to withdraw from the sensation. However, the signal intensity change response to different temperatures was essentially identical to that observed in non-injured subjects.

CLINICAL CATEGORICAL COURSE
Cardiovascular MR Imaging

Room 718B 11:00 – 13:00 Chairs: Zahi A. Fayad, Christopher Kramer, and P.V. Prasad

Educational Objectives
Upon completion of this course, participants should be able to:
- Describe basic areas of routine and promising clinical use of MR in assessing cardiovascular disease;
- Apply MR protocols for determination of crdiac morphology, dynamic function, flow, and physiologic status;
- Describe methodologies that help in the interpretation of results for cardiac MR assessment of acquired and congenital cardiac disease;
- Compare approaches for optimal presentation and analyais of cardiac MR results.

11:00 **Introduction to Cardiac MR**
Jörg Barkhausen

11:25 **Assessment of Myocardial Function, Rest, and Stress**
Christopher Kramer

11:50 **MR Coronary Angiography**
Debiao Li

12:15 **Assessing Myocardial Perfusion**
Steven D. Wolff

12:40 **Discussion**

13:00 Adjournment

Parallel Imaging Techniques

Room 701A 11:00 - 13:00 Chairs: Peter Kellman and Klaas Prüssmann

11:00 ***14***. **Minimum-Norm Reconstruction for Optimal Spatial Response in High-Resolution SENSE Imaging**

Jeffrey Tsao[1], Javier Sánchez[2], Peter Boesiger[1], Klaas P. Pruessmann[1]
[1]ETH and University of Zurich, Zurich, Switzerland; [2]Hospital General Gregorio Marañón, Madrid, Spain

High-resolution images reconstructed with Cartesian SENSE may suffer from residual aliasing artifacts, even if there are no errors in the sensitivity maps. These artifacts occur when the coil sensitivities rise sharply such that the side lobes of the spatial response function are no longer negligible. The artifacts scale with the acquired voxel size, so they become more prominent if k-space is partially zero-filled (even at 50%). In this work, we discuss the origin of these artifacts and propose the minimum-norm least-squares reconstruction to eliminate them.

11:12 ***15***. **Improved Initialization of the Iterative Reconstruction for Sensitivity-Encoded Non-Cartesian Imaging**

Holger Eggers[1], Peter Boernert[1], Peter Boesiger[2]
[1]Philips Research, Hamburg, Germany; [2]Swiss Federal Institute of Technology Zurich and University of Zurich, Zurich, Switzerland

A strategy for accelerating the convergence of the conjugate gradient method used to reconstruct images from sensitivity-encoded data sampled on arbitrary k-space trajectories is proposed. It applies the principle of localizing the coil sensitivities to the calculation of a starting image. This starting image replaces the zero image employed to initialize the conjugate gradient method so far. The required number of iterations, and with it the running time of the reconstruction, is shown to decrease thus.

11:24 *16*. MR Imaging via non-Fourier Encoding and Multiple Receiver Coils

Dimitris Mitsouras[1], William Scott Hoge[2], Alan Edelman[1], Gary P. Zientara[2]
[1]MIT Laboratory for Computer Science, Cambridge, Massachusetts, USA; [2]Brigham and Women's Hospital, Boston, Massachusetts, USA

We describe a general framework combining parallel imaging with non-Fourier encoding, yielding super-linear acquisition speedups. The approaches are complementary, given that the non-Fourier encoding and parallel data decoding steps are physically and algebraically separable. Furthermore, parallel imaging compacts the space that needs to be encoded via excitations. This allows a speedup of the excitation of the spatially selective encoding profiles, further improving the applicability of non-Fourier encoded MRI. We demonstrate 2-16x speedups using near-optimal non-Fourier encoding coupled with SMASH, SENSE and Space-RIP, acquired on a typical 4-element phased array coil system.

11:36 *17*. Combining 2D RF Excitation, Parallel Imaging and UNFOLD

Bruno Madore[1], Lei Zhao[1], Lawrence P. Panych[1]
[1]Harvard Medical School, Brigham and Women's Hospital, Boston, Massachusetts, USA

In many dynamic applications, acquisition speed remains a critical issue. We consider here three different approaches at fast imaging: parallel imaging, UNFOLD and 2D RF excitation. Previous works have shown how to combine UNFOLD with either parallel imaging or 2D RF excitation. We go one step further here, as we explore how to fuse the three methods together. Results are shown where the FOV was fitted to a small anatomical feature, the descending aorta, allowing temporal resolution to be increased by 5.5 fold. The method will be used to improve temporal resolution in aortic blood velocity measurements.

11:48 *18*. Controlled Aliasing In Parallel Imaging (CAIPI) for Multi-slice Imaging

Felix Breuer[1], Martin Blaimer[1], Mark A. Griswold[1], Peter M. Jakob[1]
[1]University of Wuerzburg, Wuerzburg, Germany

A new approach for multi slice parallel imaging has been applied by exciting several slices simultaneously while using a different phase cycle for different slices, leading to a controlled aliasing artifact in reduced data sets. In contrast to conventional methods with this technique, even folded images which have essentially identical coil sensitivity profiles can be separated by using adapted, reordered coil sensitivity profiles.

12:00 *19*. Phase-Constrained Parallel MR Image Reconstruction: Using Symmetry to Increase Acceleration and Improve Image Quality

J. D. Willig-Onwuachi[1], E. N. Yeh[2], A. K. Grant[1], M. A. Ohliger[2], C. A. McKenzie[1], D. K. Sodickson[1]
[1]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, USA; [2]Harvard-MIT Division of Health Sciences and Technology, Boston, Massachusetts, USA

A generalized method for phase-constrained parallel magnetic resonance image reconstruction is presented. This method can be used to reconstruct traditional partial-Fourier data as well as trajectories not simply handled by partial-Fourier approaches, including variable-density (self-calibrating) trajectories for parallel imaging. For full-Fourier applications, use of data symmetry results in reduced noise multiplication and higher achievable acceleration factors. In some circumstances, this new method allows a near doubling of achievable acceleration, even enabling acceleration factors larger than the number of array elements. At fixed acceleration factors, this phase-constrained method shows improved g-factor and signal-to-noise ratio compared with standard generalized encoding matrix methods.

12:12 *20*. Noise in Transmit SENSE

Ulrich Katscher[1], Peter Boernert[1]
[1]Philips Research Laboratories, Hamburg, Germany

“Transmit SENSE” adapts ideas of parallel imaging to RF transmission. Using multiple independent transmit coils, the duration of spatially-selective multidimensional RF pulses can be reduced, while the spatial definition of the pulse profile is maintained. This study discusses possible noise sources within Transmit SENSE and its influence on the resulting excitation pattern. The understanding of this subject can help in the design of optimized transmit coils and in improving the performance of Transmit SENSE. It is shown that the freedom in designing coil arrays is much larger in Transmit SENSE than in conventional “receive” SENSE.

12:24 *21*. Generalized Noise Analysis for Magnitude Image Combinations in Parallel MRI

E N. Yeh[1], C A. McKenzie[2], A K. Grant[2], M A. Ohliger[1], J D. Willig-Onwuachi[2], D K. Sodickson[2]
[1]Harvard-MIT Divison of Health Sciences and Technology, Boston, Massachusetts, USA; [2]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, USA

A general noise analysis methodology is described for sum-of-squares combinations of complex MR images. Existing theoretical analysis methods have assumed that noise in various component coil images is uncorrelated and of identical variance. Both assumptions are violated when component coil images are reconstructed using parallel imaging, making it impossible to quantitatively compare magnitude images reconstructed by different parallel imaging techniques. The proposed method enables explicit computation of g-factors for sum-of-squares-combined parallel MR images. For PARS (Parallel imaging with Augmented Radius in k-Space), the optimal k-space radius for image reconstruction is predicted based upon the computed g-factor maps.

12:36 *22.* Highly Parallel Volumetric Imaging with Accelerated Spatial Encoding along Two Dimensions

Yudong Zhu[1], Christopher Hardy[1], Randy Giaquinto[1], Kenneth Rohling[1], Charles Dumoulin[1], Daniel Sodickson[2], Michael Ohliger[2], Robert Darrow[1], Gontran Kenwood[1]
[1]GE Global Research Center, Schenectady, New York, USA; [2]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, USA

Improving imaging speed by parallel acquisition can be an SNR-limited process. Practical parallel imaging at high accelerations requires the design of many-element arrays with sufficient intrinsic SNR and spatial encoding capabilities to offset acquisition- and reconstruction-related SNR losses. We present a method and apparatus that addresses the SNR challenge at high acceleration by exploiting multidirectional acceleration in combination with the noise averaging advantages of volumetric imaging. A 32-element array and a supporting acquisition system were built. In vivo images with nine-fold acceleration were obtained to validate the method and the system.

12:48 *23.* Single Echo Acquisition (SEA) MR Imaging

Steven M. Wright[1], Mary Preston McDougall[1], David G. Brown[1]
[1]Texas A&M University, College Station, TX, USA

Improvements in gradient technology and pulse sequences have led to dramatic decreases in imaging times. Concerns over potential biological effects, as well as the cost of improved gradient technology, have driven research in parallel imaging methods in which radio-frequency coils are used for partial spatial encoding. This abstract describes MR imaging without phase encoding, in which an entire image is formed from simultaneous reception of a single echo from an array of 64 receiver coils. Single Echo Acquisition (SEA) imaging has the potential to provide unprecedented frame rates, in principle limited only by the echo spacing.

Epilepsy: MR Imaging, Spectroscopy, and Image Analysis

Room 701B 11:00 - 13:00 Chairs: Walter Kucharczyk and David J. Mikulis

11:00 *24.* Automated Detection of Focal Cortical Dysplasia based on Textural, Statistical and Morphological Analysis of MRI

Samson B. Antel[1], Neda Bernasconi[1], Louis D. Collins[1], Robert E. Kearney[2], Douglas L. Arnold[1], Andrea Bernasconi[1]
[1]Montreal Neurological Institute and McConnell Brain Imaging Centre, Montreal, Quebec, Canada; [2]McGill University, Montreal, Quebec, Canada

An automated classifier to identify focal cortical dysplasia in patients with epilepsy was developed. The classifier was trained on 3D maps of first-order statistical and morphological models based on MRI characteristics of focal cortical dysplasia and 3D second-order maps constructed from second order texture analysis. Lesions were found in 15/18 patients. No lesional areas were identified in controls.

11:12 *25.* Combined ^{1}H and ^{31}P Spectroscopic Imaging in Patients with Temporal Lobe Epilepsy : Evaluation of Neuronal Loss and Bioenergetic Impairment

Hoby P. Hetherington[1], Jullie W. Pan[1], Cynthia Pan[1], Borris Heifets[1], Jung Kim[2], Dennis D. Spencer[2]
[1]Albert Einstein College of Medicine, Bronx, New York, USA; [2]Yale University, New Haven, Connecticut, USA

Previous work has demonstrated that 1H spectroscopic imaging (SI) provides a sensitive method for localizing the epileptogenic region in patients with mesial temporal lobe epilepsy (mTLE). The reversibility of NAA losses in the contralateral lobe with successful surgery, has suggested that a significant portion of the NAA alterations are not due solely to neuronal loss. These alterations have been linked with neuronal mitochondria, the site of NAA synthesis. To investigate the relationship between bioenergetics and neuronal loss/damage in mTLE we correlated 1H SI, 31P SI and neuronal counts from mTLE patients.

11:24 *26.* Magnetic Resonance Spectroscopy and Imaging of the Thalamus in Idiopathic Generalized Epilepsy

Andrea Bernasconi[1], Neda Bernasconi[1], Jun Natsume[1], Samson B. Antel[1], Frederick Andermann[1], Douglas L. Arnold[1]
[1]Montreal Neurological Institute and McConnell Brain Imaging Centre, Montreal, Quebec, Canada

We assessed thalamic chemical and structural integrity in 20 patients with idiopathic generalized epilepsy (IGE) using proton MRS and volumetric MRI. Compared to a group of healthy subjects, IGE patients showed a significant reduction of thalamic NAA/Cr. We found a negative correlation between thalamic NAA/Cr and duration of epilepsy. On the other hand, mean thalamic volume in IGE patients was not different from that of healthy controls. These findings indicate progressive thalamic neuronal dysfunction in patients with IGE, supporting the notion of abnormal thalamo-cortical circuitry as a substrate of seizure generation in this form of epilepsy.

11:36 *27.* Memory Performance and Magnetic Resonance Spectroscopy of the Temporal Lobes in Idiopathic Generalised Epilepsy

Jon Mark Dickson[1], Steve J. Howell[2], Paul Griffiths[1], Richard A. Grunewald[1], Iain Wilkinson[1]
[1]The University of Sheffield, Sheffield, England, UK; [2]The Royal Hallamshire Hospital, Sheffield, England, UK

The relationship between memory function and neuronal integrity in the medial temporal lobes was investigated using neuropsychology and magnetic resonance spectroscopy in 17 patients with idiopathic generalised epilepsy and 12 healthy control subjects. All underwent long echo-time, single-voxel proton spectroscopy at 1.5T. There was a correlation between memory function and N-acteyl/(choline+creatine) ratio in the medial temporal lobes of people with idiopathic generalised epilepsy, but not in the healthy control group. This supports the hypothesis that memory deficits in idiopathic generalised epilepsy are associated with metabolic neuronal dysfunction in the medial temporal lobes of the brain.

11:48 *28.* Decreased N-acetyl-aspartate Levels Reflect Mitochondrial Dysfunction Rather Than Neuron Loss in the Epileptogenic Human Hippocampus.

Ognen A. C. Petroff[1], Laura D. Errante[1], Jung H. Kim[1], Dennis D. Spencer[1]
[1]Yale University, New Haven, Connecticut, USA

The N-acetyl-aspartate (NAA) concentrations and the NAA/total creatine (NAA/TCr) ratios were measured in the hippocampus of 14 patients with mesial temporal lobe epilepsy (MTLE). Perchloric-acid extracts were analyzed by high-resolution proton MRS. Adjacent slices were used for quantitative histopathology. Neuron loss accounted for <1% the variance of NAA and <16% of NAA/TCr. There were no associations with glial density. Significant associations were seen between hippocampal NAA and neocortical NAA and hippocampal TCr and between neocortical NAA and TCr. The decrease in NAA in the epileptogenic human hippocampus primarily reflects mitochondrial dysfunction rather than neuron loss or gliosis.

12:00 *29.* The Temporal Distribution of Epileptiform Discharges as a Predictor of the BOLD Response in EEG-fMRI

Yi Ching Lynn Ho[1], Afraim Salek-Haddadi[2], Beate Diehl[2], Louis Lemieux[2]
[1]National Neuroscience Institute, Singapore, Singapore; [2]Institute of Neurology, University College London, London, UK

The relationship of the BOLD response to epileptiform discharges in EEG-fMRI experiments is currently unclear. Using simultaneous and continuous EEG-fMRI, we investigated the correlation between the temporal distribution of interictal epileptiform discharges (IEDs) and how well the BOLD response can be detected and estimated. We calculated the detection and estimation efficiencies of the IED distributions and correlated them with the peak BOLD response levels using data from five patients with idiopathic generalised epilepsy (IGE). Though there were positive trends, correlations between the efficiencies and the activation statistical scores did not reach significance.

12:12 *30.* Anterior Mesiotemporal Lobe Activation Detected with fMRI : Preliminary Results in Healthy Volunteers and Temporal Lobe Epilepsy Patients

Karel Deblaere[1], Ann Tieleman[1], Pieter Vandemaele[1], Kristl Vonck[1], Guy Vingerhoets[1], Paul Boon[1], Eric Achten[1]
[1]Ghent University Hospital, Ghent, Belgium

In this study we asses the reproducibility of hippocampal and anterior mesiotemporal lobe fMRI activation in healthy subjects using a variable length block paradigm, as previously suggested by Moritz et al. This design combines the power of a classic block design with the accuracy of event-related fMRI.In all eight healthy volunteers demonstrated strong symmetrical activation foci in the anterior mesial temporal lobe (MTL), especially in parahippocampal gyrus and anterior fusiform gyrus. Hippocampal activation foci were present in all subjects, without clear lateralisation.Preliminary results in four TLE patients are reported and compared with the results of the Wada test.

12:24 *31.* T_2 Relaxometry of Deep Nuclei in Partial Epilepsy of Different Origins

Regula Sofia Briellmann[1], Gaby Pell[1], Ari Syngeniotis[1], David F. Abbott[1], Graeme D. Jackson[1]
[1]Brain Research Institute, Heidelberg West, Victoria, Australia

T2 relaxometry (T2-R) at a 3T GE system using a 10-slice sequence with eight echos (TE 28ms -231ms) was performed in 35 controls and 28 patients with partial epilepsy (12 with hippocampal sclerosis (HS), 16 without HS). Deep nuclei were assessed with ROI and SPM approaches. T2 values were increased in the hippocampus, anterior temporal lobe and amygdala in both patient groups, patients without HS had also increased T2-R in the caudate, putamen and pallidum. Thus, T2 increase is not restricted to the ipsilateral hippocampus in HS.

12:36 *32.* A Population-Based Longitudinal Volumetric MRI Study in Epilepsy

Rebecca SN Liu[1], Louis Lemieux[1], Gail S. Bell[1], Sanjay M. Sisodiya[1], Simon D. Shorvon[1], Josemir WAS Sander[1], John S. Duncan[1]
[1]Institute of Neurology, London, UK

Whether cerebral damage results from epileptic seizures remains a contentious issue. We report on the first longitudinal community-based quantitative MRI study to investigate the effect of seizures on the hippocampus, cerebellum and neocortex. Automated and manual measurement techniques were used to identify changes in brain volume in patients with chronic epilepsy, newly diagnosed seizures and control subjects who underwent two magnetic resonance imaging (MRI) brain scans 3.5 years apart. Overall, rates of hippocampal and cerebral atrophy were primarily determined by age and were not significantly different between the three subject groups.

12:48 **33.** **H-MRS and MRI Correlates of the Clinical Response to Radiosurgical Amygdalohippocampectomy**

Iain D. Wilkinson[1], Jeremy Rowe[1], Andras A. Kemeny[1], Sanjoy Nagaraja[1], Paul Vaughan[1], Mathias Radatz[1], Lee Walton[1], Paul D. Griffiths[1]
[1]University of Sheffield, Sheffield, UK

Radiosurgery has been proposed as an alternative to open surgical resection in the treatment of Ammon's horn sclerosis and intractable temporal lobe epilepsy. This study sought to compare longitudinal MRI and H-MRS with clinical response in 8 patients undergoing this procedure. A latency with the clinical effect of radiosurgery of up to 2 years matched the appearance and subsequent diminution of imaging features suggestive of vasogenic oedema. Spectroscopic findings that could represent neuronal loss and gliosis were present.

Cancer: MR Imaging of Model Systems

Room 714 A/B 11:00 - 13:00 Chairs: Zaver M. Bhujwalla and Dominick McIntyre

11:00 **34.** Young Investigator Awards Finalist: **Magnetic Resonance Image Guided Proteomics of Human Glioblastoma multiforme**

Susan Hobbs[1], Gongyi Shi[1], Ronald Homer[1], Griff Harsh[1], Scott Atlas[1], Mark Bednarski[1]
[1]Stanford University, Stanford, California, USA

The purpose of the study was to investigate the correlation between gadolinium contrast enhancement patterns on T1-weighted magnetic resonance (MR) images and spatial changes in protein expression profiles in human glioblastoma multiforme (GBM). We show that there are protein profile differences that correlate to imaging parameters, in this case contrast enhancement. Imaging can then be used as a non-invasive technique to evaluate the heterogeneity of solid tumors prior to microarray analysis for identification of tumor markers.

11:20 **35.** **MRI of Prostate Tumors Overexpressing VEGF Exhibit Distinct Alterations of Vascular Permeability**

Zaver M. Bhujwalla[1], Venu Raman[1], Dmitri Artemov[1], Yelena Mironchik[1], Peggy Kolars[1], Arvind P. Pathak[1], Meiyappan Solaiyappan[1]
[1]The Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

In this study we have characterized vascular volume and permeability of PC-3 tumors overexpressing full length VEGF. We observed that VEGF overexpressing tumors exhibited significantly higher permeability surface area product (PSP) and vascular volume, compared to vector transfected controls. 3-D reconstruction further revealed that overexpressing tumors exhibited larger spatial overlap between regions of high vascular volume and high permeability than control tumors. These data demonstrate that by overexpressing VEGF we can significantly alter the vascular phenotype of tumors so that regions of high vascular volume are also highly permeable.

11:32 **36.** **MRI Assessment of Murine Endostatin on Human Brain Tumors in a Mouse Model**

Y. Sun[1], K. Schmidt[1], N. O. Schmidt[1], R. Carroll[1], M. Ziu[1], P.Mcl. Black[1], R. V. Mulkern[2], M. S. Albert[1]
[1]Brigham and Women's Hospital, Boston, Massachusetts, USA; [2]Children's Hospital, Boston, Massachusetts, USA

The evaluation of antiangiogenic therapy by MRI provides valuable information for the assessment of therapeutic efficacy. In this study MRI was used to evaluate the changes in tumor growth of human glioma cells grown in nude mice following treatment with endostatin by two different delivery systems.

11:44 **37.** **Intratumor and Intertumor Heterogeneity in Contrast Agent Kinetics as Assessed by Functional MRI - Initial Results with Implications for Metastasis**

Arvind P. Pathak[1], Dmitri Artemov[1], David G. Jackson[2], Michal Neeman[3], Zaver M. Bhujwalla[1]
[1]The Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; [2]John Radcliffe Hospital, Oxford, UK; [3]Weizmann Institute of Science, Rehovot, Israel

While MRI has been applied to study tumor angiogenesis, its application to studying lymphatic dissemination and lymphangiogenesis has been limited at best. In this study, we characterized early and late changes in the distribution kinetics of albumin Gd-DTPA in a solid tumor mouse model, with and without an implanted vascular endothelial growth factor (VEGF) pellet. We demonstrated that lymphatic and convective conduits for tumor cell propagation could be detected with MRI, and histologically confirmed the same using a novel lymphatic endothelium marker (LYVE-1). Our initial results suggest a role for VEGF in lymphatic metastasis.

11:56 38. VSI and BV MRI Characterisation of Tumour Growth in Rat Brain

Laurent Lamalle[1], Michel Péoc'h[2], Régine Farion[1], Emmanuelle Grillon[1], Olivier Montigon[1], Hana Lahrech[1], Chantal Rémy[1]
[1]INSERM U 438, Grenoble, France; [2]CHU de Grenoble, Grenoble, France

The recently introduced Vessel Size Index (VSI) MRI technique aims at providing non-invasively quantitative insight on the microvascular architecture. It has previously been validated on healthy and tumour bearing rat brain. We applied it to characterise the cerebral microvasculature during tumour growth. C6 glioma bearing rats were imaged at several post implantation delays, from D+4 to D+24. To compute Blood Volume (BV) and VSI maps, diffusion and combined multiple gradient echoes / spin echo sequences were used, with the latter repeated after Sinerem injection at a high dose. MR-derived findings seemed coherent with histology observations.

12:08 39. Detection of Triple Quantum Na NMR in Normal and Tumored Mouse Brain.

Victor D. Schepkin[1], Ute Gawlick[2], Brian D. Ross[1], Thomas L. Chenevert[1]
[1]University of Michigan Medical School, Ann Arbor, Michigan, USA; [2]University of Illinois, Urbana, Illinois, USA

Three MR methods have been compared in terms of efficiency of bound Na detection in tumored and normal mouse brain: 90-t-90-90, spin-lock TQF pulse sequence and spin-lock pulse sequence with time-proportional phase increment (SLTPPI). SLTPPI pulse sequence demonstrates the highest efficiency and the largest sensitivity to structural changes occurring in brain tumor. Tumor formation dramatically decreases the percent of bound Na and increases Na T1 relaxation time. Development of the Na cancer marker is important itself as well as the understanding and correlation with the already established cancer cell marker based on proton diffusion mapping.

12:20 40. Effect of Core Temperature of Tumor Bearing Mice on BOLD Enhancements Obtained by Carbogen Breathing

K Reijnders[1], S J. English[1], M C. Krishna[1], Y Zhang[2], J A. Cook[1], A L. Sowers[1], C Menard[1], P L. Choyke[1], Angelo Russo[1], K CP Li[1], J B. Mitchell[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

MRI BOLD experiments were conducted with tumor bearing mice at core temperatures of 30oC and 37oC respectively. BOLD related MR signal enhancements were achieved by Carbogen (5% CO2, 95% O2) breathing. Significant differences were observed in BOLD signal enhancements at the two core temperatures. The results serve to stress the importance of proper temperature control of tumor-bearing animals undergoing BOLD MRI.

12:32 41. Assessment of Vascular Reactivity in Rat Brain Tumor by Measuring Blood Volume during Graded Hypoxic Hypoxia

Cecile Julien[1], Irene Tropres[2], Payen Jean-François[3], Regine Farion[3], Emmanuelle Grillon[3], Olivier Montigon[3], Chantal Rémy[3]
[1]Laboratoire de Physiologie, La tronche, France; [2]ESRF, Grenoble, France; [3]INSERM 438, La tronche, France

The aim of this study was to assess vascular reactivity in rat brain tumor by measuring blood volume fraction (BVf) during graded hypoxic hypoxia using steady-state susceptibility contrast MRI. During control episode, peritumoral region showed a higher BVf than contralateral and intratumoral regions, corresponding to higher vessel density. During graded hypoxic hypoxia, peritumoral BVf was reversibly increased similarly to contralateral BVf and intratumoral region was irreversibly increased only during severe hypoxia. Smooth muscle cell staining indicated that peritumoral vascular reactivity to hypoxic hypoxia could be attributed to an active and a passive mechanism. Intratumoral response was attributed to passive mechanism.

12:44 42. Amide Proton Transfer Contrast for Imaging of Brain Tumors

Jinyuan Zhou[1], Bachchu Lal[1], John Laterra[1], David A. Wilson[2], Peter C. M. van Zijl[1]
[1]Johns Hopkins University, F.M. Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

Despite the abundance of proteins and peptides inside many cell types, these molecules do not provide intense signals in proton MR spectra, and little has been studied about them in vivo. In particular, there are presently no MRI methods to spatially assess proteins and peptides in vivo. We demonstrate the possibility to produce image contrast that reflects cellular protein/peptide content in the rat brain tumor model through selective saturation transfer from exchangeable amide protons to water. This shows a clearer boundary of brain tumor when compared to several common MR images.

Functional Renal MR Imaging

Room 716 A/B 11:00 - 13:00 Chairs: David L. Buckley and Vivian Lee

11:00 *43*. Temporal Behaviour of PME/Pi in Pigs' Kidneys during the Cold Ischemic Time

Dominik v. Elverfeldt[1], Miriam Niekisch[1], Andreé El Saman[1], Ulrich Theodor Hopt[1], Jürgen Hennig[1]
[1]University Hospital, Freiburg, Germany

Quality assessment of renal grafts via 31P-MRS has been a topic of investigation since 1986[1-3]. As ATP concentrations decay rapidly during cold iscemic time CIT, the ratio of phosphorus monoesters (PME) to inorganic phosphorus within the organ (PiO) is used, being the most reliable parameter. Utilizing this ratio, derived via chemical shift imaging (CSI), we could recently demonstrate a significant correlation with the graft performance after transplantation [4]. It is necessary to extrapolate the measured ratio to the end of CIT before correlating with the graft performance. In order to achieve reliable decay information we observed pig-kidneys over 200 hours.

11:12 *44*. Measurement of Renal Extraction Fraction Using Single-shot EPI

Michael H. Buonocore[1], Richard W. Katzberg[1]
[1]UC Davis Medical Center, Sacramento, California, USA

Single kidney extraction fraction is estimated from multiple T1 recovery curves obtained using non-gated breathheld single shot EPI. This sequence has been very successful, but effects of ROI selection must be attended to, due to movement of the vessels associated with the heart rhythm, and the vessels' small size relative to the voxel size. Analysis shows that the location and size of the ROI within the vessel is a major determinant of the accuracy and precision of the T1 estimates. The impulse response of Fourier reconstruction allows contributions from the edge of and outside the vessels, adversely affecting these estimates.

11:24 *45*. Measurement of Renal Perfusion and Glomerular Filtration Rate with MRI and a Deconvolution Method

Laurent Hermoye[1], Laurence Annet[1], Philippe Lemmerling[2], Frank Peeters[1], Sabine Van Huffel[2], Bernard E. Van Beers[1]
[1]Université Catholique de Louvain, Brussels, Belgium; [2]Katholieke Universiteit Leuven, Leuven, Belgium

A method was developed to measure in vivo the renal perfusion (RP) and glomerular filtration rate (GFR) from perfusion MR images. These parameters were measured on the basis of the renal impulse response (IR), obtained by deconvolution of the cortical concentration-time curve with the arterial input function (AIF). The method was validated on 6 rabbits. RP correlated well ($r = 0.9$, $p = 0.014$) with values calculated by a validated upslope method. GFR correlated well ($r = 0.9$, $p = 0.014$) with values obtained from the clearance of 51Cr-EDTA.

11:36 *46*. Single Kidney GFR Measured using 3D MR Renography and a Multicompartmental Model

Vivian S. Lee[1], Henry Rusinek[1], Ambrose J. Huang[1], Edward Leonard[2], Elissa L. Kramer[1]
[1]New York University Medical Center, New York, New York, USA; [2]Columbia University, New York, New York, USA

A multicompartmental tracer kinetic model permits analysis of 3D MR renography data in terms of physiologic parameters such as glomerular filtration rate. Validation studies were performed in nine subjects, in whom single kidney GFR measurements were measured using radionuclide clearance methods. Agreement between model-fit values of SKGFR and reference values was high ($r=0.77$). Other physiologic parameters from the model remain to be validated.

11:48 *47*. Renal Perfusion and Function in Patients with Atherosclerotic Renovascular Disease

David L. Buckley[1], Ala'a E. Shurrab[2], Judith E. Kilgallon[3], Andrew P. Jones[3], Hari Mamtora[2], Philip A. Kalra[2]
[1]University of Manchester, Manchester, England, UK; [2]Hope Hospital, Salford, England, UK; [3]North Western Medical Physics, Christie Hospital, Manchester, England, UK

Recent studies have examined the use of a single comprehensive MR examination for the assessment of renal anatomy, function and perfusion. In our studies of patients with atherosclerotic renovascular disease (ARVD), renal function assessed by dynamic contrast-enhanced MR correlated strongly with radioisotope-determined glomerular filtration rate ($r = 0.87$, $n = 63$). Furthermore, concurrent estimates of whole kidney perfusion were poorly correlated with the severity of renal artery stenosis indicating a potentially significant role for MR in assessing intra-renal disease and its contribution to renal dysfunction in patients with ARVD.

12:00 *48*. MRI Assessment of Kidney Volumes and Dynamic Cortical Contrast Enhancement in Patients with Renal Artery Stenosis

Stephen J. Gandy[1], Robert M. Blackley[1], Thiru A. Sudarshan[1], Lynsay Allan[1], Declan G. Sheppard[1], Graeme Houston[1]
[1]Tayside University Hospitals NHS Trust, Dundee, Angus, UK

MRI kidney volume measurements and contrast enhanced MR Renography (CE-MRR) perfusion indices were examined in a group of patients with renovascular disease. Thirty patients were imaged using 3D FLASH contrast enhanced MR angiography (CE-MRA), and 3D volume interpolated breathold (VIBE) CE-MRR sequences. Cortical and total kidney volumes were calculated from venous phase MRA data, and two clinical indices of perfusion were calculated from the VIBE datasets. Kidneys with severe renal artery stenosis demonstrated significantly reduced volumes, and significantly poorer perfusion parameters. MRI volume and perfusion measurements can provide improved functional assessments of patients with renovascular disease.

12:12 *49*. Effect of Oxygen Free Radical Scavenger on Renal Medullary Oxygenation in Hypertensive Rats as Evaluated by BOLD MRI

Luping Li[1], Laura Fogelson[1], Belinda S. Li[2], Wei Li[1], Pippa Storey[1], Pottumarthi Prasad[1]
[1]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [2]GE Medical Systems, Evanston, Illinois, USA

We had previously shown that kidneys with hypertension reduced response to nitric oxide synthase inhibition, as evaluated by BOLD MRI. This was consistent with the fact that hypertension involves increased oxygen free radical production, and hence reduced bioavailability of nitric oxide. In this study, we investigated the effect of administration of Tempol--a membrane-permeable mimetic of superoxide dismutase on renal blood flow using BOLD MRI technique. Five spontaneously hypertensive rats (SHR) were used in this study. The R2* in the renal medullar and cortex showed significant drop (from 40.6±9.8 to 31.7±10.7 and from 31.8±4.4 to 25.9±5.3) after Tempol injection.

12:24 *50*. Diagnosis of Renal Malignancy by MR Imaging: Are Quantitative Measures of Enhancement Valid?

Elizabeth M. Hecht[1], Gary M. Israel[1], Jennifer P. Cha[1], Winnie Y. Hahn[1], Danny C. Kim[1], Glenn A. Krinsky[1], Vivian S. Lee[1]
[1]New York University Medical Center, New York, New York, USA

The study compares two methods for evaluating enhancement of renal masses on contrast-enhanced MRI: quantitative measures of relative enhancement vs. qualitative assessment of enhancement on subtraction (post-pre) images. Contrast-enhanced MRI studies were retrospectively reviewed in 37 patients (53 renal masses) that had pathologic correlation or MR imaging follow-up of >1 year. The sensitivities for diagnosis of malignancy with subtraction and ROI analysis were 100% (32/32). The specificity was 62% (13/21) for the subtraction images and 33% (7/21) for the ROI analysis. While both techniques are sensitive, qualitative analysis of subtracted images offers a greater specificity for diagnosing renal malignancy.

12:36 *51*. Vascular Mapping Prior to Laparoscopic Renal Surgery: Correlation of Contrast-Enhanced Three-Dimensional MRA with Intraoperative Findings

Alan H. Stolpen[1], David S. Wang[1], Kousei Ishigami[1], Stephen C. Rayhill[1], Howard N. Winfield[1]
[1]University of Iowa, Iowa City, Iowa, USA

Laparoscopic renal surgery offers a minimally invasive alternative to open surgery, but requires meticulous preoperative planning. Urologists at our institution have begun to use contrast-enhanced three-dimensional MRA (3D MRA) to map the renal vasculature prior to laparoscopic surgery in order to minimize the risk of intraoperative vascular injury. We studied the accuracy of preoperative 3D MRA in 36 patients by correlating the findings at MRA with those at laparoscopic renal surgery. The results show that 3D MRA provides highly accurate maps of renal vasculature.

12:48 *52*. SB-239063, a p38 MAP Kinase Inhibitor, Improves Renal Function in a Model of Progressive Renal Disease.

Stephen C. Lenhard[1], Sandhya S. Nerurkar[1], Thomas R. Schaeffer[1], Beat M. Jucker[1], Robert N. Willette[1]
[1]GlaxoSmithKline, King of Prussia, Pennsylvania, USA

The p38 mitogen-activated protein kinase (MAPK) signal transduction pathway is involved in a variety of inflammatory responses, including cytokine generation, proliferation and apoptosis. We evaluated the role of SB-239063, a p38 inhibitor, on renal function using dynamic contrast enhanced MRI in an animal model of progressive renal disease. Improved renal function as assessed by MRI and reduced albumin excretion together suggest the p38 inhibitor SB-239063 can ameliorate progressive renal disease.

Musculoskeletal MR Imaging: Cartilage

Room 713 A/B 11:00 - 13:00 Chairs: Brian A. Hargreaves and Timothy J. Mosher

11:00 *53.* Dynamic MR Elastography of Cartilage

Orlando Lopez[1], Phillip J. Rossman[1], Richard L. Ehman[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

MR Elastography (MRE) is a technique that allows visualization of propagating acoustic shear waves in tissue for noninvasive quantification of mechanical properties. Development of MRE for stiff tissues with shear moduli in the hundreds or thousands of kPa is presented for specific application to in vitro MRE of cartilage. The current system incorporates components for adequate generation and detection of mechanical shear waves that propagate within cartilage. Preliminary results from fetal bovine femur specimens, used as a biological model of articular cartilage, demonstrate the feasibility of characterizing the dynamic mechanical properties of cartilage with MRE.

11:12 *54.* T_2 Relaxation Reveals Differences in Spatial Collagen Network Anisotropy in Human, Bovine and Porcine Articular Cartilage

Mikko Johannes Nissi[1], Jarno Rieppo[1], Juha Töyräs[1], Mikko Sakari Laasanen[1], Heikki Juhani Helminen[1], Jukka Sakari Jurvelin[1], Miika Tapio Nieminen[2]
[1]University of Kuopio, Kuopio, Finland; [2]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

T_2 relaxation time measurements at 9.4T were correlated with structural parameters of the collagen network (collagen birefringence, fibril anisotropy and fibril angle), as revealed by quantitative polarized light microscopy. Spatial variation of T_2 relaxation time followed the depth-wise changes in the microscopic parameters, revealing differences in the arrangement of the three-dimensional collagen network between different species. The results indicate that T_2 contrast in cartilage is dominated by the collagen fibril orientation in the B_0 field through the magic angle effect. T_2 measurements can reveal differences in collagen architecture between species, possibly also related to tissue development and age.

11:24 *55.* Comparison of the Effects of Osmotic and Mechanical Pressure on the Collagen Fibers Architecture in Articular Cartilage

Hadassah Shinar[1], Galit Saar[1], Keren Keinan-Adamsky[1], Gil Navon[1]
[1]Tel-Aviv University, Tel-Aviv, Israel

Comparison between the effects of mechanical loads and osmotic stress on the ^{2}H quadrupolar splitting, ν_Q, of articular cartilage-bone plugs was studied by spectroscopic imaging. Although the two techniques had the same effect on the thickness of the cartilage, the behavior of the collagen matrix is different. For a load of 1.0MPa, there is a significant decrease in ν_Q in the calcified zone and an increase at the surface. For the same plug, equilibrated in 30%PEG, ν_Q in the calcified zone is decreased to a lesser extent while at the surface the increase is larger.

11:36 *56.* High Resolution Diffusion Tensor Imaging of Human Hyaline Articular Cartilage

Lucianna Filidoro[1], Christian Glaser[1], Olaf Dietrich[1], Juergen Weber[1], Thomas Oerther[2], Markus Witt[2], Maximilian Reiser[1]
[1]LMU University Munich-Grosshadern, Munich, Bavaria, Germany; [2]Bruker BioSpin GmbH, Rheinstetten, Baden-Württemberg, Germany

In view of osteoarthritis, diffusion tensor imaging (DTI) was used to analyze the microstructure of human hyaline articular cartilage. The experiments were performed on high-field MRI systems with a resolution of $35\times70\mu m^2$. Cartilage-on-bone samples were measured unloaded and under local compressive strain. Using a self developed software package, maps of trace, anisotropy, eigenvalues, and eigenvectors were visualized. DTI experiments seem applicable to articular cartilage structural analysis. For unloaded cartilage the various maps show a zonal arrangement, which is strikingly modified under loading. These findings are in good agreement with current literature about the collagenous fiber architecture of cartilage.

11:48 *57.* Initial Findings of Diffusion Anisotropy in Articular Cartilage

Fred Wentorf[1], Wei Chen[1], Xiaoliang Zhang[1]
[1]Center of Magnetic Resonance Research University of Minnesota, Minneapolis, Minnesota, USA

Diffusion imaging was performed on skeletally mature human and bovine articular cartilage explants. Diffusion gradients were applied parallel and perpendicular to the surface of the cartilage. The ratio between the parallel and perpendicular apparent diffusion coefficients (ADC) changed through the depth of the cartilage. The parallel ADC was higher near the surface and the perpendicular ADC was higher in the middle and deep regions of the cartilage. These findings agree with other studies on collagen fiber orientation. Further refinement of this imaging protocol could lead to a method for quantifying collagen orientation non-invasively in articular cartilage.

12:00 ***58***. **Navigated 3D Steady-State Diffusion Imaging of Knee Cartilage**

Karla L. Miller[1], Brian A. Hargreaves[1], Garry E. Gold[2], John M. Pauly[1]
[1]Stanford University, Stanford, California, USA; [2]Stanford University and Palo Alto VA Medical Center, Stanford, California, USA

Diffusion-weighted imaging (DWI) of cartilage is potentially useful in the detection and characterization of early damage but is difficult due to the short T2 of cartilage. Navigated steady-state free precession DWI (SS-DWI) has been shown to achieve high-resolution images of cartilage with strong diffusion weighting. This work presents a 3D navigated SS-DWI sequence for imaging of articular cartilage that retains the benefits of a 2D sequence while increasing the SNR efficiency. In vivo results are presented with a voxel size of 0.5 x 0.7 x 3 mm^3.

12:12 ***59***. **Effect of Spin-Locking Field on Laminar Appearance of Articular Cartilage**

Sarma V. S. Akella[1], Ravinder R. Regatte[1], Arijitt Borthakur[1], Ravinder Reddy[1]
[1]University of Pennsylvania Medical Center, Philadelphia, Pennsylvania, USA

The purpose of this study was to investigate the influence of spin-locking field of T1r sequence on the laminar appearance of articular cartilage. MR imaging experiments were performed on 4T GE signa clinical scanner. The spin-locking fields varied from 500 Hz-1500Hz. The number and the relative intensity of the laminae varied from sample to sample and the laminar appearance was due to the intramolecular dipolar interaction associated with water protons with the oriented collagen fibers. In the T1r weighted images as a function of spin-locking field, the laminae decreased while the overall image signal intensity increased.

12:24 ***60***. **Comparison of Multiparametric MRI with Histology of Human Articular Cartilage**

Nina M. Menezes[1], Martha L. Gray[1], James R. Hartke[2], Deborah Burstein[3]
[1]Harvard - Massachusetts Institute of Technology, Cambridge, Massachusetts, USA; [2]Pharmacia Corporation, St. Louis, Missouri, USA; [3]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

MRI measures of dGEMRIC, T2 and T1rho were compared with Toluidine Blue histology (TB; for GAG), and polarized light microscopy (PLM; reflects collagen architecture) in a cross-section of naturally diseased human samples. dGEMRIC closely matched TB. T2 “abnormalities” were usually, but not always, associated with collagen disorganization on PLM. T1rho was not consistently reflected by TB or PLM. There was no consistent correspondence between MRI parameters, indicating that they provide independent information: dGEMRIC is specific for GAG; T2 and T1rho are sensitive to collagen architecture and other molecular parameters not visualized in standard histological measures.

12:36 ***61***. **Severity of Cartilage Degeneration in the Goat Knee after Meniscal Transection/Cartilage Groove Surgery as Measured by MT and Gd(DTPA)-MRI**

Didier Laurent[1], James Wasvary[1], Hem Nalini Singh[1], Jeffrey DeLeo[1], Gary Pastor[1], Vincent Blancuzzi[1], Elizabeth O'Byrne[1], Theodore C. Pellas[1]
[1]Novartis Pharmaceuticals Corporation, East Hanover, New Jersey, USA

This study examined in the goat knee the effects of meniscal transection and cartilage incision on the macromolecular composition of articular cartilage over a 14-week period. Both collagen integrity and proteoglycan content were evaluated by magnetization transfer (MT) and Gd(DTPA)2- MRI, respectively. The MT rate constant k significantly increased at 2-week post-surgery, a possible sign of cartilage swelling, then decreased below baseline values, likely indicative of disruption in the collagen framework. Meanwhile, post Gd(DTPA)2- MRI acquisition indicated a significant and sustained loss of PG. This proof-of-concept study allows identifying MT and T1 parameters as useful surrogate markers of OA.

12:48 ***62***. **Identification and Quantification of Focal Cartilage Lesions of Osteoarthritic Knee Using Magnetic Resonance Imaging**

Keh-Yang Lee[1], Eugene Ozhinsky[1], Lynne Steinbach[1], Thomas Link[1], Sharmila Majumdar[1]
[1]University of California at San Francisco, San Francisco, California, USA

An algorithm to identify and quantify focal cartilage lesions was developed using MR images of knees with and without Osteoarthritis (OA). A total of eight subjects divided into three groups, normal, mild OA and severe OA, were examined. The results showed a good classification among the groups using the total volume of focal lesions. The volumes of lesions also correlated with the radiographical grade of cartilage defects as assessed by a radiologist

Diffusion Tensor Acquisition Methods

Room 715 A/B 11:00 - 13:00 Chairs: Thomas E. Conturo and Susumu M. Mori

11:00 ***63***. **Q-Ball Imaging**

David S. Tuch[1], Timothy G. Reese[1], Mette R. Wiegell[1], Van J. Wedeen[1]
[1]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, Massachusetts, USA

White matter fiber crossing can be resolved by q-space diffusion imaging methods or by mixture modeling of high angular resolution diffusion imaging data. However, q-space imaging requires long acquisition times, and mixture modeling, like diffusion tensor imaging, requires a model of the underlying diffusion function. Here, we present a model-independent reconstruction scheme for spherically-sampled diffusion imaging data. The reconstruction algorithm is based on the Funk-Radon transform, an extension of the Radon transform to the sphere. The technique, termed q-ball imaging, exhibits sharper diffusion peaks relative to a comparable Cartesian q-space acquisition.

11:12 *64*. Ultra-high Resolution SENSE-DTI at 3 Tesla

Thomas Jaermann[1], Klaas Paul Pruessmann[1], Anton Valavanis[2], Spyros Kollias[2], Peter Boesiger[1]
[1]ETH and University Zurich, Zurich, Switzerland; [2]University Hospital Zurich, Zurich, Switzerland

Limited spatial resolution is a key problem in increasing efforts to study brain white matter structure with Diffusion Tensor Imaging (DTI). Commonly relying on spin-echo EPI sequences, DTI's ability to resolve small details is seriously restricted by T2 and T2* decay, B0 inhomogeneity, and limited signal-to-noise ratio (SNR). In this work we demonstrate that all of these issues can be addressed at once by parallel acquisition. It is shown that parallel imaging at 3 Tesla indeed permits pushing spatial resolution to the sub-millimeter realm while reducing artifacts and even increasing SNR efficiency at the same time.

11:24 *65*. High-resolution DTI of the Brainstem-Cerebellum Areas using 3T and SENSE Acquisition Technique

Lidia Mayumi Nagae-Poetscher[1], Hangyi Jiang[1], Setsu Wakana[1], Xavier Golay[1], Peter van Zijl[1], Susumu Mori[1]
[1]Johns Hopkins University, and F.M. Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA

High-resolution diffusion tensor imaging (DTI) of the brainstem-cerebellum was performed using SENSE (R=3) at 3 Tesla. When using 1.8mm isotropic resolution, identification of a higher number of structures could be achieved, as compared to 1.5 Tesla. For instance, compartments of the spinal cord were identified, as well as inferior olivary nucleus, optic tract, cranial nerves III, V, dorsal and medial longitudinal fasciculus area, deep cerebellar nuclei and decussation of superior cerebellar peduncle. Identification of these structures brings up the possibility for DTI to have an impact on the diagnosis and prognosis of diseases affecting such structures.

11:36 *66*. The Use of Parallel Imaging with PROPELLER DWI

James G. Pipe[1]
[1]Barrow Neurological Institute, Phoenix, Arizona, USA

Parallel Imaging has been implemented for PROPELLER diffusion weighted imaging. Although this will work with any parallel imaging method, the combination of multiple-coil data occurs at a different stage in reconstruction than for most other methods. The result gives one the ability to reduce scan time and artifacts for PROPELLER DWI at the typical expense of SNR.

11:48 *67*. Diffusion Mapping with Serial Asymmetric Spin-Echo EPI

Nan-kuei Chen[1], Robert V. Mulkern[2], Charles R. G. Guttmann[1], Lawrence P. Panych[1]
[1]Brigham and Women's Hospital, Boston, Massachusetts, USA; [2]Children's Hospital, Boston, Massachusetts, USA

A quantitative diffusion mapping method based on serial asymmetric-spin-echo EPI is developed. Unlike conventional spin-echo EPI based diffusion mapping in which the same experimental settings are repeatedly used for multiple averages, the new method acquires a series of diffusion-weighted EPI with graded T2*-weighting. Both field inhomogeneity and diffusion quantities can be measured. Inconsistent field distortions due to varying eddy current effects can then be characterized and removed. Using the proposed technique, the achieved signal-to-noise ratio per scan time is comparable to that obtained with the conventional approach but artifacts may be further reduced using the obtained field distortion maps

12:00 *68*. Diffusion Weighted EPI with Magnetization Transfer Contrast

Rakesh K. Gupta[1], Anasuya M. Rao[2], A Kasiviswanathan[2], Sanjeev Chawla[1], Rajesh Kumar[1], Ramesh Venkatesan[2]
[1]Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, UttarPradesh, India; [2]Wipro GE Medical System, Bangalore, Karnataka, India

We have performed diffusion weighted (DW) echo planar imaging (EPI) with and without magnetization transfer preparation pulse to see the effect of macromolecular suppression on apparent diffusion coefficient (ADC) in the brain parenchyma of 10 healthy volunteers. There was a significant increase in the ADC values in different locations of the brain parenchyma after the application of Magnetization Transfer (MT) preparation pulse, suggesting that there is some relationship between the macromolecular concentration and water diffusivity across the cell membrane. This information may be of value in better understanding the pathological processes with variable macromolecular concentrations.

12:12 *69*. High-Resolution Diffusion-Weighted MRI using Variable Density Spiral Acquisition

Tie Qiang Li[1], Dong-Hyun Kim[2]
[1]Indiana Univeristy School of Medicine, Indianapolis, Indiana, USA; [2]Stanford University School of Medicine, Stanford, California, USA

A self-navigated multi-shot MR pulse sequence based on variable density spiral trajectory was implemented for high-resolution diffusion-weighted MRI. The k-space trajectory design was calculated on-line using a simple analytical approximation and the sampling density follows a hanning window function. Due to the over sampling of the center k-space, this 2D self-navigator allows more robust motion correction and the high resolution diffusion-weighted images (256x256) acquired using 8 spiral interleaves is of high quality even without elaborate correction schemes.

12:24 *70*. Analyzing the Contribution of Cardiac Pulsation to the Variability of Quantities Derived from the Diffusion Tensor

Carlo Pierpaoli[1], Stefano Marenco[1], Gustavo Rohde[1], Derek Kenton Jones[1], Alan Seth Barnett[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

We analyze the contributions of cardiac-pulsation to the variability in estimates of diffusion tensor quantities in the human brain. We identify two contributions to variability arising from cardiac pulsation, namely (i) mis-registration of different structures and (ii) non-uniform intra-voxel motion (e.g. stretch and shear of the tissue), and propose a novel approach for differentiating them.

12:36 *71*. Diffusion Tensor Imaging with FLAIR: The Effect of Eliminating CSF Contamination

Xiangyang Ma[1], Stephen M. LaConte[1], Xiaoping Hu[1]
[1]Biomedical Imaging Technology Center, Emory University/Georgia Tech, Atlanta, Georgia, USA

FLAIR was used in diffusion tensor imaging (DTI), and the resultant fractional anisotropy (FA) was compared with that obtained with conventional DTI in the human brain. DTI data from six normal volunteers, demonstrate that the application of FLAIR, which suppresses CSF signal, results in an increase in FA, particularly in the gray matter. This improved diffusion tensor measurement can be potentially used for differentiating directional dependent structure in gray matter and tracking fibers in the gray matter.

12:48 *72*. The Effect of Gradient Sampling Scheme on Estimates of Fiber Orientation: Implications for Fiber Tractography

Derek K. Jones[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

There is conflicting literature as to whether there is any benefit in using a large number of gradient sampling orientations in DT-MRI experiments over using a smaller number of carefully chosen orientations. We studied the effect of using different numbers of gradient orientations on the estimates of tensor-derived properties using Monte Carlo simulations. In particular, we focused on the effect of number of gradient orientations on the uncertainty in estimates of fiber-orientation, which impacts directly on the field of diffusion tensor tractography. Our results challenge the notion that a set of six icosahedrally-arranged orientations is optimal for DT-MRI.

Thermotherapy

Room 717 A/B 11:00 - 13:00 Chairs: Nathan J. McDannold and Chrit T. Moonen

11:00 *73*. *In Vivo* Comparison of Realtime Triggered, Navigated, Multi-baseline Thermometry with Conventional Respiratory Triggered PRF Thermometry for Monitoring Liver Ablation

Karl Vigen[1], Bruce Daniel[1], John Pauly[1], Kim Butts[1]
[1]Stanford University, Stanford, California, USA

A method is described for proton resonance frequency (PRF) temperature mapping in the presence of variable respiratory motion using respiratory triggering, navigator echoes, and the acquisition of multiple baseline images. Laser heating experiments in porcine liver *in vivo* demonstrate improvements in temperature mapping over conventional triggered single baseline techniques.

11:12 *74*. Temperature Stability of a Respiratory Gated EPI Sequence for Temperature Monitoring in Liver Tumor Patients under Free Breathing

Claudia Weidensteiner[1], Noureddine Kerioui[1], Bruno Quesson[2], Herve Trillaud[1], Chrit Moonen[1]
[1]RMSB UMR 5536 CNRS/Université Victor Segalen Bordeaux 2, Bordeaux, France; [2]Image Guided Therapy SA, Pessac, France

Temperature stability of a respiratory gated SENSE-EPI sequence for temperature mapping with the PRF-method was investigated in 11 liver tumor patients. The segmented EPI sequence was performed with a SENSE factor of 1.5, an in-plane resolution of 3-4mm, and a temporal resolution of 1 respiratory cycle for 3 slices. We measured T2* in patient livers and found a range of 10-33ms. Therefore TE=12ms was chosen for temperature mapping. The temperature standard deviation at normal body temperature was in the range of 1.5-3.5 C. Monitoring of thermal ablation of liver tumors should be possible with this method on a clinical scanner.

11:24 *75*. Referenceless PRF Shift Thermometry

Viola Rieke[1], Karl K. Vigen[1], Graham Sommer[1], Christopher J. Diederich[2], William H. Nau[2], Anthony Ross[2], Bruce L. Daniel[1], John M. Pauly[1], Kim Butts[1]
[1]Stanford University, Stanford, California, USA; [2]University of California San Francisco, San Francisco, California, USA

The proton resonance frequency (PRF) shift thermometry is a potentially powerful method for monitoring thermotherapy. However, PRF shift thermometry has to date relied on the subtraction of baseline images, making the method sensitive to motion and phase drift during the course of treatment. We demonstrate a referenceless method which eliminates these problems by estimating the baseline phase from the acquired phase image itself. Temperature maps of a phantom during laser heating, zero degree temperature rise images of in vivo liver, and temperature maps acquired during canine prostate ablation show that the referenceless method provides reliable temperature information.

11:36 *76*. MRI-guided and Monitored Percutaneous Laser Ablation of the Vertebrae (PLAV): A Feasibility and Safety Study

Sherif Gamal Nour[1], Frank K. Wacker[1], Mariana L. Meyers[1], Mark Rodgers[1], Mark R. Robbin[1], Jeffrey L. Deurk[1], Jonathan S. Lewin[1]
[1]University Hospitals of Cleveland / Case Western Reserve University, Cleveland, Ohio, USA

We investigated the use of interventional MRI techniques to guide percutaneous insertion of laser fibers into targeted areas of the vertebrae and to monitor the development of controlled areas of laser-induced osteonecrosis in a porcine animal model as a potential treatment for vertebral metastases in selected patients. We also explored the safety of laser application close to the spinal cord. MRI guidance of PLAV is feasible. The lack of interference between laser application and MR imaging renders online monitoring of the thermal lesion a simple task. MRI-guided and monitored PLAV appears to be safe, even for posterior vertebral body ablations.

11:48 *77*. Pre-Clinical Testing of a Phased Array Ultrasound System for MRI-Guided Noninvasive Surgery of the Brain

Kullervo Hynynen[1], Greg Clement[1], Nathan McDannold[1], Randy King[1], Phillip Jason White[1], Ferenc A. Jolesz[1], Shuki Vitek[2], Eyal Zadicario[2]
[1]Harvard Medical School/Brigham and Women's Hospital, Boston, Massachusetts, USA; [2]InSightec, Haifa, Tirat Carmel, Israel

A prototype system designed for MRI-guided noninvasive thermal brain surgery was tested in preparation for clinical trials. The system consisted a 0.75 MHz 500-element ultrasound array and had a complete driving system with software that allowed a CT scan of the skull to be registered on the MR image. The CT-derived geometry and density information were used to calculate a compensation factor for the bone-induced ultrasound wave distortions. This approach was tested in a phantom with ex vivo human skulls. Using MRI targeting and temperature measurements, the technique was used to produce sharp focal temperature elevations in the brain phantom.

12:00 *78*. Optimizing MR Imaging of Radiofrequency- and Cryo- Ablation Myocardial Lesions

Vivek Y. Reddy[1], Godtfred Holmvang[1], Andre d'Avila[1], Ehud Jeruham Schmidt[2], H Glenn Reynolds[2], Motoya Hayase[1], Jeremy N. Ruskin[1]
[1]Massachusetts General Hospital, Boston, Massachusetts, USA; [2]GE Medical Systems ASL, Boston, Massachusetts, USA

Catheter ablation of myocardial tissue can eliminate certain cardiac arrhythmias. In animal models, we evaluated MR imaging techniques to visualize myocardium ablated by catheter-based radiofrequency- (RF) or cryo- ablation. We demonstrate techniques that may be employed post-operatively to assess the effect of the ablation procedure, and potentially intra-operatively to actively monitor the ablation process

12:12 *79*. MR Imaging Guided Radiofrequency Ablation of Lung Tissue: Necessity or Overkill?

Frank K. Wacker[1], Sherif G. Nour[1], Jeffrey L. Duerk[1], Jonathan S. Lewin[1]
[1]Case Western Reserve University/University Hospitals, Cleveland, Ohio, USA

The purpose of this study was to assess the feasibility of MRI to control radiofrequency ablation (RFA) of pulmonary tissue in a rabbit model. Puncture and lung RFA were performed in 5 New Zealand White rabbits under MRI control using a 0.2 T open MR scanner. The ablation effect was assessed using MRI, CT and pathology. MRI procedure guidance was feasible. Pneumothorax could be detected and treated during imaging. MR was superior to CT in defining the thermal lesion. Our results indicate MRI guidance is useful for thermal ablation of pulmonary tissue and suggest that patient trials may be warranted.

12:24 *80*. Diffusion Weighted Imaging of High Intensity Focused Ultrasound Treatment for Uterine Fibroids

Michael A. Jacobs[1], Hyun S. Kim[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Eleven patients with uterine fibroids were treated using MR guided high intensity focused ultrasound (MRgHIFUS) tissue ablation. Fibroid ablation temperature was monitored using phase sensitive MR mapping and treated tissue was defined by post contrast T1-weighted and diffusion weighted images (DWI). DWI exhibited hyperintense regions colocalized with the contrast T1 images. The mean Apparent Diffusion Coefficient (ADC) was decreased in the treated tissue compared to non-treated tissue. ADC mapping may provide a mechanism to assess the effectiveness of the MRGHIFUS in uterine fibroids.

12:36 *81*. Magnetic Resonance-Guided Extracorporeal Laser Mediated Thermal Therapy of Intratumoral Gold Nanoshell Particle Injections

Roger J. Stafford[1], Lee R. Hirsh[2], Roger E. Price[1], Belinda Rivera[1], Scott R. Sershen[2], Jennifer L. West[2], John D. Hazle[1]
[1]The University of Texas M. D. Anderson Cancer Center, Houston, Texas, USA; [2]Rice University, Houston, Texas, USA

This work describes a novel thermal therapy delivery technique using an extracorporeal, near infrared (NIR) diode laser to irradiate NIR-absorbing gold nanoshell particles injected directly into a tumor. Magnetic resonance (MR) imaging was employed to monitor targeting and tissue temperature distributions during the procedure. MR guided ablations were performed on 6 tumors implanted in mice. MR temperature imaging (MRTI) data demonstrated good correlation with gross pathologic and histopathologic results. These preliminary in vivo data demonstrate the both the feasibility of the ablation technique and the ability of MRTI to provide meaningful targeting and monitoring of the procedure.

12:48 *82*. *In Vivo* Feasibility of LOcal Drug Delivery using Thermosensitive Liposomes and MR-Guided LOcal Hyperthermia

Rares Salomir[1], Jean Palussiere[2], Sigrid Fossheim[3], A Rogstad[3], U Wiggen[3], Nicolas Grenier[1], Crit T. Moonen[1]
[1]RMSB-Université Bordeaux 2, Bordeaux, France; [2]Bergonie Institute, Bordeaux, France, France; [3]Amersham Health, Oslo, Norway

Local drug release was suggested to increase the local concentration of anti-cancer drugs and to limit toxic side effects. Here, in vivo feasibility of local drug release was demonstrated using thermosensitive liposomes charged with MR contrast agent. LITT was performed under real-time, PRF based MR thermometry in the rabbit kidney. The contrast agent release was clarly identified in four successful experiments. Good correlation was obtained with respect to the MR thermometry.

GOLD CORPORATE MEMBER LUNCHTIME SYMPOSIUM
Siemens Medical Solutions
Leading Experts Choose Siemens

Hall F/G 13:00 - 14:00

CLINICAL SCIENCE FOCUS SESSION
Peripheral MR Angiography: Time-Resolved vs. Flow-Arrested

Room 718A 14:00 - 16:00 Chairs: Jeffrey H. Maki and Yi Wang

14:00 ***83*.** **Single Pass Four Station Peripheral Vascular Mra Utilizing Parallel Imaging: Imaging from the Renal Arteries to the Foot in 31 Seconds**

Jeffrey P. Goldman[1]
[1]Mount Sinai Medical Center, New York, New York, USA

The goal of our study was to optimize an imaging protocol for four station single pass moving table bolus chase peripheral vascular MRA without sacrificing spatial resolution or increasing venous contamination. We increased our imaging speed by utilizing parallel imaging and the increased slew rates available on ultrahigh gradient systems. This enabled us to image from the renal arteries down to the feet in 31 seconds. We were able to incorporate a fourth station dedicated to the foot with minimal venous contamination.

14:10 ***84*.** **Optimized Whole-Body 3D MR Angiography with Suprapopliteal Venous Compression: A Feasibility Study**

Christoph Ulrich Herborn[1], Waleed Mahmud Ajaj[1], Mathias Goyen[1], Sandra Massing[1], Jörg Felix Debatin[1], Stefan Günther Ruehm[1]
[1]University Hospital Essen, Essen, Germany

The purpose of the study was to assess whether the transient venous compression (60 mmHg) using external air pressure at the mid-femoral level in combination with a high resolution gradient recall echo sequence for the lower extremities improve the delineation of calf vessels and reduces venous overlay in 3D whole-body MRA. Venous compression was well tolerated by all study participants and yielded significantly higher quantitative and qualitative results compared to standard WB-MRA. The outlined strategy suggest that mid-femoral venous compression should be incorporated into multi-station protocols of the lower extremities for improved delineation of calf arteries without disturbing venous overlap.

14:20 ***85*.** **Infragenual Compression for Optimized CE-MRA of the Crural Arteries**

Deniz Bilecen[1], Anja-Carina Schulte[2], Markus Aschwanden[1], Kurt Jäger[1], Georg Bongartz[1]
[1]Kantonsspital Basel, Basel, Switzerland; [2]University Freiburg, Freiburg, Germany

Contrast-Enhanced MR-Angiography of the crural arteries is an essential imaging procedure in the diagnostic work-up of peripheral arterial occlusive disease. However, the quality of MRA images is often hampered by the superposition of contrast-enhanced deep veins. This study demonstrates that an infragenual compression with a subdiastolic pressure of 40 mm Hg significantly reduces and delays the contrast-filling of deep and superficial veins. Complementary EPI results were obtained which underline that this phenomenon can be explained by a pooling-effect of the contrast agent in the capillary tissue on the compressed side. Infragenual compression, thus, facilitates the evaluation of cural arteries considerably.

14:30 ***86*.** **First Clinical Test of Timed Arterial Contrast Enhanced Magnetic Resonace Angiography (tac-CE-MRA) of the Hand**

Klaus-Ulrich Wentz[1], Michael A. Patak[1], Johannes M. Froehlich[1], Melanie Schroeder[1], Constantin von Weymarn[1], Regula Jenelten[1], Christoph L. Zollikofer[1]
[1]Kantonsspital, Winterthur, Switzerland

A complete temporal blood flow arrest is achieved by inflating a blood pressure cuff. It is used to improve contrast enhanced MRA of the arteries of the hands. Exactly timed to the arterial filling, it permits high resolution arterial imaging. An initial study in ten volunteers had confirmed our theory. The purpose of this study was to test clinical applicability in fifteen patients with occlusive arterial disease and the comparison with volunteer results. Compared to a standard MR-angiography, acquisition time was arbitrarily extended by a factor of four, leading to a quadrupled image resolution (pixel size:0.59x0.29x0.7mm).

14:40 **87.** High Resolution, Time-Resolved MRA Provides Superior Definition of Lower Extremity Arterial Segments

Frank J. Thornton[1], Jiang Du[1], Sam S. Suleiman[1], Robert S. Dieter[1], Girma Tefera[1], Kris R. Pillai[1], Charles A. Mistretta[1], Tom M. Grist[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

Identification of segmental artery branches below knee is paramount to planning vascular surgery. We compared the ability of time-resolved contrast enhanced MRA (PR-hyperTRICKS) to non-contrasted 2D Time-Of-Flight (TOF) for identification of possible by-pass graft targets on pre-operative MRA in patients with Class III-IV peripheral vascular disease. All images acquired underwent quantative and qualitative analysis. Our findings show that PR-hyperTRICKS is a superior study for below-knee vascular mapping in patients with lower extremity ischemia.

14:50 **88.** Time-Resolved Three Dimensional Contrast Enhanced MR Angiography of the Peripheral Vessels : Comparison with Conventional CE-MRA

Valerie Laurent[1], Patrice Hervo[2], Michel Nicolas[1]
[1]CHU Brabois, Vandoeuvre les Nancy, France; [2]GE Medical Systems, Buc, France

We compared conventional bolus chasing MRA technique with high temporal resolution technique ECTRICKS on lower peripheral vessels. 3D T1 fat suppressed MRA was performed with and automatic table motion on three stations. First station with centric K-space encoding, subtraction from mask scan on the second and third stations with elliptic-centric encoding. The ECTRICKS scan immediately followed to the most distal station. K-space was partitioned into four concentric areas generating 8 temporal phases. A double blind analysis was done the third station. The contribution of ECTRICKS emerges as a complementary and essential technique when examining patients with high risk venous return.

15:00 **89.** EC-Star: Time-Resolved Contrast-Enhanced MRA

Ananth Jayaseelan Madhuranthakam[1], David G. Kruger[1], Stephen J. Riederer[1], James F. Glockner[1], Houchun Harry Hu[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

A challenge of time-resolved 3D imaging is the maintenance of adequate spatial resolution within each temporal frame. Projection reconstruction (PR) techniques have been used to allow some reduction in acquisition time for fixed resolution. The purpose of this work is to apply PR-like sampling to the views in the phase encoding (ky-kz) plane of 3DFT acquisition. This allows centric encoding in ky and kz and Fourier reconstruction without regridding. By further apportioning the ky-kz plane into radial zones and applying differential sampling, this allows high spatial resolution time-resolved imaging. The method is demonstrated experimentally in imaging the popliteal trifurcations.

15:10 **90.** Soft Tissue Enhancement of Diabetic Feet on Time-resolved Peripheral MRA: Preliminary Study

Honglei Zhang[1], Harry Bush[1], Craig Kent[1], Priscilla Winchester[1], Richard Watts[1], Yi Wang[2], Martin Prince[1]
[1]Weill Medical College of Cornell University, New York, New York, USA; [2]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

Enhancing foci were identified in the feet of 92% of diabetic patients undergoing peripheral MRA. This enhancement occurred at sites where diabetic patients typically develop cellulitis, foot ulcereration or charcot joints. By comparison only 51% of non-diabetic patients had pedal enhancement ($P<0.0001$) and it tended to be less prominent. This suggests the possibility that time-resolved MR imaging of the feet may detect precursor lesions to diabetic ulceration and cellulitis and thereby offer an opportunity to intervene earlier before full-fledged cellulitis or ulceration develops.

15:20 **91.** Predicting Venous Enhancement in Peripheral MRA using a Two Station Timing Bolus

Jeffrey H. Maki[1], Gregory J. Wilson[2], William B. Eubank[1], Romhild M. Hoogeveen[3]
[1]Puget Sound VASHCS, Seattle, Washington, USA; [2]Philips Medical, Bothell, Washington, USA; [3]Philips Medical, Best, Netherlands

Venous enhancement is a significant pitfall in peripheral contrast-enhanced MR angiography (CE-MRA). We describe a two station timing bolus that can a priori determine whether venous enhancement will occur, thereby helping to choose the optimal exam protocol (moving table vs. multiple injection). Preliminary testing (n=18) accurately predicted which extremities subsequently exhibited lower station venous enhancement. In addition, lower extremity data demonstrated a significant difference between patients with and without venous enhancement in terms of aorta-calf transit time (Tac), calf arteriovenous window duration (Tav), and interval between start of lower station acquisition and venous arrival (Tacq-v).

15:30 **92.** Multi-Station Segmented Volume Acquisition Integrated with Time-Resolved Multi-Phase Segmentation for Bolus Chase Peripheral MRA

Pelin Aksit[1], Vincent B. Ho[2], Peter L. Choyke[3], Marcela Montequin[1], Sandy L. Hess[3], Maureen N. Hood[2], Thomas KF Foo[1]
[1]GE Medical Systems, Baltimore, Maryland, USA; [2]Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA; [3]National Institutes of Health, Bethesda, Maryland, USA

A technique that combines segmented volume acquisition (a.k.a. "shoot and scoot" or 3D SNS) for multi-station bolus chasing with time-resolved segmented volume acquisition of the calf/foot station is described. Multi-phase imaging was achieved using a segmented volume approach wherein the peripheral k-space data from the last acquisition was merged with previously acquired centers of k-space data. In the case of bolus chase peripheral imaging, this combination approach can provide multiple phases of contrast enhancement in the infrapopliteal arteries for improved comprehensive bolus chase 3D MRA.

15:40 *93*. Distal Lower Extremities: Prospective Comparison of 2D Time-of-Flight, 3D Time-Resolved Contrast-Enhanced MR Angiography, and 3D Bolus Chase Contrast-Enhanced MR Angiography

Winnie Yoonhee Hahn[1], Elizabeth M. Hecht[1], Barak Friedman[1], Vivian S. Lee[1]
[1]NYU Medical Center, New York, New York, USA

Magnetic resonance angiography of the calf and pedal arteries is challenging due to the issues of venous contamination and small vessel size. Therefore, contrast-enhanced MRA is typically supplemented with TOF imaging below the knee. In this study, we compared the conventional TOF sequence with 3D contrast-enhanced time-resolved MRA and 3D bolus chase MRA for calf and pedal imaging. Both 3D methods are superior to TOF imaging in the evaluation of arterial length and stenosis grade. Furthermore, the time-resolved technique adds important dynamic information about blood flow direction.

15:50 *94*. Table-Moving Contrast-Enhanced MRA of the Lower Extremities in Patients with Arterial Occlusive Disease:Its Diagnostic Acuracy and Reliability in Comparison with IA-DSA

Yoko Saito[1], Hiraku Yodono[2], Hiroshi Noda[1], Yoko Itabashi[1], Taisuke Sasaki[1]
[1]Hirosaki University Hospital, Hirosaki, Aomori, Japan; [2]Narumi Hospital, Hirosaki, Aomori, Japan

The diagnostic accuracy of table-moving contrast-enhanced 3D MRA was evaluated in comparison with IA-DSA. 59 patients with peripheral arterial diseases were examined. Evaluation of the stenotic degree up to the trifurcation was highly accurate in comparison with IA-DSA, except for arterial segments treated with metallic stent placement. The sensitivity, specificity and accuracy for detecting hemodynamically significant stenosis (stenosis more than 50%)of CE-MRA were 95.2%, 96.0%, 95.8%, respectively, when stented arterial segments were excludes. However, overlay of vein often impaired the demonstration of arteries and stenotic lesions in calf. Therefore 2 or 3 phase injection should be considered.

SMRT FORUM
MR Purchase Decisions

Room 718B 14:00 - 16:00 Chair: Nanette Keck

Educational Objectives
Upon completion of this course, participants should be able to:

- Describe the various types of MR systems available today;
- List the major differences between systems;
- Describe the advantages and disadvantages of each;
- Explain how various system components impact MR image quality;
- Explain the system requirements for various types of MR procedures.

14:00 **Analytic Approach to Equipment, Finances, Compatibility, Site Preparation, PACs, and Delivery**
Herbert Y. Kressel

14:30 **Dedicated vs. Whole Body Systems**
William Faulkner

15:00 **1.0/1.5T vs. Low Field**
James J. Stuppino

15:30 **1.5T vs. 3T**
Gary H. Glover

CLINICAL SCIENCE FOCUS SESSION
Micro- and Macro-Vascular Imaging of Cerebrovascular Disease

Room 701B 14:00 - 16:00 Chairs: John Huston and Josef P. Debbins

14:00 ***95.*** **Effect of Acquisiton of an Earlier Contrast-enhanced MRA (CE-MRA) on Dynamic Susceptibility Contrast (DSC) Perfusion-weighted Imaging (PWI)**
Nakul C. Sharma[1], Robert J. Sevick[2], Richard Frayne[1]
[1]University of Calgary, Calgary, Alberta, Canada; [2]Foothills Medical Centre, Calgary, Alberta, Canada

In the evaluation of ischemic stroke it is desirable to have information on both vascular patency and brain perfusion. Dynamic-susceptibility contrast perfusion weighted imaging (DSC PWI) and contrast-enhanced MR angiography (CE MRA) are the two pre-ferred methods of providing this information clinically; however, both require an injection of contrast agent. In this study, we show that that previous injections can affect signal-versus-time, S(t), characteristics of PWI, particularly in infarcted tissue where a 28.0% ($p = 0.046$) reduction in the peak estimated contrast agent was found.

14:10 ***96.*** **Constrained vs. Unconstrained Deconvolution Based Perfusion Analysis: Implications in Stroke**
Michael Gillard[1], Vadim Beletsky[1], James Eastwood[2], Michael Lev[3], Brian Rutt[1], Ting-Yim Lee[1]
[1]Robarts Research Institute, London, Ontario, Canada; [2]Duke University Medical Centre, Durham, North Carolina, USA; [3]Harvard Medical School, Boston, Massachusetts, USA

We compare two available software packages designed for cerebral perfusion analysis. Perfusion data from acute ischemic stroke patients presenting within 6 hours of symptom onset, were analyzed using two deconvolution-based perfusion software packages. Results were compared based on ischemic, penumbral and infarcted lesion volumes identified by relative CBF and relative CBV. No significant difference was detected between ischemic volumes identified by the two methods ($p = 0.3$). Infarct and penumbral volumes differed significantly: $p < 0.03$ and $p < 0.008$ respectively. The cSVD blood volumes were not significantly different from the AUC blood volumes based on predicted infarct size.

14:20 *97*. Assessment of Infratentorial Acute Ischemic Stroke with Diffusion-Weighted-Imaging

Chuh-Hyoun Lie[1], Jochen Hirsch[1], Stefanie Schwenk[1], Kristina Szabo[1], Michael G Hennerici[1], Achim Gass[1]
[1]University Hospital Mannheim, University of Heidelberg, Mannheim, Baden-Wuerttemberg, Germany

Systematic clinico-topographical correlation studies of vertebrobasilar stroke are rare due to limitations of visualization of infratentorial structures and small strokes. We analysed DWI data of 275 patients with acute infratentorial infarction from a stroke center serving a 1 million population. Even minute lesions and multifocal pathology are regularly detected with DWI, allowing exact identification of infratentorial stroke with identification of reoccuring stroke-subtypes, which in turn frequently provides important clues as to the understanding of the clinical deficit and underlying etiology/stroke mechanism. This study provides a data bank on the frequency of infratentorial stroke subtypes and related clinical phenomena.

14:30 *98*. The Optimum *b* Factor for Diffusion-Weighted Magnetic Resonance Imaging (DWI) Assessment of Ischemic Stroke With Anisotropic Diffusion

Peter B. Kingsley[1], W. Gordon Monahan[1]
[1]North Shore University Hospital, Manhasset, New York, USA

The use of b = 1500 s/mm^2 or even higher has been recommended for DWI assessment of ischemic stroke. In acute stroke in adults without T2 changes, contrast is maximum with b ~ 1500 s/mm^2. Calculations presented here show that in several cases -- anisotropic diffusion, smaller apparent diffusion coefficient (ADC) changes, in neonates, with T2 changes, and when echo time (TE) changes along with b -- the contrast-to-noise ratio (CNR) and diffusion-to-noise ratio (DNR) are optimum with lower b values, and b = 1000 s/mm^2 is recommended for general DWI assessment of ischemic stroke.

14:40 *99*. High b Value Diffusion MRI in Stroke

Yaniv Assaf[1], Michal Kafri[1], Irena Bova[1], Pazit Pianka[1], Natan Bornstein[1], Dafna Ben-Bashat[1], Moshe Graif[1], Talma Hendler[1], Yoram Cohen[2]
[1]Tel Aviv Sourasky Medical Center, Tel Aviv, Israel; [2]Tel Aviv University, Tel Aviv, Israel

Diffusion tensor imaging detects reduction in diffusion anisotropy in acute and chronic white matter ischemic lesions. However, it is not clear weather this anisotropy reduction is due to damage to the white matter or structural changes in the tissue. In this work we have used high-b-value diffusion weighted imaging in order to study this issue. We have found that the slow diffusing component is isotropically increased in acute stroke areas, which might originates from increased tortuosity in the extra cellular space. Four weeks after stroke, the diffusion anisotropy at high-b-value approached control value while the low-b-value DTI was still reduced.

14:50 *100*. Flow Measurement and Velocity Field Visualization in Intracranial Arteriovenous Malformations

John W. Grinstead[1], Satoshi Tateshima[1], Yih-Lin Nien[1], Fernando Vinuela[1], Shantanu Sinha[1]
[1]University of California, Los Angeles, Los Angeles, California, USA

Persons with intracranial arteriovenous malformations are at increased risk of hemorrhage. The goal of this work is to implement methods to study complex cerebral flow dynamics using an in-vitro aneurysm model and apply them to patients with AVM. Arterial and venous flow was measured, and velocity field maps were constructed from data acquired with flow quantification pulse sequences. These plots allow the visualization of velocity over a 3d volume and throughout the cardiac cycle. Patients undergoing treatment can be monitored over time noninvasively.

15:00 *101*. Quantitative R_1 Measurements in Ischemic Stroke.

Elizabeth Maria Kalowska[1], Sverre Rosenbaum[1], Egill Rostrup[1], Henrik B.W. Larsson[1], Palle Petersen[1]
[1]Copenhagen University Hospital, Hvidovre, Denmark

Hemorrhagic transformation (HT) of ischemic brain tissue may occur in acute stroke patients either spontaneously or after thrombolysis due to disruption of the blood-brain barrier (BBB). A method to detect early deficiency of BBB in acute cerebral ischemia could offer a substantial increase in the safety and success of advanced stroke therapies. The aim was to develop simple quantitative measurements of BBB deficiency based on R1 changes (ΔR1) after gadolinium DTPA (Gd) injection, and to estimate the relationship between BBB disruption, HT and apparent diffusion coefficient (ADC) in acute ischemic stroke.

15:10 *102*. MRA of the Carotid Arteries Using Three Different Techniques: Accuracy Compared with Intraarterial DSA and Endarterectomy Specimen

Claudia Fellner[1], Werner Lang[1], Rolf Janka[1], Ralf Wutke[1], Werner Bautz[1], Franz A. Fellner[2]
[1]University of Erlangen-Nürnberg, Erlangen, Germany; [2]Landesnervenklinik Wagner-Jauregg, Linz, Austria

3D TOF MRA for the carotid bifurcation, fluoroscopically triggered CareBolus and dynamic CE-MRA for the supraaortic arteries were compared with DSA. Sensitivity and specificity for detection of severe stenoses were evaluated using identical projections in DSA and MRA. CareBolus (sensitivity: 100%, specificity: 96%) revealed somewhat better results than TOF (90%, 96%) and dynamic (95%, 91%) MRA; in contrast to both other techniques 3D TOF did not tend to overestimate stenoses. Evaluation of additional MRA projections increased the degree of stenosis in several vessels. In 11 cases endarterectomy specimens were examined with high resolution MR and confirmed the results of MRA.

15:20 ***103***. **Comparison of Test Bolus Timing and Fluoroscopic Triggering for Carotid MRA**

John Huston III[1], Matt A. Bernstein[1], A. T. Vu[2], Josef P. Debbins[2]
[1]Mayo Clinic and Foundation, Rochester, Minnesota, USA; [2]GE Medical Systems, Waukesha, Wisconsin, USA

Elliptical centric CEMRA has become an accepted method for the clinical assessment of the carotid and vertebral arteries. Test bolus timing (TBT) and fluoroscopic triggering (FT) are both well-accepted methods to synchronize the start of a 3D acquisition to the peak of the contrast agent bolus. We compared TBT and FT in 10 patients. Both methods produced excellent results. FT required a faster frame rate (e.g., 2.0 fps versus 0.84 fps for TBT) because the observer cannot retrospectively interpolate between adjacent frames. For maximal speed, FT used a thick-slab coronal acquisition with a twister (i.e., projection dephaser) gradient.

15:30 ***104***. **MRA Measurements of Primary Collateral Blood Flow Before and After Carotid Surgery**

Jeroen Hendrikse[1], Dirk R. Rutgers[1], Bert Eikelboom[1], Jeroen Van der Grond[1]
[1]UMC Utrecht, Utrecht, Netherlands

In patients with obstruction of the internal carotid artery (ICA), the circle of Willis is an important predictor of hemispheric ischemia. In the present study we used magnetic resonance angiography (MRA) to study changes in collateral flow and vessel diameters of the circle of Willis in 48 patients with a 70-99% ICA stenosis, before and after carotid surgery. Results indicate that, the collateral ability of the circle of Willis, as determined with MRA, may have a benificial effect on long term outcome in patients with a stenosis and contrateral ICA occlusion but not in patients with an unilateral ICA stenosis.

15:40 ***105***. **Reduction of Susceptibility Artifacts in High-Resolution BOLD MR-Venography at 3 Tesla**

Alexander Rauscher[1], Jürgen Reichenbach[2], Ewald Moser[1], Markus Barth[3]
[1]University of Vienna, Vienna, Austria; [2]Friedrich Schiller Universität, Jena, Thüringen, Germany; [3]University Hospital, Vienna, Austria

The aim of this study was to eliminate undesired susceptibility effects in BOLD MR-Venography (MRV), especially at high field strenghts. High resolution gradient echo images were acquired employing the susceptibility difference between blood vessels and the surrounding tissue as a source of contrast. Optimal visualization of veins in MRV is achieved by multiplication of magnitude images with corresponding phase-masks, hence phase wraps are a major problem in MR-venograms created by minimum intensity projection. Artifacts in regions of strong background susceptibility were highly reduced by unwrapping the phase images using a novel automated algorithm and subsequent high pass filtering.

15:50 ***106***. **High Resolution Time-resolved Contrast Enhanced MR Angiography of the Circle-of-Willis using 4X Parallel Imaging**

Belinda SY Li[1], Qun Chen[2], Wei Li[2], Jason A. Polzin[3], Robert R. Edelman[2]
[1]GE Medical Systems, Evanston, Illinois, USA; [2]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [3]GE Medical Systems, Waukesha, Wisconsin, USA

While 3D time-of-flight is the current method of choice for MR angiography (MRA) of the intracranial arteries, it is time-consuming, taking anywhere from 2 - 6 minutes to acquire, and thus presents a problem for stroke and pediatric patients who cannot hold still during the scan. Contrast enhanced MRA (ceMRA) would be a useful alternative. However, a typical acquisition time of 20-30 seconds means that venous contamination is often observed. Using ASSET parallel imaging with four times acceleration, the acquisition time for each 3D volume can be reduced to 3 - 4 seconds, allowing pure arterial phases to be obtained.

CLINICAL SCIENCE FOCUS SESSION
Musculoskeletal MR Imaging: Clinical Studies

Room 713 A/B 14:00 - 16:00 Chairs: Robert Boutin and Garry E. Gold

14:00 ***107***. **Use of Femoral Abduction External Rotation (FABER) Positioning for the Diagnosis of Acetabular Labral Tear During MR Arthrography**

William B. Morrison[1], Mark E. Schweitzer[1], J. Antoni Parellada[1]
[1]Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA

Evaluation of tear of the acetabular labrum is difficult by MR imaging. Our hypothesis is that introduction of capsular stress to the hip joint during imaging could improve diagnostic capability. This was performed through femoral abduction and external rotation (FABER) during MR arthrography. Twelve patients with suspected labral tear underwent MR arthrography in both neutral and FABER position. Quality of labral visualization was improved on the FABER images, as was detection of labral tears. MR arthrography of the hip performed in the FABER position appears to improve visualization of the acetabular labrum and associated tears.

14:10 *108*. DYNAMIC Real-Time Magnetic Resonance Imaging - A New Diagnostic Modality for Groin Pain of Obscure Aetiology

Tushar Agarwal[1], Paul Wragg[1], Wadilslaw Gedroyc[1], Ara Darzi[1], Stuart William Thomas Gould[1]
[1]Imperial College of Medicine, London, UK

Persistent groin pain without clinical signs is a difficult diagnostic problem. Some patients have occult inguinal herniae, but others have musculotendinous injuries not necessarily requiring surgery. No existing imaging modality is sufficiently sensitive to reliably distinguish the two. Therefore the negative surgical exploration rate is high. Interventional Magnetic Resonance units (IMR) allow real-time imaging in physiological positions and during muscular exertion. This study aimed to develop a new non-invasive imaging technique which combines soft tissue imaging capabilities of MR with real time dynamic assessment of groin structures to aid differentiation between the two conditions.

14:20 *109*. Low-Field MR Arthrography of the Shoulder Joint: Results of a Prospective, Surgically Controlled Study

Karl-Friedrich Jakob Kreitner[1], Roland Loew[2], Klaus Kurt Gast[1], Peter Robert Kalden[1], Manfred Thelen[1]
[1]Johannes Gutenberg-University Mainz, Mainz, Germany; [2]Universitätsspital Basel, Basel, Switzerland

The purpose of our study was to determine diagnostic accuracy of MR-arthrography of the shoulder obtained on an open low-field MR unit. 82 patients could be included in this prospective study. The image material was evaluated by two observers blinded to patients' data, clinical history, and surgical results. Both observers achieved high sensitivities, specificities and accuracies for detection of labral lesions and partial and complete tears of the rotator cuff. There was a substantial to excellent interobserver agreement. Low-field MR arthrography of the shoulder proved as sufficient for evaluation labral and rotator cuff abnormalities using a time consuming examination protocol

14:30 *110*. Clinical Effectiveness of MRI in Diagnosis of Infection in Patients With Total Knee Arthroplasties

Donald John Bitto[1], Mark E. Schweitzer[1], Adam Zoga[1]
[1]Thomas Jefferson University, Philadelphia, Pennsylvania, USA

In this study we sought to determine the accuracy and clinical effectiveness of diagnosing post operative infection in total knee arthroplasties using MRI and simple artifact reduction sequences. The study entailed the retrospective evaluation of 18 total knee arthroplasties. We correlated the MRI readings of two blinded radiologists with the clinically determined infectious status. We found that those patients with confirmed infection displayed signs consistent with infection, while those who were pathology free showed normal exams. We conclude that MR imaging of total knee arthroplasties can yield accurate and clinically relevant diagnoses with straightforward sequence modifications.

14:40 *111*. Imaging of the Knee with Ultrashort TE (Ute) Pulse Sequences

Peter D. Gatehouse[1], Rhidian W. Thomas[2], Simon Coleridge[2], Dimitrios Karadaglis[2], Adam Mitchell[2], Amy H. Herlihy[2], Taigang He[2], Graeme M. Bydder[2]
[1]MRRS, Guildford, Surrey, UK; [2]Imperial College, London, UK

Knee imaging was performed with ultrashort TE (Ute) pulse sequences. Later echoes were also used to produce difference images and intravenous contrast was given to most patients. High signal was seen on the TE = 80 microseconds images and difference images derived from them in ligaments and menisci. A superficial low signal and a deep high signal layer were seen in articular cartilage. Greater contrast enhancement was seen with Ute images than with later echoes. Abnormalities were demonstrated in injury to the cruciate ligaments, patella tendon and articular cartilage.

14:50 *112*. Prevalence of Cartilage T_2 Abnormalities in an Asymptomatic Patient Population

Timothy J. Mosher[1], Yi Liu[1], Michael B. Smith[1]
[1]Penn State University College of Medicine, Hershey, Pennsylvania, USA

The purpose of this study is to determine the prevalence of T2 abnormalities in articular cartilage of an asymptomatic population, and to determine if this prevalence increases with age. MRI T2 maps of knees from 54 asymptomatic volunteers were evaluated for T2 lesions. Abnormal T2 was identified in 11% of sites studied in patients under age 45, and 28% of sites in patients 45 and over. Sites of increased cartilage T2 are uncommon in a young asymptomatic population, however, the prevalence of abnormal cartilage T2 not associated with clinical symptoms increases with age.

15:00 *113*. The Assessment of Vascularity in Rheumatoid Arthritis and Spondyloarthropathy using Dynamic Contrast Enhanced MR Imaging.

Laura Anne Rhodes[1], Ai Lyn Tan[2], Philip O' Connor[2], John Philip Ridgeway[1], Helena Marzo-Ortega[2], Paul Emery[2], Dennis McGonagle[2], Steven Frederick Tanner[1]
[1]University of Leeds, Leeds, Yorkshire, UK; [2]Leeds General Infirmary, Leeds, Yorkshire, UK

Magnetic resonance measurments of contrast agent uptake within the synovium have been made in patients with rheumatoid arthritis and spondyloarthropathy (SpA). The relatively higher synovial volumes and vascular permabilities measured in the SpA patients are consistent with previous arthroscopic and histological studies showing differences in vascularity in these different arthritides.

15:10 *114*. Reducing Costs, Duration and Invasiveness of MRI in Rheumatoid Arthritis by Omitting Intravenous Gadolinium Injection – Does It Affect Assessments of Synovitis, Bone Erosions and Bone Edema?

Mikkel Østergaard[1], Phil O'Connor[2], Philip Conaghan[2], Bo Ejbjerg[1], Marcin Szkudlarek[1], Charles Peterfy[3], Mette Klarlund[1], Harry Genant[4], Paul Emery[3]
[1]Copenhagen University Hospital, Hvidovre, Denmark; [2]University of Leeds, Leeds, UK; [3]Synarc Inc, San Francisco, California, USA; [4]University of California, San Francisco, California, USA

To evaluate the importance of i.v. gadolinium-contrast(Gd) in MRI of rheumatoid arthritis(RA), finger and wrist joints were evaluated according to the OMERACT-RA-MRI score twice by 2 blinded observers. Firstly, only pre-Gd-images were available. Secondly, after reblinding, pre-Gd+post-Gd-images were available. Gd-injection appeared unimportant to scores of bone edema and erosions, while pre-Gd-scores of synovitis showed moderate-good correlation with scores obtained with post-Gd-images available. High interobserver agreement rates were achieved. The advantage of using gadolinium in MRI of RA joints may for clinical purposes be outweighed by the possibility to assess more joints and/or reduced costs, duration and invasiveness.

15:20 *115*. Detection of Skeletal Metastases in Patients with Solid Tumors: Whole Body-MRI as a New Screening and Staging Technique in Comparison to Skeletal Scintigraphy and Whole Body-FDG-PET

Nadir Alexander Ghanem[1], Carsten Altehoefer[1], Stefan Högerle[1], Jan Winterer[1], Thomas Kelly[1], Oliver Schäfer[1], Thorsten Bley[1], Mathias Langer[1]
[1]University Hospital Freiburg, Freiburg, Germany

Metastatic disease of bone marrow is much more frequently found in approximately 50 up to 85 % in autopsy studies than in routine staging procedures, so the purpose of our study was to compare the diagnostic values of Whole Body-MRI, skeletal scintigraphy and Whole Body-FDG-PET in detection of skeletal metastases in patients with solid tumors. For Whole Body-MRI, a Turbo-STIR sequence was performed using a rolling table platform" bodysurf-coil"for an unlimited field of view. Our preliminary results demonstrated that Whole Body-MRI, as a fast imaging technique in cancer patients was superior to skeletal scintigraphy and Whole Body-FDG-PET.

15:30 *116*. Accuracy of MR Imaging in Detection of Pedal Osteomyelitis in the Postoperative Patient

Rashi I. Mehta[1], Mark E. Schweitzer[1], William B. Morrison[1], Hans P. Ledermann[2], Steven M. Raikin[1]
[1]Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA; [2]University Hospital Basel, Basel, Switzerland

The diagnosis of osteomyelitis is difficult, particularly in patients with diabetic pedal disease, especially following surgical procedures. In this study we investigated the accuracy of contrast enhanced MR imaging in the diagnosis of osteomyelitis in 88 feet of 78 patients who had prior surgery. Sensitivity of MR imaging overall was 96%; specificity was 87%; PPV was 97%; NPV was 81%. Among diabetics, sensitivity was 96%; specificity was 93%; PPV was 98%; NPV was 87%. We conclude that contrast enhanced MRI is accurate for the diagnosis of post-operative osteomyelitis, even in diabetic patients.

15:40 *117*. Soft Tissue Impingement of The Ankle Joint: Efficacy of Contrast Enhanced 3D-FSPGR Imaging

Yong-min Huh[1], Jin-suck Suh[1], Jin Woo Lee[1]
[1]Yonsei University College of Medicine, Seoul, Republic of Korea

The purpose of this study was to investigate the diagnostic accuracy of CE 3D-FSPGR in assessing synovitis and soft tissue impingement of the ankle joint. All of the thirty seven patients studied had had ankle pain associated with a traumatic injury. MR grading of the synovial enhancement (synovitis, grade III or IV; soft tissue impingement, grade IV) was compared with findings at arthroscopy. CE 3D-FSPGR MR imaging was not found specific but very sensitive for the assessment of synovitis, whereas this imaging method was not sensitive but very specific for the diagnosis of soft tissue impingement of the ankle joint.

15:50 *118*. Diffusion-Weighted Imaging (DWI) for Evaluation of Muscle Diseases: Dermatomyositis and Polymyositis

Jane Harting Park[1], Jing Qi[1], Ronald Price[1], Nancy Olsen[1]
[1]Vanderbilt University Medical School, Nashville, Tennessee, USA

Diffusion-weighted imaging (DWI) shows potential for evaluation of inflammatory myopathies, such as dermatomyositis (DM) and polymyositis (PM). Regions of inflammation in muscles of DM patients showed anisotropy and elevated apparent diffusion constants (ADC), which were partially normalized following immunosuppressive therapy. With the PM patients, regions of extensive fat replacement showed ADC values lower than that of normal muscle and anisotropy in the z direction, indicating residual structural morphology. DWI provides useful information for characterization of myopathies and evaluation of therapy.

Functional Neuro MR Imaging: Physiological Measurement Applications

Room 718A 16:30 - 18:30 Chairs: François Lazeyras and Peter Van Zijl

16:30 *119*. Oxygenation Changes in Intravascular and Extravascular Compartments of the Brain: Implications for fMRI

Hubert Trübel[1], Natasja Maandag[2], Fahmeed Hyder[1]
[1]Yale University, New Haven, Connecticut, USA; [2]University of Nijmegen, Nijmegen, Netherlands

Since the oxygen limitation model proposes that blood oxygenation changes dominate tissue oxygenation changes because significantly larger changes in CBF are necessary to support modest changes in CMRO2, the Balloon model relies on CBF-CMRO2 coupling for BOLD dynamics. In this animal study we measured changes in CBF and CMRO2 (by NMR) along with changes in blood and tissue oxygenation (by optical methods). Since the results demonstrate that absolute changes in tissue and blood oxygenation are proportional when CBF and CMRO2 increase, we propose that oxygen diffusion into the tissue is not limited.

16:42 *120*. Proof of a Second Contrast Mechanism in fMRI: Functional MRI at 0.2 T

Patrick W. Stroman[1], Mihaela Onu[1], Krisztina L. Malisza[1], Amanda Bergman[2], Jennifer Kornelsen[2], Jane Lawrence[2], Mark Torchia[3], Richard Tyc[3], Boguslaw Tomanek[1]
[1]Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]University of Manitoba, Winnipeg, Manitoba, Canada; [3]Saint Boniface General Hospital Research Center, Winnipeg, Manitoba, Canada

A non-BOLD contribution to fMRI contrast has been proposed based on proton-density changes. SEEP (Signal Enhancement by Extravascular water Protons), is theorized to arise from increased exudation of water from blood vessels with a rise in intravascular pressure at sites of neuronal activation. In order to verify this theory, brain fMRI studies were carried out with a short TE spin-echo method, at 0.2 Tesla to eliminate any BOLD contribution. FMRI results obtained with a motor task and thermal stimulation of the hand demonstrate signal changes of ~3% in the corresponding cortical areas and confirm the SEEP theory.

16:54 *121*. Simultaneous High-Density Evoked Potential Recordings and 3 T fMRI Acquisition

Carrie Jane Tobolski[1], Curtis W. Ponton[2], Jos J. Eggermont[1], Bradley Gordon Goodyear[1]
[1]University of Calgary, Calgary, Alberta, Canada; [2]Neuroscan, Inc., El Paso, Texas, USA

We demonstrate the feasibility of recording evoked potentials from a high-density electrode montage while simultaneously obtaining fMRI data at 3 T. Auditory stimuli were presented and auditory evoked potentials (AEPs) were recorded from 128 scalp electrodes followed by a sparse acquisition of fMRI data at empirically determined times corresponding to the peak of the hemodynamic response and baseline. There was excellent agreement in the location of increased brain activity within auditory cortex as determined by EEG and fMRI demonstrating that high-field fMRI and EEG are complimentary techniques and are simultaneously feasible.

17:06 *122*. fMRI Measurement of Voxel-Wise $CMRO_2$ Changes during Rat Forepaw Stimulation

Feng Luo[1], Gaohong Wu[1], Peter Kufahl[1], Guofan Xu[1], Shi-Jiang Li[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

A transient-state biophysical model was employed to calculate voxel-wise CMRO2 during rat forepaw stimulation. Unlike previous studies, in which CMRO2 changes were calculated from ROI, this study reports for the first time the measurement of voxel-wise CMRO2 changes. Our results show that oxygen metabolism is heterogeneous. In the functional area activated by forepaw stimulation, there are voxels with an increase in CMRO2 and other voxels with a decrease in the ipsilateral somatosensory cortex. With the high spatial and temporal resolution of fMRI methods, the long-time controversy on whether neuronal activity significantly increases CMRO2 could be addressed.

17:18 *123*. Sex Differences of Brain ^1H_2O T_1 Values in Controls and MS Subjects: The Role of Estradiol

William D. Rooney[1], Patricia K. Coyle[2], Xin Li[1], Abhishek Dwivedi[2], Maria Taylor[2], Frank W. Telang[1], Charles S. Springer, Jr.[1]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]State University of New York, Stony Brook, New York, USA

The purpose of this study was to investigate sex differences in brain white matter (WM) ^1H_2O T_1 values in controls and MS subjects. Cerebral ^1H_2O T_1 maps were collected from 23 controls (12M, 11F) and 25 MS subjects (8M, 17F) at 4 T. A significant WM T_1 difference was found between control and MS groups, and this difference was maintained when controlled for sex. A significant WM T_1 difference was found between sexes for the control group (F > M), but not for the MS group. Plasma levels of estradiol were significantly associated with WM ^1H_2O T_1

17:30 *124*. Echo Relaxation Imaging (ERI) Demonstrates that Activation Induced Spin-Echo Changes Are Not Due to Changes in T_2

Wen-Ming Luh[1], *Rasmus Birn*[1], *Peter A. Bandettini*[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Using an Echo Relaxation Imaging (ERI) combined gradient-echo and spin-echo multi-echo sequence to create densely sampled T2*, T2, and T2' decay curves, we investigate activation-induced T2*, T2', and T2 changes in the cortex without confounding effects of a long readout window (and intermixed T2' effects) associated with EPI. Our primary finding was that, while significant activation-induced T2* and M0 changes were observed, we did not detect significant T2 changes.

17:42 *125*. Multi-Modal Measurements of CBF, $CMRO_2$, and pO_2 to Determine Oxygen Back Flux from Blood to Brain: Implications for fMRI

Peter Herman[1], *Hubert Trübel*[1], *Fahmeed Hyder*[1]
[1]Yale University, New Haven, CT, USA

If oxygen from brain flows back into blood then oxygen can become limiting in tissue. Since the degree of this oxygen back flux into blood has bearing on quantitative interpretation of fMRI, we measured in rat brain absolute values of CBF and CMRO2 (by NMR) along with blood and tissue oxygen partial pressure (by optical methods). Our results applied with a three-compartment model indicate that the probability of oxygen reentering the blood from the brain is significantly less than 0.1 for situations observed in vivo. Therefore the inclusion of this assumption in the Balloon model should be used with caution.

17:54 *126*. Imaging Creatine Kinase Reaction Activity in Human Brain using 3D ^{31}P CSI at 7 Tesla

Xiao-Hong Zhu[1], *Hongyan Qiao*[1], *Xiaoliang Zhang*[1], *Hao Lei*[1], *Wei Chen*[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

3D 31P chemical shift imaging (CSI) was performed on entire human brain using a 1H/31P double-tuned volume coil at 7 Tesla. Excellent 31P NMR sensitivity was achieved in a small voxel of 4 ml. The 31P imaging approach was incorporated with the saturation transfer for mapping the forward rate constant of creatine kinase reaction in entire brain. The results indicate the promise of 31P CSI at 7 Tesla for differentiating spatial variations of phosphate concentrations and CK enzyme activity. They suggest that ultra-high field is significantly advantageous for performing in vivo 31P spectroscopy on human brain.

18:06 *127*. Investigation of BOLD and Total-Hb Responses using fMRI and Near-Infrared Spectroscopy (NIRS) during Graded Visual Activations

Kenichi Kashikura[1], *Tetsuo Sato*[1], *Hiroshi Toyoda*[1], *Sadahiko Nishizawa*[1], *Yasuhisa Fujibayashi*[1], *Yoshiharu Yonekura*[1]
[1]Fukui Medical University, Yoshida-gun, Fukui-ken, Japan

Blood oxygenation level-dependent (BOLD) signals and total hemoglobin (total-Hb) concentrations in human primary visual cortex (V1) were investigated using functional magnetic resonance imaging (fMRI) and near-infrared spectroscopy (NIRS), respectively. The magnitude of the BOLD, oxygenated hemoglobin (oxy-Hb), deoxygenated hemoglobin (deoxy-Hb), and total-Hb responses induced by different photic patterns (flicker, small checkerboard, and large checkerboard) and stimulus frequencies (1, 4, 8, and 16 Hz) was measured. The relationship between BOLD and total-Hb responses showed a linear correlation during graded visual activations.

18:18 *128*. Relationship Between CBF and $CMRO_2$ during Graded Motor Activations

Kenichi Kashikura[1], *Tetsuo Sato*[1], *Hiroshi Toyoda*[1], *Sadahiko Nishizawa*[1], *Yasuhisa Fujibayashi*[1], *Yoshiharu Yonekura*[1]
[1]Fukui Medical University, Yoshida-gun, Fukui-ken, Japan

The relationship between cerebral blood flow (CBF), blood oxygenation level-dependent (BOLD) signals, and cerebral metabolic rate for oxygen ($CMRO_2$) was investigated during human primary motor activations. The relative $CMRO_2$ changes were computed from the magnitude of the CBF and BOLD responses induced by finger movement at frequencies of 1, 2, and 3 Hz and by inhalation of CO_2 at concentrations of 3, 5, and 7%. The results showed that the $CMRO_2$ increased at a rate approximately half that of the CBF during graded motor activations. This was consistent with recent MRI studies of primary visual activations.

MR PHYSICS AND TECHNIQUES FOR CLINICIANS

Room 718B 16:30 - 18:30 Chairs: Frank R. Korosec and Joseph C. McGowan

Educational Objectives

Upon completion of this course, participants should be able to:

- Define and describe the fundamental principles of MR imaging, including the definition of spin magnetization, the Larmor relationship, relaxation phenomena, and the process of using the spin magnetization to produce an image;
- Explain imaging pulse sequences based upon spin and gradient echoes, incuding fast spin echo and echo planar techniques;
- Design MR imaging protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio, and artifacts;
- Describe the principles and capabilities of various advanced MR techniques including diffusion, cardiac and functional MRI and spectroscopy.

16:30 **Spin Gymnastics I**
Walter Kucharczyk and Donald B. Plewes

17:10 **Spin Gymnastics II**
Walter Kucharczyk and Donald B. Plewes

17:50 **Spectroscopy**
Kim M. Cecil

Contrast Mechanisms and Relaxometry

Room 701A 16:30 - 18:30 Chairs: John C. Gore and Richard I. Watts

16:30 ***129.*** **A Method for Quantitative Imaging of the Macromolecular ^{1}H Fraction in Tissues**

Stefan Ropele[1], Thomas Seifert[1], Christian Enzinger[1], Franz Fazekas[1]
[1]University of Graz, Graz, Austria

A method for mapping the relative density of the macromolecular protons involved in magnetization transfer is presented. This method employs a stimulated echo preparation scheme in order to modulate the phase distribution of water spins. These labeled spins are then used as an intrinsic indicator which is diluted due to magnetization exchange with macromolecular protons. A pulse sequence is presented which compensates for longitudinal relaxation thus allowing observation of the dilution effect only and to calculate parameter maps using indicator dilution theory. The sequence has been used to measure the macromolecular content in cross-linked BSA and human brain in vivo.

16:42 ***130.*** **An *In-Vivo* Examination of Skeletal Muscle Water Energetics Post Exercise Using NMR Relaxomety, Multi-Frequency Bio-impedance Analysis and ^{31}P Spectroscopy**

Mohan Krishnan Raja[1], Gerald Moran[2], Graydon Howard Raymer[1], Miria Bartiolini[2], Greg Marsh[1], R. Terry Thompson[1]
[1]Lawson Health Research Institute, University of Western Ontario, London, Ontario, Canada; [2]McMaster University, Hamilton, Ontario, Canada

Using NMR relaxometry we previously have shown that five T2 components could be resolved, in vivo, for muscle water. The three components with T2 < 100 ms were tentatively assigned to intracellular water (ICWnmr). In this study, we have utilized multi-frequency bio-impedance (MFBIA) as an independent measure of ICW and compared this with ICWnmr at the end of exhaustive exercise and during recovery. No significant differences were found between short-term recovery of ICWnmr and ICWmfbia. Furthermore using 31P spectroscopy, significant correlations were found between increases in ICW and pH at the end of exercise.

16:54 ***131.*** **Blood Relaxation Properties at 3T -- Effects of Blood Oxygen Saturation**

Tammy Lee[1], Jeff A. Stainsby[1], Juimiin Hong[1], Eric Han[2], Jean Brittain[2], Graham A. Wright[1]
[1]Sunnybrook & Women's College Health Sciences Centre, Toronto, Ontario, Canada; [2]GE Medical Systems, Menlo Park, California, USA

T2 values of blood vary characteristically with the amount of blood oxygenation (%O2) due to paramagnetic deoxyhemoglobin. This relationship has been well characterized at 1.5T as $1/T2=1/T2_o + K(1-\%O2/100)^2$. At 3T, K increases and $T2_o$ decreases, resulting in lower blood T2s and greater variation with %O2 compared to 1.5T. These changes, together with increased SNR at 3T can yield more accurate %O2 measurements in vivo. The feasibility of using a 3T system for in vivo oximetry has been demonstrated through scans of the femoral vein in healthy subjects.

17:06 *132*. New Approach for Estimating dR_2^* in fMRI

Valur Thor Olafsson[1], *Douglas C. Noll*[1], *Jeffrey A. Fessler*[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

We introduce a framework in which $\Delta R2^*$ in an fMRI experiment can be estimated directly from a single echo, estimate of a baseline image and a baseline $R2^*$. This approach uses a linearized model of the difference signal between the non active signal and active signal during a task along the time course. $\Delta R2^*$ maps, are estimated at each time point using the Conjugate-Gradient (CG) method. Dynamic estimate images of $\Delta R2^*$ were created for a study of motor activation using a finger tapping task. These maps were also thresholded to yield the expected areas of activation in primary motor cortex.

17:18 *133*. Experimental Characterization of Relaxation Properties of Ho, Dy, Gd, and Y-loaded Microspheres for Internal Radiation Therapy of Liver Tumors

Jan Henry Seppenwoolde[1], *Sander Zielhuis*[1], *Frank Nijsen*[1], *Chris J. G. Bakker*[1]
[1]University Medical Center, Utrecht, Netherlands

In internal radiation therapy for treatment of unresectable liver tumors, radioactive therapeutic microspheres are injected in the hepatic artery. Because several radionuclides are also highly paramagnetic, they can be directly visualized with MRI. In this study, microspheres were loaded with Holmium, Gadolinium, Dysprosium and Yttrium. Relaxometry was performed under variation of particle size and field strength, showing a strong and linear relationship between concentration of the microspheres and observed $R2^*$ relaxivity for Ho, Gd and Dy. The calibration curves as determined in this study can be used to obtain quantitative and dosimetric maps for internal radiation therapy under MRI.

17:30 *134*. T_2 Relaxation Study of Water in Human Brain using Carr-Purcell Spin-Echoes at 4T and 7T. Frequency shift $\Delta\omega$ at 4T and 7T.

Shalom Michaeli[1], *Kamil Ugurbil*[1], *Michael Garwood*[1]
[1]University of Minnesota School of Medicine, Minneapolis, Minnesota, USA

Fully adiabatic Carr-Purcell (CP) type sequence (CP-LASER) with SPIRAL readout was used to investigate the change in $\Delta\omega$ (difference in angular Larmor frequency) with the field (4T vs. 7T). T_2 - weighted images were acquired to measure the apparent $T_2^\dagger$ in human visual cortex V1 as a function of interpulse time interval in CP train. It was found that $\Delta\omega$ increases slightly with the field but significantly less than linearly. This suggest that chemical exchange does not explain the data and that Nuclear Overhauser Effect (NOE) and/or NOE in the rotating frame (ROE) are contributing to MR signal decay.

17:42 *135*. Quantification of Both T_1 and T_2 with IR TrueFISP

Peter Schmitt[1], *Mark A. Griswold*[1], *Peter M. Jakob*[1], *Markus Kotas*[1], *Michael Flentje*[1], *Axel Haase*[1]
[1]University of Würzburg, Würzburg, Germany

A novel procedure is proposed to extract both T1 and T2 from the signal time course sampled with a single IR TrueFISP experiment. This is accomplished by fitting the measured data to theoretical data from numerical simulations based on the Bloch equations, which describe the magnetization time course dependence on flip angle, TR, T1, T2 and off resonance frequency. In phantoms T1 and T2 values derived by this procedure show excellent agreement with those from single point reference measurements. In human volunteers high SNR T1 and T2 maps were obtained in accordance with literature values with single IR TrueFISP scans.

17:54 *136*. Voxel Based Relaxometry

Gaby S. Pell[1], *Anthony B. Waites*[1], *Regula S. Briellmann*[1], *Graeme D. Jackson*[1]
[1]Brain Research Institute, Heidelberg, Victoria, Australia

The standard procedure for analysis of clinical T2 relaxometry data uses manually drawn regions of interest. This approach is subject to criticism due to its subjective nature and because of the variability introduced in grey matter regions by partial voluming with CSF. This study aims to tackle these issues by a two-fold approach. An improved fitting procedure is used that takes account of CSF contamination in grey matter. Statistical analysis was then carried out with a methodology akin to voxel based morphometry. This approach is tested in a study comparing controls and patients with temporal lobe epilepsy.

18:06 *137*. Intermolecular Cross-Relaxation during Adiabatic Pulses – Implications for Carr-Purcell T_2 Contrast

Heidi Mäkelä[1], *Olli Gröhn*[1], *Lance DelaBarre*[1], *Shalom Michaeli*[1], *Risto Kauppinen*[2], *Michael Garwood*[1]
[1]Center for Magnetic Resonance Research, Minneapolis, Minnesota, USA; [2]University of Manchester, Manchester, UK

To assess the influence of RF pulses on Carr-Purcell-T_2 (CP-T_2), water CP-T_2 in protein phantoms was measured using different adiabatic pulses (HS*n*). Possible cross-relaxation contributions were investigated using the same CP trains for mixing in 1D-ROE measurements in DMSO/water. CP-T_2s showed clear dependency on pulse shape and B_1, which could not be explained by Bloch simulations of an isolated spin system. In ROE experiments, significant cross-relaxation during adiabatic CP trains was detected, indicating that cross-relaxation may affect the measured CP-T_2 values and provide a way to tailor CP-T_2 contrast. Also, adiabatic mixing was exploited to image DMSO indirectly via water.

18:18 ***138***. **Enhancing Contrast in Susceptibility Weighted Imaging**

E. Mark Haacke[1,2], Limin Feng[2], Caixia Hu[2], Todd Parrish[3], Yingbiao Xu[1]
[1]Wayne State University, Detroit, Michigan, USA; [2]The MRI Institute for Biomedical Research, Detroit, Michigan, USA; [3]Northwestern University, Chicago, Illinois, USA

Purpose: To optimize contrast enhancement in SWI. Introduction: Phase imaging offers a means to enhance contrast in SWI. Theory: A statistical theory was developed to predict the optimal number of phase mask multiplications to best enhance the CNR for a given SNR and imaging time. Methods: A series of circles were created and MR data simulated with different phases and SNR to test the theory. Results: The predictions match well with both the simulations and real human data. Discussion and Conclusions: The ability to enhance CNR in SWI is significantly enhanced with the new theoretical approach described herein.

Clinical Human Brain MR Spectroscopy

Room 701B 16:30 - 18:30 Chairs: Mary A. McLean and Brian D. Ross

16:30 ***139***. **Quantitative Proton Magnetic Resonance Spectroscopy of Children with Adrenoleukodystrophy Before and After Hematopoietic Stem Cell Transplantation**

Peter Dechent[1], Jürgen Finsterbusch[1], Bernd Wilken[2], Knut Brockmann[2], Folker Hanefeld[2], Jens Frahm[1]
[1]Biomedizinische NMR Forschungs GmbH am MPI für biophysikalische Chemie, Göttingen, Germany; [2]Georg-August-Universität, Göttingen, Germany

Boys with ALD can develop a rapidly progressive cerebral form, ultimately leading to death. Hematopoietic stem cell transplantation (HSCT) at an early stage of the active disease has been promising, but its morbidity requires a reliable selection of asymptomatic boys threatened by disease progression. Here, we performed follow-up quantitative MRS in white matter of ALD patients before and after HSCT to test whether criteria for the outcome after HSCT can be provided. Positive outcome correlated with high tNAA levels in affected white matter before HSCT. Therefore, the preservation of neuroaxonal integrity seems to be a prerequisite for an arrested course.

16:42 ***140***. **Gray Matter NAA Deficits in Secondary Progressive but not Relapse Remitting Multiple Sclerosis: Quantification with Volumetric MR Spectroscopic Imaging**

Elfar Adalsteinsson[1], Adolf Pfefferbaum[2], Edith V. Sullivan[1], Archana Rao[1], Annette Langer-Gould[1], Scott W. Atlas[1]
[1]Stanford University, Stanford, California, USA; [2]SRI International and Stanford University, Menlo Park, California, USA

Volumetric proton MR spectroscopic imaging and high resolution MRI were used to compare metabolite concentrations in brain tissue without structurally-identifiable lesions in relapsing-remitting multiple sclerosis (RRMS) patients, secondary progressive (SP) MS patients and normal, age-matched controls. Segmented MRI and spectroscopic images were co-registered, and metabolite signals per unit of tissue volume were calculated. Relative to controls, both RRMS and SPMS had significantly lower N-acetylaspartate (NAA) concentration in white matter, but only SPMS showed a reduction in gray matter NAA. This deficit pattern comports with the more severe clinical course and greater cognitive deficits of SPMS than RRMS.

16:54 ***141***. **Creatine Therapy for Huntington's Disease: Clinical and Magnetic Resonance Spectroscopy Findings in a One Year Pilot Study**

Sarah J. Tabrizi[1], Andrew M. Blamire[2], David N. Manners[2], Bheeshma Rajagopalan[2], Peter Styles[2], Anthony H V Schapira[3], Thomas T. Warner[3]
[1]Institute of Neurology, London, UK; [2]University of Oxford, Oxford, UK; [3]University College Medical School, London, UK

Creatine has been shown to have a neuroprotective effect in a murine model of Huntington's disease (HD). In this study, creatine was given to HD patients and controls over a 12 month period at a high dose, similar to that given to mice. Magnetic resonance spectroscopy showed significant elevation of creatine in the brain at 6 and 12 months and phosphocreatine in muscle at 6 months. Clinical function in this patient group would be expected to decline during the study, however no such decline was observed. This suggests that creatine therapy may have a stabilising effect on disease progression.

17:06 ***142***. **Brain GABA Differs by Subtype of Depression**

Graeme F. Mason[1], C. Neill Epperson[1], Amit Anand[2], Hilary Blumberg[1], Michael Appel[1], Douglas L. Rothman[1], John H. Krystal[1], Gerard Sanacora[1]
[1]Yale University, New Haven, Connecticut, USA; [2]Indiana University and Purdue University, Indianapolis, Indiana, USA

The detection of GABA by 1H MRS has allowed the study of neuropsychiatric disorders, including depression. The GABAergic system interacts with serotonergic and other neurotransmitter systems that may be affected in depression. Some evidence that GABA levels in the cerebral spinal fluid may be altered in depression, and some studies show changes in GABA receptors in the brain. Depression appears to divide into several categories that differ in their symptoms and responses to treatment, and this study investigated if the divisions are reflected in GABA levels.

17:18 *143*. [1]H Magnetic Resonance Spectroscopy Detection of Chromosomal Defects in Alzheimer's Dieases and Down Syndrome

Alexander Peter Lin[1], Cathleen Mateo Enriquez[1], Brian David Ross[1]
[1]Huntington Medical Research Institutes, Pasadena, California, USA

Down syndrome and Alzheimer's disease (AD) are thought to result from genetic defects that affect the formation of amyloid precursor protein (APP). In vivo short-echo single voxel 1H MRS was acquired in a population of patients with: genetically confirmed AD, post-mortem confirmed AD, genetically confirmed Downs with and without dementia, and age-matched controls. Results indicate that 1H MRS measurements of increased mI are identified in all patient groups that exhibit genetic defects in the APP pathway. This study also confirms the diagnosis of AD with MRS with genetic, histopathological, and neuropsychological confirmation.

17:30 *144*. Evidence for Early Widespread Gray Matter Involvement in Relapsing Remitting Multiple Sclerosis

Matilde Inglese[1], Yulin Ge[1], Massimo Filippi[2], Andrea Falini[2], Robert I. Grossman[1], Oded Gonen[1]
[1]New York University, New York, New York, USA; [2]San Raffaele Hospital, Milan, Italy

Multiple sclerosis is an inflammatory demyelinating syndrome of the central nervous system, widely believed for over a century to be a white matter (WM) disease (1). However, recent pathological and MRI evidence suggest gray matter (GM) involvement as well (2,3). To test this involvement we compared the concentration of N-acetylaspartate (NAA), a metabolite found almost exclusively in neuronal cells, between 71 relapsing-remitting (RR) MS patients and 41 age- and sex-matched healthy controls. To ensure the all the GM and WM were examined, we applied whole-brain NAA (WBNAA) concentration quantification, a new 1H-MRS technique (4), to both patient and control cohorts.

17:42 *145*. [1]H-MRS Study of Hypothalamus Metabolism in Patients with Cluster Headache

Raffaele Lodi[1], Giulia Pierangeli[1], Caterina Tonon[1], Sabina Cevoli[1], Fabiola Magnifico[1], Pietro Cortelli[2], Pasquale Montagna[1], Bruno Barbiroli[1]
[1]University of Bologna, Bologna, Italy; [2]University of Modena and Reggio Emilia, Modena, Italy

The pathophysiology of cluster headache (CH), one of the most severe pain syndromes, is still poorly understood. Recent PET and voxel-based morphometric MRI studies have found altered function and volume of the hypothalamus in CH. We studied, using in vivo 1H-MRS 22 CH patients in a headache free state. In CH patients hypothalamic NAA/Cr was significantly reduced compared to controls (p=0.001). Reduction in hypothalamic NAA content can be related to neuronal loss/ dysfunction and/or changes in the relative content of glial and neural cells. This alteration may be linked to the pathophysiological mechanism underlying headache attacks in CH.

17:54 *146*. [1]H-MRS Study of Brain Metabolism in Patients with Obstructive Sleep Apnoea Syndrome Before and After Nasal Continuous Positive Airway Pressure Therapy

Caterina Tonon[1], Raffaele Lodi[1], Roberto Vetrugno[1], Federica Provini[1], Stefano Iotti[1], Valeria Clementi[1], Giuseppe Plazzi[1], Pasquale Montagna[1], Bruno Barbiroli[1]
[1]University of Bologna, Bologna, Italy

Neurological and cardiovascular complications have been associated with obstructive sleep apnoea syndrome. Nasal continuous positive airway pressure (nCPAP) is the first line of therapy to normalise sleep pattern. We evaluated by in vivo 1H-MRS ten OSAS patients without comorbidities. In OSAS patients cortical NAA concentration was significantly lower than in controls and persisted unchanged after treatment, despite the normalisation of polysomnographic parameters. These findings suggest that irreversible brain biochemical alteration in OSAS precede the development of MRI cerebrovascular abnormalities. 1H-MRS may be useful for detecting early CNS damage and play a significant role in the timing of therapeutic interventions.

18:06 *147*. Brain GABA Falls with Sobriety in Alcohol-Dependent Subjects

Graeme F. Mason[1], Michael Appel[1], Robin A. de Graaf[1], Elizabeth Ruff[1], Douglas L. Rothman[1], John H. Krystal[1]
[1]Yale University, New Haven, Connecticut, USA

The detection of GABA by 1H MRS has allowed the investigation of a variety of neuropsychiatric disorders, including substance abuse. The GABAergic system has been thought to be involved in the processes of alcohol abuse and dependence, and it has been shown previously that GABA is reduced in alcohol-dependent subjects during sobriety (Behar et al., 1998). The present work is a longitudinal examination of GABA levels during detoxification.

18:18 ***148***. **Improvement of Reproducibility by Selection of MRS Data Depending on Spectral Quality Expressed by Lower Bounds of Linear Model Curve Fitting**

Hitoshi Kubo[1], Masafumi Harada[1], Minoru Sakama[1], Hiromu Nishitani[2]
[1]University of Tokushima, School of Health Sciences, Tokushima, Japan; [2]University of Tokushima, School of Medicine, Tokushima, Japan

Reproducibility of quantitative proton MRS was influenced by accuracy of curve fitting that was indicated by lower bound of estimated result. To evaluate the influence of curve fitting accuracy, intraclass correlation coefficient (ICC) was used. Due to selection of the quantitative data by curve-fitting reliability, reproducibility was much changed and selection by lower bound was possible to maintain the reproducibility as clinical meaningful data. The age dependent differences of glutamate concentration was statistically shown by the selection based on the curve-fitting reliability.

Flow Quantitation

Room 714 A/B 16:30 - 18:30 Chairs: Stefan O. Schoenberg and James F.M. Meaney

16:30 ***149***. Young Investigator Awards Finalist: **Correction of the Inflow Effect on Fast GRE MR Sequence for Perfusion Imaging**

Marko Ivancevic[1], Ivan Zimine[1], Xavier Montet[1], Jean-Noel Hyacinthe[1], François Lazeyras[1], David Foxall[2], Jean-Paul Vallée[1]
[1]Geneva University Hospital, Geneva, Switzerland; [2]Philips Medical Systems, Cleveland, Ohio, USA

The purpose of this study was to assess the inflow effect on signal intensity for fast GRE sequences in MR first pass tissue perfusion quantification with contrast media. An in-vitro experiment with a flow apparatus was performed to determine signal intensity vs. Gd-DTPA concentration for various velocities. Therefrom a flow-sensitive calibration method was developed, and validated on bolus injections both in-vitro and in patients. We show that calibration methods based on static phantoms are not appropriate for accurate signal calibration in flow-affected images. Our flow-corrected calibration method improves the accuracy and robustness of the arterial input function determination.

16:50 ***150***. ***In Vivo* Quantification of Abdominal Aortic Hemodynamic Conditions at Rest and During Cycling Exercise in Healthy Subjects Aged 50-70**

Christopher P. Cheng[1], Charles A. Taylor[1], Robert J. Herfkens[1]
[1]Stanford University, Stanford, California, USA

Atherosclerosis prevalence in the human abdominal aorta increases with age and correlates with low wall shear stress (WSS) and shear oscillations. Exercise modulates these adverse conditions, observed at rest in the infrarenal aorta, in healthy subjects aged 23.6+/-2.2. Hemodynamic conditions were quantified in the abdominal aorta of 8 healthy subjects (aged 57.1+/-3.4) at rest and during exercise using an open-MRI and custom MR-compatible exercise-cycle. For the older subjects, exercise resulted in greater increases in WSS and elimination of greater shear oscillations (observed at rest) at the supraceliac and infrarenal locations as compared to the younger subjects.

17:02 ***151***. **Wall Movement and Compliance are Required to Produce Helical Flow in the Ascending Aorta**

John N. Oshinski[1], Suo Jin[2], Don P. Giddens[2]
[1]Emory University, Atlanta, Georgia, USA; [2]Georgia Institute of Technology, Atlanta, Georgia, USA

Helical flow patterns have been observed in-vivo in the ascending, transverse and proximal descending aorta. Vessel curvature has been suggested as the cause for this rotational component in the flow. We employed MR phase velocity mapping in the aorta to measure flow, vessel movement, and vessel compliance, then used these data in combination with computational fluid dynamics (CFD) to examine the effects of vessel movement and compliance on aortic flow patterns. We found that the movement and compliance of the aorta must be included in the CFD model to reproduce the helical flow patterns found in-vivo.

17:14 ***152***. **MR-Derived Aortic Wave Velocity: Correlation with Physical Fitness Status**

Kenneth Kraft[1], James Arrowood[1], Ding-Yu Fei[1], Stephen Harkins[1], Robert Johnson[1], Ravi Naalla[1], Domenic Sica[1]
[1]Virginia Commonwealth University, Richmond, Virginia, USA

We examined the relationship between degree of physical fitness and aortic stiffness in a sample of healthy adults (ages 24 - 65, N=50). Men (N=22) and women (N=28) underwent fitness testing using a standardized exercise protocol. A rapid one-dimensional MR sequence was employed to measure flow wave velocity, a metric of arterial stiffness, in the descending thoracic aorta. In all age groups, aortic wave velocity decreased with increasing fitness level. This novel MR wave velocity sequence may be a useful tool for non-invasive assessment of aortic stiffness.

17:26 *153*. Measurement of Pulmonary Flow Patterns Using Phase Contrast MRI and Correlation Analysis

Christopher K. Macgowan[1], Christian J. Kellenberger[1], Kevin Roman[1], Shi Joon Yoo[1]
[1]University of Toronto and The Hospital for Sick Children, Toronto, Ontario, Canada

A correlation analysis is proposed to detect blood flow in small pulmonary vessels from phase-contrast MRI. The flow pattern in a large pulmonary vessel is used as a template to detect similar flow patterns throughout the image, according to the correlation coefficient (CC). Spatial maps of the CC are thresholded and spatially filtered to segment vessels with flow patterns matching the template. Unique to this approach, it is possible to measure flow patterns in small peripheral pulmonary vessels, which may improve our understanding of pulmonary physiology and dysfunction. An analysis of pulmonary venous flow is presented.

17:38 *154*. Real-Time Volume Flow Measurements with Complex Difference MRI

Richard B. Thompson[1], Elliot R. McVeigh[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Complex difference processing of differentially flow encoded image data (phase contrast MRI) greatly simplifies image content by subtracting out signal from stationary tissue. We demonstrate that a single projection can be used to measure quantitative volume flow rates in large vessels (several mm) with a real-time temporal window of two acquisition lengths (TRs). We address the suppression of unwanted background signals and calibration of the projected complex difference signal (ml/s). Validation is provided by comparison with conventional gated-segmented phase contrast MRI in a flow phantom and in-vivo in the popliteal artery and aorta in a normal volunteer.

17:50 *155*. Imaging and Quantitation of High-Speed Flow Jets in a Single Breath-Hold

Krishna S. Nayak[1], Miriam Amitai[1], Michael V. McConnell[1], Bob S. Hu[1], Dwight G. Nishimura[1]
[1]Stanford University, Stanford, California, USA

Flow jets containing velocities up to 5-7 m/s are common in patients with congenital defects and patients with valvular disease (stenosis and regurgitation). We have developed a gated breath-held sequence, which can acquire a CINE phase contrast loop with 22 ms temporal resolution and 2 x 2 mm spatial resolution in a single 10-second breath hold. Using short spiral readouts adequate resolution can be achieved while minimizing artifacts from fast flow. Simulations and in-vivo results indicate signal from flow up to 5 m/s is achieved.

18:02 *156*. Perfusion Imaging Using Velocity Encoding

Andrzej Jesmanowicz[1], James S. Hyde[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

A new strategy for MRI perfusion imaging is introduced here, which we call “Velocity Encoding Perfusion” (VEP). Echo planar imaging is used. Every shot is preceded by a tailored tagging pulse that saturates tissues in an adjacent slab by varying flip angles across the slab. The profile is also varied in time to create a sinusoidal oscillation of magnetization Mz. The velocity of flow depends on a time delay of tagged blood that arrives at the imaging slice and is detected by the phase and frequency of oscillations in the time-course series of images.

18:14 *157*. Quantitative Flow Imaging With “NoQuist” Reduced Field of View Acquisition

Marijn E. Brummer[1], David Moratal-Pérez[2], José Millet-Roig[2], Roderic I, Pettigrew[3], W. Thomas Dixon[4]
[1]Emory University, Atlanta, Georgia, USA; [2]Universitat Politècnica de València, València, Spain; [3]National Institutes of Health, Bethesda, Maryland, USA; [4]General Electric Global Research, Niskayuna, New York, USA

High-resolution breathhold phase velocity encoded imaging is performed by conventional full-grid acquisition and by NoQuist rFOV reconstruction using 53% of the data. Comparison of calculated aortic blood flow shows excellent agreement between the two techniques. NoQuist may accelerate high-resolution flow imaging to within clinically feasible breathhold times.

Vessel Wall MR Imaging

Room 716 A/B 16:30 - 18:30 Chairs: Zahi A. Fayad and Thomas S. Hatsukami

16:30 *158*. Clinical Correlates of MRDTI-defined Carotid Complicated Plaque

Rachael E. Murphy[1], Alan R. Moody[1], Paul S. Morgan[1], Anne L. Martel[1]
[1]Queen's Medical Centre, Nottingham, Nottinghamshire, UK

MR Direct Thrombus Imaging (MRDTI) demonstrates carotid complicated plaque as high signal within the arterial wall. MRDTI was used to scan the carotid arteries of 120 patients with proven carotid stenosis and recent cerebrovascular symptoms. Relationships between high signal and patient atherosclerotic risk factors were examined. Patient statin use had an inverse relationship with MRDTI high signal in carotid arteries and cholesterol value had a positive relationship (both $p<0.05$). Cholesterol level may be related to the presence of MRDTI-defined complicated plaque in the carotid arteries of patients who have had cerebrovascular events. Statin use may modify this plaque

16:42 *159*. MRI is Able to Distinguish between Intraplaque Hemorrhage and Juxtaluminal Hemorrhage/Thrombus in Advanced Atherosclerotic Plaques

Annette Kampschulte[1], Marina Ferguson[1], William S. Kerwin[1], Baocheng Chu[1], Tom S. Hatsukami[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

High resolution multi-contrast magnetic resonance imaging has developed into a very effective tool for the in vivo identification of atherosclerotic plaque components such as lipid, calcium, fibrous tissue and hemorrhage. The association between intraplaque hemorrhage and clinical symptoms is well documented in the literature. Furthermore, the distribution of plaque hemorrhage, whether it is intraplaque with an intact fibrous cap, or extends into the lumen (juxtaluminal hemorrhage/thrombus) is of tremendous clinical relevance. Any erosion, ulceration or rupture of the surface can cause further plaque instability. This study shows that multicontrast MRI can differentiate between intraplaque hemorrhage and juxtaluminal hemorrhage/thrombus.

16:54 *160*. Optimization of USPIO Enhanced *In Vivo* MRI of Human Carotid Atherosclerosis

Rikin Trivedi[1], Jean UKing-im[1], Martin Graves[1], Jo Horsley[2], Joanna Segieth[3], Martin Goddard[2], Liqun Wang[3], Peter Kirkpatrick[4], Jonathan Gillard[1]
[1]University of Cambridge, Cambridge, England, UK; [2]Papworth Hospital, Cambridge, England, UK; [3]GlaxoSmithKline, Cambridge, England, UK; [4]Addenbrooke's Hospital, Cambridge, England, UK

We have optimized the timing and sequences of Ultrasmall Superparamagnetic Particles of Iron Oxide (USPIO) enhanced magnetic resonance (MR) imaging of the carotid arteries in 8 patients scheduled for carotid endarterectomy. Patients underwent MR imaging before, 24, 36, 48, 72 and 96 hours after infusion of the USPIO agent, Sinerem®. USPIO induced a signal decrease within the atheromatous plaque on 2D spiral T2*W images of the carotid artery. The decrease in signal intensity was seen as early as 24 hours but was maximal at 48 hours post infusion. Immunohistochemical analysis of excised plaques revealed co-localisation of iron and activated/immature macrophages.

17:06 *161*. Growing of Atherosclerotic Plaque: A Long-Term Follow-Up Study in Hereditable Hyperlipidemic Rabbits using Contrast Enhanced Magnetic Resonance Imaging

Joerg Barkhausen[1], Wolfgang Ebert[2], Claudia Heyer[2], Joerg F. Debatin[1], Hanns Joachim Weinmann[2]
[1]University Hospital, Essen, Germany; [2]Research Laboratories Schering, Berlin, Germany

Recently it has been shown that Gadofluorine (Schering, Berlin, Germany), an intravascular contrast agent, enhances aortic wall segments with plaque burden in Watanabe hereditary hyperlipidemic rabbits. In this study we monitored the growing of atherosclerotic plaque in-vivo using T1 weighted MRI in conjunction with this new compound.

17:18 *162*. Molecular Imaging of Angiogenesis in Atherosclerosclerotic Rabbits By MRI With an $\alpha_v\beta_3$ Targeted Paramagnetic Nanoparticle

Patrick M. Winter[1], Shelton D. Caruthers[2], Anne H. Schmieder[1], Thomas D. Harris[3], Ralph W. Fuhrhop[1], John S. Allen[1], Huiying Zang[1], Samuel A. Wickline[1], Gregory M. Lanza[1]
[1]Washington University School of Medicine, St. Louis, Missouri, USA; [2]Philips Medical Systems, Best, Eindhoven, Netherlands; [3]Bristol-Myers Squibb Medical Imaging, Billerica, Massachusetts, USA

Molecular imaging is emerging as a new technique for the sensitive and specific detection of a wide variety of diseases and for planning and monitoring an array of different therapies. Angiogenesis is integral to the development and progression of atherosclerotic disease. $\alpha_v\beta_3$-integrin is a selective molecular epitope expressed by angiogenic endothelium (1). The objective of this research is to demonstrate sensitive identification of developing plaques in a rabbit model of atherosclerosis with T_1-weighted signal enhancement after systemic injection of $\alpha_v\beta_3$-targeted paramagnetic nanoparticles.

17:30 *163*. A New Interleaved Multi-Slice Black Blood Double Inversion Recovery Technique for Vessel Wall Imaging

Venkatesh Mani[1], Vitalii V. Itskovich[1], Michael Szimtenings[2], Juan Gilberto S. Aguinaldo[1], Daniel D. Samber[1], Gabor Miszei[1], Zahi A. Fayad[1]
[1]Mount Sinai School of Medicine, New York, New York, USA; [2]Siemens Medical Solutions Inc, Malvern, Pennsylvania, USA

Synopsis: The purpose of this study was to develop a new pulse sequence for interleaved double inversion recovery (DIR) multislice black blood imaging. DIR modules were used in combination with interleaved turbo spin-echo (TSE) acquisitions to minimize inversion time (TI) of dark blood and reduce the total experiment time, allowing imaging of up to 20 slices per acquisition. All measurements were made on a 1.5 T Siemens clinical MR scanner on the aortae of three human volunteers.

17:42 *164*. Simultaneous Acquisition of Proton Density and T_2 Weighted Images with Double Inversion Multi-Slice FSE for Black-Blood MRI

Hideto Kuribayashi[1], Jean J. Tessier[1], David R. Checkley[1], Yi Xiang Wang[1], Leif Hultin[2], John C. Waterton[1]
[1]AstraZeneca, Macclesfield, Cheshire, UK; [2]AstraZeneca, Pepparedsleden, Möndal, Sweden

The aim was to improve MRI techniques for identification and characterization of atherosclerotic plaque with reduced scan time. We combined two techniques: a simultaneous proton density weighted image (PDWI)/T_2 weighted image (T2WI) acquisition; and a multi-slice Black-Blood FSE sequence with double inversion recovery pulses employing k-space reordering to ensure a correct inversion time for each slice. Using this technique, the vessel wall in rabbit abdominal aorta was visualized robustly at 4.7 T with both PDWI and T2WI contrast without losing the Black-Blood effect in any slice.

17:54 *165*. Ultra-fast, Parallel Imaging of the Carotid Arteries Using an 8 Channel Coil Array

Gabor Mizsei[1], Vitalii Itskovich[1], Venkatesh Mani[1], Zahi Adel Fayad[1]
[1]Mount Sinai School of Medicine, New York, New York, USA

The study of atherosclerotic disease during its natural occurrence and following therapeutic intervention will enhance our understanding of the disease and aid in selecting appropriate treatments. Compared to other modalities, magnetic resonance has potential advantages in vessel wall imaging: with its multi-contrast and high-resolution capabilities non-invasive vessel wall imaging and atherosclerotic plaque characterization becomes feasible. By combining novel hardware and software techniques a feasible imaging protocol can be established for high volume longitudinal studies and/or screening of the high risk population. We are presenting our preliminary results on a new ultra-fast, high-resolution carotid imaging protocol and receiver array design.

18:06 *166*. Identification and Characterization of Atherosclerotic Plaques with an Intravascular Coil

Daniel F. Kacher[1], Y Yeghiazarians[1], M Aikawa[1], E Rabkin[1], S Kinlay[1], P Ganz[1], A P. Selwyn[1], P Libby[1], E K. Yucel[1]
[1]Brigham and Women's Hospital, Boston, Massachusetts, USA

Intravascular coils have been demonstrated for imaging of vessel wall. We present our initial findings in ex-vivo, animal, and patient studies. We characterize plaque appearance with various image weightings and perform correlation of appearance with histology. The coil has shown to be safe in our initial experience with imaging of iliac arteries in patients.

18:18 *167*. Artifact-Free Visualization of the Coronary Vessel Wall in the Presence of a New Coronary MRI Stent

Elmar Spuentrup[1], Alexander Ruebben[1], Andreas H. Mahnken[1], Matthias Stuber[2], Christian Koelker[1], Rene M. Botnar[2], Sylvia Kinzel[1], Trung Hieu Nguyen[1], Rolf W. Günther[1], Arno Buecker[1]
[1]Aachen Technical University, Aachen, Germany; [2]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

The aim of this study was the investigation of a new dedicated coronary MRI stent for artifact-free visualization of the coronary vessel wall. Dual inversion recovery black-blood turbo spin echo vessel wall imaging was performed in 15 healthy swine perpendicular to the main axis of the coronary arteries at the level of the stent. Images were analyzed by two investigators in terms of visible artifacts. In all cases, coronary vessel wall could be completely artifact free visualized. In conclusion, the new coronary MRI stent allows for artifact-free visualization of the coronary vessel wall.

Body MR at 3T?

Room 713 A/B 16:30 - 18:30 Chairs: Neil M. Rofsky and Piotr A. Wielopolski

16:30 *168*. T_1 and T_2 Measurements of Breast Tissue at 0.5 T, 1.5 T and 3.0 T

Rebecca Rakow[1], Bruce Daniel[1], Anne Sawyer-Glover[1], Gary Glover[1]
[1]Stanford University, Stanford, California, USA

Synopsis: With the introduction of 3.0T scanners and the use of open, low-field scanners, it is important to assess relaxation times and accordingly optimize tissue contrast in applications such as breast imaging. The right breasts of five healthy volunteers were scanned at 0.5T, 1.5T, and 3.0T. T1 and T2 calculations and analysis from collected images indicate a significant increase in T1 for glandular tissue of the breast. From the sample data collected, there was a 45% increase of T1 in breast glandular tissue from 0.5T to 1.5T, and a 26% increase from 1.5T to 3.0T.

16:42 *169*. Using Combined T_2* and T_1 Measurement for Improved Determination of the Arterial Input Function in Perfusion and Permeability Studies of Body Metastases at 3.0 Tesla

Cedric MJ de Bazelaire[1], Jenifer Zhang[1], Guillaume D. Duhamel[1], Neil M. Rofsky[1], David C. Alsop[1]
[1]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

With bolus contrast injection, the peak arterial concentration is more than 10 times higher than for tissue. Measurement of the arterial concentration is challenging because arterial spins are fully relaxed in T1 sequences appropriate for tissue. At high field strengths or with high contrast agent doses, the T2* of arterial blood can cause attenuation of even short echo time data. The use of a dual echo sequence to simultaneously measure the T1 and T2* of the arterial input is reported. T2* was used to measure the concentration near the peak of the bolus where the T1 measurement is inaccurate.

16:54 *170*. Renal BOLD MRI at 3.0T

Luping Li[1], Tony Vu[1], Wei Li[1], Pottumarthi Prasad[1]
[1]Evanston Northwestern Healthcare, Evanston, Illinois, USA

Higher magnetic field strength is beneficial for BOLD MRI, especially for small vessels and capillaries. While fundamental SNR should improve with field strength, it depends on the radio-frequency chain performance and limitation on choice of parameters based on specific absorption rate and increased T1. With the increased availability of 3T scanners with body imaging capability, we sought to compare renal BOLD MRI at 1.5 and 3.0 T. R2* in the renal medulla and cortex, liver and muscle were (mean±st.Err) 35.9±1.9, 19.2±0.7, 60.7±7.8 and 39.8±0.6 at 3.0 T compared to 27.0±2.0, 18.6±0.9, 37.4±4.1 and 36.5±0.5 at 1.5 T.

17:06 *171*. Breath-Hold Abdominal and Thoracic Proton Magnetic Resonance Spectroscopy at 3T

Rachel Katz-Brull[1], Neil M. Rofsky[1], Robert E. Lenkinski[1]
[1]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

This work demonstrates the feasibility of in vivo breath-hold body 1H-MRS on a 3T scanner equipped with a torso multicoil array. Frame-to-frame phase and frequency shifts and voxel contamination (associated with respiratory motion) were eliminated or markedly reduced using breath-holding. Tumor free kidney tissue and metastases of renal cell carcinoma in the abdomen and thorax were investigated using a single or multiple breath-hold datasets. Spectra of the tumors showed a resonance at 3.2 ppm. The results suggest that biochemical characterization of abdominal and thoracic tumors may now be possible in vivo.

17:18 *172*. ^{1}H Magnetic Resonance Spectroscopy in Assessment of Large Focal Hepatic Lesions: Preliminary Experience at 3.0T Whole-body Scanner

Yu Ting Kuo[1], Chun Wei Li[1], Chiao Yun Chen[1], Ding Kwo Wu[1], Chien Kuo Wang[1], Twei Shiun Jaw[1], Gin Chung Liu[1]
[1]Kaohsiung Medical University, Kaohsiung, Taiwan

Single-voxel proton MR spectroscopy (MRS) with body coil at 3.0T whole body scanner is done for normal volunteer and patients with large focal hepatic lesions, which include malignant and benign masses. The technical success rate for MRS acquisition is 76%. The mean Cho/Lipid peak height ratios for malignant tumors, benign tumors, normal parenchyma and malignant tumors post transcatheter arterial chemoembolization are 0.21±0.16, 0.13±0.16, 0.08±0.06 and 0.04±0.03 respectively. We conclude MRS may be feasible in differentiating malignant tumors from benign lesions or normal parenchyma and also useful in monitoring the therapeutic response

17:30 *173*. Prostate MRI and MRSI with an Endorectal Coil at 3 T

Tom Scheenen[1], Jurgen Fütterer[1], Dennis Klomp[1], Stefan Röll[2], Ferdi van Dorsten[1], Jelle Barentsz[1], Arend Heerschap[1]
[1]University Medical Center, Nijmegen, Netherlands; [2]Siemens Medical Solutions, Erlangen, Germany

The first results of high resolution T2-weighted imaging, spectroscopic imaging and (dynamic) contrast enhanced (DCE) imaging of the prostate at 3T with an endorectal coil are presented. The increased SNR at 3T was used to increase spatial, temporal and spectral resolution of these methods. In T2-weighted and post-contrast T1-weighted imaging the increased anatomical detail improved delineation of tumor tissue and evaluation of extracapsular extension. The high temporal resolution and SNR of DCE imaging increased the accuracy of pharmakokinetic parameters. In spectroscopic imaging the relevant individual resonances were well-resolved with minimal contamination from residual water and lipid signals.

17:42 *174*. Considerations on Shimming for Cardiac Applications at 1.5 and 3.0T

Michael Schär[1], Sebastian Kozerke[1], Peter Boesiger[1]
[1]University and ETH, Zürich, Switzerland

Fast cardiac imaging suffers from static field inhomogeneities. Pronounced susceptibility effects have been reported adjacent to the posterior vein of the left ventricle. Field inhomogeneities are assumed to scale linearly with field strength. As high field MR systems are increasingly used for cardiac applications shimming issues have to be revised. In this study we have measured field maps in five volunteers at 1.5T and 3.0T and calculated the potential correction using linear and 2nd order shimming. Results indicate the necessity of 2nd order shimming at 3.0T. Furthermore, optimal shimming depends on the respiratory state as well as the cardiac phase.

17:54 *175*. Dual-stack 3D Coronary MRA with SENSE at 3 Tesla

Michael E. Huber[1], Sebastian Kozerke[1], Peter Boesiger[1]
[1]University and ETH Zurich, Switzerland

In coronary MRA, the simultaneous acquisition of two independent 3D stacks can be used for the visualization of both coronary arterial systems within 50% of the scan time of a single-stack approach. However, the cardiac rest phase during mid-diastole is relatively short and motion artifacts may further arise from the prolonged time delay between the navigator and the second imaging stack. In this work SENSE imaging at 3Tesla was successfully used to reduce the acquisition window of each 3D stack and hence the time delay between the navigator and the second imaging stack, resulting in better vessel visualization.

18:06 ***176***. **3.0T Carotid Bifurcation Imaging**

Denise Hinton[1], Lawrence Wald[1], Van Weeden[1], Franz Schmitt[2]
[1]Massachusetts General Hospital, Charlestown, Massachusetts, USA; [2]Siemens Medical Solutions, MGH-NMR Center, Charlestown, Massachusetts, USA

The goal of this work is to investigate techniques to characterize the vessel wall of the carotid bifurcation at 3.0T. We were interested in evaluating at 3.0T increases in spatial resolution and reduction in image acquisition times compared to 1.5T for the standard 2D "dark blood" methods. Additionally, we explored the feasibility of 3D "dark blood" Turbo spin echo (TSE) for even higher spatial resolution vessel wall imaging and cine gradient echo imaging of vessel wall motion. These techniques have been implemented at 3.0T and have been applied to subjects with varying amounts of carotid atherosclerotic disease.

18:18 ***177***. **Pulmonary Perfusion Using Arterial Spin Labeling at 3 Tesla MR Scanner**

Vu Minh Mai[1], Qun Chen[1], Anthony Vu[1], Wei Li[1], Belinda S. Li[2], Linda Pierchala[1], Saban Kurucay[3], Jason A. Polzin[3], Pottumarthi V. Prasad[1], Robert R. Edelman[1]
[1]Evanston Northwestern Healthcare and Feinberg School of Medicine at Northwestern University, Evanston, Illinois, USA; [2]GE Medical Systems, Evanston, Illinois, USA; [3]GE Medical Systems, Milwaukee, Wisconsin, USA

Pulmonary perfusion imaging using flow-sensitive alternating inversion recovery (FAIR) technique was demonstrated at 3T. Despite the fact that susceptibility effect, already particularly large at 1.5 T, worsens at high field, pulmonary perfusion imaging using arterial spin labeling was successful. Preliminary measurement of T1 of the lung at 3T was approximately 1597 msec, which was longer than that of approximately 1370 msec at 1.5T.

Cognitive and Psychiatric Disorders

Room 715 A/B 16:30 - 18:30 Chairs: David Alsop and Jair Soares

16:30 ***178***. **Increased Hippocampal Perfusion in Early Alzheimer's Disease**

David C. Alsop[1], Melynda Casement[1], Daniel Press[1]
[1]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, USA

Synopsis: Fourteen patients with probable Alzheimer's Disease and eight normal controls were imaged with whole brain continuous Arterial Spin Labeling at 4 mm spatial resolution. Absolute blood flow to the hippocampal formation was significantly higher for mild AD subjects, MMSE>21 n=11, than for normal controls. Blood flow decreases in the neocortex were also readily detected, consistent with previous nuclear medicine studies. These results suggest hyperactivity of the hippocampal formation occurs early in the development of AD either as a response to neuronal damage or as part of the primary pathologic mechanism.

16:42 ***179***. **q-Space Diffusion Imaging of Dementia: Application to Vascular Dementia and Alzheimer's Disease**

Orna Mayzel-Oreg[1], Yaniv Assaf[2], Ariela Gigi[2], Dafna Ben-Bashat[2], Mordechi Mordohovitch[2], Ruth Verchovsky[2], Irit I. Reider-Groswasser[2], Talma Hendler[2], Moshe Graif[2], Amos D. Korczyn[2], Yoram Cohen[1]
[1]Tel Aviv University, Tel Aviv, Israel; [2]Tel Aviv Sourasky Medical Center, Tel Aviv, Israel

Diffusion weighted imaging and diffusion tensor imaging have been used to study white matter (WM) changes in many neurological disorders, including dementia. In the present work we have used high b value q-space diffusion MRI to characterize vascular dementia (VaD) and Alzheimers disease (AD). The results clearly demonstrate massive WM changes in VaD while in AD clear changes were obsereved mostly in the gray matter. High b value q-space diffusion MRI shows high sensitivity to WM changes, may be useful to characterize tissue loss in VaD and AD, and may assist the differentiation between those two pathologies.

16:54 ***180***. **Testing the Cerebral Reserve Hypothesis in a Unique Cohort of Elderly People**

Roger T. Staff[1], Alison D. Murray[1], Steven A. Leaper[1], Ian J. Deary[2], Lawrence J. Whalley[1]
[1]University of Aberdeen, Aberdeen, Scotland, UK; [2]University of Edinburgh, Edinburgh, Scotland, UK

The cerebral reserve hypothesis proposes that the contribution of a given amount of brain pathology to intellectual decline is modified by the extent of 'cerebral reserve'. Theoretical mediators of such reserve are larger brain size and higher intellectual attainment. This study uses childhood intelligence at age 11, MR imaging and intelligence at age 79 to test the reserve hypothesis and whether this is implemented by passive (brain reserve) or active (cognitive reserve) models. The results show that head size is independent of cognitive decline whereas those with greater levels of educational and occupational attainment decline less.

17:06 ***181***. **Neural Markers of Impaired Episodic Memory in Alzheimer's Disease and Major Depression**

Arthur Peter Wunderlich[1], Georg Grön[1], Daniel Bittner[1], Matthias W. Riepe[1], Hans-Jürgen Brambs[1]
[1]University Clinic Ulm, Ulm, Baden-Württemberg, Germany

Depressive patients frequently present with memory complaints that have contributed to coin the term "depressive pseudo-dementia". Cross-sectional differential diagnosis between depressive patients, demented patients, and older healthy subjects on behavioral measures is often ambiguous. We used functional magnetic resonance imaging during free recall of abstract geometric patterns to assess episodic memory in older subjects who sought first-time medical attention with subjective memory complaints and were diagnosed with probable Alzheimer's Disease or major depressive disorder. Neuronal correlates of memory activity showed distinct differences between the two groups.

17:18 *182*. Voxel-Based and Region-Of-Interest Morphometry Convergently Reveal Regional Gray Matter Abnormalities in Unipolar Depression

Vaibhav A. Diwadkar[1], Acioly L. T. Lacerda[2], Matcheri S. Keshavan[1], Antonio Y. Hardan[1], Jair C. Soares[3]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [2]State University of Campinas, Campinas, Sao Paulo, Brazil; [3]University of Texas Health Science Center, San Antonio, Texas, USA

We concurrently applied voxel-based (VBM) and region-of-interest (ROI) morphometry toward the study of abnormalities in gray matter concentration and volume in unipolar depression. Whereas VBM permits the voxel-wise analyses of reductions in gray matter concentration over the entire brain, the ROI analyses focused on measuring the volume of the orbitofrontal cortex (OFC), a critical ventral frontal lobe structure involved in affective regulation of emotion and mood. The ROI analyses indicated reduced gray matter volume in the left medial OFC. Consistent with this, VBM analysis revealed reductions in gray matter concentration in a region of tissue centered in the same structure.

17:30 *183*. Tissue Segmentation Changes Statistical Significance for ^{1}H MRSI of the Thalamus in Schizophrenic Patients

Gabriele Ende[1], Wolfgang Weber-Fahr[1], Sigi Walter[1], Fritz A. Henn[1]
[1]Central Institute of Mental Health, Mannheim, Germany

We re-evaluated proton MR spectroscopic imaging data of the thalamus in schizophrenic patients using tissues segmentation and CSF correction. Signals of N-acetylaspartate, creatine and phosphocreatine, and choline containing compounds were evaluated in the region of the mediodorsal nuclei of the thalamus bilaterally. Our previous findings of reduced signals from N-acetylaspartate and choline containing compounds in patients with schizophrenia could not be corroborated for the CSF corrected values. It has to be discussed whether previously reported evidence for a neuronal dysfunction and/or loss in this region schizophrenics might by an artifact of increased CSF content or decreased thalamic volume, respectively

17:42 *184*. Practice Makes Imperfect ? An fMRI Study of Practice-Related Interference in Schizophrenic Patients and Healthy Controls

J Martijn Jansma[1], Heleen A. Slagter[2], Rene S. Kahn[3], Nick F. Ramsey[3]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]University of Amsterdam, Amsterdam, Netherlands; [3]University Medical Center Utrecht, Utrecht, Netherlands

This study examines effects of task-practice on ‘opposite’ tasks in healthy controls (HC) and schizophrenic patients (SP). Subjects were scanned (blocked design), while performing a Sternberg task using novel stimuli, and tasks using targets and non-targets that were practiced, but switched (interference task (IT)). Opposite of expectation, in HC, but not in SP, fMRI results suggested facilitated task-performance in IT, as activity in anterior cingulate and caudate nucleus was reduced. This reduction was absent in SP. Results suggest that in HC, but not in SP, implicit learning processes reduced working memory related brain activity, and exceeded inhibitory effects.

17:54 *185*. Normalisation of BOLD Response Following Psychotherapy in Posttraumatic Stress Disorder.

Tom F. Farrow[1], Iain D. Wilkinson[1], Michael D. Hunter[1], Camal Gouneea[2], Di Fawbert[3], Roger Smith[1], Ying Zheng[2], Suzanne Mason[3], Sean A. Spence[1], Peter W. Woodruff[1]
[1]University of Sheffield Medical School, Sheffield, South Yorkshire, UK; [2]University of Sheffield, Sheffield, South Yorkshire, UK; [3]Northern General Hospital, Sheffield, South Yorkshire, UK

Thirteen patients with posttraumatic stress disorder underwent BOLD fMRI before and after cognitive behavioural therapy. The paradigm was designed to indicate judgments of other’s intentions, distress (invoking empathy) and forgivability versus ‘baseline’ social reasoning. Control data (n=12) indicated that empathic judgements activate left middle temporal gyrus, medial frontal gyrus and posterior cingulate gyrus / precuneus whilst forgivability judgements activate left medial frontal gyrus and posterior cingulate gyrus / precuneus. Prior to therapy, patients failed to show BOLD responses to empathic or forgivability judgements, compared to controls. Post-therapy, there was an increase in patient response to empathic judgment.

18:06 *186*. Functional MRI Neuroanatomic Correlates of the Hooper Visual Organization Task

Chad H. Moritz[1], Kathryn M. McMillan[1], Baxter P. Rogers[1], Victor M. Haughton[1], Sterling C. Johnson[1], M. Elizabeth Meyerand[1]
[1]University of Wisconsin-Madison Medical School, Madison, Wisconsin, USA

The Hooper Visual Organization Task (HVOT), a commonly applied neuropsych test of visual spatial ability, is often used for assessing neurological impairments. To date, no published report has examined this test with functional MRI (fMRI). In this study, the characteristic visual organization and object naming aspects of the HVOT task presentation were adapted to a fMRI paradigm to probe the neuroanatomic correlates of this important neuropsychiatric metric. fMRI mapping results are reported on a cohort of normal subjects.

18:18 ***187.*** **Monitoring Music Processing of Harmonic Chords using fMRI: Comparison between Professional Musicians and Amateurs**

Ing-Jye Huang[1], Chi-Ning Chen[1], Fu-Nien Wang[1], Hsiao-Wen Chung[1], Cheng-Yu Chen[2]
[1]National Taiwan University, Taipei, Taiwan; [2]Tri-Service General Hospital, Taipei, Taiwan

In this study, perception of harmonic relationship was studied using fMRI. Professional musicians and amateurs participated in two different harmony experiments: identifying simple triads' name and distinguishing triads from non-harmonic chords, respectively. Broca's area (BA44, 45) is shown to be related to these two tasks. Also, a left hemisphere lateralization was observed on professional musicians when dealing with chords.

Mouse Phenotyping: MR omics

Room 717 A/B 16:30 - 18:30 Chairs: Alan P. Koretsky and A. Dean Sherry

16:30 ***188.*** **Liver Flux Profile of a Transgenic Mouse Model of Congenital Generalized Lipodystrophy, aP2-SREBP-1c**

Natasha L. Hausler[1], Shawn Burgess[1], Angela Richman[1], Charles J. Storey[1], Jay D. Horton[1], A. Dean Sherry[1], Craig R. Malloy[1]
[1]The University of Texas Southwestern Medical Center, Dallas, Texas, USA

A conspicuous feature of type 2 diabetes for many patients is hepatic steatosis. This elevation of hepatic triglyceride content is also a consistent feature of murine models of type 2 diabetes and insulin resistance syndromes such as congenital generalized lipodystrophy (CGL). It has been suggested that increased availability of triglycerides to hepatocytes stimulates both beta oxidation and gluconeogenesis. ^{13}C and ^{2}H NMR were used to measure relative fluxes through metabolic pathways leading to glucose production (GP) in a murine model of CGL.

16:42 ***189.*** **Deuterium NMR Correctly Reports Gluconeogenesis in Livers From PEPCK Knockout Mice**

Shawn C. Burgess[1], Natasha Hausler[1], Charles Storey[1], Angela Richman[1], Mark A. Magnuson[2], Craig r. Malloy[1], A Dean Sherry[1]
[1]University of Texas Southwestern Medical Center, Dallas, Texas, USA; [2]Vanderbilt University, Nashville, Tennessee, USA

The deuterated water method takes advantage of hydrogen exchange in specific catalytic steps of gluconeogenesis to determine the contribution of glycogen versus gluconeogenesis to glucose production. This method has been used successfully under many different conditions. 2H also offers a convenient method to differentiate the contributions of glycerol versus TCA cycle to gluconeogenesis by detecting 2H enrichment at H6 of glucose, but the method has not been validated. In this work, we use a strain of mice lacking hepatic PEPCK and demonstrate that 2H NMR correctly reports that gluconeogenesis from the TCA cycle is indeed absent in these KO animals.

16:54 ***190.*** **MRI of Gastric Cancer in Tff1 Knock-Out Mice**

Stuart S. Berr[1], James K. Roche[1], Wa'el El-Rifai[1], Michael F. Smith, Jr.[1], Steven M. Powell[1]
[1]University of Virginia, Charlottesville, Virginia, USA

Knock-out of the trefoil Tff1 gene results in the spontaneous development of gastric tumors in mice. We present MRI methods to image and stage stomach dysplasia and carcinoma in a mouse model of gastric cancer using deuterated water to distend the stomach, an injectable form of glucagon to quell peristaltic motion and Gd-DTPA to enhance the tumors. Fourteen homozygous Tff1 -/- mice and twenty control mice were imaged at 2, 3, 4, 5, and 6 months of age. MRI was compared with histology. There was not a statistically significant difference between the numbers of nodules determined by the two methods.

17:06 ***191.*** **VEGF Induced Permeability of Blood-Retinal Barrier: MR Microimaging of a Transgenic Mouse Model**

Dmitri Artemov[1], Peter Gehlbach[1], Satoru Yamamoto[1], Zaver Bhujwalla[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

This study utilizes MR microimaging to examine a transgenic mouse model of blood-retinal barrier (BRB) breakdown, a pathological condition that leads to macular edema and vision loss. The mice in this study utilize doxycycline to induce over-expression of vascular endothelial growth factor (VEGF) resulting in increased BRB permeability. High-resolution dynamic MRI was used to follow the kinetics of GdDTPA in the mouse eye. Increased leakage of GdDTPA was detected in VEGF over-expressing animals as compared to control animals and corresponded to histopathological findings. MR microimaging provides an informative and quantitative way to assess the progression of BRB permeability change.

17:18 192. Striatal Neurochemical Changes in Transgenic Huntington's Disease Mice Detected by *In Vivo* ^{1}H NMR Spectroscopy

Ivan Tkac[1], Christopher Dirk Keene[1], Pierre Gilles Henry[1], Walter C. Low[1], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Sixteen metabolites (neurochemical profile) were reliably quantified non-invasively in the left striatum of wild type and R6/2 transgenic Huntington's disease mice using high performance *in vivo* ^{1}H NMR spectroscopy at 9.4T and LCModel data processing. Significant differences in metabolite concentrations were detected between wild type and R6/2 mice, such as increased Cr, Gln, GSH, cholines, and decreased Glu and NAA. Neurochemical changes of Cr, Gln, and NAA were significant enough to be detected in individual mice. Decreased ratios of [Glu]/[Gln] and [PCr]/[Cr] are consistent with impaired Glu-Gln cycling and energy metabolism.

17:30 193. A Tale of Two Mice: Impaired Glial and Neuronal Function in Transgenic Mouse Models of Huntington's Disease and Amyotrophic Lateral Sclerosis using Proton and Carbon Spectroscopy

Ji-Kyung Choi[1], Ekkehard Kustermann[1], Ole Andreassen[1], Alpaslan Dedeoglu[1], M. Flint Beal[1], Bruce G. Jenkins[1]
[1]MGH-NMR Center, Charlestown, Massachusetts, USA

Development of transgenic mouse models of human neurodegenerative illness such as Huntington’s disease (HD) [1] and amyotrophic lateral sclerosis (ALS) [2] have greatly enhanced our understanding of these diseases. HD is caused by an expansion of a CAG repeat on carboxyl terminal end of a protein (huntingtin) with unknown function. Familial ALS (FALS) is caused by a mutation in the free radical scavenging enzyme superoxide dismutase (SOD) that leads to death of motor neurons in mice [2]. We have studied these two models using 1H and 13C spectroscopies.

17:42 194. Dietary Creatine Supplementation in a Mouse Model of Huntington's Disease

Rupert A. Page[1], Alan Bainbridge[2], Daniel A. West[3], John S. Thornton[3], H J. Parkes[3], Ern B. Cady[2], Gillian P. Bates[4], Ben Woodman[4], Roger J. Ordidge[3], Charles A. Davie[1]
[1]Royal Free Hospital, London, UK; [2]University College Hospital London, London, UK; [3]University College London, London, UK; [4]Guy's Hospital, London, UK

Huntington’s disease (HD) is a progressive neurodegenerative disorder in which a bio-energetic defect is believed to contribute to neurological dysfunction. Creatine (Cr) supplementation has been proposed as being of potential benefit in HD. The R6/2 mouse is a model of HD, which has previously been studied using 1H MRS. We describe the results of a 1H MRS study assessing dietary Cr supplementation in this model using absolute quantification and conclude that it does not appear to alter disease progression as measured by previously identified metabolite markers.

17:54 195. Complementary Displacement-Encoded MRI for Contrast-Enhanced Infarct Detection and Quantification of Myocardial Function in Mice

Wesley Gilson[1], Zequan Yang[1], Brent French[1], Frederick Epstein[1]
[1]University of Virginia, Charlottesville, Virginia, USA

MRI is emerging as an important imaging modality for assessing myocardial function in transgenic and knockout mouse models of cardiovascular disease, including myocardial infarction (MI). We developed a modified displacement-encoded imaging (DENSE) pulse sequence for measuring myocardial displacement and strain at high resolution using phase-reconstructed images and simultaneously depicting contrast-enhanced regions of MI using magnitude-reconstruction of the same raw data.

18:06 196. Odor Quality Distinguished by Activity Patterns of the Glomerular Sheet: fMRI of Mouse Olfactory Bulb

Fuqiang Xu[1], Ikuhiro Kida[1], Douglas L. Rothman[1], Fahmeed Hyder[1], Gordon M. Shepherd[1]
[1]Yale University, New Haven, Connecticut, USA

Odors are encoded by spatial activity pattern (SAP) in the olfactory bulb. Because the SAP for any odor requires consideration of all glomeruli and traditional methods are incapable of imaging the entire glomerular space, we applied fMRI at glomerular resolution in mouse bulb to reveal that odor molecules with different functional groups but same chain length generate intense foci which are distributed randomly, whereas molecules with same functional groups but different chain lengths generate intense foci which are conserved. These results suggest, for the first time, that odors are represented by hierarchical mechanisms within the entire glomerular space.

18:18 197. E-selectin-specific MRI Probes for Monitoring Proinflammatory Sites in a Mouse Xenograft Model

Hye-Won Kang[1], Ralph Weissleder[1], Alexei Bogdanov[1]
[1]Massachusetts Gerneral Hospital/ Harvard Medical School, Charlestown, Massachusetts, USA

Conjugates of cross-linked iron oxide nanoparticles and anti-human E-selectin fragments were prepared for the imaging of the endothelial proinflammatory marker by MRI. In vivo experiments were performed in mice 2-4 weeks after implantation with Matrigel plugs bearing HUVECs. T2-weighted signal changes were observed in the sites with implanted HUVECs by intravenous injection of iron conjugates following intraperitoneal injection of IL-1beta. In mice implanted either with Matrigel alone or without IL-1beta treatment, no significant signal intensity change was observed. The present study demonstrates that MRI of E-selectin expression holds promise as a targeted diagnostic agent for monitoring inflammatory, angiogenesis, and atherosclerosis.

BRONZE CORPORATE MEMBER SYMPOSIUM
Mallinckrodt
Contrast Enhanced Breast MRI for Breast Cancer Staging

Hall F/G 18:30 - 20:00

Speaker: *Scott Partyka, M.D.*
Brooke Army Medical Center, Fort Sam Houston, Texas, USA

STUDY GROUP
Cardiac MR

Room 718A 19:30 - 21:30

Scientific Meeting
Myocardial Stress Perfusion Imaging – Controversies in Data Acquisition and Analysis

- Data Acquisition
  Andrew Arai, M.D., National Institutes of Health, Bethesday, Maryland, USA
  Frederick Epstein, Ph.D., University of Virginia, Charlottesville, Virginia, USA

- Data Analysis
  Eike Nagel, M.D., German Heart Institute, Berlin, Germany
  Michael Jerosch-Herold, Ph.D., University of Minnesota, Minneapolis, Minnesota, USA
  Steven Wolff, M.D., Ph.D., Lenox Hill Hospital, New York, New York, USA

STUDY GROUP
MR Engineering

Room 716 A/B 19:30 - 21:30

The MR Engineering Study Group will present a scientific program.

STUDY GROUP
MR of Cancer

Room 718B 19:30 - 21:30

Business Meeting

Scientific Program
Molecular Imaging in Oncology

- Molecular Imaging of Neoplasia using MR
  Brian Ross, Ph.D., University of Michigan, Ann Arbor, Michigan, USA

- Monitoring Transgene Expression with PET and MR
  Juri Gelovani Tjuvajev, Ph.D., M.D., Memorial Sloan Kettering Cancer Center, New York, New York, USA

- Optical Imaging in Cancer

Eyk Schellenberger, M.D., Massachusetts General Hospital, Boston, Massachusetts, USA

STUDY GROUP
White Matter Diseases

Room 717 A/B 19:30 - 21:30

The White Matter Study Group will present a scientific program. The meeting will be divided into three parts: during the first, the new WMSG Steering Committee will present themselves and their program for the next three years; the second part will host short oral presentations of ten abstracts we will choose from among those related to White Matter accepted for poster presentation in the ISMRM Scientific Meeting; during the last part, proposals for the 2004 workshop of the WMSG will be discussed.

STUDY GROUP
Dynamic NMR Spectroscopy

Room 714 A/B 19:30 - 21:30

The Dynamic NMR Spectroscopy Study Group will present a scientific program.

STUDY GROUP
Hyperpolarized Noble Gas MR

Room 713 A/B 19:30 - 21:30

Scientific Program

- Polarized Gas MR and Lungs
  Peter Macklem, McGill University, Montreal, Quebec, Canada

- Hyperpolarization Methods for ^{13}C-Containing Molecules
  Oskar Axelsson, Amersham Health R&D, Malmo, Sweden

- Low Field MRI with Hyperpolarized Helium: Status, Prospects, and Issues
  Genevieve Tastevin, Ecole Normale Supérieure,, Paris, France

STUDY GROUP
MR In Drug Research

Room 701A 19:00 - 21:30

Agenda

19:00 Social hour with members of the Society for Non-Invasive Imaging in Drug Development

19:30 Tim McCarthy, President of SNIDD

19:40 Business Discussion

20:00 Update on DICOM – The Impact of HIPAA Regulations
Andrew Kraus Beacon Bioscience, Doylestown, Pennsylvania, USA

20:30 The Use of Metabonomics in Drug Safety Evaluations
Dr. Marielle Delnomdedieu, Pfizer

21:00 Experiences in Establishing Multi-Site MR Trials
Dr. David Saloner, VA Medical Center, San Francisco, California, USA

MORNING CATEGORICAL COURSE
Controversies and Advances in Musculoskeletal MRI

Room 713 A/B 07:00 - 08:00 Chairs: Garry E. Gold and Lawrence M. White

Educational Objectives
Upon completion of this course, participants should be able to:
- Compare MRI with other advanced imaging modalities;
- Explain the role of interventional MRI in the musculoskeletal system;
- Explain the role of high-field MRI in the musculoskeletal system;
- Describe the technical issues related to high-resolution joint imaging;
- Evaluate options for open MRI scanners for musculoskeletal imaging.

07:00 **Cartilage MRI: Technical Issues**
Brian A. Hargreaves

07:25 **Cartilage MRI: Clinical Evaluation**
Douglas W. Goodwin

07:50 **Questions and Discussion**

MORNING CATEGORICAL COURSE
Parallel Imaging

Room 714 A/B 07:00 - 08:00 Chairs: Neil M. Rofsky and Daniel K. Sodickson

Educational Objectives
Upon completion of this course, participants should be able to:
- Explain the basic principles of parallel imaging, including elements both of RF coil array design and image reconstruction;
- Survey promising applications of parallel MRI in cardiovascular imaging and body imaging;
- Describe new developments in image reconstruction and coil array design, and outline emerging parallel imaging applications;
- Identify the key steps in a practical parallel imaging examination and compare the nuts-and-bolts features of various MR vendors' existing implementations.

Basics
07:00 **Introduction**
Daniel K. Sodickson

07:05 **Coil Arrays (The Technological Tools)**
Michael Ohliger

07:30 **Image Reconstruction (The Mathematical Tools)**
Klaas Prüssmann

07:55 **Discussion**

MORNING CATEGORICAL COURSE
Emerging Body MR: From Structure to Function

Room 715 A/B 07:00 - 08:00 Chairs: Vivian S. Lee and Riccardo Manfredi

Educational Objectives
Upon completion of this course, participants should be able to:
- Recognize and implement recent technical advances in body MRI including BOLD and perfusion techniques, fast T_2-weighted imaging methods, and new contrast agents;
- Describe recent advances in the assessment of liver and breast for tumor, structural and functional studies of the biliary system, and MR measurements of renal function;
- Identify applications of MR to the evaluation of large and small bowel disease;
- Compare the information provided by MR elastography in the assessment of organ pathologies, such as in the breast and prostate, to conventional MR imaging techniques.

Technical Developments

07:00 **Perfusion MRI and BOLD Techniques**
P.V. Prasad

07:20 **Fast T_2 Imaging Techniques**
Stefan G. Ruehm

07:40 **New Contrast Agents**
Carlo Bartolozzi

MORNING CATEGORICAL COURSE
fMRI Experimental Methods

Room 718 B 07:00 - 08:00 Chairs: R. Todd Constable and Mathias Hoehn

Educational Objectives
Upon completion of this course, participants should be able to:
- Explain the latest developments in fMRI with respect to understanding the underlying physiology leading to the BOLD response and its relationship to neuronal activity and the influence of pharmacological substances on activation;
- Describe the factors influencing paradigm design and the optimum acquisition strategy for event-related versus block designs;
- Recognize which analysis approach is most appropriate for a particular experimental design;
- Describe the spatial limits of fMRI and factors influencing resolution.

Physiological Changes

07:00 **Mechanisms of fMRI**
Richard B. Buxton

07:30 **fMRI in Birds**
Annemie van der Linden

MORNING CATEGORICAL COURSE
Diffusion Tensor Imaging

Room 718A 07:00 - 08:00 Chairs: Gareth J. Barker and Scott D. Swanson

Educational Objectives

Upon completion of this course, participants should be able to:

- Describe how/why the proton diffusion pathway in tissue can be explained by a tensor;
- Explain how the tensor is acquired, measured, and mapped;
- Describe the limitations of such diffusion tensor imaging;
- Describe more advanced diffusion measurement techniques, such as q-space and diffusion spectrum imaging;
- Appreciate the multi-exponential and/or multi-compartmental nature of diffusion;
- List and describe important clinical applications of DTI.

07:00 **Introduction and Background**
Peter Basser

08:00 **Adjournment**

MORNING CATEGORICAL COURSE
Advanced MR Angiography Techniques

Room 716 A/B 07:00 - 08:00 Chairs: James Meaney, Martin Prince and Stefan Schoenberg

Educational Objectives

Upon completion of this course, participants should be able to:

- Identify the challenges of MRA implementation in anatomic areas with high technical demands;
- Compare the advantages and disadvantages of different technical approaches in these areas;
- Recognize the clinical benefit of advanced MRA protocols for a comprehensive, non-invasive work-up of vascular disease.

Optimizing MRA in the Feet

07:00 **2D Projection MRA**
Yi Wang

07:10 **3D Tricks**
Stefan O. Schoenberg

07:20 **Moving Table: Sagittal Feet**
Jeffrey H. Maki

07:30 **Moving Table: Coronal Feet**
James F.M. Meaney

07:40 **Discussion**

MORNING CATEGORICAL COURSE
Spectroscopy Beyond NAA

Room 717 A/B 07:00 - 08:00 Chairs: Peter Allen, Rolf Gruetter, John Griffiths, Stephen Williams

Educational Objectives
Upon completion of this course, participants should be able to:
- List the major metabolites in addition to NAA, Crn, Cho that can be detected *in vivo* in the brain by MRS;
- Describe the biological and clinical importance of these metabolites;
- List the key factors to achieve good spectra;
- Describe the principles of data analysis in both frequency and time domain;
- Explain how MRS can be used to measure metabolic fluxes as well as steady-state concentrations;
- List the advantages and disadvantages of $^{13}C/^{15}N$ with respect to ^{1}H.

07:00 **Introduction**
Stephen R. Williams

07:30 **Glucose, Glycogen, Glutathione and GABA by 1H and 13C NMR**
Rolf Gruetter

PLENARY LECTURES
Safety and MRI

Hall F/G 08:15 - 09:30 Chairs: Kim Butts and David J. Lomas

Educational Objectives
Upon completion of this session, participants should be able to:
- Identify the physiological limits of MRI;
- Evaluate an epidemiological study on MRI
- Identify who makes recommendations on MRI guidelines;
- List MRI regulations.

08:15 ***198***. **Physiological Limits of MRI**

John Schenck[1]
[1]GE Corporate R&D, Schectady, New York, USA

There is a very high degree of patient safety in the strong magnetic fields currently in use for MRI. This is attributed to the extremely low value of the magnetic susceptibility and the lack of ferromagnetic components in human tissues. Providing that rapid patient motion in the field is avoided, it is expected that normal humans will safely tolerate static magnetic fields susbstantially larger than those of the highest field whole body magnets (9.4-12T) currently planned for human MRI.

08:40 ***199***. **Clinical Safety Issues**

Donald M. Hadley[1]
[1]Institute of Neurological Sciences, Glasgow, Scotland, UK

If strict adherence to certain precautions is maintained MR provides one of the safest clinical examinations available. In general referring clinicians do not appreciate the potential hazards or the safety precautions enacted to mitigate the risks to their patients. As the field strengths used in clinical MR increase maintaining this safe MR environment becomes an ever-greater daily challenge.

09:05 ***200***. **Gradient Safety Concerns**

Brian K. Rutt[1]
[1]Robarts Research Institute, London, Ontario, Canada

Modern day whole-body MRI gradient systems are now performance-limited more by human physiology than by hardware constraints. A significant physiological limit to rapidly switched gradient coils, particularly at main field strengths greater than 1.5T, is acoustic noise. A review of gradient coil acoustic properties, and strategies for acoustic noise control will be presented. The high strength/high slew rate capability of the highest performance gradient systems means that peripheral nerve stimulation (PNS) is a potential side effect of most high speed or high resolution pulse sequences. Basic theory and current concepts in PNS prediction/avoidance will be reviewed.

Fast Imaging Sequences: Pushing the Limit

Room 718A 10:30 - 12:30 Chairs: Jürgen Finsterbusch and Dwight G. Nishimura

10:30 ***201***. **Calculation of Refocusing Flip Angles for CPMG-Echotrains with a Given Amplitude Envelope: Basic Principles and Applications to Hyperecho-TSE**

Juergen Hennig[1]
[1]University Hospital, Freiburg, Germany

The forward calculation of echo amplitudes in a CPMG-echo train as used for sequences like RARE(TSE), Hyperecho-TSE etc. is straightforward using numerical simulation of the Bloch equations. The paper presents an approach for the solution of the inverse problem, namely to calculate the flip angles necessary to achieve echoes with a predefined amplitude. The algorithm used is based on the extended phase graph algorithm and allows to produce echotrains with a predefined amplitude envelope. Applications for echotrains with optimised envelopes for low SAR-hyperecho TSE-sequences based on the TRAPS-approach demonstrate the improved imaging behaviour at significantly reduced RF-power.

10:42 ***202***. **"Extreme Echoes" in FSE Sequences with Quadratically Incremented Phase (QUIP)**

James B. Murdoch[1]
[1]Philips Medical Systems, Cleveland, Ohio, USA

“Non-CPMG” fast spin echo sequences in which the refocusing pulse phase increases quadratically can refocus both components of initial transverse magnetization, even at reduced tip angles. Sequences with an even number (4-32) of pulses per phase cycle have been analyzed using Mathematica – refocusing is nearly perfect at the end of each cycle for tip angles as low as ~110 degrees.

10:54 ***203***. **Practical Implementation of Optimized Tissue-Specific Prescribed Signal Evolutions for Improved Turbo-Spin-Echo Imaging**

John P. Mugler, III[1], *Heiko Meyer*[2], *Berthold Kiefer*[2]
[1]University of Virginia, Charlottesville, Virginia, USA; [2]Siemens Medical Solutions, Erlangen, Germany

Tissue-specific prescribed signal evolutions, achieved by variable refocusing RF-pulse flip angles, have been used to decrease acquisition time and SAR for turbo/fast spin-echo imaging. Because the required flip angles depend on the sequence configuration and relaxation times for the reference tissue, practical use demands a rapid calculation algorithm that is integrated into the sequence. We developed such an algorithm and demonstrated its integration into the TSE sequence on a commercial MR system. With calculation times below one second for up to 300 echoes, this implementation provides the flexibility necessary to make prescribed evolutions practical for routine imaging.

11:06 ***204***. **Simultaneous Spin Echo Refocusing**

Matthias Guenther[1], *David Feinberg*[1]
[1]Advanced MRI Technologies, Sebastopol, California, USA

High-resolution MR images of moving structures like cardiac image require sophisticated navigation methods. In this work in progress, we will propose an approach, which utilizes an ultrasound scanner for measurement of the navigational information (position and orientation) during MR data acquisition. It is shown, that interference between US- and MR scanner can be controlled and minimized to avoid image artifacts. Update rates of up to 200Hz are possible. The promising approach of US-navigated MRI can provide an independent source of motion detection, which lets the MR sequence timing unchanged.

11:18 ***205***. **Fast Three Dimensional *k*-space Trajectory Design Using Missile Guidance Ideas**

Roberto Mir[1], *Andres Guesalaga*[1], *Matias Rosenblitt*[1], *Pablo Irarrazaval*[1]
[1]Pontificia Universidad Católica de Chile, Santiago, Chile

In this work we present a new fast three dimensional *k*-space trajectory. The algorithm used for its design was inspired on a missile guidance trajectory, and uses basic automatic control techniques to guide the trajectory through previously defined differential *k*-space volume elements. Computer simulations under off-resonance show good resultant point spread functions in comparison with established trajectories.

11:30 ***206***. **Body Imaging at 3T: Lower SAR yields Improved Coverage with VERSE and Modulated Angle Refocusing Trains**

Reed F. Busse[1], Yuval Zur[2], Xiaojuan Li[3]
[1]GE Medical Systems, Menlo Park, California, USA; [2]GE Medical Systems, Haifa, Israel; [3]University of California, San Francisco, California, USA

To meet the challenge of providing adequate coverage at high field strength, a combination of two complementary methods is proposed: reshaped waveforms with the VERSE technique and a modulated angle refocusing train. It was hypothesized that pulses can be reshaped and flip angles can be modulated such that power is cut in half and thus coverage doubled. Volunteer experiments at 3T using an SSFSE sequence in the abdomen demonstrate a power reduction of 50% with unchanged contrast and SNR and improved resolution.

11:42 ***207***. **Self-Referencing Multi-Gradient-Echo Projection Reconstruction**

Tobias Schaeffter[1], Steffen Weiss[1], Holger Eggers[1], Peter Börnert[1], Volker Rasche[1]
[1]Philips Research, Hamburg, Germany

A multi-gradient-echo Projection Reconstruction (PR) technique is presented that allows the compensation of phase-errors caused by eddy currents and off-resonances. The proposed method is called self-referencing, since no additional measurements are required for the corrections. The technique combines the advantages of PR-imaging and the high temporal resolution of multi-gradient-echo techniques. Results from phantoms and volunteers are presented. The technique is combined with a steady state free precession (SSFP) contrast. The introduced method is interesting for interactive real-time imaging, e.g. in cardiac and interventional MRI.

11:54 ***208***. **An Interleaved Cylindrical k-Space Trajectory for Rapid 3D GRE Acquisitions**

Kai Ruppert[1], Koichi Oshio[1], Matthias Guenther[1], John P. Mugler III[2]
[1]Advanced MRI Technologies, Sebastopol, California, USA; [2]University of Virginia, Charlottesville, Virginia, USA

The signal-to-noise ratio (SNR) and level of image artifacts for a preliminary version of an interleaved 3D cylindrical gradient-echo pulse sequence were evaluated and compared to those for 3D stack-of-spirals and conventional 3D FLASH pulse sequences. For equivalent experimental conditions we found the SNR to be similar for all sequences. However, the high sampling efficiency of the 3D cylindrical sequence coupled with its benign off-resonance behavior may make it an excellent choice for rapid 3D acquisitions in the future.

12:06 ***209***. **Eight-Fold Acceleration in Real-Time Cardiac Imaging using *k-t* BLAST and *k-t* SENSE with SSFP and Segmented EPI**

Jeffrey Tsao[1], Sebastian Kozerke[1], Peter Boesiger[1], Klaas P. Pruessmann[1]
[1]ETH and University of Zurich, Zurich, Switzerland

Real-time (i.e. untriggered, ungated, free-breathing) cardiac images with high spatial (≤2.5mm) and temporal (30 & 73 frames/sec) resolutions were obtained using *k-t* BLAST and *k-t* SENSE at 8-fold acceleration. Acquisition was performed using an SSFP or a gradient-echo segmented EPI sequence, with either a single surface coil or a 5-element phased-array coil. The results demonstrate that *k-t* BLAST and *k-t* SENSE significantly improve the spatiotemporal resolutions of real-time cardiac imaging beyond existing capabilities.

12:18 ***210***. **Vastly Undersampled Isotropic Projection Reconstruction Imaging with Multi-half-Echo (VIPR ME)**

Aiming Lu[1], Oliver Wieben[2], Thomas M. Grist[1], Walter F. Block[1]
[1]University of Wisconsin-Madison, Madison, Wisconsin, USA; [2]University of Freiburg, Freiburg, Germany

A multi-half-echo technique is presented that dramatically improves the data sampling efficiency of 3D PR sequences. K-space trajectory deviations are measured quickly and are corrected on a per sample basis. These corrections allow for sampling throughout the gradient waveform, including ramps and the half echoes formed during the gradient dephaser and rephaser. This capability was implemented in VIPR sequences to significantly increase the data acquisition efficiency with only slight increases in TR.

CLINICAL CATEGORICAL COURSE
High Field Neuroimaging

Room 718B 10:30 - 12:30 Chairs: Clifford R. Jack and Christiane K. Kuhl

Educational Objectives
Upon completion of this course, participants should be able to:

- List the advantages and disadvantages of high field (3-4T) vs. systems ≤ 1.5T for clinical neuroimaging;
- Describe which clinical neuroimaging applications are likely to benefit substantially from high field (304T);
- Recognize which clinical neuroimaging applications are unlikely to see a major performance improvement at 3-4T vs. ≤1.5T.

The final five minutes of each talk will be reserved for questions.

10:30 **3T Neuro MRI in a Clinical Setting: Benefits and Limitations**
Christiane K. Kuhl

11:00 **Clinical 3T Neuroimaging: MRA**
Matt A. Bernstein

11:30 **BOLD Surgical Planning at 3T**
Keith R. Thulborn

12:00 **Clinical DTI at 3T**
Xiaohong J. Zhou

12:30 **Adjournment**

Functional Neuro MR Imaging: Spatial and Temporal Characteristics

Room 701A 10:30 - 12:30 Chairs: Peter A. Bandettini and Xiaoping P. Hu

10:30 ***211*. The Negative BOLD Response in Monkey V1 is Associated with Decreases in Neuronal Activity**

Amir Shmuel[1], Mark Augath[1], Axel Oeltermann[1], Jon Pauls[1], Nikos K. Logothetis[1]
[1]Max-Planck Institute for Biological Cybernetics, Tuebingen, Germany

This study aimed at revealing the neuronal correlates of the negative BOLD response (NBR). Electrical recordings were obtained from NBR regions in monkey V1 simultaneously with fMRI. The NBR was associated with a reduction in neuronal activity, both in the Multi-Unit-Activity and the Local-Field-Potential domains. The onset of the decrease in neuronal signal preceded the corresponding onset of the NBR, indicating that the origin of the NBR was a decrease in neuronal activity that triggered a reduction in CBF, rather than decreased neuronal activity caused by reduced CBF.

10:42 ***212*. Laminar Heterogeneity of BOLD Response to Neuronal Events at Milliseconds Time Scale**

Afonso C. Silva[1], Alan P. Koretsky[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

The present work examines the amplitude of the BOLD response in different layers of the rat somatosensory cortex during activation of both hemispheres of the brain. An inhibitory paradigm is used to modulate the hemodynamic response to neuronal events timed to a few tens of milliseconds. Results demonstrate the specificity of fMRI to neuronal events in sub-regions of the cortex, and suggest the observed modulation is of neuronal, not vascular, origin.

10:54 *213*. Event-related BOLD versus IRON

Francisca Pais Leite[1], Joseph B. Mandeville[2]
[1]Massachusetts Institute of Technology, Cambridge, Massachusetts, USA; [2]Massachusetts General Hospital - NMR Center, Charlestown, Massachusetts, USA

The optimization of the functional sensitivity of event-related (ER) experimental designs is an important subject in fMRI. Randomization of the ISI increases the sensitivity of the BOLD signal at short ISI and stimulus duration, compared with fixed ISI. For block experimental designs, a large increase in sensitivity is achieved by using the IRON method, but the slower IRON response penalizes this method more than the BOLD method for ER experimental designs. Simulations performed using previously measured hemodynamic IRFs and assuming linearity, showed that combining IRON contrast with randomization of ISI recovers loss in sensitivity observed for rapidly presented stimuli.

11:06 *214*. Empirical Determination of Brain R_2^* Relaxivity due to Blood Volume Magnetic Susceptibility: Using BALD to Calibrate BOLD

William D. Rooney[1], Charles S. Springer, Jr.[1]
[1]Brookhaven National Laboratory, Upton, New York, USA

The absolute quantification of the blood oxygenated iron level is problematic because microvascular geometric factors are also important determinants of transverse signal intensity changes. The purpose of this study was to obtain an empirical determination of the brain tissue ^1H_2O R_2^* relaxivity due to blood volume magnetic susceptibility, χ_b. Contrast reagent was used to modify χ_b, and tissue R_2^* was measured during the first pass. The empirical relaxivity obtained allows estimation of blood oxygenated iron level changes associated with brain activation.

11:18 *215*. A Novel Data Reduction Procedure for Estimating Low-Frequency BOLD Fluctuation Signals

Mark J. Lowe[1], Sea Chen[1], Charles A. Bouman[2]
[1]Indiana University, Indianapolis, Indiana, USA; [2]Purdue University, West Lafayette, Indiana, USA

Correlations in low-frequency BOLD fluctuations (LFBF) in dynamic MRI data have been shown by many investigators to reflect functional connectivity in the human brain. The typical approach to assessing these correlations has been to combine digital filtering in the Fourier domain to remove frequencies higher than 0.1Hz and perform cross-correlation analysis between a region of interest (a seed region) and other brain regions. We present a methodology that uses a novel signal subspace estimation procedure to reduce the degrees of freedom present in the low frequency domain of BOLD-weighted to those important in assessing functional connectivity of the brain.

11:30 *216*. Widespread BOLD Signal Changes in the Resting Brain are Associated with Fluctuations in End-Tidal CO_2

Richard G. Wise[1], Marc J. Poulin[2], Kojiro Ide[2], Irene Tracey[1]
[1]Oxford University, Oxford, UK; [2]University of Calgary, Calgary, Alberta, Canada

A rise in the partial pressure of carbon dioxide in arterial blood ($PaCO_2$) increases cerebral blood flow (CBF) and hence BOLD signal. Spontaneous fluctuations in the partial pressure of end-tidal carbon dioxide ($PETCO_2$) of approximately 1 mmHg were observed in volunteers at rest. Associated with these fluctuations, at a physiologically reasonable lag, were significant generalized grey matter BOLD signal fluctuations and smaller fluctuations in white matter. Significant $PETCO_2$ correlated fluctuations in middle cerebral artery blood velocity were observed using trans-cranial Doppler ultrasound. We suggest that resting fluctuations in CO_2 induce a significant variation in BOLD signal at 3 Tesla.

11:42 *217*. Rat Brain Vasculature in BOLD Activated Voxels at Ultra-High Resolution Using MION

Hanbing Lu[1], Feng Luo[1], Shi-Jiang Li[1], James S. Hyde[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Using spin-echo EPI (SE-EPI) and gradient-recalled EPI (GR-EPI), fMRI experiments were carried out at 3T at a sub-laminar spatial resolution. MION was injected to visualize the vessels using the same sequence at the same spatial resolution. The pixels that exhibited high percent enhancement were characterized. Our data suggest that, at 3T: i) using GR-EPI, most, if not all of the pixels that exhibit high percent enhancement have high blood volume, which can be localized on the surface layers and/or deep layers depending on local vasculature; ii) using SE-EPI, $41.9 \pm 8.78\%$ of the activated pixels had small blood volume.

11:54 *218*. Single Shot Full k-Space Echo-Planar-Imaging with an Eight-Channel Phase Array Coil at 3T.

Jerzy Bodurka[1], Peter van Gelderen[1], Patrick Ledden[2], Peter Bandettini[1], Jeff Duyn[1]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]Nova Medical Inc, Wakefield, Massachusetts, USA

Single shot full k-space EPI with an 8-channel phase array coil at 3T was conducted. The 16-channel receiver (1MHz bandwidth per channel) was built for the 3T GE MRI VH/3 scanner. Comparison of temporal stability of the EPI signal between a standard birdcage head coil and an 8-channel gapped array receive only brain coil was done. The increased image SNR, available with an 8-channel coil, translated into an increase of temporal stability or an increased spatial resolution. Two fold increase in in-plane resolution was achieved with 8-channel coil compared to the head coil without reduction in temporal stability.

12:06 ***219***. **Intravascular BOLD Transverse Relaxation: Exchange vs. Diffusion through Field Gradients**

Chekesha Clingman[1], Johanna Silvennoinen[2], Xavier Golay[1], Risto Kauppinen[2], Peter van Zijl[1]
[1]Johns Hopkins University & F.M. Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA; [2]University of Kuopio, Kuopio, Finland

The exact mechanism responsible for the oxygenation dependence of the transverse relaxation rate of blood, $R_{2,blood}$, is unclear, and has been attributed to either exchange between plasma and erythrocytes or/and diffusion through field gradients close to the erythrocyte membrane (1-5). $R_{2,blood}$ was investigated as a function of oxygen saturation fraction (Y), inter-echo spacing in a Carr-Purcell-Meiboom-Gill sequence (τ_{CPMG}), and hematocrit fraction (Hct), using a circulating perfusion system at 1.5T, 3.0T and 4.7T. Results show that the oxygenation-dependent term in $R_{2,blood}$ is dominated by diffusion through local magnetic field gradients. This susceptibility-based contribution increases with the square of the field strength.

12:18 ***220***. **Method for Functional MRI Mapping of Non-Linear Neuronal Response**

Peter Kellman[1], Peter van Gelderen[2], Jacco A. de Zwart[2], Jozef H. Duyn[2]
[1]Laboratory of Cardiac Energetics, NHLBI, National Institutes of Health, DHHS, Bethesda, MD, USA; [2]Laboratory of Functional and Molecular Imaging, NINDS, National Institutes of Health, DHHS, Bethesda, MD, USA

Non-linear systems analysis combining BOLD fMRI and m-sequence stimulation paradigms are proposed as a new method for exploring neuronal responses and interactions. Despite the confounding effect of the seconds long hemodynamic response, it is demonstrated that BOLD fMRI can be used to probe neuronal interactions on a time scale of 10's of ms. Visual activation experiments were performed with various stimuli, and amplitude maps of first and second order kernels were generated using correlation analysis. By including a reference experiment with slightly modified stimulus presentation, distinction could be made between (fast) neuronal non-linearities and (slow) hemodynamic effects.

New Contrast Agents

Room 701B | 10:30 - 12:30 | Chairs: Friedrich Cavagna and Peter Caravan

10:30 ***221***. Young Investigator Awards Finalist: **Modulation of the Pharmacokinetics of Macromolecular Contrast Material by Avidin Chase: Magnetic Resonance Imaging, Fluorescence Microscopy and Histological Tracking of Triple Labeled Albumin**

Hagit Dafni[1], Assaf Gilead[1], Nava Nevo[1], Raya Eilam[1], Michal Neeman[1]
[1]The Weizmann Institute of Science, Rehovot, Israel

The goal of this work was to develop a method for experimentally controlling the clearance of macromolecular contrast materials. Intravenous administration of avidin resulted in elimination of albumin labeled with biotin, fluorescein and GdDTPA (but not of non-biotinylated fluorescent albumin) from the circulation, as observed by MRI and confirmed by fluorescence microscopy and histology. Contrast material that extravasated from leaky blood vessels in a VEGF over-expressing tumor, was not cleared by avidin and showed continued interstitial convection. Thus, avidin chase can provide an effective tool for experimental control over the rate of clearance of intravascular biotinylated contrast materials.

10:50 ***222***. **Chelator Charge and Structure and Their Effects on Polymeric Agent Conformation and Imaging Efficacy**

Egidijus Edward Uzgiris[1], Barham Moasser[1], Mohan Amaratunga[1], Dan E. Meyer[1], Amihti Narendran[1], Joanne F. Smith[1]
[1]GE Global Research Center, Niskayuna, NY, USA

The imaging effectiveness of Gd-polymeric agents relies on polymer conformation. We test the dependence of polymer conformation on Gd-chelator charge by measuring polymer hydrodynamic properties that include gel permeation chromatography, gel electrophoresis, and T1 relaxivity and correlate these to tumor imaging efficacy in a rat mammary tumor model. As predicted by molecular modeling, charge interactions between neighboring residues are decisive factors in whether polymer is extended or collapsed. However, charged DOTA-isothyocyanate derivatives, although producing a correct polymer conformation, appear to cause the polymer agent not to be transported across the tumor endothelium.

11:02 ***223***. **A Novel High Relaxivity Manganese(II) Contrast Agent**

P Caravan[1], J S. Troughton[1], S Dumas[1], M T. Greenfield[1], J M. Greenwood[1], M Spiller[2], A J. Wiethoff[1], J A. Barrett[1], T J. McMurry[1]
[1]EPIX Medical, Cambridge, Massachusetts, USA; [2]New York Medical College, Valhalla, New York, USA

Compound **1** is a Mn(II) complex based on EDTA and contains one inner-sphere water molecule (q=1). In the presence of rabbit plasma, compound **1** is 95% protein bound with a relaxivity of 51 $mM^{-1}s^{-1}$ (20 MHz, 35 C). Variable temperature and variable field relaxation studies on **1** and **2**, a q = 0 analog, suggest that the relaxivity stems from an efficiently exchanging inner-sphere water; the already high relaxivity could be increased at least 2-fold by tuning the water exchange rate. Imaging studies in rabbits confirmed that compound **1** exhibited high relaxivity *in vivo*.

11:14 *224*. Towards Quantitative CEST Imaging

Martin Lepage[1], Daniel F. Gochberg[1], John C. Gore[1]
[1]Vanderbilt University, Nashville, Tennessee, USA

Contrast obtained via the Chemical Exchange Saturation Transfer (CEST) effect can potentially be useful in the design of new molecular probes and contrast agents. For those applications, the numerous factors affecting the CEST effect have not yet been well described. In addition, extracting quantitative parameters from CEST experiments through modeling has not been reported. We report here on experimental studies on Starburst® polyamidoamine dendrimers (SPD) in solutions of controlled T_1 and T_2 as well as on simulation and fitting procedures for CEST experiments.

11:26 *225*. New Metalloporphyrins as Potential MR Imaging Contrast Agents for Tumor Detection

Daryoush Shahbazi-Gahrouei[1], Barry Allen[2]
[1]Shahrekord University of Medical Sciences, Shahrekord, Chaharmahal, Iran; [2]St George Cancer Care Center, Sydney, New South Wales, Australia

New potential MR imaging contrast agents, Gd-hematoporphyrin (Gd-H) and Gd-tetra-carboranylmethoxyphenyl-porphyrin (Gd TCP), were synthesized and applied to nude mice with human melanoma (MM 138) xenografts. A reduction (16%) in T1 values was revealed 24 hr after injection of the Gd-TCP and Gd-H. The percent of Gd that localized to the tumor was measured by ICP-AES to be 21 and 28% for Gd-TCP and Gd-H respectively and was much higher compared with known compound Gd-DTPA. Signal enhancement of 120 and 70% over the control was observed for Gd TCP and Gd H, respectively.

11:38 *226*. MR Imaging of Tumor via LDL Receptor Mediated Accumulation of Gd-Based Contrast Agent

Hui Li[1], Rong Zhou[1], Brian D. Gray[2], Jerry Glickson[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]PTI Research Inc., Exton, Pennsylvania, USA

Low density lipoproteins (LDL) were labeled with a lipophilic Gd-based contrast agent. Receptors mediated uptake of labeled-LDL was observed by MRI in a B16 melanoma tumor, which over expresses LDL receptors. Increase of longitudinal relaxation rate constant was observed in tumor 3 hours after infusion of labeled LDL.

11:50 *227*. Receptor-Mediated Endocytosis of Iron-Oxide Particles Efficiently Labels Dendritic Cells for *In Vivo* MRI

E. T. Ahrens[1], M. Feili-Hariri[2], H. Xu[1], G. Genove[1], P. A. Morel[2]
[1]Carnegie Mellon University, Pittsburgh, Pennsylvania, USA; [2]University of Pittsburgh Medical School, Pittsburgh, Pennsylvania, USA

Dendritic cells (DCs) function as antigen presenting cells in vivo. We describe an efficient method for intracellularly-labeling DCs with superparamagnetic iron-oxide (SPIO) particles using receptor-mediated endocytosis (RME). DCs were incubated with SPIO conjugated to anti-CD11c monoclonal antibodies under conditions favoring RME. DCs exhibited a 50-fold increase in uptake relative to DCs incubated with antibody-free SPIO. Assays for cell surface markers and immunological function confirmed that the DCs were unharmed by the labeling. RME was confirmed using EM and endocytosis inhibition assays. Labeled DCs were injected into murine quadriceps and monitored in vivo for several days using microimaging at 11.7T.

12:02 *228*. Evaluation of [Gd(Bz-TTDA)]as a Potential Contrast Agent in MR Imaging of Hepatobiliary System: An Animal Study

Twei Shiun Jaw[1], Gin Chung Liu[1], Yun Ming Wang[1], Reu Shen Sheu[1], Yu Ting Kuo[1], Tsann Hwang Cheng[1]
[1]Kaohsiung Medical University, Kaohsiung, Taiwan

To evaluate the potential of a lipophilic paramagnetic complex, [Gd(Bz-TTDA)] as liver MR contrast agent, we performed MR imaging studies with normal and implanted hepatoma rats. The results revealed an intense enhancement of liver with a plateau during 5-50 minutes after intravenous injection of 0.1 mmol/kg [Gd(Bz-TTDA)]. The efficacy of tumor characterization was similar to [Gd-DTPA]2- at the early dynamic phase. The liver-lesion signal-to-noise ratios were significantly improved with [Gd(Bz-TTDA)] in the later phase when tumor enhancement has washed out. The results indicated that [Gd(Bz-TTDA)] has the potential of becoming a reliable liver MR contrast agent.

12:14 *229*. Detection of Single Particles and Single Cells by MRI

Erik M. Shapiro[1], Stanko Skrtic[1], Jonathan M. Hill[1], Cynthia E. Dunbar[1], Alan P. Koretsky[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Labeling cells with iron oxide is a useful tool for MRI-based molecular and cellular imaging. Here we demonstrate, in vitro, that single, ~micron size superparamagnetic iron oxide particles can be robustly visualized with resolutions of between 50-200 microns. The enhancement effect of the particles is as high as several hundred microns and at high resolution the dipolar field of a single particle is clearly visible. Furthermore, we demonstrate in isolated cells, that individual cells with only single iron oxide particles can be readily detected. Due to this, these particles may be useful under conditions where labeling efficiencies are low.

MR Safety and Bioeffects

Room 714 A/B 10:30 - 12:30 Chairs: Christopher M. Collins and Donald M. Hadley

10:30 *230*. Induction in ECG Leads Causes Fire in the MR Bore - an Effect of the Electric HF Component

Harald Kugel[1], Christoph Bremer[1], Marco Pueschel[1], Roman Fischbach[1], Horst Lenzen[1], Bernd Tombach[1], Hugo van Aken[1], Walter Heindel[1]
[1]University of Muenster, Muenster, Germany

Potential hazards exist when patients with attached or implanted long conductors are examined in MR scanners. Our observations demonstrate that coupling of the electric field to patient monitoring set ups is relevant, and that even with dedicated MR compatible devices hazardous situations may occur. To illustrate the potential of induction in a non-coiled long conductor we report on an incident with a patient who was examined in a 1.5 T MR scanner under ECG monitoring.

10:42 *231*. A Fiber-Optical Position Sensor for Interventional MRI

Michael Bock[1], Jana Sikora[1], Reiner Umathum[1], Wolfhard Semmler[1]
[1]Deutsches Krebsforschungszentrum, Heidelberg, Germany

The design and construction of an optical sensor for interventional device tracking is described which does not contain any conducting material. Utilizing the Faraday effect, the location and orientation of the sensor is determined by measuring the local magnetic field, which is modulated by MR imaging gradients. The sensor consists of a small Terbium-Gallium-Garnet crystal which is placed between two polarizing filters where optical fibers are attached. The amplitude of the transmitted light was measured as a function of the position as well as of the local angle with the B_0 field.

10:54 *232*. Modelling the Effect of MRI Gradient Switches on Electrocardiograms

Feng Liu[1], Huawei Zhao[1], Ling Xia[2], Stuart Crozier[1]
[1]University of Queensland, Brisbane, Queensland, Australia; [2]Zhejiang University, Hangzhou, People's Republic of China

Theoretical investigations into the induced E-fields in the thorax from gradient swtiching are made. Whole-body cylindrical and planar gradient coils have been explored as electromagnetic source. The calculations of the induced fields are based on an efficient, quasi-static, finite-difference (FDTD) scheme. The potential for cardiac stimulation is evaluated using an electric model of the heart. 12-lead ECG signals have been simulated and inspected for arrhythmias caused by the applied fields for both healthy and diseased hearts. Stimulation thresholds are discussed.

11:06 *233*. Analysis of the Quasistatic Impedance Approximation for Gradient Coil Peripheral Nerve Stimulation

Megan E. Slinkard[1], Vivek J. Srinivasan[1], Blaine A. Chronik[1]
[1]Stanford University, Stanford, California, USA

The validity of the quasistatic impedance approximation for the calculation of gradient induced electric fields in biological tissues was evaluated as a function of frequency. It was found that the approximation is relatively poor for many tissues at frequencies below 1 kHz and above 1 MHz. This is counter to conventional wisdom, which states that the approximation is acceptable for all frequencies below approximately 100 kHz, and has ramifications for the modeling and analysis of peripheral nerve stimulation in gradient coils.

11:18 *234*. A Radiometric Approach to Temperature Monitoring in the MR Scanner : A Feasibility Study

AbdEl-Monem El-Sharkawy[1], Ergin Atalar[2]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]Johns Hopkins University School of Medicine and Bilkent University (Turkey), Baltimore, Maryland, USA

In this work we test the feasibility of using the MR scanner as a radiometer for measuring body temperatures. The goal of this methodology is to be able to estimate absolute body temperatures by measuring radiated thermal noise. Our hypothesis is that an MR scanner can be used to measure the noise power without the need for hardware changes. Various hardware components of an existing MR scanner were analyzed and their effect on the measurement accuracy was evaluated. Controlled phantom experiments show a high correlation between the received radiometric signal (estimated noise power) and temperature of the measured object.

11:30 235. Calculation of the Fields Induced by Body and Head Motion in High-Field MRI

Feng Liu[1], Huawei Zhao[1], Stuart Crozier[1]
[1]University of Queensland, Brisbane, Queensland, Australia

This paper presents theoretical investigations into the spatial distribution of induced electric fields and currents in the patient when moving into the MRI scanner and also for head motion at various positions in the magnet. Three-dimensional field profiles from an actively-shielded 4T magnet system are used and the body model projected through the field profile with a range of velocities. The simulation shows that it possible to induce electric fields/currents near the level of physiological significance under some circumstances.

11:42 236. Mechanical Testing of Human Cardiac Tissue Strength and Stiffness: Implications for MRI Safety

Maria-Benedicta Edwards[1], Edward RC Draper[2], Jeffrey W. Hand[3], Kenneth M. Taylor[4], Ian R. Young[3]
[1]UK Heart Valve Registry, London, UK; [2]Charing Cross Hospital, Imperial College, London, UK; [3]Hammersmith Hospital, Imperial College, London, UK; [4]Department of Cardiothoracic Surgery, London, UK

The friability of cardiac tissue depends upon age and disease state. This preliminary study determines the tensile strength of human tissue ex vivo to assess the risk arising from magnetically induced forces on heart-valves. Methods: Human cardiac tissue was subjected to a suture pull-strength test to assess tensile strength. Results: The tissue ruptured at the suture point at a force of 2.7N. Conclusions: There is no significant additional risk to patients with implanted heart valves from magnetically induced forces (typically 2.6 x 10-3N at 4.7T) based on the tensile strength of this tissue sample exhibiting moderately degenerative disease.

11:54 237. Comparison of Detailed Neuro-psychological Human Performance Testing at 8 and 0.05 Tesla

Donald William Chakeres[1], Alayar Kangarlu[1], Robert Bornstein[1]
[1]The Ohio State University College of Medicine and School of Public Health, Columbus, Ohio, USA

This study examined whether there was a measurable alteration in human cognitive performance to a static magnetic field of 8 Tesla (T). Twenty five subjects were evaluated at 0.05 and 8 T. Twelve standardized neuro-psychological measures were administered The neuropsychological data was statistically analyzed using t-tests for correlated means. There were no clinically significant differences in any of the measures. This study showed that there was no alteration in human neuro-psychological performance with exposure of the brain to high magnetic fields.

12:06 238. Induced Voltages on Pacing Leads by the Gradient Field

Roger Luechinger[1], Volkert Zeijlemaker[2], Markus Oelhafen[1], Firat Duru[3], Reto Candinas[3], Peter Boesiger[1]
[1]Institute for Biomedical Engineering, Zurich, Switzerland; [2]Bakken Research Center, Maastricht, Netherlands; [3]University Hospital, Zurich, Switzerland

Pacemakers (PM) are regarded as a contraindication for MRI due to safety reasons. However, reports on MR investigations of PM or Implantable cardiac defibrillators (ICD) patients have been published recently. In addition to heating effects, induced voltages and inhibition of the PM by the gradients may be potential risks. We have shown that up to 1 Volt can be induced in a unipolar lead. Due to filters in the PM the signal used for the sensing will be reduced by a factor of ~50. However, these signals are still strong enough to inhibit the PM.

12:18 239. A Ferromagnet Detector for MRI Safety

C. Bewsky[1], S-K. Yeong[1], G. Kolansky[1], R. Bernhardt[1], T. Asker[1], A. Procca[1], D. I. Hoult[1]
[1]National Research Council Canada, Winnipeg, Manitoba, Canada

A prototype detector of ferromagnetic objects is described. The device, relying on electromagnetic induction caused by motion of the magnetic moment induced by the fringe field of an imaging magnet, takes advantage of that field to enhance sensitivity. The theory of operation, method of implementation and the detection of 1 g of iron are described. Building vibration is implicated as limiting the sensitivity via floor motion and/or creation of random magnetic field gradients, and ideas for improving sensitivity are outlined.

Diffusion Analysis I: Tracts and Errors

Room 716 A/B 10:30 - 12:30 Chairs: Derek K. Jones and Carlo Pierpaoli

10:30 240. Tractography with Multiple Fibre Directions

Rebecca Blyth[1], Philip Cook[1], Daniel Alexander[1]
[1]University College London, London, UK

Performing fibre tracking in the brain using diffusion tensors is well established but fails in areas where the Gaussian density is a poor approximation of water molecule displacements in a voxel. We describe a new fibre tracking algorithm that uses mixtures of two Gaussian densities in these regions where the Gaussian model is poor. Results show that this algorithm allows tracking to continue through regions of fibre crossings.

10:42 *241*. Solving of a Problem of Fiber Crossing with a Multi-Tensor Approach

Björn Wolf Kreher[1], J. F. L. Schneider[2], E. Martin[2], J. Hennig[1], Kamil Il'yasov[1]
[1]University Hospital Freiburg, Freiburg, Germany; [2]University Children's Hospital, Zürich, Switzerland

DTI provides information about fiber directions in brain white matter and can be used for neuronal fiber pathways tracking. Commonly, it is assumed that fiber directions coincide with the principal direction of the diffusion tensor. This is, however, not the case for regions with fiber crossings. In such cases q-space imaging or spherical harmonic decomposition of high angular resolution DTI provides more adequate results. In this work we explore an alternative approach by fitting a multi-tensor model to high angular resolution DTI data, which allows detection of fibers crossing even in regions with partial volume effect.

10:54 *242*. Generalized Diffusion Tensor Imaging (GDTI) Using Higher Order Tensor (HOT) Statistics

Chunlei Liu[1], Roland Bammer[1], Burak Acar[1], Michael E. Moseley[1]
[1]Stanford University, Stanford, California, USA

Diffusion tensor imaging (DTI) is known to have limited capability of resolving multiple fiber orientations within one voxel. Angular distribution of the apparent diffusion coefficient is incapable of inferring the correct fiber orientations as demonstrated in this abstract. A new methodology is proposed by generalizing the Fick's law to a higher order partial differential equation and reconstructing the probability density function of the displacement using higher order cumulants. The higher order cumulants can be measured using conventional diffusion-weighted imaging techniques. Simulations demonstrate that this method is capable of accurately resolving multiple fiber orientations.

11:06 *243*. Diffusion Tensor Imaging and Axonal Tracking Reveal Distinct Cortico-Striatal Circuits

Stephane Lehericy[1], Mathieu Ducros[2], Lionel Thivard[1], Pierre-Francois F. Van de Moortele[3], Claude Marsault[1], Nick Swindale[2], Kamil Ugurbil[3], Dae-Shik S. Kim[3]
[1]Salpetriere Hospital, Paris, France; [2]University of British Columbia, Vancouver, Canada; [3]CMRR, Minneapolis, Minnesota, USA

This study identifies the anatomical connections of the striatum using diffusion tensor imaging (DTI) axonal tracking. Nine volunteers were studied at 1.5T. Fiber tracking showed that each striatal compartment (putamen, caudate nucleus and ventral striatum) had specific connections with the cortex, and particularly the frontal lobes. These results suggest that the human striatum is organized in parallel circuits in agreement with animal studies.

11:18 *244*. A Tractography Approach to Studying Fronto-Temporal Fasciculi in Schizophrenia and Late Onset Schizophrenia-like Psychosis

Derek K. Jones[1], Marco Catani[2], Suzanne J C Reeves[2], Sukhwinder S. Shergill[2], Phillip McGuire[2], Mark A. Horsfield[3], Andrew Simmons[2], Steven C R Williams[2], Robert J. Howard[2]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]Institute of Psychiatry, De Crespigny Park, London, UK; [3]Leicester Royal Infirmary, Leicester, UK

DT-MRI tractography was used to study fronto-temporal fasciculi (the superior longitudinal fasciculus, the uncinate fasciculus, the inferior fronto-occipital fasciculus, and the cingulum) in (i) subjects with schizophrenia, (ii) subjects with late onset schizophrenia-like psychosis (onset after age 60), and (iii) age-matched controls. Tissue anisotropy was determined at regular intervals along the tractographically-reconstructed fiber-trajectories – thereby allowing anisotropy measurements to be localized to within particular fasciculi. Our results imply that in schizophrenia, tissue anisotropy is reduced in left-hemispheric fronto-temporal fasciculi, while it is not affected in late-onset schizophrenia-like psychosis.

11:30 *245*. Connectivity-Based Grey Matter Segmentation using Diffusion Imaging.

Timothy EJ Behrens[1], Heidi Johansen-Berg[1], Mark W. Woolrich[1], Stephen M. Smith[1], Claudia Wheeler-Kingshott[2], Gareth J. Barker[2], Phil A. Boulby[2], J M. Brady[1], P M. Matthews[1]
[1]University of Oxford, Oxford, UK; [2]Institute of Neurology, London, UK

Connectivity information is used to define boundaries between grey matter structures. Probabilistic tractography is shown to generate anatomically plausible pathways from the thalamus all the way to cortex using diffusion weighted imaging data. Connectivity probability distributions are generated from every voxel in the thalamus. Seed voxels are classified according to cortical zones with the highest probability of connection. The result is commonly connected clusters showing strong resemblance to histologically defined thalamic nuclei and nuclear clusters. A similar approach could be applied to other grey matter structures.

11:42 *246*. Analysis of Noise Effect on DTI Based Fiber Tractography

Hao Huang[1], Jiangyang Zhang[1], Peter van Zijl[1], Susumu Mori[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

While tractography technique based on line propagation is a promising and widely used technique, it is known to be sensitive to noise, partial volume effect, and ROI placement. In this presentation, we analyzed the effect of noise and ROI locations and sizes on the tractography results using a high-resolution postmortem mouse brain sample. Gold standard was created from anatomical knowledge and deviation of the tracking results were measured as a function of SNR. The results confirmed that two-ROI and brute-force approach could effectively reduce the sensitivity to the noise and ROI placement.

11:54 **247.** **Models for Estimation of White Matter Tractography Error**

Mariana Lazar[1], *Andrew L. Alexander*[2]
[1]University of Utah, Salt Lake City, Utah, USA; [2]University of Wisconsin, Madison, Wisconsin, USA

White Matter Tractography (WMT) has been used to estimate WM pathways in the human brain. Image-based noise is one potential cause for inconsistencies between anatomy and tract estimates. In this study, analytic models for estimating tract dispersion and mean displacement as a function of anisotropy, tract distance, curvature, signal-to-noise ratio and algorithm were developed. The proposed models may be useful for quantifying the confidence of WMT results.

12:06 **248.** **Reliability of Brain Diffusion Tensor Imaging**

Adolf Pfefferbaum[1], *Elfar Adalsteinsson*[2], *Edith V. Sullivan*[2]
[1]SRI International, Menlo Park, California, USA; [2]Stanford University School of Medicine, Stanford, California, USA

In order to evaluate the reliability of Diffusion Tensor Imaging (DTI) metrics (fractional anisotropy [FA] and trace) ten young healthy adults were scanned on three separate days, twice on the same scanner and once on a scanner at another site. Within scanner FA and trace measures for an anatomically specific white matter region (corpus callosum) were highly reproducible (CV=1.9% for FA and 2.6% for trace), but there was systematic mean bias across scanners (4.5% for FA and 7.5% for trace) which can be quantified and applied to longitudinal and multi-site studies.

12:18 **249.** **Anisotropy as a Certainty Measure in Terms of Entropy**

Evren Ozarslan[1], *Thomas H. Mareci*[1]
[1]University of Florida, Gainesville, Florida, USA

Many indices have been proposed to quantify the anisotropy from the angular variation of the diffusion coefficients obtained from diffusion tensor imaging (DTI) and high angular resolution diffusion imaging (HARDI). However, these indices incorrectly quantify the level of orientational certainty in a given distribution of diffusivites. In this work, scalar measures based on information theory are derived from entropy. It is shown that entropy of the diffusivity distribution obtained from HARDI is approximately equal to the von Neumann entropy of diffusion tensor divided by its trace provided that diffusion tensor model is valid for the voxel.

Peripheral MR Angiography: Technical Developments

Room 713 A/B 10:30 - 12:30 Chairs: Vincent B. Ho and Tim Leiner

10:30 **250.** **Increased Opacification of the Pedal Vasculature in One Run Moving Table Bolus Chase MRA by Employing a Biphasic Contrast Bolus Timed to the Aortic Bifurcation and the Feet**

Jeffrey P. Goldman[1], *Andrew Shih*[1], *Victoria Teodurescu*[1]
[1]Mount Sinai Medical Center, New York, New York, USA

The goal of our study was to determine if by timing a contrast bolus to the aortic bifurcation and a second bolus to the foot we could increase the opacification of the pedal vasculature in one run moving table peripheral vascular MRA. We found that timing a second contrast bolus to foot significantly improved the signal intensity of the enhancement of the pedal vasculature and equaled that found by doing two separate injections for the upper and lower stations.

10:42 **251.** **Continuously Moving Table Contrast-Enhanced MRA: Technical Development**

David George Kruger[1], *Stephen J. Riederer*[1], *James F. Glockner*[1], *Jason A. Polzin*[2], *Ananth Jayaseelan Madhuranthakam*[1], *Houchun Harry Hu*[1]
[1]Mayo Clinic, Rochester, Minnesota, USA; [2]GE Medical Systems, Milwaukee, Wisconsin, USA

Recently a technique has been described in which an image is formed of an extended object while it is moved continuously through the bore of the MR magnet. This initial work described image formation, derived the relationship between table velocity and spatial resolution, and provided experimental results in animals. The purpose of this work is to present additional challenges of implementation and describe how these have been addressed for peripheral runoff MR angiography in humans. These challenges include adequate table velocity, adequate SNR, correction for gradient warping, and synchronization of table motion to the transient contrast bolus.

10:54 **252.** **Novel Undersampled Acquisition Schemes for Continuously Moving Table Peripheral Contrast-Enhanced MRA**

Mohammad Sabati[1], *Michal Louis Lauzon*[2], *Richard Frayne*[1]
[1]University of Calgary, Calgary, Alberta, Canada; [2]Seaman Family MR Research Centre, Calgary, Alberta, Canada

A large coverage is required in the study of peripheral vascular disease (PVD). In the continuously moving-table peripheral contrast-enhanced MR angiography (CE MRA), the large field-of-view (FOV) is built up as a local FOV_x is translated along the patient in the x-direction. To achieve optimal quality, the translation needs to follow the arterial passage of the contrast agent. The acquisition of 3D time-limited undersampled MR data is investigated in this study. The results show that an optimal trade-off between the temporal and spatial resolution can be achieved to produce high-spatial resolution angiograms when appropriately acquiring a small portion of **k**-space.

11:06 *253*. Time-Resolved Whole-Body MRA During Continuous Table Motion Using Floating Table Isotropic Projection Acquisition (FLIPR)

Sean B. Fain[1], Fred J. Browning[1], Jason Polzin[2], Yong Zhou[2], Thomas M. Grist[1], Charles A. Mistretta[1]
[1]University of Wisconsin, Madison, Wisconsin, USA; [2]GE Medical Systems, Milwaukee, Wisconsin, USA

3D PR with continuous moving table, and Gd contrast injection is a promising technique for whole-body MRA because of its time-efficiency and high isotropic spatial resolution. The technique was applied to whole body MRA in volunteer studies with whole-body coverage in 80 sec, 7 sec temporal resolution, and improved SNR using “on the fly” switching between elements of a surface coil phased array.

11:18 *254*. High-Resolution Whole-Body MR Angiography Featuring Parallel Imaging

Harald H. Quick[1], Florian Vogt[1], Christoph U. Herborn[1], Silke Bosk[1], Mathias Goyen[1], Joerg F. Debatin[1], Mark E. Ladd[1]
[1]University Hospital Essen, Essen, Germany

Purpose of this study was to implement a parallel acquisition technique (PAT) into the concept of multistation 3D whole-body (WB) MRA with the AngioSURF table to increase the spatial resolution of the standard imaging protocol. Whole-body MRA was performed on a 1.5T scanner on 8 volunteers in two imaging series: 1. standard protocol, 2. modified high-resolution protocol employing PAT. Compared to the standard protocol, PAT allowed for higher spatial resolution for all five stations in 8/8 volunteers. The overall SNR and CNR was lower in PAT examinations. The implementation of PAT into WB MRA resulted in more detailed MR angiograms.

11:30 *255*. Artifact Reduction in PR-HyperTRICKS

Jiang Du[1], Frank Thornton[1], Frank R. Korosec[1], Sean B. Fain[1], Walter F. Block[1], Thomas M. Grist[1], Chuck A. Mistretta[1]
[1]University of Wisconsin-Madison, Madison, Wisconsin, USA

The PR-HyperTRICKS acquisition integrates Cartesian slice encoding through-plane and undersampled projection reconstruction in-plane. It provides both high spatial resolution and high temporal resolution. But the undersampling artifacts from either the top or bottom of the FOV may severely degrade the image quality. We report here an artifact reduction method in PR-HyperTRICKS that greatly reduces the undersampling streak artifact.

11:42 *256*. Time-Resolved Contrast Enhanced MRA for Extended FOV Moving Table Imaging

Ananth Jayaseelan Madhuranthakam[1], David G. Kruger[1], Stephen J. Riederer[1], James F. Glockner[1], Houchun Harry Hu[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

There has been recent interest in imaging an extended field of view for MRA of peripheral arteries using either multiple-station or continuous table motion techniques. Virtually all such techniques to date have provided a single image; i.e. there is no time resolution. The purpose of this work was to develop a technique for time-resolved 3D imaging of an arbitrarily long FOV during continuous table motion. This is done by acquiring data with differential sampling of 3D k-space during continuous motion to reconstruct a times series. Each point in the object is “seen” in four consecutive 3D image sets.

11:54 *257*. 3D Gd-Enhanced Peripheral MR Angiography using Multi-Station SENSE (WakiTrak LS) - An Update

Jeffrey Harold Maki[1], Gregory J. Wilson[2], William B. Eubank[1], Romhild M. Hoogeveen[3]
[1]Puget Sound VASHCS, Seattle, Washington, USA; [2]Philips Medical Systems, Bothell, Washington, USA; [3]Philips Medical Systems, Best, Netherlands

Peripheral MRA using sagittal WakiTrak has several advantages. By using SENSE in the upper station, middle and lower station acquisitions begin earlier (lower station averages 31 s after initiation upper station), thereby decreasing the incidence of venous enhancement. Additionally, by using lower station SENSE with sagittal acquisition and elliptical centric encoding, high spatial resolution (1mm true isotropic) lower extremity images that include the pedal vessels are obtained. The technique is quite robust, with 100% diagnostic images in the upper and middle stations, and only one lower station non-diagnostic exam due to early venous enhancement (n = 18 patients).

12:06 *258*. Diagnostic Performance of Whole-Body 3D MR Angiography in Patients with Peripheral Arterial Occlusive Disease

Christoph Ulrich Herborn[1], Mathias Goyen[1], Knut Kroeger[1], Silke Bosk[1], Harald Hartmut Quick[1], Jörg Felix Debatin[1], Stefan Günther Ruehm[1]
[1]University Hospital Essen, Essen, Germany

The purpose of our study was to assess whole-body 3D MRA using AngioSURF in comparison to DSA for the peripheral vasculature and for the detection of additional atherosclerotic lesions in patients with PAD. 52 patients with documented PAD underwent contrast-enhanced whole-body MRA on a 1.5T MR-Scanner. Overall sensitivity and specificity were 0.91 and 0.94, respectively, for detection of vascular pathologies. Unsuspected disease was found in 12 patients: renal artery stenosis (6), carotid arterial stenosis (3), subclavian artery stenosis (1), and AAA (2). Whole-body 3D MRA permits a fast, reliable, and comprehensive evaluation of the arterial system in patients with PAD.

12:18 *259*. 3D CE Whole Body MRA with 16–Channel Array Coil System for Japanese Population

Satoru Kitano[1], Shinji Hirohashi[1], Koji Ueda[1], Nagaaki Marugami[1], Wtaru Higashiura[1], Kimihiko Kichikawa[1], Hajime Ohishi[1]
[1]Nara Medical University, Kashihara, Nara, Japan

The purpose of this study is to clearly 16-channel array coil system can be applied to 3D whole body MRA. 26 patients underwent whole body MRA in a four step automatic table feed technique. Upper part of MRA was obtained using 3D time-resolved MRA. Abdominal, femoral and popliteal MRA were obtained 3D high resolution MRA. The excellent image quality enables detailed assessment of the displayed vascular territories. 3D whole body MRA with 16–channel array coil system is a promising technique in the diagnosis of the arterial vascular system from aortic arch and major branches to the distal trifurcation arteries.

Spectroscopic Quantitation

Room 715 A/B 10:30 - 12:30 Chairs: Thomas Ernst and Douglas L. Rothman

10:30 *260*. Towards *In Vivo* ^{13}C Isotopomer Analysis in the Rat Brain

Pierre Gilles Henry[1], Ivan Tkac[1], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Carbon-13 isotopomer analysis provides unique information on relative metabolic fluxes and substrate selection. We show that ^{13}C isotopomers, previously commonly measured from tissue extracts, can also be quantified in the rat brain *in vivo* using LCModel, yielding relative concentrations for more than 50 different ^{13}C-labeled compounds. Even for the complex spectral pattern formed by glutamate and glutamine C2, the relative distribution of isotopomers determined *in vivo* using LCModel was in very good agreement with quantification of brain extracts.

10:42 *261*. Absolute Quantitation of Glycogen by Means of ^{13}C-MRS: A Comparison of Two Different Approaches

Michael Ith[1], Bruno Jung[1], Monica Zehnder[1], Karin Zwygart[1], Roland Kreis[1], Chris Boesch[1]
[1]University & Inselspital Berne, Berne, Switzerland

Glycogen covers a substantial part of mammalian energy metabolism. Therefore, a determination of its concentration in absolute units is crucial. However, absolute quantitation of 13C-MR spectra acquired by surface coils is difficult since X-nuclei generally lack a ubiquitous internal standard. This abstract expands two methods, which have been mainly used for the determination of relative concentrations so far, towards absolute quantitation of glycogen in human skeletal muscle: one that uses creatine as internal concentration standard, and one that is based on the superposition of a coil sensitivity map on anatomical images combined with a single reference measurement.

10:54 *262*. Metabolic Flux Measurement from a 8 μl Volume in the Rat Brain using *Ex Vivo* ^{1}H-{^{13}C} NMR Spectroscopy Combined with LCModel Analysis

Julien Valette[1], Françoise Vaufrey[1], Pierre Gilles Henry[2], Gilles Bonvento[3], Fawzi Boumezbeur[1], Philippe Hantraye[1], Gilles Bloch[1], Vincent Lebon[1]
[1]CEA - SHFJ, Orsay, France; [2]University of Minnesota, Minneapolis, Minnesota, USA; [3]CNRS URA2210 - SHFJ, Orsay, France

Our purpose has been to measure the TCA cycle rate in a somatosensory functional area of the rat brain without partial volume effect (~8 ml volume). Ex vivo 13C NMR spectroscopy was implemented using numerical optimization of tissue sampling timing and LCModel analysis of high resolution NMR spectra. Quantitation of the TCA cycle rate VTCA and of the exchange rate between glutamate and a-ketoglutarate VX were achieved from brain extract analysis, leading to VTCA=0.66±0.12 mmol.g-1.min-1 and VX=0.61±0.29 mmol.g-1.min-1.

11:06 *263*. Automatic Determination of Relative Peak Positions in Non-Water-Suppressed Proton Spectra for Cerebral Temperature Mapping by Spectroscopic Imaging

John S. Thornton[1], Ernest B. Cady[1], Alan Bainbridge[1], Andrew N. Priest[1], Osuke Iwata[1], Sachiko Iwata[1], Shanthi Shanmugalingam[1], John S. Wyatt[1], Roger J. Ordidge[1]
[1]University College London, London, UK

An automatic method for determining chemical shift differences between water and metabolite peaks in non-water-suppressed proton spectra is described. Spectra are corrected for modulation artifacts, then water and metabolite signals are separated by application of a time domain filter. Relative peak positions are determined by calculating the cross-correlation of the water and metabolite spectra. The efficacy of the method for cerebral temperature determination is shown, and the feasibility of cerebral temperature mapping via spectroscopic imaging is demonstrated.

11:18 *264*. Bad Spectra Can Be Better Than Good Spectra

Roland Kreis[1], Chris Boesch[1]
[1]University & Inselspital Berne, Berne, Switzerland

When judging spectra from patients, one usually controls for age, gender and brain region. There is no obvious need to match data for spectral quality. However, if fitting algorithms cannot fully cope with differences in linewidth, or introduce systematic errors for low SNR spectra, control spectra of similar quality must be used, in order not to yield systematically different normal ranges. It is shown with synthetic and in vivo spectra that results from linear-combination fitting can depend on shim and SNR even for dominating singlet peaks. Error estimates may be misleading and, hence, erroneously confirm a diagnosis of pathology.

11:30 *265*. Quantification of *In Vivo* Breast MRS

Patrick John Bolan[1], Eva H. Baker[1], Sina Meisamy[1], Joseph C. Lin[1], Doug Yee[1], Michael Garwood[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Quantifying the level of total choline-containing compounds (tCho) in breast MRS can be valuable for both diagnosis of lesions and monitoring cancer therapies. In this work we present and compare internal and external referencing methods for quantifying *in vivo* tCho levels. The internal referencing method is more robust, but both methods produce results that are consistent with previously reported *in vivo* and *ex vivo* studies. Mean tissue concentrations of tCho are presented for several pathologies. These results confirm that tCho is elevated in malignant lesions and show that quantitative MRS can be used to distinguish between different pathologies.

11:42 *266*. Towards Absolute Quantitation Including T_1, T_2 and the Macromolecular Baseline from Individual ^{1}H MR Spectra

Roland Kreis[1], Johannes Slotboom[2], Lucie Hofmann[1], Chris Boesch[1]
[1]University & Inselspital Berne, Berne, Switzerland; [2]Inselspital, Berne, Switzerland

Absolute quantitation of ^{1}H-MR spectra is often incomplete for single patients, 1) because classical determination of individual relaxation times in single subjects is prohibitively long and 2) because experimental determination of the individual macromulecule baseline (MM-BL) adds further measurement time. Hence, quantitation is performed using relaxation times and MM-BL's from patient groups, rather than the investigated subject. It is suggested to combine acquisition of saturation recovery (SR) PRESS spectra with two-dimensional prior-knowledge fitting to determine simultaneously metabolite T_1 (from SR analysis), T_2 (from lineshape), MM-BL (from SR) and metabolite concentrations (linear combination fitting plus absolute standardization).

11:54 *267*. Unobstructed Measurement of Brain Glutamate using TE-Averaged PRESS at 3T

Napapon Sailasuta[1], Radhika Srinivasan[2], Daniel Vigneron[2], Daniel Pelletier[2], Sarah Nelson[2], Ralph Hurd[1]
[1]GE Medical Systems, Menlo Park, California, USA; [2]University of California, San Francisco, California, USA

A method is introduced to accurately measure the tissue level of brain glutamate at 3T. This method, based on a TE-Averaged PRESS data acquisition, gives an unobstructed single line response for glutamate at 2.38 ppm. A glutamate signal is also observed at 3.82 ppm, which co-resonates with glutamine. The tissue level of glutamate can be estimated using a ratio of glutamate to water or any other known metabolites level, or by external referencing. The method also provides the effective metabolite T2 relaxation rates for uncoupled spins, a measure of the intrecellular status.

12:06 *268*. Measurement of Thalamic and Striatal Glutamate

Jullie W. Pan[1]
[1]Albert Einstein College of Medicine, Bronx, New York, USA

In vivo measurements of glutamate are important given its central role in neurotransmission and metabolism. The subcortical nuclei in particular are known to function as part of a network to modulate cortical output. We have developed a robust acquisition of glutamate using a quad adiabatic refocusing double echo sequence. This has been implemented to evaluate thalamic and striatal glutamate levels in human brain. The volume resolution achieved with this localized spectroscopic imaging sequence is 1cc.

12:18 *269*. Improved Spectroscopy Using Cluster Analysis and Lipid Signals as a Motion Indicator

Arnold J. M. Skimminge[1], Karin Markenroth[1], Anne-Mette Hejl[2], Lars G. Hanson[1]
[1]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital, Hvidovre, Denmark; [2]Copenhagen University Hospital, Rigshospitalet, Denmark

Variations in the lipid signals between consecutive acquisitions of SVS-spectra is shown to be a sensitive marker of subject motion. A cluster analysis is performed on these variations to distinguish motion-ridden acquisitions, thereby reducing distortion. The method is tested on short-TE spectra from 16 controls. The resulting spectra show improved signal and resolution as long as subject movement is limited.

Neurological MR: Inflammation and Encephalopathy

Room 717 A/B 10:30 - 12:30 Chairs: Douglas Arnold and David H. Miller

10:30 *270*. Spinal Cord Cross-Sectional Area Correlates with Brain and Intra-Cranial Volume

Sridar Narayanan[1], D. Louis Collins[1], Simon Francis[1], Douglas L. Arnold[1]
[1]McGill University, Montreal, Quebec, Canada

Spinal cord cross-sectional area as a measure of atrophy has shown good correlation with disability in multiple sclerosis, but the variability of cord area among normal individuals is high, suggesting the need for a good correlate, unaffected by disease, with which to normalize the measure. We assessed the potential for intra-cranial capacity (ICC, used to normalize brain volume measurements) to fill this role in 18 controls and 99 patients. ICC correlated well with cord area (Pearson $r = 0.7$, $p<0.001$) and normalization of cord area to ICC reduced variability among the controls from 10.5% to 8.4%.

10:42 *271*. Characterizing Cortical Grey Matter in Multiple Sclerosis by MRI: Relating cGM Changes to Disease Course

Jacqueline T. Chen[1], Sridar Narayanan[1], D. Louis Collins[1], Stephen M. Smith[2], Paul M. Matthews[2], Douglas L. Arnold[1]
[1]Montreal Neurological Institute/McGill University, Montreal, Quebec, Canada; [2]Oxford Centre for Functional Magnetic Resonance of the Brain/University of Oxford, Oxford, UK

Cortical grey-matter (cGM) is affected in multiple sclerosis (MS), however regional characteristics and relation with disease course are unknown. Using an automated method, we characterized cGM on MRI. In early MS, we found globally reduced grey-matter/white-matter interface (GM/WM) integrity, particularly in post-central cortex (p=0.02). Comparing patients with progressing disability to patients with stable disability, we found that decreased post-central thickness was associated with progression, and cGM thinning coincided with progression (frontal=3.2%yr, parietal=3.7%/yr, pre-central=5.2%/yr, post-central=5.3%/yr). Normalized GM/WM integrity in pre-central cortex correlated with disability (MSFC): SRCC=0.62, p=0.002. Regional cGM damage is related to disability progression and disease severity.

10:54 *272*. Multi-Center Proton MRSI of Primary Progressive Multiple Sclerosis

Ponnada A. Narayana[1], Jerry S. Wolinsky[1], Renjie He[1], Meghana Mehta[1], PROMiSE Trial MRSI Group[2]
[1]University of Texas Medical School at Houston, Houston, Texas, USA; [2]PROMiSE Trial MRSI Group, Houston, Texas, USA

Multi-center, short echo proton MRSI studies were performed in primary progressive multiple sclerosis (PPMS) patients. The average NAA/Cr ratio in PPMS was significantly lower compared to normal controls. No significant differences in the average metabolite ratios were observed between the normal appearing tissue (NAT) and lesion-containing regions (LCR). Strong abnormal resonances in the 0.8 to 1.8 ppm regions were observed, both from gray and white matter. In general, gray matter appears to be affected more in PPMS compared to relapsing-remitting MS (RRMS). These studies suggest extensive diffuse and/or microscopic pathology in PPMS.

11:06 *273*. ^{1}H-MRS Quantitation of NA and Cr in the Normal Appearing and the Lesional White Matter of Patients with MS

Zografos Caramanos[1], Sridar Narayanan[1], Stanley Hum[1], Douglas L. Arnold[1]
[1]Montreal Neurological Institute, Montreal, Quebec, Canada

We performed a meta-analysis of peer-reviewed publications that compared absolute quantitation of NA and Cr in the lesional and NAWM tissue of patients with MS to that in the WM of normal controls. Almost all studies found NA to be decreased in MS lesions and many found it to be decreased in MS NAWM. A fair number found either increased or decreased Cr in MS lesions and, importantly, a few found Cr to be slightly increased in MS NAWM. Given the frequent use of Cr to normalize NA, the reasons for the last finding must be better understood.

11:18 *274*. Conventional and Magnetization Transfer MRI Predictors of Clinical Multiple Sclerosis Evolution: A 4.5 Years Follow-Up Study.

Marco Rovaris[1], Federica Agosta[1], Matilde Inglese[1], Vittorio Martinelli[1], Mariaemma Rodegher[1], Maria A. Rocca[1], Maria Pia Sormani[1], Giancarlo Comi[1], Massimo Filippi[1]
[1]Scientific Institute and University H San Raffaele, Milan, Italy

This study was performed to assess the value of conventional and magnetization transfer (MT) MRI-derived measures in predicting the disease evolution of 73 patients with multiple sclerosis (MS). Brain MRI scans were obtained at baseline and after 12 months. Clinical MS evolution and neurological disability were re-assessed in all patients after a median follow-up of 4.5 years. The final multivariable model included average brain MT ratio percentage change after one year ($p=0.02$, Odds Ratio -OR=0.86) and baseline T2 lesion volume ($p=0.04$, OR=1.04) as independent predictors of long-term disability worsening.

11:30 *275*. Histological Correlates of Quantitative MT-MRI Measures in Fresh Post-Mortem Multiple Sclerosis Brain

Klaus Schmierer[1], Daniel J. Tozer[1], Gerard R. Davies[1], Gareth J. Barker[1], Francesco Scaravilli[1], Paul S. Tofts[1], David H. Miller[1]
[1]Institute of Neurology, UCL, London, England, UK

Quantitative magnetisation transfer (qMT) MRI was performed along with MTR, and quantitative T1 in fresh post-mortem (PM) brain of 7 patients with multiple sclerosis (MS). Myelin content and axonal density in lesions and in normal-appearing white matter (NAWM) were quantified by assessing their transmittance (T) using digital image analysis (DIA). qMT indices correlated with MTR, T1, and myelin content. Significant differences were detected for all MT indices between demyelinated and remyelinated lesions. The combined use of qMT MRI of PM brain specimens and DIA of their histology delivers robust data and may aid the validation of qMT.

11:42 *276*. Quantitative Measurement of Contrast Reagent Blood-Brain Barrier Permeability in Multiple Sclerosis

William D. Rooney[1], Thomas E. Yankeelov[1], Patricia K. Coyle[2], Frank W. Telang[1], Charles S. Springer, Jr.[1]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]State University of New York, Stony Brook, New York, USA

Systematic lesion characterization could lead to important insights into MS pathophysiology. MR bolus-tracking was used to obtain rate constants for plasma-interstitial contrast agent transport (K^{trans}) and extracellular volume fraction (v_e) for MS lesions. We used two models to extract lesion properties; (1) the standard model, that assumes fast exchange of water between the intra- and extracellular compartments, and (2) a modified two-site exchange (2SX) model, that allows intercompartmental water exchange to depart the fast exchange limit.

11:54 *277*. Temporal Texture Analysis of Normal Appearing White Matter in Multiple Sclerosis

Hongmei Zhu[1], Xingchang Wei[1], Yunyan Zhang[1], Gregory S. Mayer[1], J Ross Mitchell[1]
[1]University of Calgary, Calgary, Alberta, Canada

Detecting abnormalities in normal appearing white matter (NAWM) may help reveal the subtle pathological changes in multiple sclerosis (MS). We developed a novel texture analysis technique based on the polar S-transform (PST), a localized Fourier transform providing local frequency information with multi-scale analysis. We applied this algorithm to analyze regions of NAWM on serial T1-weighted Gadolinium-enhanced MRI, and detected early textural changes even before lesion activity becomes evident in terms of focal contrast-enhancement.

12:06 *278*. Brain Morphologic Changes Suggest Persistent Brain Injury in Treated HIV-Seropositive Patients

Dieter J. Meyerhoff[1], Valerie Cardenas[1], Enmin Song[1], Diana Truran[1], Robert Blumenfeld[1], Frank Ezekiel[1], Colin Studholme[1], Johannes Rothlind[1], Joselyn Lindgren[1], Michael W. Weiner[1]
[1]DVA Medical Center University of California San Francisco, San Francisco, California, USA

Standard MRI volumetric methods and deformation morphometry were used to measure brain volume changes in treated HIV-seropositive individuals compared to controls. Postulated exacerbating effects of co-morbid chronic alcohol consumption were also assessed by comparing light and heavy drinkers in each group. In 217 individuals, we detected ongoing brain tissue loss due to HIV infection, despite treatment, and these losses were greater in heavy alcohol users. Cognitive deficits were related to many of these abnormal imaging measures. Preliminary longitudinal results suggest that HIV mediated brain injury is an ongoing process despite antiretroviral treatment.

12:18 ***279*. Anatomical and Neurochemical Changes in Minimal Hepatic Encephalopathy and Their Neuropsychological Correlates**

Nathaniel Wyckoff[1], Nader Binesh[1], Mary Bugbee[1], Kenneth Yue[1], Michael Green[1], Steven Han[1], M. Albert Thomas[1]
[1]David Geffen School of Medicine at UCLA, Los Angeles, California, USA

Patients with minimal hepatic encephalopathy (HE) and healthy controls were scanned by T1-weighted MRI, and had spectra recorded from their occipital white matter, frontal gray matter and basal ganglia regions. Both patients and healthy controls underwent various neuropsychological tests. Using normalized representative gray levels of the globus pallidus, HE patients could be distinguished from healthy controls. HE patients had significantly elevated ratios of combined glutamate and glutamine to creatine, as well as reduced ratios of choline to creatine and myo-inositol to creatine, compared to healthy controls. MRI abnormalities and neuropsychological deficits were correlated with various metabolic changes in HE patients.

GOLD CORPORATE MEMBER LUNCHTIME SYMPOSIUM
G.E. Medical Systems
New Frontiers in MRI Technology

Hall F/G 12:30 - 13:30

HOT TOPICS IN CLINICAL PRACTICE

Room 718A 13:30 - 15:30 Chairs: Thomas M. Grist and Clifford R. Jack

Educational Objectives
Upon completion of this course, participants should be able to:
- Describe five points that can be used to improve imaging strategies in important areas of clinical practice;
- Assess the applicability to clinical practice of three newer imaging techniques.

The final five minutes of each presentation will be reserved for questions.

Body Imaging
13:30 **Multi-Coil Acceleration Technique: Protocols, Prospects, and Pitfalls**
Robert R. Edelman

13:50 **Musculoskeletal MRI at 3T**
Garry E. Gold

14:10 **Whole Body MRI: Technique, Clinical Applications, and Controversies**
Susanne C. Goehde

Neuroimaging
14:30 **Clinical Applications of Diffusion Tensor Imaging**
John D. Port

14:50 **Fast Imaging: Neuroimaging Applications**
Ronald Wolf

15:10 **Clinical Neuroimaging at 3T: How I Do It**
Edmond A. Knopp

15:30 **Adjournment**

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
Cancer: Perfusion and Permeability

Room 718B 13:30 - 15:30 Chairs: Truman R. Brown and June S. Taylor

Please see page 254 for details.

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
Neurodegeneration: From Mouse to Man

Room 701B 13:30 - 15:30 Chairs: Laurel O. Sillerud and Steve C.R. Williams

Please see page 406 for details.

CLINICAL SCIENCE FOCUS SESSION
Assessing Breast Tissue with MR

Room 713 A/B 13:30 - 15:30 Chair: Robert E. Lenkinski

13:30 *280*. The Role of MRI in the Workup of Mammographic Architectural Distortion

Frederick Kelcz[1], Pamela A. Propeck[1], Elizabeth S. Burnside[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

Mammographic evaluation of architectural distortion can be frustrating. A review of 57 patients sent for contrast-enhanced breast MRI after indeteminate mammographic showed that 25% of patients had cancer. MRI correctly classified 13 of 14 cancers and 33 of 43 benign lesions. In 10 of 57 patients, followup studies (6 - mammography; 4 - MRI) were recommended due to slow Gd-DTPA uptake specific to the area of concern. One of these studies resulted in a diagnosis of cancer 18 months after MRI. We conclude that MRI can reliably aid in the workup of architectural distortion.

13:40 *281*. Exploring Symmetries in Breast MRI Scans

Robert Alterson[1], Donald B. Plewes[1]
[1]University of Toronto, Toronto, Ontario, Canada

Currently, breast MR images are assessed in terms of the kinetics and location of uptake of Gd-DTPA. However, mammographic interpretation often uses symmetry between left and right breasts to indicate the site of potential tumour masses but has not been used in breast MRI. In this work, we present such a method for characterizing breast symmetry based on three objective measures of similarity including multiresolution non-orthogonal wavelet representation, three-dimensional intensity distributions and concurrence matrices. Studies based on 51 normal MRI scans of randomly selected patients showed that the sensitivity of symmetry detection rate approached 94%.

13:50 *282*. MRI in Equivocal Breast Cytology: Does Quantitative Textural and Morphometric Analysis Have Added Value?

David John Manton[1], Peter Gibbs[1], Peter Kneeshaw[1], Lindsay Wilson Turnbull[1]
[1]Centre for MR Investigations, Hull, East Yorkshire, UK

Quantitative textural (co-occurrence matrix) and morphometric (cross-sectional area and shape) analyses were carried out upon static T1-weighted contrast-enhanced MRI images acquired in 38 cases of suspected breast cancer in which an equivocal cytology result had been obtained. It was found that the small increase in diagnostic power provided by the textural and morphometric parameters, over and above that provided by pharmacokinetic analysis of dynamic T1-weighted contrast-enhanced imaging carried out at the same time, was not statistically significant; suggesting that textural and morphometric analyses do not provide added value.

14:00 *283*. High Spatial and Spectral Resolution MR Imaging of Small Breast Lesions

Milica Medved[1], Gillian Newstead[1], Peter M. MacEneaney[1], Marta A. Zamora[1], Gregory S. Karczmar[1]
[1]The University of Chicago, Chicago, Illinois, USA

We compare the fat-suppressed images obtained using high spatial and spectral (HiSS) resolution imaging with the clinical fat-saturated images. In HiSS-generated images the fat suppression is not affected by the main field inhomogeneities, and is superior to that obtained by the standard clinical sequence. Hence we obtain better lesion delineation and conspicuity. In addition, we find that HiSS images show a larger dynamic range and better contrast within the lesion. This may lead to better lesion characterization, and improved specificity of breast MR.

14:10 *284*. Parametric Contrast Enhanced MRI of Ductal Carcinoma *In Situ* of the Breast.

Edna Furman-Haran[1], Dov Grobgeld[1], Frederick Kelcz[2], Kevin Kirshenbaum[3], Hadassa Degani[1]
[1]The Weizmann Institute of Science, Rehovot, Israel; [2]University of Wisconsin Hospital, Madison, Wisconsin, USA; [3]Illinois Masonic Medical Center, Chicago, Illinois, USA

Model-based methods of dynamic contrast enhanced MRI were applied to characterize the various forms of ductal carcinoma *in situ* (DCIS). Parametric images of permeability limited transcapillary transfer constant and extracellular volume fraction (EVF), as well as combined color-coded images of these two parameters were constructed. The analysis demonstrated a progressive increase in the (k^{ps}) and EVF values from low-grade to high-grade DCIS.

14:20 *285*. Silicone Prosthesis Imaging Using an Inversion Recovery Fast Spin Echo and Fast Dixon Technique

Jingfei Ma[1], Haesun Choi[1], Roger Jason Stafford[1]
[1]The University of Texas M. D. Anderson Cancer Center, Houston, Texas, USA

This research presents a technique for silicon-specific imaging using a fast spin-echo based, fast 3-point Dixon acquisition for separation of silicone and water with inversion recovery fat suppression. A breast and silicone prosthesis were imaged in a volunteer. Excellent fat suppression and separation between silicone and water were demonstrated across the field of view using acquisition parameters comparable to existing clinical techniques. We conclude that this technique is capable of overcoming several intrinsic limitations of the previously-published techniques and can be used for robust and more efficient silicone-specific imaging.

14:30 *286*. Characterization of Breast Tumors using the FIESTA Technique and Contrast-Enhanced MRI

Catherine S. Klifa[1], Savannah C. Partridge[1], Jessica E. Gibbs[1], Niles Bruce[1], Evelyn C. Proctor[1], Nola M. Hylton[1]
[1]University of California, San Francisco, California, USA

In this study we explored the usefulness of the Fast Imaging Employing Steady-State Acquisition (FIESTA) pulse sequence for characterization of breast tumors. Contrast in the FIESTA sequence is related to T2/T1 ratio and FIESTA can be acquired in a 3D format, allowing T2 information to be spatially matched to T1-weighted contrast enhanced MR images (CE-MRI). We performed a preliminary investigation using the combined information from FIESTA and CE-MRI to characterize breast tumors (invasive ductal and lobular carcinomas, DCIS) in a group of 10 patients.

14:40 *287*. Detection of Minimal Nodal Disease in Patients with Breast Cancer

Mukesh G. Harisinghani[1], Elizabeth Rafferty[1], Peter F. Hahn[1], Daniel Kopans[1], Kevin Hughes[1], Mansi Saksena[1], Ralph Weissleder[1]
[1]Massachusetts General Hospital, Boston, Massachusetts, USA

Ultrasmall superparamagnetic iron oxide (USPIO) is a relatively new RES targeted MR contrast agent that has been shown to have lymph node uptake. The purpose of this study was to evaluate and correlate USPIO induced signal intensity changes in excised lymph nodes with histopathology for staging patients with breast cancer.

14:50 *288*. Characterization of Sodium-23 Concentration and T_2 Relaxation Behavior in Normal Breast Tissue

William H. Perman[1], Cecil E. Hayes[2]
[1]Saint Louis University, St. Louis, MO, USA; [2]University of Washington, Seattle, WA, USA

We hypothesize that multiple-echo three-dimensional 23Na magnetic resonance mammography (Na-3DMRM) of both breasts and axilla will allow early, non-invasive, detection of malignant breast lesions while they are small (<10 mm) and more responsive to excision and therapy, and may provide an accurate means for tumor grade determination. Before using Na-3DMRM to differentiate benign from malignant tumors we must first characterize the concentration and T2 relaxation behavior of 23Na in normal breast tissue. SOLUTION: We present our preliminary results characterizing the concentration and T2 relaxation behavior of 23Na in normal breast tissue.

15:00 *289*. Mapping of Unsaturated Lipid in Human Breast Cancer using Sel-MQC

Qiuhong He[1], Pavel Shkarin[2], Carol H. Lee-French[2]
[1]Memorial Sloan-Kettering Cancer Center, New York, New York, USA; [2]Yale University School of Medicine, New Haven, Connecticut, USA

Spatial distribution of unsaturated lipid was mapped non-invasively in human breast tissue using Sel-MQC, which was developed for in vivo detection of tumor lactate. Different from the triglyceride distributions, the MR visible unsaturated lipids appear to concentrate in areas of high ductal glands in healthy human breast, which may explain the elevated level of unsaturated lipid observed in a human breast carcinoma. The pattern of unsaturated lipid distribution is sensitive to breast tissue changes, which merits a further investigation using unsaturated lipid as a tumor marker or an index of abnormal tissue fatty acid metabolism in physiological conditions.

15:10 *290*. Matching 3D MR Breast Images using a Localized Radial Basis Function

Michael Andrew Wirth[1], Dennis Nikitenko[1], Jennifer Lyon[1]
[1]University of Guelph, Guelph, Ontario, Canada

The interpretation of Magnetic Resonance (MR) images of the breast involves detecting changes between corresponding images. Since the breast is an intrinsically nonrigid structure, changes in breast positioning, patient movement and associated thoracic motion may contribute to spatial differences between analogous structures in corresponding images. These differences, which may inhibit comparative analysis, are significantly reduced through the process of registration. This paper presents an approach to matching Magnetic Resonance images of the breast using a point-based registration methodology incorporating nonrigid deformations in the form of a localized 3D radial basis function.

15:20 ***291***. **Incremental Value of ADC as an Indicator of Treatment Response in Patients Undergoing Neoadjuvant Chemotherapy for Locally Advanced Breast Cancer**

Jessica E. Gibbs[1], Savannah C. Partridge[1], Nola M. Hylton[1]
[1]University of California San Francisco, San Francisco, California, USA

Twenty-eight women undergoing neoadjuvant chemotherapy for locally advanced breast cancer were imaged using diffusion weighted MRI to assess treatment response. The apparent diffusion coefficient (ADC) of tumor was measured before chemotherapy and after one cycle, and the value of ADC for predicting treatment response was compared to volumetric and vascular parameters measured by contrast-enhanced MRI. Early change in ADC significantly contributed to the prediction of residual disease size at pathology, but was not significantly predictive of other treatment response measures (nodal status, volume change).

Artifact Reduction in Rapid Imaging

Room 718A 16:00 - 18:00 Chairs: Walter F. Block and E. Mark Haacke

16:00 ***292***. Young Investigator Awards Finalist: **Dixon Techniques in Spiral Trajectories with Off-Resonance Correction: A New Approach for Fat Signal Suppression without Spatial - Spectral RF Pulses**

Hisamoto Moriguchi[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]University Hospitals of Cleveland / Case Western Reserve University, Cleveland, Ohio, USA

One of the main disadvantages of spiral imaging is blurring artifacts due to off-resonance effects. Spatial-spectral (SPSP) pulses are commonly used to suppress fat signals to avoid their blurring artifacts. However, SPSP pulses are usually long relative to spiral readouts and thus increase acquisition time. Furthermore, these pulses may produce non-uniform fat signal suppression or unwanted water signal suppression in the presence of B0 inhomogeneity. Dixon techniques have been developed as methods of unequivocal water-fat signal decomposition in rectilinear sampling schemes. In this study, Dixon techniques are extended to spiral data acquisition for unambiguous water-fat decomposition with off-resonance blurring correction.

16:20 ***293***. Young Investigator Awards Finalist: **Flow Effects in Balanced Steady State Free Precession Imaging**

Michael Markl[1], Marcus Alley[1], Chris Elkins[1], Norbert Pelc[1]
[1]Stanford University, Stanford, California, USA

An analysis of the effect of flow on 2D fully balanced Steady State Free Precession (SSFP) imaging is presented. Transient and steady-state SSFP signal intensities in presence of steady and pulsatile flow were simulated using a matrix formalism based on the Bloch equations. For accurate modeling of SSFP it is crucial to include properties such as imperfect slice profiles and, more importantly, 'out-of-slice' signal contributions. Simulations and experiments show that there can be considerable flow related changes in SSFP signal intensity resulting from frequency-dependent contributions from flowing spins that have already left the slice but still influence the SSFP signal.

16:40 ***294***. **Eddy Current Optimized Phase Encoding Schemes to Reduce Artifacts in Balanced SSFP Imaging**

Klaus Scheffler[1], Jürgen Hennig[2]
[1]University of Basel, Basel, Switzerland; [2]University Hospital Freiburg, Freiburg, Germany

Balanced SSFP is very sensitive to spin dephasing induced be different mechanisms within the completely balanced gradient scheme. A source of imperfections are eddy currents that change from excitation to excitation produced by the changing phase encode (PE) gradients. Rapid and large changes of the encoded k-space position as seen in conventional 3D PE trajectories generate signal instabilities and fluctuations that lead to image artifacts. Optimized PE trajectories are proposed with minimal changes of k-space position from excitation to excitation.

16:52 ***295***. **In/Out Elliptic Centric View Ordering and Modulated Phase-Cycling for Reduced Motion Artifact in Phase-Cycled SSFP**

Heidi A. Ward[1], Jason A. Polzin[1], Matthew A. Bernstein[2], Bernice E. Hoppel[1]
[1]GE Medical Systems, ASL-Central, Waukesha, Wisconsin, USA; [2]Mayo Clinic, Rochester, Minnesota, USA

Phase-cycling techniques reduce susceptibility-related banding artifacts in steady-state free precession imaging (SSFP). However, the required sequential acquisition of multiple volumetric datasets increases the sensitivity of these techniques to patient motion. For a two phase-cycle case, acquiring the first volume with reversed elliptic centric (REC) view ordering and the second volume with elliptic centric (EC) view ordering localizes the center of k-space for both volumes within a short period of time, reducing the probability of misregistration. Furthermore, modulated phase-cycling between acquisition of the volumes helps maintain the steady-state for the EC dataset.

17:04 *296*. The Impact of View Order on Steady-State Magnetization in Radial Sampling

Anja C.S. Brau[1], G. Allan Johnson[1]
[1]Duke University, Durham, North Carolina, USA

The steady-state magnetization in radial sampling sequences was investigated using Bloch equation simulations and verified with phantom experiments. Image artifacts arising from inadvertent transverse coherences appeared as concentric circles about the geometric center of the image in a Bessel-like pattern, unlike parallel banding artifacts observed in FLASH imaging. The conspicuity and position of these radial artifacts was found to be highly dependent on view order. Theoretical understanding of the mechanisms underlying radial sampling artifacts is essential to pulse sequence design in order to acquire artifact-free images with desired contrast.

17:16 *297*. Centering the Projection Reconstruction Trajectory

Dana C. Peters[1], J. Andrew Derbyshire[1], Elliot R. McVeigh[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

This investigation demonstrates that an important source of projection reconstruction (PR) trajectory errors is gradient delay which causes radial trajectories to miss the center of k-space in an angularly dependent manner, providing effective echo times that vary with projection angle. Using only a one-time measurement of the gradient delay times, the timing errors were removed by addition of compensatory gradient areas to the prephasers of the logical x and y readout gradients. Echo time variability was reduced for all image orientations, and PR image quality was improved. This correction eliminates a serious source of artifact from the PR trajectory.

17:28 *298*. Correction of Trajectory Errors in Radial Acquisitions

Oliver Wieben[1], Ethan Brodsky[2], Charles A. Mistretta[2], Walter F. Block[2]
[1]University of Wisconsin-Madison (now with Universität Freiburg, Freiburg, Germany), Madison, Wisconsin, USA; [2]University of Wisconsin-Madison, Madison, Wisconsin, USA

Eddy currents and gradient anisotropies lead to derivations of the actual from the nominal k-space trajectory. This can cause significant artifacts in 2D and 3D radial acquisitions if their effects are not corrected for. Here we present a method to estimate the errors from very few echoes and correct for them during the acquisition in order to traverse on the nominal trajectory. The technique is demonstrated in phantoms and humans with a 3D radial acquisition but can also be used for 2D acquisitions.

17:40 *299*. Unattended Image-based Ghost Correction for EPI

Michael H. Buonocore[1]
[1]UC Davis Medical Center, Sacramento, California, USA

Image-based ghost correction can provide significant reduction of N/2 ghosts in EPI images, however, some published techniques require that the user draw a region of interest around the object in the uncorrected image, so that the eligible pixels, defined as those pixels inside the object that have their ghost location outside the object, can be identified. An algorithm for unattended identification of eligible pixels has been developed based on unique phase properties of images reconstructed using only left-to-right or right-to-left k-space lines. The algorithm provides higher quality ghost correction than previously obtained with the ROI-based method.

MR PHYSICS AND TECHNIQUES FOR CLINICIANS

Room 718B 16:00 - 18:00 Chairs: Frank R. Korosec and Joseph C. McGowan

Educational Objectives

Upon completion of this course, participants should be able to:

- Define and describe the fundamental principles of MR imaging, including the definition of spin magnetization, the Larmor relationship, relaxation phenomena, and the process of using the spin magnetization to produce an image;
- Explain imaging pulse sequences based upon spin and gradient echoes, incuding fast spin echo and echo planar techniques;
- Design MR imaging protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio, and artifacts;
- Describe the principles and capabilities of various advanced MR techniques including diffusion, cardiac and functional MRI and spectroscopy.

16:00 **Spin Echo Imaging**
James G. Pipe

16:40 **Gradient Echo Imaging**
John P. Mugler III

17:20 **Fast Spin Echo Imaging**
Frank R. Korosec

Experimental Stroke and Other Cerebral Disease Models

Room 701A 16:00 - 18:00 Chairs: Risto A. Kauppinen and Mark F. Lythgoe

16:00 ***300***. **Neurosphere Therapy of Stroke Using MR Tracking of Magnetically Labeled Cells in Rat**

Quan Jiang[1], Zheng Gang Zhang[1], Li Zhang[1], Rui Lan Zhang[1], Guang Lian Ding[1], Polly Arniego[1], Jia Ni Hu[2], Qing Jiang Li[1], James R. Ewing[1], Robert A. Knight[1], Michael Chopp[1]
[1]Henry Ford Health System, Detroit, Michigan, USA; [2]Wayne State University, Detroit, Michigan, USA

We intracisternally transplanted adult SVZ cells labeled by ferromagnetic particles into adult stroked rats 48 hours after stroke. Migration of transplanted cells was tracked using MRI. We found that transplanted cells selectively migrated towards to the ischemic parenchyma at a mean speed of 65 ± 14.6 mm/hr in living rats. Migration and integration of transplanted cells in the host brain were also detected using histochemical staining. Our data suggest that intracisternal transplantation of adult SVZ cells may provide an avenue for cell therapy of stroke and that MRI can be used to track migration of grafted cells in living animals.

16:12 ***301***. **Delayed Treatment with the Defibrinogenating Agent, Acutobin, Salvages Brain Tissue in a Rat MCAO Model**

Jingna Wei[1], Qingchuang Wang[2], Guangfen Liu[2], Michael J. Quast[1]
[1]UTMB, Galveston, Texas, USA; [2]Fujian Medical University, Fuzhou, Fujian, People's Republic of China

The effect of Acutobin, a purified protein fraction of venom from Deinakistrodon acutus, on a rat right middle cerebral artery intraluminal hollow filament insertion model (MCAO/R) was evaluated. The proton MRI results showed that internal carotid artery infusion of Acutobin (10U/kg, 2 h after MCAO/R) reduced T2WI measured lesion by 31% and the residual CBF in the pre-ischemic area recovered to baseline as compared to saline controls at 24 h after MCAO/R. The results suggest that Acutobin improved cerebral microcirculation which may offer a safe and effective therapy following an ischemic insult.

16:24 ***302***. **Quantification of Blood Brain Barrier Permeability in Acute Stroke Using T_1 Look-Locker Methods**

Vijaya Nagesh[1], Robert A. Knight[1], Tavarekere Nagaraja[1], James R. Ewing[1], Polly Arniego[1], Joseph D. Fenstermacher[1]
[1]Henry Ford Health Sciences Center, Detroit, Michigan, USA

Opening of the blood brain barrier (BBB) is known to result in a host of neuropathologic conditions. Often BBB disruption results from deterioration of brain microvascular function and structure. Knowledge of the degree and severity of BBB injury may be useful to exclude the possibility of hemorrhagic transformation after thrombolytic therapy in human stroke. The aim of this study was to develop MR techniques that can uniquely identify damaged BBB regions and quantitatively evaluate these areas.

16:36 ***303***. **Quantitative Assessment of Temporal Changes in the “Perfusion/Diffusion Mismatch” Following Focal Cerebral Ischemia in the Rat Brain**

Xiangjun Meng[1], Qiang Shen[1], Fuhai Li[1], Marc Fisher[1], Christopher H. Sotak[2], Timothy Q. Duong[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA; [2]Worcester Polytechnic Institute, Worcester, Massachusetts, USA

The goals of this study were to: i) establish the absolute and percent ADC and CBF thresholds for quantifying the ischemic lesion volume in association with focal cerebral ischemia in the rat brain during the acute phase; and ii) employ these thresholds to assess the perfusion/diffusion mismatch in the ischemic lesion volume as a function of time. These results were validated by using histology.

16:48 *304*. Effects of 2-deoxy-D-glucose and 3-O-methyl-glucose on Focal Cerebral Ischemia in Hyperglycemic Rats

Jingna Wei[1], David M. Cohen[2], Michael J. Quast[1]
[1]UTMB, Galveston, Texas, USA; [2]Baylor College of Medicine, Houston, Texas, USA

The effect of 3-O-methylglucose (3OMG) and 2-deoxy-D-glucose (2DG) on neurological outcome was evaluated on a hyperglycemic rat middle cerebral artery occlusion/reperfusion (MCAO/R) model using proton MRI/MRS. The results showed that daily injection of 2DG (300mg/kg, ip) combined with single dosage of 3OMG (500mg/kg, iv) 10 min prior to MCAO significantly reduced DWI measured lesion by 48% and lactate/NAA ratio by 56% at 4 h after MCAO/R. The results indicated that the competitive 3OMG and 2DG inhibition of glucose uptake (glucose transporter) and initial metabolism (hexokinase) has a beneficial effect in reduing brain damage in hyperglycemic rats exposed to MCAO/R.

17:00 *305*. Interleukin-1 Receptor 1 Deletion Confers Protection from Ischemic Brain Damage

Jelena Lazovic-Stojkovic[1], Anirban Basu[1], Raymond P. Rothstein[1], J Kyle Krady[1], Steven W. Levison[1], Michael B. Smith[1]
[1]Penn State College of Medicine, Hershey, Pennsylvania, USA

MR imaging was utilized to study the changes in T2 values between 24 h and two months following hypoxia-ischemia (HI) in wild type and IL-1 receptor 1 null mice. Initially elevated T2 values at 24 h post HI comprised a significantly smaller volume in the IL-1 receptor null mice and returned to near normal values after 2 months, while the initially elevated T2 values in the wild type mice remained elevated. Inducible Nitric Oxide Synthase (iNOS) mRNA induction was severely curtailed in the IL-1R1 null mice at 24 h and 72 h post HI.

17:12 *306*. Influence of Thromboembolic Load on the Outcome of rt-PA Treated Experimental Stroke

Frank Nießen[1], Thomas Hilger[1], Mathias Hoehn[1], Konstantin-Alexander Hossmann[1]
[1]Max-Planck-Institute for Neurological Reasearch, Cologne, Germany

Ischemic stroke, the most frequent disabling disease in the western world, is mainly caused by cerebral thromboembolism. The amount of clot leading to vessel occlusion, the embolic load, varies and is difficult to assess clinically. Heterogeneous treatment results with recombinant tissue plasminogen activator (rt-PA) might be explained by different embolic loads. Main criterion of successful rt-PA treatment prediction is time from onset of symptoms, but as reperfusion is variable, embolic load must also be considered. We investigated the influence of thromboembolic load on outcome of rt-PA treatment in experimental stroke.

17:24 *307*. Monitoring of Monocyte Infiltration into the Brain during Experimental Allergic Encephalomyelitis by Magnetic Resonance Imaging

Erwin Blezer[1], Sarah Floris[2], Ed Döpp[2], Susanne van der Pol[2], Christine Dijkstra[2], Klaas Nicolay[3], Helga de Vries[2]
[1]Medical Center Utrecht, Utrecht, Netherlands; [2]VU Medical Center, Amsterdam, Netherlands; [3]Eindhoven University of Technology, Eindhoven, Netherlands

MRI was used to measure the time dependence of BBB leakage and cerebral monocyte infiltration in a rat model of acute experimental autoimmune encephalomyelitis (EAE) in which transient neurological deficits develop from 11 to 17 days after immunization. Animals showed maximal BBB-leakage, explored with quantitative GdDTPA enhanced T1W-imaging, 11 days after immunization. Monocyte infiltration was maximal, explored with quantitative USPIO enhanced T2-imaging and immunohistochemistry, 14 days after immunization (peak of the disease). We conclude that these techniques are sensitive to different aspects of disease processes occurring in EAE and they may be valuable tools to evaluate neuropathological status in MS

17:36 *308*. Reactivation of Immune Response by Peripheral Infection Causes Increased CBV

Kerry Anne Broom[1], Daniel Anthony[2], Andrew Blamire[1], Sara Waters[2], V Hugh Perry[2], Peter Styles[1], Nicola Sibson[1]
[1]University of Oxford, Oxford, UK; [2]University of Southampton, Southampton, UK

MRI is an established clinical tool in the diagnosis of Multiple Sclerosis (MS). Peripheral infections have been implicated in relapses of MS, but little experimental data exists to support this. Using the Delayed Type Hypersensitivity (DTH) model to mimic aspects of MS pathology, we show that peripheral challenge with E coli endotoxin lipopolysaccharide (LPS) causes reactivation of a previously quiescent cerebral lesion. Reactivation is observed initially as a rapid increase in cerebral blood volume, which is followed later by re-opening of the blood brain barrier (BBB). These findings may have considerable implications for the treatment of MS.

17:48 *309*. Decreased Cerebral Perfusion Correlates with Increased BOLD Hyperoxia Response in a Transgenic Mouse Model of Sickle Cell Disease.

Richard P. Kennan[1], Sandra M. Suzuka[1], Ronald Nagel[1], Mary E. Fabry[1]
[1]Albert Einstein College of Medicine, Bronx, New York, USA

Neurological complications such as stroke are well known consequences of sickle cell disease (SCD). Using BOLD MRI, we have previously demonstrated that transgenic mice expressing high levels of human alpha and betaS-globin have higher levels of deoxy Hb in liver, and kidney, (areas showing pathology) compared to control mice. As an extension of this work we use magnetic resonance imaging to non-invasively evaluate cerebrovascular function in transgenic mouse models of human SCD. The study shows that transgenic mouse models with SCD demonstrate reduced cerebral perfusion and enhanced BOLD hyperoxia response which may indicate stroke risk.

Vascular Interventions

Room 701B 16:00 - 18:00 Chairs: Albert C. Lardo and Mark E. Ladd

16:00 *310*. Next Generation Interface for Interventional MRI

Daniel Robert Elgort[1], Matthew Mendez[1], Frank S. Wacker[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]University Hospitals of Cleveland and Case Western Reserve University, Cleveland, Ohio, USA

Interventionalists can perform procedures efficiently and safely if provided clear real-time access to relevant image information. Hence, adjustment of imaging parameters must be made easier during MR-based procedures. We describe an improved IMRI interface where the catheter's position, orientation, and insertion speed are continually monitored using a real-time tracking system. Two graphical displays use this information: real-time images automatically follow the position/orientation of the catheter, and a 3D reference map shows the catheter's current position. Further, interventionalists adjust imaging parameters during the procedure simply by controlling the speed of the catheter; no interaction with a keyboard or mouse is required.

16:12 *311*. An Active MRI Intramyocardial Injection Catheter

Parag V. Karmarkar[1], Ergin Atalar[1], Lawrence Hofmann[1], Dara L. Kraitchman[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

We have developed an intramyocardial injection catheter that can be actively tracked under MRI to deliver therapeutics into the myocardium. Components of the catheter are arranged to form a modified loopless antenna. The catheter was tested in a canine model using real-time MR guidance. The entire length of the catheter could be seen as it was tracked into the left ventricle. The catheter was positioned against the myocardium in the area of interest, needle advanced in the myocardium and MR contrast solution injected. Intramyocardial injection was confirmed by imaging the slice before and after injection and by post-mortem histological staining.

16:24 *312*. *In-Vivo* Results of Catheter Visualization and Slice Tracking with an Optically Switchable Resonant Marker

Steffen Weiss[1], Titus Kuehne[2], Gabriele Krombach[3], Florian Brinkert[4], Tobias Schaeffter[1], Arno Buecker[3], Rolf Guenther[3]
[1]Philips Research, Hamburg, Germany; [2]German Heart Institute, Berlin, Germany; [3]University of Technology, Aachen, Germany; [4]University Hospital, Hamburg, Germany

In-vivo results of safe catheter visualization and slice tracking during an image-guided intervention in a pig are presented using an optically switchable resonant marker on a 5F-multipurpose catheter. In-plane flashing of the marker by optical switching at low frequency during real-time radial balanced FFE imaging resulted in excellent visualization of the in-plane position and the vasculature. On-demand slice tracking was performed by acquisition of tracking projections during high-frequency optical switching of the marker. Both, in-plane flashing and slice tracking proved to provide valuable support during transfemoral catheterization of the heart and the carotid arteries.

16:36 *313*. Visualization of CO_2 Filled Balloon Catheters in a Flow Phantom and in Patients using SSFP Imaging

Marc E. Miquel[1], Benjamin J. Corcoran[1], Sanjeet R. Hegde[1], Stephen F. Keevil[1], Derek L G Hill[1], Reza S. Razavi[1]
[1]King's College London, London, England, UK

Passive catheter tracking involves direct interaction between the device and its surroundings creating a signal loss or enhancement on the image. In this abstract we used standard balloon catheters filled with CO2 and imaged them using Steady State Free Precession (SSFP). Using this technique it was possible to visualize and track the catheters both in a flow phantom and in patients. Frame rates greater than 7 frames/s were achieved giving enough temporal resolution for interventions in patients.

16:48 *314*. Active MR-Tracking Catheters Employing a Large Number of Independent Tracking Coils

Charles L. Dumoulin[1], I John Khan[2], Robert D. Darrow[1], Charles J. Rossi[1], Kamal Vij[2], Carl O. Buyer[2], Tom Sierocuk[3], Mark Inderbitzen[3]
[1]General Electric Global Research Center, Niskayuna, New York, USA; [2]Cordis Corporation, Warren, New Jersey, USA; [3]Cordis Corporation, Miami Lakes, Florida, USA

An active device tracking system for tracking up to 32 coils was developed. Catheter devices having a large number of independent tracking coils were also constructed; each coil having a direct connection to one of the system's 32 receivers. The tracking method employs a non-selective RF pulse that excites all spins within the imaging volume of the magnet. MR signals from each coil are detected in the presence of magnetic field gradients and processed to determine the three-dimensional coordinates of each coil. The three-dimensional structure of the device is presented as a graphic overlay on a previously acquired MR image.

17:00 ***315***. **Improving the Reliability of Catheter Tracking by using a Real-Time Maximum Entropy Method**

Michael Zenge[1], Steffen Weiss[1], Ralph Sinkus[1], Tobias Schaeffter[1]
[1]Philips Research, Hamburg, Germany

Fast reliable localisation of interventional devices and automatic scan plane positioning are key elements required for the success of MR-guided interventions. Lately, a patient-safe marker for real-time tracking was presented. With this technique, the quality of in-vivo tracking signals is not sufficient in some cases to unambiguously detect the catheter position. Here, a Maximum Entropy Method, MEM, is presented to improve the detectability of the catheter. Its performance is compared with signal restoration by Wiener filtering. In-vitro and in-vivo measurements were performed to proof the superior artefact elimination by MEM. Although the ME-algorithm is iterative, real-time processing is feasible.

17:12 ***316***. **Clinical MR Guided Cardiac Catheterization**

Reza Razavi[1], Derek L. Hill[1], Joop J. van Vaals[2], Marc Miquel[1], Vivek Muthurangu[1], Stephen F. Keevil[1], Edward J. Baker[1]
[1]King's College London, London, UK; [2]Philips Medical Systems, Best, Netherlands

We describe clinical experience of XMR guided cardiac catheterisation of 13 patients. We were able to guide catheters to all the chambers of the heart and great vessels from either venous or arterial access. There was a substantial reduction in x-ray dose compared to traditional procedures. The availability of anatomical and functional information from MR was found of great benefit.

17:24 ***317***. **Real-Time Magnetic Resonance Imaging-Guided Coronary Catheterization in Swine**

Reed A. Omary[1], Jordin D. Green[1], Brian Schirf[1], Yongzhong Li[1], James Carr[1], J. Paul Finn[1], Debiao Li[1]
[1]Northwestern University, Chicago, Illinois, USA

In 11 swine, we performed real-time MRI-guided left coronary artery catheterization from a percutaneous femoral artery approach. A 0.30-inch diameter active guidewire was coaxially inserted within 6 or 7-French Judkins left coronary catheters. The catheter was filled with 4% contrast agent and tracked using an inversion-recovery-prepared spoiled gradient echo sequence at 7 frames/s. The guidewire was tracked using steady-state precession imaging at 9 frames/s. Selective MR coronary angiography with injections of dilute contrast agent was used to verify catheter positioning. Left coronary artery catheterization under MRI guidance was successful in 11/11 pigs (100%).

17:36 ***318***. **Intravascular MR Imaging/RF Heating-Enhanced Vascular Gene Transduction: An *In Vivo* Feasibility Study**

Xiangying Du[1], Bensheng Qiu[1], Xiaoming Yang[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

To validate the feasibility of using an MR-imaging/radiofrequency (RF)-heating system for enhancement of vascular gene transduction in vivo, green fluorescent protein (GFP) gene/lentivirus was transferred into the bilateral femoral artery walls of 7 pigs via a catheter-based delivery. During and after infusion of GFP/lentivirus, the targeted right femoral arteries were heated from 37oC to 41oC using the MR-imaging/RF-heating system. Quantitative Western Blot analysis of harvested vessels showed that GFP expression was significantly higher in the heated group than in the non-heated group. The MR-imaging/RF-heating system is a potential tool for local thermal enhancement of vascular gene transduction.

17:48 ***319***. **MR Guidance of Treatment of Liver Tumors with Holmium-Loaded Microspheres**

Jan Henry Seppenwoolde[1], Frank Nijsen[1], Lambertus W. Bartels[1], Sander Zielhuis[1], Chris J. G. Bakker[1]
[1]University Medical Center, Utrecht, Netherlands

In this study, MRI is utilized as a novel modality for guiding internal radiation therapy: treatment of liver tumors with holmium-loaded microspheres. To demonstrate the value of MR, microspheres were administered to ex vivo rabbit livers, tumor-bearing living rabbits and a living pig. The pig was catheterized under X-ray, and successive doses of microspheres were administered during dynamic MR imaging. All experiments showed the ability of MR to depict and monitor the microsphere-biodistribution during delivery under in vivo conditions, indicating a future role of MRI in internal radiation therapy.

Body MR Angiography Techniques

Room 714 A/B 16:00 - 18:00 Chairs: J. Paul Finn and Thomas M. Grist

16:00 ***320***. **Non-Contrast Enhanced Dual Half Echo VIPR Angiography with Fat and Water Separation**

Aiming Lu[1], Thomas M. Grist[1], Frank J. Thorton[1], Walter F. Block[1]
[1]University of Wisconsin-Madison, Madison, Wisconsin, USA

A 3D multi-half-echo fully refocused steady state free precession (SSFP) technique is presented that can create isotropic, sub-millimeter resolution non-contrast enhanced vessel images in a two-minute scan with fat and water separation. Differences in the blood oxygenation result in a strong contrast between arterial and venous signal without an intravenous injection. The inherently bright lipid signal in SSFP is avoided by maintaining a TR under 3 ms which in turn allows Linear Combination SSFP (LC SSFP) to generate separate fat and water volumes.

16:12 *321*. Frequency-Shift Based Detection of Contrast Agents using SSFP: Potential for MRA

Jessica Dubois[1], Franck Lethimonnier[1], Françoise Vaufrey[1], Philippe Robert[2], Denis Le Bihan[1]
[1]Service Hospitalier Frédéric Joliot, CEA, Orsay, France; [2]Guerbet Research, Aulnay-sous-Bois, France

We evaluated a novel approach for imaging blood vessels filled with BMS contrast agent. The method was based on the detection, with a balanced SSFP sequence, of intravascular protons frequency shift induced by the agent. After optimization of acquisition parameters, validation was first performed in vitro with DOTA-Dysprosium. In anesthetized rabbits, a 100% signal change, linked to a shift of about 60Hz, was detected at 1.5T in the neck arteries and veins following a bolus injection. The detection times were coherent with the vascular circulation. This method already presents several advantages, such as the possibility of repeated or sustained injections.

16:24 *322*. Using Multiple Half-Echos to Improve Sampling Efficiency and Fat Supression in Time-Resolved MRA

Ethan K. Brodsky[1], Aiming Lu[1], Frank J. Thorton[1], Thomas M. Grist[1], Walter F. Block[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

We present a T1-weighted application of Vastly undersampled Isotropic PRojection imaging with Multiple Echoes (VIPR-ME) that doubles sampling efficiency and suppresses fat signal. Sampling during the previously idle time of gradient ramps, dephaser, and rephaser allows nearly double the sampled projections per unit time. This significantly increases SNR and CNR in VIPR contrast-enhanced angiography by decreasing the undersampling artifact as well as the stochastic noise signal. Fat suppression decreases the impact of subcutaneous and retroperitoneal fat. The improved performance shows fine vessel detail without the thinly targeted MIPs previously necessary.

16:36 *323*. Rapid Functional CE-MRA in Determining Direction of Contrast Flow: Initial Feasibility and Clinical Applications

Jeffrey P. Goldman[1], Robert Lookstein[1], Michael Marin[1]
[1]Mount Sinai Medical Center, New York, USA

Utilizing ultra-fast gradient systems with parallel imaging acquisition, rapid 3D CE MRA can now be performed with a frame rate up to 3 frames per second. Images of the reconstructed MIPS can be viewed in a cine loop. This technique provides physiologic information about vessel flow dynamics much akin to conventional x-ray angiography and opens the door for many clinical applications which cannot be answered by static imaging and which have traditionally been left to conventional x-ray angiography. We call this technique Rapid Cine Contrast Angiography do to its similarity to traditional x-ray angiography its historic predecessor.

16:48 *324*. One-Second Temporal Resolution 4D MR DSA with 3D TRICKS, Elliptical Centric View Ordering, and Parallel Imaging

Masashi Ookawa[1], Nobuyasu Ichinose[2], Mitsue Miyazaki[2], Isao Miyazaki[3], Satoshi Sugiura[2]
[1]Toshiba Medical Systems Engineering Co., Ltd., Otawara, Tochigi, Japan; [2]Toshiba Medical Systems R&D Center, Otawara, Tochigi, Japan; [3]Kyorin University, Mitaka, Tokyo, Japan

A technique combining 3D TRICKS, elliptical centric view ordering and parallel imaging was developed and applied to contrast enhanced MR angiography. Four volunteer studies were performed on a 1.5 T superconductive imager (EXCELART, Toshiba, Japan) equipped with a 16 element 8ch QD Torso SPEEDER coil. Speeding up factor of both TRICKS and parallel imaging were 3 and 3, respectively. As a result, 9 times increased temporal resolution was achieved. With this technique, temporal resolution of one second is achieved while keeping the spatial resolution of regular 3D MR DSA, which provides clear observation of dynamics for contrast media passage.

17:00 *325*. Time Resolved 3D Body MRA with 4X Parallel Imaging

Saravanan Kokila Krishnamoorthy[1], Wei Li[2], Vu M. Mai[2], Belinda Li[2], Priti Madhav[3], Robert R. Edelman[2], Qun Chen[2]
[1]Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA; [2]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [3]Northwestern University, Evanston, Illinois, USA

Conventional 3D contrast-enhanced MR angiography (3D CE-MRA) suffers from long breath-hold time and the potential contamination of venous enhancement. In the current work, we propose to use a parallel imaging technique (ASSET) with four times acceleration in imaging speed to achieve time-resolved 3D CE-MRA with a 2-second temporal resolution. In the six healthy volunteers studied, ASSET technique generated artifact-free images with high SNR and CNR and distinct arterial enhancement. Such an approach eliminates the need for contrast timing, breath holding, and solved problems associated with venous enhancement often found in conventional 3D CE-MRA.

17:12 *326*. CE-MRA for Endoleak Characterization after Endovascular Abdominal Aortic Aneurysm Repair: A Comparison with CTA

Lambertus W. Bartels[1], Maarten J. Van der Laan[1], Jan D. Blankensteijn[1], Chris J.G. Bakker[1]
[1]University Medical Center, Utrecht, Netherlands

In this study we evaluated the value of CE-MRI techniques for the detection and characterization of endoleaks in patients who underwent endovascular treatment for an abdominal aortic aneurysm. The results were compared to those obtained using standard spiral CTA techniques. Using MRI techniques we were able to detect significantly more endoleaks then with CTA. Furthermore, dynamic MRA series showed additional value for depicting the source of inflow of an endoleak, which can enhance the planning of reinterventions. In addition, MRI allows the discrimination between endoleak and artifacts caused by metal in the prostheses and calcifications, which is impossible with CTA.

17:24 *327*. High-resolution MR-Angiography of the Renal Arteries using Integrated Parallel Acquisition Techniques (iPAT) with an Auto-SMASH-Algorithm

Stefan O. Schoenberg[1], Johannes Rieger[1], Berthold Kiefer[2], Mathias Nittka[2], Tobias Waggershauser[1], Maximilian F. Reiser[1]
[1]Ludwig-Maximilians-University, Munich, Bavaria, Germany; [2]Siemens Medical Solutions, Erlangen, Bavaria, Germany

This study compares high-resolution 3D contrast-enhanced MR-angiography (3D-Gd-MRA) with integrated parallel acquisition techniques (iPAT) to selective X-ray angiography. Imaging was performed on 20 patients with renal artery stenosis using a 12-element array coil system. For PAT imaging an auto-SMASH based GRAPPA-algorithm was used enabling an isotropic spatial resolution of less than 1 mm3. Stenosis grading was compared to X-ray angiography based on reduction of vessel area and diameter. 3D-Gd-MRA with iPAT allowed a highly accurate assessment of the degree of the stenosis in all patients. The iPAT technique appears to be promising for improvement of the accuracy of 3D-Gd-MRA.

17:36 *328*. MR Angiography with Sensitivity Encoding (SENSE): Improvement of Diagnostic Capability of Pulmonary Embolism

Yoshiharu Ohno[1], Takanori Higashino[1], Hideaki Kawamitsu[2], Daisuke Takenaka[3], Hiroto Hatabu[4], Kazuro Sugimura[1]
[1]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [2]Kobe University Hospital, Kobe, Hyogo, Japan; [3]Kobe Ekisaikai Hospital, Kobe, Hyogo, Japan; [4]Beth Israel Deconess Medical Center, Boston, Massachusetts, USA

The aim of the present study is to determine the utility of MR angiography with SENSE (MRA-SENSE) in pulmonary embolism (PE) patients. Diagnostic capability was statistically compared among MRA-SENSE, CE MD-CT and perfusion scintigraphy. Sensitivity of MRA- SENSE was significantly higher than that of CE MD-CT on a per vascular zone basis ($p<0.05$). Specificity of MRA- SENSE was significantly higher than that of perfusion scintigraphy on a per patient basis ($p<0.05$). In conclusion, MR angiography with SENSE is useful for diagnosis of PE.

17:48 *329*. High-Resolution Isotropic Whole-brain Angiography at 1.5T and 3.0T with PCA using Highly Accelerated SENSE Imaging

Romhild Hoogeveen[1], Fredy Visser[1], Johan van den Brink[1]
[1]Philips Medical Systems, Best, Netherlands

High-resolution phase contrast angiography (PCA) suffers from long acquisition times. However, in combination with highly accelerated SENSE (6 times faster) using an 8-element head coil it is shown that complete brain MRA images can be obtained at an isotropic resolution of about 1x1x1 mm in less than 7 minutes. This was shown both at 1.5T and 3.0T. Excellent visualization of most medium to large arteries and veins were obtained at a high SNR/CNR. The availability a complete brain angiogram opens new horizons for vascular diagnosis and planning.

Pediatric Brain MR Spectroscopy

Room 716 A/B 16:00 - 18:00 Chairs: David G. Gadian and Karen A. Tong

16:00 *330*. Neurochemical Profile of Childhood Adrenoleukodystrophy by ^{1}H MRS at 4 Tesla

Gulin Oz[1], Ivan Tkac[1], In Young Choi[1], Kendra J. Bjoraker[1], Elsa G. Shapiro[1], Lawrence R. Charnas[1], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

The neurochemical profile consisting of concentrations of 11 metabolites was measured by ^{1}H MRS at 4 tesla in patients diagnosed with adrenoleukodystrophy (ALD). In spectra acquired from 8-16 ml volumes in the white matter in 5 minutes, characteristic changes were detected in NAA, creatine, choline, glutamate, glutamine, *myo*-inositol, lactate and glutathione, of which choline, lactate, glutamine and glutathione appeared normalized upon treatment with bone marrow transplantation. Treated lesions as well as untreated lesions correlated with neuropsychological testing better than did either with findings in T_2-weighted MRI. Therefore, MRS at high fields provides precision suitable for management of the individual patient.

16:12 *331*. Quantitative ^{1}H-MRS Shows Prominent Increase of Lactate in Cerebral White Matter in Premature Infants with Intrauterine Growth Restriction (IUGR)

Francois Lazeyras[1], Aileen Chen[2], Frank Henry[1], Cristina Borradori-Tolsa[2], Pierre Magistretti[3], Petra S. Hüppi[2]
[1]University Hospital of Geneva, Geneva, Switzerland; [2]Children's Hospital of Geneva, Geneva, Switzerland; [3]University of Lausanne, Lausanne, Switzerland

Using advanced MR-techniques the current study aimed at investigating the effects of placental insufficiency with IUGR, on brain metabolism and the use of lactate as an alternative substrate to the immature brain. We used quantitative 1H-MRS to assess brain metabolite alterations in premature infants with fetal growth restriction (IUGR) due to placental insufficiency. With respect to controls, IUGR showed an increase of mI at birth and an increase of myo-Inositol (mI) and Creatine (Cr) at term age. Lactate was significantly higher in cerebral white matter at birth and remained high at 40 weeks of gestational age.

16:24 *332*. Brain GABA in SSADH Deficiency

Edward J. Novotny[1], Robin A. de Graaf[1], Graeme Mason[1], Michael Appel[1], Phillip Pearl[2], K. Michael Gibson[3], Douglas L. Rothman[1]
[1]Yale University, New Haven, Connecticut, USA; [2]George Washington University, Washington, DC, USA; [3]Oregon Health Sciences University, Portland, Oregon, USA

Gamma-hydroxybutyric acid (GABA) is the major inhibitory neurotransmitter in the mammalian nervous system. Dysfunction of GABA neurotransmission has been implicated in several neurological and psychiatric disorders. However, genetically determined disorders of GABA metabolism are rare and the most common recessively inherited disorder involves a defect in the catabolism of GABA via succinic semialdehyde dehydrogenase (SSADH)(1). Several proton MRS methods have been developed to non-invasively monitor GABA levels in the human brain in vivo (2,3). We studied three subjects with SSADH deficiency that have severe neuropsychiatric dysfunction and demonstrated major alterations in GABA and other metabolites in vivo.

16:36 *333*. Evaluation of Pediatric Diffuse Axonal Injury using Susceptibility Weighted Imaging (SWI) and MR Spectroscopy.

Karen Angela Tong[1], Barbara Ann Holshouser[1], Stephen Ashwal[1]
[1]Loma Linda University Medical Center, Loma Linda, California, USA

Diffuse axonal injury (DAI) remains a difficult diagnosis in the initial period, particularly in the pediatric population. A new 3D susceptibility weighted imaging (SWI) technique dramatically improves detection of small parenchymal hemorrhages suggestive of shearing injury. Using SWI, a significant inverse correlation between hemorrhage extent and Glasgow Coma Scale (GCS) is definitively shown. There is also a significant difference between mean values in dichotomized GCS groups. In addition, MRS abnormalities are greater in voxels with microscopic hemorrhage, suggesting that areas of DAI are associated with neuronal loss or dysfunction. This study shows improved delineation of DAI with SWI and MRS.

16:48 *334*. Proton MRSI of Tourette Syndrome at 3.0 Tesla: Abnormalities of the Cortico-Striato-Thalamo-Cortical Circuit

Timothy J. DeVito[1], Rob Nicolson[1], Peter C. Williamson[1], William Pavlosky[2], Beth Craven-Thuss[1], N Rajakumar[1], Dick J. Drost[2]
[1]University of Western Ontario, London, Ontario, Canada; [2]Lawson Health Research Institute, St. Joseph's Health Care, London, Ontario, Canada

Eight boys with Tourette Syndrome and a control group of twelve healthy boys were scanned using proton magnetic resonance spectroscopic imaging (MRSI) at 3.0 tesla. Localized spectra were acquired with a multislice inversion-recovery spin-echo MRSI sequence (TI/TE/TR=230/135/1800 ms, ~1-cc voxels). Patients with Tourette Syndrome showed increased NAA in the left caudate ($p=0.02$), and decreased NAA in left frontal grey matter ($p=0.05$) relative to controls. No differences were observed in left or right thalami. These results are consistent with previous reports of a dysfunctional cortico-striato-thalamo-cortical circuit in Tourette Syndrome, and suggest abnormalities of neuronal density in parts of this circuit.

17:00 *335*. Regional Metabolic Abnormalities in Autism: a Proton MRSI Study at 3.0 Tesla

Timothy J. DeVito[1], Rob Nicolson[1], Peter C. Williamson[1], William Pavlosky[2], Beth Craven-Thuss[1], N Rajakumar[1], Dick J. Drost[2]
[1]University of Western Ontario, London, Ontario, Canada; [2]Lawson Health Research Institute, St. Joseph's Health Care, London, Ontario, Canada

Fourteen children with autism and a control group of eleven healthy children were scanned using proton magnetic resonance spectroscopic imaging (MRSI) at 3.0 tesla. Spectra were acquired with a multislice inversion-recovery spin-echo MRSI sequence (TI/TE/TR=230/135/1800 ms, ~1-cc voxels). Autistic patients showed trends of increased NAA in right frontal grey matter ($p=0.09$), reduced NAA in left frontal grey matter ($p=0.09$) and a reversed frontal grey asymmetry index ((left-right)/(left+right)) ($p=0.04$) relative to controls. No significant differences were observed in frontal white matter regions. These preliminary findings support previous imaging and behavioural studies, which suggest abnormal lateralization in autism.

17:12 336. A Longitudinal Magnetic Resonance Study Following Prolonged Febrile Convulsion in Childhood

Rod C. Scott[1], David G. Gadian[1], Brian GR Neville[1], Alan Connelly[1]
[1]Institute of Child Health, London, UK

The relationship between prolonged febrile convulsion (PFC) in childhood and later mesial temporal sclerosis (MTS) remains uncertain. This work describes a longitudinal study of patients with a history of PFC. Acute (<5 days) and follow-up (4-8 months later) hippocampal volumetry and T2 relaxation time data were acquired in 14 patients. Acutely, hippocampal volume and T2 relaxation time were abnormally high bilaterally and a decrease in both over time suggests hippocampal oedema in the acute phase. Increasing asymmetry with time is suggestive of developing MTS. Further work is necessary to establish this.

17:24 337. Multinuclear MRS Screening of Untreated Pediatric Brain Tumors

Stefan Bluml[1], Mark J. Albers[1], Mark D. Krieger[1], Floyd H. Gilles[1], Marvin D. Nelson[1]
[1]Childrens Hospital Los Angeles, Los Angeles, California, USA

Proton-decoupled 31P (31P-[1H]) and 1H MR spectroscopy was combined with MR imaging to assess the metabolic profile of untreated pediatric brain tumors. Five patients with tumors of different pathologies were studied. Striking differences between tumors of different pathologies were seen in 31P-[1H] and 1H MR spectra. A quantitative cross-check of 31P-[1H] and 1H tumor spectra revealed additional information about the composition of the choline peak, an important marker of tumor malignancy. Multinuclear MRS allows a more complete screening of the molecular basis of tumors in vivo and may improve the predictive value of non-invasive tests.

17:36 338. Anterior Cingulate and Amygdalar ^{1}H MRS Abnormalities in Childhood Autism

Joseph O'Neill[1], Jennifer Levitt[1], James T. McCracken[1], Arthur W. Toga[1], Jeffrey R. Alger[1]
[1]UCLA, Los Angeles, California, USA

Recent work in autism centers on the amygdala and anterior cingulate, but few studies have examined these structures with MRS. An exploratory single-voxel 1H MRS investigation of 8 autistics (Aut; 11.2 ± 2.6 yr, 1 f) and 9 healthy controls (HC; 13.3 ± 2.6 yr, 5 f) tested these regions for metabolite abnormalities. Compared to controls, autistics exhibited 27.9 % higher Glx, 15.4 % lower Cr, and 19.6 % lower mI in midline anterior cingulate and 27.2 % lower Glx and 19.0 % lower Cr in left amygdala. These findings suggest neurotransmission-neurometabolic disturbances and/or glial imbalances in these structures.

17:48 339. Abnormalities of Cerebral Metabolite Levels in Children with Pervasive Developmental Disorder: A Preliminary ^{1}H MRS Study

Wei Huang[1], Lidia Gabis[1], Allen Azizian[1], Patricia Roche[1], Carla DeVincent[1], John Pomeroy[1]
[1]State University of New York, Stony Brook, New York, USA

The goal was to assess neurochemical abnormalities in children with Pervasive Developmental Disorder (PDD), of which the underlying neuropathology is unclear. Anatomic MRI was largely normal in children with this disorder. Single-voxel proton MR spectra were acquired from the left and right hippocampus-amygdala regions and the cerebellum. Compared to age-matched controls, ratios of NAA/Cr were significantly decreased, while those of Cho/Cr and mI/Cr were significantly increased in PDD. The findings of this preliminary study suggest neuronal loss/dysfunction or immature neurons, as well as gliosis in these brain regions of PDD subjects.

Bowel MR: Form and Function

Room 713 A/B 16:00 - 18:00 Chairs: Thomas Lauenstein and Diego R. Martin

16:00 340. Dark Lumen MR Colonography: Comparison to Conventional Coloscopy

Waleed Ajaj[1], Nickolas Papanikolaou[2], Jörg F. Debatin[1], Thomas Lauenstein[1], Stefan G. Ruehm[1]
[1]University Hospital Essen, Essen, Germany; [2]Department of Radiology, Crete, Greece

The aim of this study was to assess MR colonography for the detection of colonic polyps/malignancy. 50 subjects underwent MR colonography prior to conventional colonoscopy. MRC is based on a rectal enema with water in combination with the intravenous application of a paramagnetic contrast agent. MRC correctly identified 20 polyps in 12 patients. Two small polyps seen at colonoscopy were missed by MRC. The MRC concept based on a dark colonic lumen and a bright, contrast enhanced colonic wall appears to be a promising alternative to traditional MRC based on a bright colonic lumen.

16:12 341. MR Colon: Evaluation of Minimal Preparation Strategies

Victoria Louise Jardine[1], Johanna Pinney[1], Evis Sala[1], Jane Skinner[2], David J. Lomas[1]
[1]Addenbrookes Hospital and University of Cambridge, Cambridge, UK; [2]Strangeways Research Laboratory, University of Cambridge, Cambridge, UK

Prospective study to evaluate minimal preparation strategies for MRI colonography avoiding cleansing procedures. Ferric ammonium citrate (FAC) with a low residue diet and barium sulphate (BS) with a low residue/fat diet were compared with control (no diet or agent) by 3 randomised consecutive MR studies in 9 healthy volunteers using 4 different breath-hold sequences. Studies were evaluated by colonic segment and sequence for overall intra-luminal signal and ability to exclude polyps. BS proved significantly better than control for excluding potential mass lesions. Although volunteers significantly preferred FAC it did not significantly improve the ability to exclude lesions.

16:24 **342**. MR-Colonography without Extensive Colonic Cleansing: Comparing Three Different Strategies.

Jasper Florie[1], Rogier E. van Gelder[1], Cristina Lavini[1], Jaap Stoker[1]
[1]Academic Medical Center, Amsterdam, Netherlands

Three different strategies for MR-colonography with fecal tagging were compared with regard to image quality and polyp detection: using gadolinium as oral tagging agent and a gadolinium water mixture for rectal filling (strategy 1), using barium as oral tagging agent and tap water for rectal filling (strategy 2) and using barium as oral tagging agent and room air for rectal filling (strategy 3). 3D-T1 sequences, and 2D-HASTE sequences were used with all three strategies. In strategy 2 and 3 gadolinium was injected intravenously. Preliminary results indicate that strategy 1 (using the 2D-HASTE) shows the best image quality and diagnostic value.

16:36 **343**. Comparison of Different Techniques for MR Colonography

Thomas C. Lauenstein[1], Waleed Ajaj[1], Silke Bosk[1], Jörg F. Debatin[1], Stefan G. Rühm[1]
[1]University Hospital Essen, Essen, Germany

The study was performed to compare contrast–enhanced dark lumen MR colonography (MRC) with bright lumen MR colonography (not requiring i.v. contrast administration) based on 2D TrueFISP images for the detection of colorectal masses. 31 patients underwent both bright-and dark lumen MRC. MR findings were compared to conventional endoscopy. While dark-lumen MRC was able to visualize all colorectal masses larger than 5mm, bright lumen MRC was less sensitive. With the bright-lumen approach false-positive results were present in 5 patients, whereas dark-lumen MRC did not provide any false-positive findings.

16:48 **344**. MR Rectosigmoid Colon: Baseline Appearance

Victoria Louise Jardine[1], David J. Lomas[1]
[1]Addenbrookes Hospital and University of Cambridge, Cambridge, UK

Retrospective review of 100 pelvic MR examinations to evaluate the appearance of the unprepared rectosigmoid colon, and inform future strategies for MR colonography. Examinations included matched-location axial T1w and T2wFSFSE images. Tumor-mimicking foci occurred in 91% of T1w and 85% of T2w studies and the overall appearance of intraluminal material mimicked tumor in 80% of T1w and 17% of T2w images. This reduced to 7% by matching the T1w and T2w findings, excluding foci. The results indicate strategies to reduce signal on T2w (fecal tagging) and eliminate high signal foci should be investigated along with matching T1w and T2w information.

17:00 **345**. Evaluation of Crohn's Disease Activity with MRI

Michael A. Patak[1], Johannes M. Froehlich[1], Constantin von Weymarn[1], Christoph L. Zollikofer[1], Klaus-Ulrich Wentz[1]
[1]Kantonsspital, Winterthur, Switzerland

The purpose of our study was to assess the activity of Crohn's disease(CD) with MRI and to correlate the results with laboratory findings of inflammatory activity. 9 patients with known Crohn's disease underwent MRI using a 3D-T2wbFFE and a contrast enhanced 3D-T1wGRE sequence. An oral non-invasive preparation method(either 0.8g/kgBW Metamucil, in 1000ml water over 4h(5pat) or 1000ml of Mannitol 3% over 1h(4pat)) was used for optimal distension. MR evaluation of CD activity showed an excellent correlation(Correlation kappa=1) with laboratory findings but generated additional information about morphology, extraluminal pathologies and was well suited for localization and monitoring of inflammatory activity.

17:12 **346**. Evaluation of the Need for Emergency Surgery in the Acute Phase of Strangulated Small Bowel Obstruction: Comparison between Cine MR Imaging and CT.

Taro Takahara[1], Hiroki Haradome[1], Kei Aoki[1], Hiroyoshi Matsuoka[1], Toshiaki Nitatori[1], Junichi Hachiya[1], Marc Van Cauteren[2]
[1]Kyorin University, Mitaka, Tokyo, Japan; [2]Philips Medical Systems, Shinagawa, Tokyo, Japan

PURPOSE: To determine the usefulness of cine MR imaging as compared with CT in the evaluation of an indication for emergency operation in the case of strangulated small bowel obstruction. METHOD AND MATERIALS: Between January 2001 and August 2002, cine MR images of 38 patients (18 male, 20 female) with small bowel obstruction were assessed prospectively by 2 abdominal radiologists (TT or HH) and correlated to the clinical course. The patients' age ranged from 23 to 83 (mean 57.4) years. An emergency operation was indicated if the peristalsis gap (PG) sign was positive. The PG sign was considered positive if

17:24 **347**. Magnetic Resonance Imaging to Investigate the Influence of Posture on Gastric Physiology

Reto Treier[1], Andreas Steingoetter[1], Mark Fox[2], Dominik Weishaupt[2], Michael Fried[2], Werner Schwizer[2], Peter Boesiger[1]
[1]ETHZ, Zurich, Switzerland; [2]University Hospital, Zurich, Switzerland

In this study, the influence of posture on the physiology of the human stomach was analyzed using a compact 1.5T MR system and a 0.5T open MR system. A method for the detection of gastric function during one imaging session and using different MR system was developed and evaluated in volunteers. Gastric emptying, motility were similar in seated and right decubitus body position. However, differences in gastric relaxation and retained intragastric air volume were observed. The data suggest that posture has effects on gastric physiology. Measured data in lying position from compact MR systems must be interpreted with caution.

17:36 *348*. Intra-Gastric Fat Spatial Distribution Affects Gastric Emptying: An EPI Study

Luca Marciani[1], Martin Wickham[2], Benito de Celis Alonso[1], Debbie Bush[3], Jeff Wright[3], Richard Faulks[2], Annette Fillery-Travis[2], Robin C. Spiller[3], Penny A. Gowland[1]
[1]Magnetic Resonance Centre, Nottingham, UK; [2]Institute of Food Research, Norwich, UK; [3]QMC Hospital, Nottingham, UK

7 healthy volunteers were intubated naso-gastrically and ingested 500 ml of 2 different 15% oil emulsion test meals on separate occasions. The first emulsion was designed to be stable in the acid gastric environment and the second to be unstable. Gastric volumes (using rapid multislice EPI) and the intra-gastric oil volume fraction (using T_1 inversion recovery EPI) were measured at intervals. We conclude that the intra-gastric fat spatial distribution influences fat delivery to the duodenum and this, in turn, modifies gastric emptying.

17:48 *349*. Monitoring of Drug Effects on Intestinal Motility with MRI

Johannes M. Froehlich[1], Michael A. Patak[1], Constantin von Weymarn[1], Christoph L. Zollikofer[1], Klaus-Ulrich Wentz[1]
[1]Kantonsspital, Winterthur, Switzerland

A non-invasive MR monitoring method to study motility effects of drugs at various sites of the gastrointestinal tract is proposed. A standardized distension method together with a positive intraluminal contrast agent were used in order to allow reproducible contraction amplitude measurements over time. Motility was measured with ultrarapid T1-w 2D-GRE sequences concomitantly in all three planes and with a 1.6s temporal resolution. Different pharmacological actions with varying degrees of pro- and akinetic effects on peristalsis were demonstrated exemplarily for Buscopan®, Paspertin® and erythromycine with follow-up times of up to 35 minutes.

fMRI of Novel Animal Systems

Room 715 A/B 16:00 - 18:00 Chairs: Mathias Hoehn and Dae-Shik Kim

16:00 *350*. Understanding Regional Temperature Dynamics in the Brain: Implications for fMRI

Hubert Trübel[1], Laura Sacolick[2], Fahmeed Hyder[1]
[1]Yale University, New Haven, Connecticut, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

Brain temperature (Tb) is affected by heat removal/delivery into a region-of-interest (ROI) by CBF. We measured Tb, CBF, and CMRO2 (by optical/NMR methods) in anesthetized rats to understand Tb dynamics during activation. Tb increased by ~0.1 C in the ROI, whereas CBF and CMRO2 increased by ~95% and ~73%, respectively. Net heat (ÄQ) in the ROI was dependent on sum of heats from metabolism (Qm), flow (Qf), conduction (Qc), and environment (Qe). Although cooling of the ROI due to Qf and Qc were enhanced during activation, net increase in Tb was due to a much larger increase in Qm.

16:12 *351*. Anaesthesia Dependence of the fMRI Responses to Direct Cortical Stimulation in the Rat

Vivienne Catherine Austin[1], Andrew M. Blamire[1], Peter Styles[1], Paul M. Matthews[1], Nicola R. Sibson[1]
[1]University of Oxford, Oxford, UK

In order to investigate the effect of anaesthesia, the fMRI response to direct cortical stimulation of the rat brain was assessed under halothane and alpha-chloralose anaesthesia. fMRI responses under halothane were independent of dose, but under alpha-chloralose, there was increased secondary and striatal activation, although this was not apparent until three to four hours after anaesthetic transfer. The response onset under alpha-chloralose was found to be delayed relative to that under 0.8% halothane. These findings suggest that although alpha-chloralose can provide increased sensitivity, this only occurs after several hours which has important implications for experimental design.

16:24 *352*. CBF and BOLD Functional MRI in Awake Animals: A Hypercapnia Study

Qiang Shen[1], Kenneth Sicard[1], Timothy Q. Duong[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA

Little is known regarding the extent to which anesthetics affect cerebral blood flow (CBF) and cerebrovascular coupling relative to the awake conditions. In this study, combined CBF and BOLD measurements were made in awake and anesthetized (isoflurane or α-chloralose) rats during a CO2 challenge. The goals of this study were to determine whether quantitative CBF can be measured under awake and restrained conditions using MRI, and to investigate the differences in CBF and BOLD fMRI responses to hypercapnic challenges under awake and anesthetized conditions.

16:36 *353*. Neuroglial Metabolism and CO_2 Fixation in the Awake Rat Brain: A Combined ^{13}C and ^{14}C Labeling Study

Gulin Oz[1], Deborah A. Berkich[2], Pierre Gilles Henry[1], Yuping Zu[2], Kathryn F. LaNoue[2], Susan M. Hutson[3], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA; [2]Pennsylvania State University, Hershey, Pennsylvania, USA; [3]Wake Forest University, Winston-Salem, North Carolina, USA

Rates of label incorporation into amino acids from ^{13}C labeled glucose and ^{14}C labeled bicarbonate in conscious rats were measured in whole brain extracts. Both measures of compartmentation revealed a significant rate of glial carbon fixation and neurotransmission along with high neuronal TCA cycle rates. The exchange of label between 2-oxoglutarate and glutamate was comparable to pyruvate dehydrogenase flux and the total oxidative glucose metabolic rate was in excellent agreement with previous autoradiography results. The combined results indicate a glutamate/glutamine cycle rate that is half the oxidative glucose metabolic rate.

16:48 *354*. Correlation of Functional MRI of the Rat Spinal Cord with Histological Neuronal Activation

Jane Meagan Lawrence[1], Krisztina L. Malisza[1], Saro Bascaramurty[1], Carolyn Gibbs[2], Patrick W. Stroman[1]
[1]National Research Council, Winnipeg, Manitoba, Canada; [2]University of Manitoba, Winnipeg, Manitoba, Canada

Functional Magnetic Resonance Imaging has been shown to indirectly detect neuronal activity in the spinal cord (Spinal fMRI). Neuronal activation using a histochemical method can confirm that Spinal fMRI demonstrates areas of neuronal activity. C-fos staining labels cellular proteins released within some cells upon repetitive noxious stimulation. Spinal fMRI activation within the rat cervical and lumbar spinal cord correlated with areas of activation determined by c-fos labeling.

17:00 *355*. Efficacy of Lamotrigine Investigated with fMRI and Electrophysiology: Implications for Treatment in Epilepsy

Ikuhiro Kida[1], Arien Smith[1], Kevin L. Behar[1], Hal Blumenfeld[1], Fahmeed Hyder[1]
[1]Yale University, New Haven, Connecticut, USA

Neurotransmission in glutamatergic synapses, mediated by voltage-dependent sodium-channels, plays a major role in neuroenergetics. Although impeding voltage-dependent sodium-channel activity with lamotrigine, a sodium-channel blocker and glutamate release inhibitor, is used in treatment of epilepsy, actions of this drug on the metabolic and neurovascular coupling are not known. In α-chloralose-anesthetized rats, we measured changes in oxidative metabolism (CMRO2; calibrated fMRI) and spiking frequency of neurons (ν; extracellular recordings) with lamotrigine treatment. While stimulation-induced increments of CMRO2 and ν were coupled in both conditions, changes in the magnitude and volume of activation were reduced by more than $\times 2$ with lamotrigine.

17:12 *356*. Coupling of Hemodynamic Changes Induced by Dopamine Drugs with Dopamine Receptor Distribution on the Cerebral Microvasculature

Ji-Kyung Choi[1], Y. Iris Chen[1], Edith Hamel[2], Bruce G. Jenkins[1]
[1]MGH-NMR Center, Charlestown, Massachusetts, USA; [2]MNI, Montreal, Quebec, Canada

Many drugs of abuse such as cocaine and amphetamine target the dopamine receptor system. These drugs produce powerful hemodynamic effects that can be mapped using MRI techniques. The coupling between the dopamine release evoked by these drugs and the vascular response is still unknown. Dopamine receptors have been identified on cerebral vasculature previously, though no sub-type specification has been made (1,2). We therefore investigated the relationship between dopamine receptors on the cerebral vasculature and hemodynamic effects elicited by various dopaminergic ligands.

17:24 *357*. Spatial Correlation of BOLD fMRI and Neuronal Activation Localized by Fos Expression

Hanbing Lu[1], Sachin Patel[1], Feng Lu[1], Guofan Xu[1], Shi-Jiang Li[1], Cecilia Hillard[1], James S. Hyde[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

The spatial relationship between the measured fMRI signal and underlying neuronal activity remains unclear. One obstacle is the localization of neuronal activity; another is the spatial resolution of fMRI. In the present study, ultra-high resolution BOLD fMRI was carried out using spin echo EPI as well as gradient-recalled EPI in a rat whisker barrel stimulation (WBS) model at 3T. Fos immunohistochemistry is introduced to map neuronal activity at different cortical layers. Comparison was made between BOLD response and neuronal activity at corresponding layers.

17:36 *358*. Heroin-Induced Negative BOLD Signal in the Nucleus Accumbens of Rat Brain is Related to Neuronal Inhibition

Shi-Jiang Li[1], Feng Luo[1], Janine Havnen[1], James Wood[1], Anthoney Hudetz[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

BOLD fMRI methods are widely employed for mapping brain functions. Although the detailed mechanism of BOLD contrast is not fully understood, Logothetis et al.'s results demonstrate that the positive BOLD signal is correlated to a change in local field potentials reflecting manly post-synaptic depolarization from excitatory neurotransmission. However, there are few reports regarding the mechanisms of the negative BOLD signal. By employing a neuropharmacological model, we demonstrate that the negative BOLD signal is related to an increase in GABAergic inhibitory neurotransmission.

17:48 *359*. Functional MRI of Songbirds When Listening to Songs.

Vincent Van Meir[1], Tiny Boumans[1], Marleen Verhoye[1], Johan Van Audekerke[1], Annemie Van der Linden[1]
[1]RUCA (University of Antwerp), Antwerp, Belgium

Functional MRI data were obtained on songbirds upon listening consecutively to unfamiliar conspecific birdsong, white noise and multitones. Field L, the bird's analogue of the mammalian auditory cortex, was activated upon all three stimuli, while NCM, the region considered as substrate for auditory recognition memory, was exclusively activated upon hearing birdsong. The brain of songbirds offers several advantages: it is active during sleep and anesthesia, it possesses a neuronal pathway which is exclusively activated by songs and not by aspecific noise (e.g. gradient sounds) and it will allow us in the future to perform fMRI of cognitive tasks in animals.

Cardiac Stem Cells

Room 717 A/B 16:00 - 18:00 Chairs: Jeff W.M. Bulte and Pottumarthi V. Prasad

16:00 *360*. *In Vivo* MR Delivery and Tracking of Mesenchymal Stem Cells in Myocardial Infarction

Dara L. Kraitchman[1], Parag Karmarker[1], Luciano C. Amado[1], Ergin Atalar[1], Lawrence V. Hofmann[1], Alan W. Heldman[1], Bradley J. Martin[2], Mark F. Pittenger[2], Jeff W. M. Bulte[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; [2]Osiris Therapeutics, Inc., Baltimore, Maryland, USA

This study explores the labeling of mesenchymal stem cell (MSCs) with MR contrast agents as a method to non-invasively serially track and quantify MSC transplantation to regenerate infarcted myocardium. A closed-chest swine model of myocardial infarction was studied using intramyocardial x-ray fluoroscopic delivery of MR-labeled MSCs. MR fluoroscopic MSC delivery offers a method to target the infarct periphery to enhance the engraftment efficiency. Initial results demonstrate the ability to determine the location and number of MSC injections in addition to tracking local MSC migration in the first weeks post-infarction.

16:12 *361*. Serial *In Vivo* Cardiac Magnetic Resonance Imaging of Injected Mesenchymal Stem Cells

Jonathan M. Hill[1], Alexander J. Dick[1], Venkatesh K. Raman[1], Richard B. Thompson[1], Breno S.S. Pessanha[1], Zu-Xi Yu[1], Allison Hinds[1], Timothy R. Varney[2], Cynthia E. Dunbar[1], Elliot R. McVeigh[1], Robert J. Lederman[1]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]Osiris Therapeutics Inc, Baltimore, Maryland, USA

We show that mesenchymal stem cells (MSCs) can be labeled, injected directly into the heart, and then imaged in vivo in the beating heart on a conventional cardiac MR scanner. They were labeled with an intracellular dual iron-fluorophore particle (IFP) that imparts useful MR contrast without impairing in vitro proliferation or differentiation. Injections of labeled cells could be visualized serially for weeks by MRI and could be identified histologically based on particle fluorescence.

16:24 *362*. *In Vitro* Labeling of Rat Mesenchymal Stem Cells with Super Paramagnetic Iron Oxide Particles: Dose-Effect and Labeling Stability

Clemens Bos[1], Olivier Hauger[1], Yahsou Delmas[1], Cristophe Grosset[1], Isabelle Dubus[1], Anne Solanilla[1], Jeff W. Bulte[2], Chrit T.W. Moonen[1], Christian Combe[1], Jean Ripoche[1], Nicolas Grenier[1]
[1]Université Bordeaux 2, Bordeaux, France; [2]Johns Hopkins Medical School, Baltimore, Maryland, USA

Rat mesenchymal stem cells (MSC) were labeled using super paramagnetic iron oxide particles. Dose-effect curves showed a linear dependence of iron uptake on the iron concentration in the medium as evidenced by the R2*/cell signal change. Reduced proliferation capacity of cells was found at iron concentrations >50 microgram/ml. Electron microscopy showed uptake of iron in the endosomal compartment. Replating of labeled cells and subsequent proliferation analysis demonstrated that the labeling was stable for over a week.

16:36 *363*. Targeted Delivery of Magnetically Labeled Human Mesenchymal Stem Cells (hMSC) Using an External Magnet

Ali Syed Arbab[1], E Kay Jordan[1], Lindsey Bashaw[1], Bradley Miller[1], Bobbi Lewis[1], Jeff WM Bulte[2], Joseph Frank[1]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]John Hopkins University, Baltimore, Maryland, USA

Feridex®-PLL labeled human Mesenchymal Stem Cells (hMSCs) were administered into rats intravenously and targeted delivery to the liver of the magnetically labeled cells was facilitated by the addition of an external magnet (EM) on the abdomen and compared to rats without EM. MR signal intensity, Prussian blue staining, immunohistochemistry and iron concentration demonstrated an increased number of cells in the liver of rats with EM versus no EM.

16:48 *364*. MRI Tracking of Stem Cell Homing to Myocardial Infarction

Jonathan Michael Sorger[1], Daryl Despres[2], Dan Schimel[2], Elliot R. McVeigh[1], Jonathan M. Hill[2]
[1]Johns Hopkins University and National Institutes of Health, Bethesda, Maryland, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

We have demonstrated the feasibility of tracking iron loaded mesenchymal stem cells in vivo in the heart at 4.7 and 7 Tesla and have presented preliminary data showing the homing of mesenchymal stem cells to infarcted myocardium in an allogeneic rat model. Such a technique can be useful in determining the time course of migration of cells to injured tissue, as the same animal can undergo serial imaging sessions.

17:00 *365*. Real-Time MRI Enables Targeted Injection of Labeled Stem Cells to the Border of Recent Porcine Myocardial Infarction Based on Functional and Tissue Characteristics

Alexander J. Dick[1], Michael A. Guttman[1], Venkatesh K. Raman[1], Dana C. Peters[1], Jonathan M. Hill[1], Breno S.S. Pessanha[1], Greig Scott[2], Scott Smith[2], Elliot R. McVeigh[1], Robert J. Lederman[1]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]Boston Scientific Scimed, Plymouth, Minnesota, USA

We test the feasibility of precise targeted delivery of mesenchymal stem cells (MSCs) into the borders of porcine myocardial infarction using real-time MRI. MSCs were MRI- and fluorescence-labeled with iron-fluorophore particles. A customized 1.5T MRI scanner permitted 7-8 frames/s and enabled real-time identification of infarction based on wall motion and delayed hyperenhancement. Real-time MRI guidance and a new two-channel injection catheter coil permitted precise delivery of labeled stem cells into infarct borders which were readily visualized in vivo by MRI and postmortem using confocal fluorescence microscopy.

17:12 *366*. Real-Time Imaging of Transplantation of Iron-Oxide Labeled Mouse Lymphocytes into *Ex-Vivo* Porcine Heart

Girish Narayan[1], Jeff W. Bulte[2], John M. Pauly[1], Bob S. Hu[1], Michael V. McConnell[1], Phillip C. Yang[1]
[1]Stanford University, Stanford, California, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

Labeling of cells with MR contrast agents will enable in vivo monitoring of transplanted cells. Several transfection agents including monoclonal antibodies, tat-proteins, and magnetodendrimers have all enhanced magnetic labeling by facilitating cellular incorporation of MR contrast agents (1-3). Recent report has demonstrated the effective use of commercially available polymer, poly-L-lysine, (PLL) as a transfection agent (4). Using PLL as a transfection agent, we report real-time imaging of the transplantation of Feridex (Fe) labeled mouse T-lymphocytes into ex-vivo porcine heart.

17:24 *367*. Magnetic Cell Labeling Approach for Imaging and Tracking Transfused CD4+ Lymphocytes in Immune Reconstitution

Hui Mao[1], Bruce Sundstrom[1], Francois Villinger[1], Aftab A. Ansari[1], Encai Hao[1]
[1]Emory University, Atlanta, Georgia, USA

Immune reconstitution is a promising therapeutic approach to treat simian immunodeficiency virus (SIV) or human immunodeficiency virus (HIV) disease. Transferring autologous preinfection-collected peripheral blood mononuclear cells (PBMCs) or activated “SIV Naïve” CD4+ lymphocytes into rhesus monkey infected with SIV can restore cell-mediated responses and lead to the long term anti-SIV/HIV. The ability to track activated CD4+ lymphocytes in SIV-infected monkeys after cell transfusion could provide important knowledge of lymphocyte trafficking for further developing and improving this method. We report our work on developing MRI method for in vivo tracking transfused activated CD4+ lymphocytes using magnetic cell labeling approach.

17:36 *368*. Noninvasive Monitoring and Tracking of Muscle Stem Cells

Kevin S. Cahill[1], Xeve Silver[1], Gabriel Gaidosh[1], Barry J. Byrne[1], Glenn Adam Walter[1]
[1]University of Florida, Gainesville, Florida, USA

We tested the hypothesis that a FDA approved supraparamagnetic iron-oxide (SPIO) contrast agent could be utilized to monitor therapeutic muscle stem cell transplants in the murine models of muscular dystrophy. Multipotent muscle derived stem cells (mc13) were extensively labeled by Feridex I.V.‰-poly-L-lysine complexes. Growth rate, viability, and differentiation assays indicated that the SPIO-poly-L-lysine mediated process is non-toxic and does not interfere with either in vitro or in vivo myogenesis. Regions of decreased MR signal intensity were correlated with marker genes and iron. Cell fate studies indicated that label released from dead cells was sequestered by macrophages and not muscle fibers.

17:48 *369*. Delineation of Microscopic Cardiac Tissue Remodeling in Cardiomyopathic Syrian Hamster with Diffusion Tensor MRI

Junjie Chen[1], Wei Liu[1], Sheng-Kwei Song[1], Liz Lacy[1], Stacy Allen[1], Samuel A. Wickline[1], Xin Yu[1]
[1]Washington University in Saint Louis, Saint Louis, Missouri, USA

The purpose of this study is to explore the potential of diffusion tensor MRI (DTMRI) for sensitive detection of alterations in cardiac structure in cardiomyopathic (CM) Syrian hamster hearts. DTMRI studies were performed on formalin fixed hearts of both T02 (CM) and F1B (control) hamsters. T02 hamsters exhibited increased trace values in scattered regions that were 40% higher than the trace in normal myocardium. Histology revealed that increased trace regions were in accordance with fibrotic scar locations. This study suggested that DTMRI may be used to assess the structural integrity of the myocardium.

BRONZE CORPORATE MEMBER SYMPOSIUM
Bracco Imaging S.p.A.
New Frontiers in Contrast Enhanced MR Angiography

Room 701A 18:30 - 20:00

Presented by: Northwest Imaging Forums
Supported by an unrestricted educational grant from Bracco Diagnostics

Symposium Chair and Moderator:
J. Paul Finn, M.D.
David Geffen School of Medicine, UCLA, Los Angeles, California, USA

18:30 **Contrast Enhanced MRA in Practice**
Gunther Schneider, M.D., Ph.D.
University Hospital Homburg/Saar, Homburg, Germany

18:55 **High Resolution Imaging of the Vessel Wall**
Kenneth R. Maravilla, M.D.
University of Washington, Seattle, Washington, USA

19:20 **From Subsecond MRA to Functional Imaging**
Jeffrey Goldman, M.D.
Mount Sinai Medical Center, New York, New York, USA

19:45 **Interactive Panel Discussion**
Moderated by J. Paul Finn, M.D.
David Geffen School of Medicine, UCLA, Los Angeles, California, USA

20:00 **Adjournment - Light Buffet Served**

BRONZE CORPORATE MEMBER SYMPOSIUM
Bruker BioSpin MRI, Inc.
Functional and Molecular Imaging of the Brain

Room 718A 18:30 - 20:00

Speaker: *Alan P. Koretsky, Ph.D.*
National Institutes of Health, Bethesda, Maryland, USA

MORNING CATEGORICAL COURSE
Controversies and Advances in Musculoskeletal MRI

Room 713 A/B 07:00 - 08:00 Chairs: Garry E. Gold and Lawrence M. White

Educational Objectives
Upon completion of this course, participants should be able to:
- Compare MRI with other advanced imaging modalities;
- Explain the role of interventional MRI in the musculoskeletal system;
- Explain the role of high-field MRI in the musculoskeletal system;
- Describe the technical issues related to high-resolution joint imaging;
- Evaluate options for open MRI scanners for musculoskeletal imaging.

07:00 **Interventional MRI: Technical Issues**
Kim Butts

07:25 **Interventional MRI: Clinical Issues**
John A. Carrino

07:50 **Questions and Discussion**

MORNING CATEGORICAL COURSE
Parallel Imaging

Room 714 A/B 07:00 - 08:00 Chairs: Neil M. Rofsky and Daniel K. Sodickson

Educational Objectives
Upon completion of this course, participants should be able to:
- Explain the basic principles of parallel imaging, including elements both of RF coil array design and image reconstruction;
- Survey promising applications of parallel MRI in cardiovascular imaging and body imaging;
- Describe new developments in image reconstruction and coil array design, and outline emerging parallel imaging applications;
- Identify the key steps in a practical parallel imaging examination and compare the nuts-and-bolts features of various MR vendors' existing implementations.

Applications
07:00 **Recap of Basics**
Daniel K. Sodickson

07:05 **Cardiovascular Imaging**
Peter Boesiger

07:30 **Body Imaging**
Neil M. Rofsky

07:55 **Discussion**

MORNING CATEGORICAL COURSE
Emerging Body MR: From Structure to Function

Room 715 A/B 07:00 - 08:00 Chairs: Vivian S. Lee and Riccardo Manfredi

Educational Objectives
Upon completion of this course, participants should be able to:
- Recognize and implement recent technical advances in body MRI including BOLD and perfusion techniques, fast T_2-weighted imaging methods, and new contrast agents;
- Describe recent advances in the assessment of liver and breast for tumor, structural and functional studies of the biliary system, and MR measurements of renal function;
- Identify applications of MR to the evaluation of large and small bowel disease;
- Compare the information provided by MR elastography in the assessment of organ pathologies, such as in the breast and prostate, to conventional MR imaging techniques.

Hepatobiliary Imaging
07:00 **Liver MRI: Anatomic and Perfusion Imaging**
Pari V. Pandharipande

07:30 **MRCP/Pancreas MRI**
Carlo Procacci

MORNING CATEGORICAL COURSE
fMRI Experimental Methods

Room 718 B 07:00 - 08:00 Chairs: R. Todd Constable and Mathias Hoehn

Educational Objectives
Upon completion of this course, participants should be able to:
- Explain the latest developments in fMRI with respect to understanding the underlying physiology leading to the BOLD response and its relationship to neuronal activity and the influence of pharmacological substances on activation;
- Describe the factors influencing paradigm design and the optimum acquisition strategy for event-related versus block designs;
- Recognize which analysis approach is most appropriate for a particular experimental design;
- Describe the spatial limits of fMRI and factors influencing resolution.

Experimental Design (Paradigms/Acquisition Strategies)
07:00 **Paradigm Design Issues: Event-Related vs. Block Design**
Rasmus M. Birn

07:30 **Acquisition Strategies/Pulse Sequences**
Xiaoping P. Hu

MORNING CATEGORICAL COURSE
Diffusion Tensor Imaging

Room 718A 07:00 - 08:00 Chairs: Gareth J. Barker and Scott D. Swanson

Educational Objectives
Upon completion of this course, participants should be able to:
- Describe how/why the proton diffusion pathway in tissue can be explained by a tensor;
- Explain how the tensor is acquired, measured, and mapped;
- Describe the limitations of such diffusion tensor imaging;
- Describe more advanced diffusion measurement techniques, such as q-space and diffusion spectrum imaging;
- Appreciate the multi-exponential and/or multi-compartmental nature of diffusion;
- List and describe important clinical applications of DTI.

07:00 **Dealing with Tensors**
Derek K. Jones

08:00 **Adjournment**

MORNING CATEGORICAL COURSE
Advanced MR Angiography Techniques

Room 716 A/B 07:00 - 08:00 Chairs: James Meaney, Martin Prince and Stefan Schoenberg

Educational Objectives
Upon completion of this course, participants should be able to:
- Identify the challenges of MRA implementation in anatomic areas with high technical demands;
- Compare the advantages and disadvantages of different technical approaches in these areas;
- Recognize the clinical benefit of advanced MRA protocols for a comprehensive, non-invasive work-up of vascular disease.

Renal Artery Stenosis Grading Shoot-Out
07:00 **3D Phase Contrast**
Martin R. Prince

07:10 **2D Cine PC Flow Curves**
Stefan O. Schoenberg

07:20 **Gadolinium Clearance Rate**
To Be Announced

07:30 **Captopril MR Renography**
Pottumarthi V. Prasad

07:40 **Discussion**

MORNING CATEGORICAL COURSE
Spectroscopy Beyond NAA

Room 717 A/B 07:00 - 08:00 Chairs: Peter Allen, Rolf Gruetter, John Griffiths, Stephen Williams

Educational Objectives
Upon completion of this course, participants should be able to:
- List the major metabolites in addition to NAA, Crn, Cho that can be detected *in vivo* in the brain by MRS;
- Describe the biological and clinical importance of these metabolites;
- List the key factors to achieve good spectra;
- Describe the principles of data analysis in both frequency and time domain;
- Explain how MRS can be used to measure metabolic fluxes as well as steady-state concentrations;
- List the advantages and disadvantages of $^{13}C/^{15}N$ with respect to ^{1}H.

07:00 **Time-Domain Based Analysis**
Danielle Graveron-Demilly

07:30 **LC Model Applications at High Field**
Ivan Tkac

PLENARY LECTURES
The RF Renaissance

Hall F/G 08:15 - 09:30 Chairs: Michael B. Smith and Daniel K. Sodickson

Educational Objectives
Upon completion of this session, participants should be able to:
- Understand the complexity and diversity of the evolution of coil design;
- Identify and explain the specific requirements and challenges for coil development at high fields;
- Describe the theory and implementation of parallel imaging.

08:15 ***370***. **History of NMR Coils**
Eiichi Fukushima[1]
[1]New Mexico Resonance, Albuquerque, New Mexico, USA

Nuclear magnetic resonance has undergone rapid development and changes over the course of its history. A key component of the technique is the coil that couples sample's spins with measurement electronics. A sampling of various historical NMR coils will be presented, not for priority or completeness but mostly for scientific curiosity and also to support my thesis that there is much to be learned from studying these novel coils.

08:40 ***371***. **Development and Challenges of High-Field Probes**
D. I. Hoult[1]
[1]National Research Council Canada, Winnipeg, Manitoba, Canada

The importance of the MR probe in obtaining good images is emphasised and an attempt made to demystify for a general audience some of the aspects of its design at ultra-high frequency. The origins of the MR signal are first explained and the roles of Faraday induction and radio waves clarified. The speed of propagation of radio waves is introduced as the villain and strategies invented circa 1940 for dealing with it are invoked. These have found expression in current designs and point the way to concepts such as phased arrays that are probably the way of the future.

09:05 ***372***. **Parallel MRI: Breaking the Acquisition Speed Limit Using RF Coil Arrays**
Joseph V. Hajnal[1]
[1]Imperial College, London, UK

Partially Parallel Imaging (PPI) makes use of simultaneous data streams, one from each coil element in an array of receiver coils. The component coils have localised sensitivity profiles that result in some spatial specificity. The independent signals from these multiple coils can be used with reduced phase encoding to decrease image acquisition time. PPI reconstruction methods regenerate full images from the reduced data sets. The extra information provided by the array coils can also be used in other ways, such as reducing image artefacts. Parallel imaging is already having a major impact on MRI and is set to expand.

Techniques in Cardiac MR

Room 718A 10:30 - 12:30 Chairs: Graham A. Wright and John N. Oshinski

10:30 *373*. Myocardial Tagging During High-Dose Dobutamine Stress using an Optimized FGRE-EPI Sequence

Daniel Kim[1], Christina M. Bove[1], John M. Christopher[1], Christopher M. Kramer[1], Frederick H. Epstein[1]
[1]University of Virginia, Charlottesville, Virginia, USA

Hybrid fast gradient echo/echo-planar imaging (FGRE-EPI) is potentially well-suited for myocardial tagging during dobutamine stress testing because it can achieve high temporal resolution and good tag contrast during breath-hold imaging. However, FGRE-EPI is also more sensitive to off-resonance and motion-induced artifacts than conventional FGRE. For FGRE-EPI tagging, phase discontinuities in the raw data due to motion and off-resonant magnetization may interfere with the k-space peaks of tagging. We sought to assess the importance of phase discontinuities in FGRE-EPI tagging at stress and develop a modified FGRE-EPI tagging sequence that achieves high temporal resolution and artifact suppression at peak stress.

10:42 *374*. Myocardial Tagging in a Single Heartbeat with EPI-SSFP and TSENSE

Daniel A. Herzka[1], J. Andrew Derbyshire[2], Peter Kellman[2], Elliot R. McVeigh[2]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

Cardiac tagged images are acquired within a single heartbeat using a combination of EPI-SSFP and TSENSE. Images with matrix sizes ranging from 256x120 to 160x120 and with TRs from 5.2 to 3.9 ms were acquired with rate 4 acceleration rates, leading to temporal resolutions of 52 to 39 ms, and to ~15-25 cardiac phases acquired in a single heartbeat. The resulting real-time functional cardiac movies can be used for direct visualization of the beat-to-beat response to stress, or treatments such as RF ablation or ethanol injections.

10:54 *375*. Comparison of HARP MRI Tagging Analysis and Manual Approach for Quantification of Left Ventricular Strain in Rats after Myocardial Infarction

Wei Liu[1], Junjie Chen[1], J. Stacy Allen[1], Mark McLean[1], Samuel A. Wickline[1], Xin Yu[1]
[1]Washington Unviersity, St. Louis, Missouri, USA

Harmonic Phase (HARP) analysis of MR tagging was proposed for fast and automated assessment of myocardium kinematics. In this study, its outcome was evluated in a rat model of myocadial infarction with comparsion to maunally based approach. The results indicated that manual and HARP analysis exhibited a good concordance in assessing alterations in myocaridium wall motion despite the fact that the calculated strains were in different state. Manual and HARP analysis yielded similar results for assessment of the strain patterns in both control and infarct rats. Both methods detected significant changes in E2 strain after myoicardial infarction.

11:06 *376*. A System for Real-Time HARP-MRI Strain Visualization

Khaled Z. Abd-Elmoniem[1], Smita Sampath[1], Nael F. Osman[1], Jerry L. Prince[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

We present a system for real-time cardiac strain visualization using FastHARP imaging sequence. The system integrates FastHARP acquisition in parallel with a recently developed rapid strain computation and visualization tool. The marriage of these two components can now provide an update in myocardial strain in a CINE sequence of images once every three heartbeats.

11:18 *377*. Evaluation of a Multiple TE, Black-Blood Single Shot FSE Sequence for T_2 Mapping of the Myocardium

Damien Mandry[1], Jean-Marie Escanyé[1], Patrick Le Roux[2], Pierre-Yves Marie[1], Jacques Felblinger[1]
[1]CHU de Nancy Brabois, Vandoeuvre, France; [2]GE Medical Systems, Buc, France

In order to improve T2 mapping of the myocardium for detection of edema, we evaluate a new single shot black-blood FSE sequence permitting acquisition of all TE values in one breath-hold. We compared this sequence on a phantom with a black-blood FSE sequence used routinely on patients and with a spin echo sequence. Despite of large differences in T2 values between FSE and SE based sequences (factor 1.6) shown in phantom experiments, T2 mapping was possible on patients. While no registration of the images is necessary, this sequence is very interesting clinically for fast characterization of the myocardium

11:30 *378*. Quadrupled Efficiency for Black Blood Imaging Using Slice-Pair Interleaving

Manojkumar Saranathan[1], Glenn S. Slavin[1]
[1]GE Medical Systems, Baltimore, Maryland, USA

A new method for achieving four-fold increase in scanning efficiency of black blood imaging is proposed. This technique involves interleaving slice-pairs in successive R-R intervals of a Double Inversion Recovery Fast Spin Echo (DIRFSE) sequence, enabling four slices to be imaged in a single breath-hold. The sequence was used to successfully scan the carotid arteries, abdominal aorta and short-axis sections of the heart on human subjects. Image S/N and blood suppression were comparable to that of the conventional DIRFSE sequence obtained with one slice per breath-hold.

11:42 *379*. Self-Gated Projection Reconstruction Cardiac Cine Imaging

Andrew Christian Larson[1], Orlando P. Simonetti[2], Richard D. White[3], Gerhard Laub[2]
[1]National Institutes of Health, Bethesda, Maryland, and Northwestern University, Chicago, Illinois, USA; [2]Siemens Medical Solutions, Chicago, Illinois, USA; [3]Cleveland Clinic Foundation, Cleveland, Ohio, USA

ECG-based gating continues to be a time-consuming and problematic aspect of cardiac MRI. While ECG-gating is not required for contemporary real-time cine imaging sequences, real-time techniques make significant sacrifices in spatial and temporal resolution compared to gated scans. A new "wireless" self-gating technique is presented that derives cardiac cycle timing information directly from the acquired projection reconstruction image data. This technique was compared to ECG-gated cine imaging in 5 volunteers in 4 image orientations. Retrospective reconstruction demonstrated comparable image quality between self-gated and conventional ECG-gated scans. This technique shows the potential to remove the need for ECG-gating entirely.

11:54 *380*. Single-shot FIESTA Single-breath-hold Whole-heart MRI with 4X Parallel Imaging

Belinda SY Li[1], Qun Chen[2], Wei Li[2], Anila Lingamneni[3], Lisa Angelos[3], Jason A. Polzin[3], Robert R. Edelman[2]
[1]GE Medical Systems, Evanston, Illinois, USA; [2]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [3]GE Medical Systems, Waukesha, Wisconsin, USA

In cardiac function measurements requiring images from the whole heart, one method of choice is a gated 2D FIESTA sequence. Typically, 8-10 slices are required to cover the entire heart; with each slice taking 8-15 sec to acquire, multiple-breath-holds are therefore necessary. This results in patient discomfort, possible slice misregistration between breath-holds, and difficulty with uncooperative patients such as pediatrics. ECG gating can also be difficult to obtain on some cardiac patients. We have therefore developed and implemented an ungated 2D FIESTA technique, using ASSET parallel imaging with 4-times acceleration and half-Fourier (half-NEX), to acquire whole-heart images in a single-breath-hold.

12:06 *381*. Simultaneous MR and Ultrasound Imaging: Towards US-Navigated MRI

David Feinberg[1], Matthias Guenther[1]
[1]Advanced MRI Technologies, Sebastopol, California, USA

A new approach to cardiac and interventional imaging is proposed using fusion of two imaging technologies by simultaneously performing ultrasound (US) imaging within the magnet during MR imaging. Applications of simultaneous US/MRI acquisition include real time interventional imaging and 3D US navigation of MR imaging of the heart and other moving structures. Initial studies showed no interference in real-time cardiac US imaging from the magnetic and RF environment of the MR scanner during different pulse sequences. The degree of US interference in the MR image was minimal below 20db of US transmitter gain using an unshielded conventional US scanner.

12:18 *382*. Myocardial Imaging at High Field using SSFP Methods

Sascha Köhler[1], Karl-Heinz Hiller[1], Axel Haase[1], Peter M. Jakob[1]
[1]Physikalisches Institut, Wuerzburg, Germany

The purpose of the present study was to investigate the microstructure of the heart with steady-state free precession sequences at high fields. With different phase cycles of the radiofrequency excitation pulses, the spectral profile of the sequence and consequently the image contrast behavior was modified. The myocardial fiber structure of isolated beating hearts was visualized with SSFP sequences and the structure of formalin-fixed samples was investigated. A spatial resolution of 78x78x500 µm was achieved in 16s for formalin-fixed samples and 51s for isolated beating hearts. The information on myocardial fiber structure was almost equivalent to diffusion-weighted imaging.

CLINICAL CATEGORICAL COURSE
Interventional MR Imaging

Room 718A 10:30 - 12:30 Chairs: Wady M. Gedroyc and Ferenc A. Jolesz

Educational Objectives
Upon completion of this course, participants should be able to:
- List procedures that can be enabled or improved with MRI guidance;
- List devices that are MR-compatible and commercially available;
- Recognize desired areas of further technical innovation.

10:30 **Percutaneous Procedures**
John A. Carrino

10:55 **Intraoperative Procedures**
Charles L. Truwit

11:20 **Thermal Ablations**
Nasreddin D. Abolmaali and Thomas J. Vogl

11:45 **Vascular Interventions**
Jonathan Lewin

12:10 **Panel Discussion: Requirements for Widespread Adoption**

CLINICAL CATEGORICAL COURSE
Imaging in Drug Development

Room 701A 10:30 - 12:30 Chairs: David S. Lester and Steve C.R. Williams

Educational Objectives
Upon completion of this course, participants should be able to:
- Identify the key objectives of an MR study in development of a given drug;
- Explain why MR methodology studies (e.g., reproducibility, validation) should precede deployment of MR in clinical trials of novel therapy;
- Recommend MR protocols for use in drug development; explain how and why these differ from protocols used in routine diagnostic practice;
- Recognize the impact of Good Clinical Practice regulations in the MR study and advise physicist and physician co-workers accordingly.

10:30 **The Emerging Role of MR in Drug Development**
John C. Waterton

10:50 **Imaging and Neurological Drug Development**
Douglas L. Arnold

11:10 **Imaging and Cardiovascular Drug Development**
Chun Yuan

11:30 **Imaging and Oncologic Drug Development**
Teresa McShane

11:50 **Imaging and Arthritis Drug Development**

Charles G. Peterfy

12:10 **What Radiologists Need to Know About Roles and Rules in Clinical MR Trials**
Richard P. Jacobs

fMRI Data Analysis I

Room 701B 10:30 - 12:30 Chairs: R. Todd Constable and Thomas E. Nichols

10:30 ***383***. **How Many Subjects Are Enough: Subsampling and Consensus in fMRI**

Joanna G. B. Schafer[1], Stewart H. Mostofsky[2], Michael A. Kraut[2], Avery C. Boyce[1], Brian S. Caffo[3], Abigail A. Flower[1], Melissa C. Goldberg[2], Krestin J. Radonovich[6], James J. Pekar[2]
[1]Kennedy Krieger Institute (KKI), Baltimore, Mar;yland, USA; [2]KKI and Johns Hopkins University, Baltimore, Maryland, USA; [3]Johns Hopkins University, Baltimore, Maryland, USA; [4]Johns Hopkins School of Medicine, Baltimore, Maryland, USA

Limitations in our ability to know effect size, estimation efficiency, and statistical power in fMRI lead to uncertainty about the proper size for a representative group study. To test how many subjects are enough, data from 40 subjects participating in an event-related paradigm involving a button press was sampled randomly, with replacement, into groups of size 15 and 20. Only 50% of subsamples with N=15 had overlapping activation with the entire group in the primary motor cortex; the number was 91% for N=20. The findings suggest that more than 15 subjects are needed to provide a representative sample.

10:42 ***384***. **Solving the Multiple Comparison Problem in fMRI with a Novel Nonparametric Approach using Bootstrap in Autoregression**

Rajesh Ranjan Nandy[1], Dietmar Cordes[1]
[1]University of Washington, Seattle, Washington, USA

The multiple comparison problem has always been a challenging one in fMRI due to the complex nature of spatial dependence among neighboring voxels. A popular conservative solution is the Bonferroni correction which works well when the hypotheses are independent but turns out to be too conservative for fMRI analysis. A better approach is the Gaussian random field approach, but it makes several strong assumptions, the validity of which cannot always be justified. Here we propose to solve the multiple comparison problem by bootstrapping resting state data while preserving its autoregressive structure and then calculating the distribution of the maximum statistic.

10:54 ***385***. **A Comparative Study of fMRI Head Motion obtained with a Retrospective Coregistration Algorithm versus External Monitoring**

Marleine Tremblay[1], Simon J. Graham[2]
[1]University of Toronto, Toronto, Canada; [2]University of Toronto, and SWCHSC, Toronto, Ontario, Canada

Head motion is a major confounding problem to widespread applications of Functional Magnetic Resonance Imaging (fMRI). We propose a novel means of obtaining independent accurate head motion information, allowing effective motion correction, using an infrared position tracking system. Here we compare head translation and rotation parameters obtained during an fMRI data acquisition using our new method with those of a well known coregistration algorithm.

11:06 ***386***. **Investigating the Frequency Dependence of Spatial Gradient Artifacts for the Analysis of Resting-State fMRI Data**

Dietmar Cordes[1], Rajesh Ranjan Nandy[1]
[1]University of Washington, Seattle, Washington, USA

Artifacts in functional connectivity imaging resembling spatial gradient-like appearances are investigated by computation of the power spectral density function at each voxel. Results show a strong dependence on the value of the lower limit of the frequency used in functional connectivity imaging. This dependence is different in different data sets even in the same subject and must be taken into consideration when investigating functional connectivity phenomena.

11:18 ***387***. **Adaptive Suppression of Random and Physiological Noise in Event-Related fMRI Data using Nonparametric Spectrum Subtraction**

Tamer Youssef[1], Stephen LaConte[2], Xiaoping Hu[2], Yasser M. Kadah[1]
[1]Cairo University, Giza, Egypt; [2]Emory Universty, Atlanta, Georgia, USA

We present a new technique for suppressing both random and physiological noise in event-related fMRI data. The new technique has the advantage of being model-free and having no assumptions about the statistical relationship between signal and noise. It is therefore more robust than previous techniques given its fewer assumptions.

11:30 388. A Selective Detrending Method for Reduction of Noise Associated with Event-Correlated Motion in FMRI Time-Series for an Event-Related Overt Word-Generation Paradigm

K.S. Gopinath[1], K. Peck[1], D. Soltysik[1], Christy Milsted[1], Megan Gaiefsky[1], B. Crosson[1], R.W. Briggs[1]
[1]University of Florida, Gainesville, Florida, USA

We introduce a selective detrending method for reducing noise associated with event-correlated motion (ECM) in functional magnetic resonance imaging (FMRI) time-series for an event-related overt word generation paradigm. We demonstrate the superiority of this method with respect to sensitivity and specificity over three other methods proposed in literature, (1) a non-selective detrending method, (2) ignoring images during and after speech and (3) motion parameter regression.

11:42 389. Extraction of the Hemodynamic Response Function using an Adaptive Filter

Jason Randall Steffener[1], Benjamin Martin Bly[2], Bharat Biswal[3], Stanley Reisman[1]
[1]NJIT, Newark, New Jersey, USA; [2]Rutgers University, Newark, New Jersey, USA; [3]UMDNJ, Newark, New Jersey, USA

The Hemodynamic Response Function (HRF) is the impulse response of the blood oxygen level dependent (BOLD) signal in the brain. The BOLD signal is what FMRI is sensitive to; therefore, an estimate of the HRF provides valuable information about the underlying function of the brain. The normalized least mean squares adaptive filter estimates the HRF and extracts its shape for every voxel in a time series of fMRI data. Furthermore, this filter can estimate the HRF at each time point in an experiment allowing temporal tracking of the HRF.

11:54 390. Use of Spatial Correlations for Removal of Structured Noise in fMRI

Gregory H. Turner[1], Donald B. Twieg[1]
[1]University of Alabama at Birmingham, Birmingham, Alabama, USA

The noise in fMRI data consists of both white and structured noise components. This study examined the hypothesis that the spatial correlations exhibited by structured components can be used to identify and remove them. In this study a filter was devised which assumes that spatial components are likely to be fixed, rather than assuming that local noise is stationary. A combination of physiological baseline data and a hemodynamic response model was used to evaluate filter performance. The filter effectively removed the structured noise: improvement was seen both visually and quantitatively via t-scores and correlation to the model.

12:06 391. Cross-Modal Correspondence Analysis for MEG and fMRI data

W.K.W. Chau[1], M. Schulz[1], C. Pantev[1], S. Graham[2], A. R. McIntosh[1]
[1]University of Toronto, Toronto, Ontario, Canada; [2]Sunnybrook and Women's College Health Sciences Centres, Toronto, Ontario, Canada

Relating MEG and fMRI data is of scientific interest, and new approaches are required to do this quantitatively. A multivariate technique, Cross-Modal Correspondence Analysis (CMCA), is presented for measuring how the cortical synchronization in different frequency bands, derived from MEG data, relates to fMRI data. Using somatosensory stimulation as an example, CMCA indicates that for primary (SI) and secondary (SII) cortical areas, MEG signals in low frequency bands are highly correlated with sites of activation measured by fMRI. Such data provide a new window through which neurovascular coupling can be explored.

12:18 392. Fuzzy Cluster Analysis of Galantamine Effects on fMRI

Isak Prohovnik[1], Ellen Scanley[2], Mark Does[3], John Gore[3], Hu Cheng[1], Jeremy Chow[4]
[1]Mount Sinai School of Medicine, New York, New York, USA; [2]Yale University, New Haven, Connecticut, USA; [3]Vanderbilt University, Nashville, Tennessee, USA; [4]Cornell University, Ithaca, New York, USA

Investigation of drug effects by fMRI is limited by the knowledge of time course required by traditional analysis methods. We here report successful application of a new technique, Fuzzy Cluster Analysis (FCA), which is free of this limitation. Complex pharmacological experiments were performed in anesthesized rats to evaluate the hypothesis of a nicotinic mechanism of action for a new drug, galantamine. FCA (implemented in EvIdent), was successful in detecting pharmacological events, even when complex or at very low doses, without requiring prior phrmacokinetic knowledge or even the time of injections. Evidence of allosteric nicotinic potentiation was observed.

Diffusion Tensor Imaging: Clinical Applications

Room 714 A/B 10:30 - 12:30 Chairs: Geoff J.M. Parker and Thomas E. Conturo

10:30 393. Quantitative Diffusion Tensor Imaging During Maturation of The Brain's White Matter

Jacques F.L. Schneider[1], Kamil A. Il'yasov[2], Jürgen Hennig[2], Ernst Martin[1]
[1]University Children's Hospital, Zürich, Switzerland; [2]University Medical Center of Freiburg, Freiburg, Germany

As it was demonstrated recently, DTI is sensitive to white matter maturation processes. This work investigates isotropic diffusion coefficient and fractional anisotropy changes in white matter during brain development. This study provides a normative database of the brain's white matter development from neonates to early adulthood. Additionally its demonstrated late change in anisotropy in the deep white matter when conventional MR imaging using T1-, or T2-weighted images do not reveal any change of intensity after the second year of age.

10:42 394. "Two are Better than One": Combining fMRI and DTI Based Fiber Tracking for Effective Pre-Surgical Mapping

Talma Hendler[1], Pazit Pianka[1], Michal Sigal[1], Michal Kafri[1], Dafna Ben-Bashat[1], Shlomi Constantini[2], Moshe Graif[1], Itzhak Fried[1], Yaniv Assaf[1]
[1]Tel Aviv Sourasky Medical Center, Tel Aviv, Israel; [2]Dana Children's Hospital, Tel Aviv, Israel

Functional MRI (fMRI) is used extensively for pre-surgical functional mapping. However, it is crucial for favorable neurosurgical outcome to delineate also fiber-tracks spreading in vicinity of brain lesion. The objects of this study were to combine diffusion tensor imaging (DTI) and fMRI for 3D visualization of motor functionality and related connectivity in vicinity of discrete brain lesions. The combination of fMRI and DTI based fiber tracking provides valuable functional information that cannot be extracted from each method separately. The use of three-dimensional visualization is crucial for understanding the spatial relation between the tumor, critical neuronal activations and fiber tracks.

10:54 395. Sematotopic Organization of Motor Fibers in the Corticospinal Tract - A Combined fMRI and DTI Study

Richard Watts[1], Andrei I. Holodny[2], Christopher G. Filippi[1], Aziz M. Ulug[1]
[1]Weill Medical College of Cornell University, New York, New York, USA; [2]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

The sematotopic organization of motor fibers in the corticospinal tract is poorly understood. However, it is known that superior-inferior white matter fiber tracts connect the motor cortex to the spinal cord. Although animal models have demonstrated sematotopic organization in primates, human data has been limited to patients with Wallerian degeneration. In this work, diffusion tensor imaging is used in vivo to track the corticospinal tract from the spinal cord through posterior limb of the internal capsule to different sections of the motor cortex that are identified using functional MRI.

11:06 396. Functional Activation using ADC Contrast Allows Better Spatial Localization to the Neuronal Activity: Evidence using DTI Fiber Tracking

Allen W. Song[1], Todd Harshbarger[1], Tianlu Li[1], Keun-Ho Kim[2], Susumu Mori[3], Dae-Shik Kim[2]
[1]Duke University, Durham, North Carolina, USA; [2]University of Minnesota, Minneapolis, Minnesota, USA; [3]Johns Hopkins University, Baltimore, Maryland, USA

Recent studies suggested that functional activation using apparent diffusion coefficient (ADC) contrast can be used to detect synchronized signal changes during brain activation1,2 and may be used to achieve better spatial localization to the smaller vessels3. Such localization is believed to label the areas of neuronal activity more accurately. The parallel development of the diffusion tensor imaging (DTI) has also seen rapid progress that allows detailed nerve fiber tracking4,5. In this report, DTI was used to track the fiber connections among the discrete areas determined using the ADC contrast. As a comparison, activated areas using BOLD contrast were also obtained.

11:18 397. DTI Fiber Tracking From Motor Points Defined by Intra-operative Cortical Stimulation

Jeffrey I. Berman[1], Mitchel S. Berger[1], Srikantan S. Nagarajan[1], Pratik Mukherjee[1], William P. Dillon[1], Roland G. Henry[1]
[1]UC San Francisco, San Francisco, California, USA

This project combines intra-operative cortical stimulation information with DTI fiber tracking in brain tumor patients. Cortical stimulations were performed during surgical resections on 11 patients and motor cortex points for specific functions were registered to MRI. DTI fiber tracking was performed from these cortical points to study the subcortical location and organization of the descending motor pathway. Corticospinal fiber tracks were observed bordering and displaced by tumors. In addition, fiber tracks exhibited the expected cortical and subcortical somatotopic organization. DTI fiber tracking can be a useful tool for surgical planning and study of white matter pathways in brain tumor cases.

11:30 398. Temporal and Spatial Evaluation of Wallerian Degeneration after Cerebral Cortical Infarction using Diffusion Tensor Imaging

Masaki Fukunaga[1], Chuzo Tanaka[1], Toshihiko Ebisu[1], Masahiro Umeda[1], Ichio Aoki[1], Yuki Mori[1], Asuka Nakagoshi[1], Shoji Naruse[2]
[1]Meiji University of Oriental Medicine, Funai, Kyoto, Japan; [2]Kyoto Prefectural University of Medicine, Kyoto, Japan

In this study, we studied the temporal and spatial extent of corticospinal tract degeneration (Wallerian degeneration) after cerebral cortical infarction using a whole brain diffusion tensor MRI (DTI). The area of reduction in FA caused by cerebral infarction could be detected in ipsilateral internal capsule and midbrain one week after. This approach is expected to be very useful in studying the pathophysiology of degeneration after cerebral ischemia.

11:42 399. Diffusion Tensor MRI Depicts White Matter Reorganization After Surgery

Andrew L. Alexander[1], Benham Badie[1], Aaron S. Field[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

Diffusion tensor (DT) MRI provides unique information about the magnitude, anisotropy and orientation of water diffusion in brain tissues. In particular, the anisotropy and orientational information cannot be observed using any other imaging method and can be used to identify specific white matter fiber tracts. Recent studies have shown that DT-MRI is able to depict the deviation of white matter tract trajectories when brain tumors are present. In this study, DT-MRI was used to depict the preservation and reorganization of white matter tracts in the brain after surgical resection of brain tumors.

11:54 ***400***. **Quantitative Diffusion Tensor Imaging Evidence of Brain Damage in Professional Boxers**

Lijuan Zhang[1], Lisa D. Ravdin[1], Norman R. Relkin[1], Robert D. Zimmerman[1], Aziz M. Ulug[1]
[1]Weill Medical College of Cornell University, New York, New York, USA

Chronic Traumatic brain injury is a common neurological abnormality found in professional boxers. Routine MRI is usually not diagnostic. Recent studies suggested that diffusion weighted imaging may be useful in diagnosing traumatic brain injury by quantifying the microstructural diffusion changes. In this work, we investigated the average brain diffusion coefficient in professional boxers and compared it with that of normal controls and patients with normal pressure hydrocephalus, a syndrome associated brain dysfunction.

12:06 ***401***. **Structural MRI and Diffusion Anisotropy Abnormalities Associated with Language Deficits in Patients with Acquired Unilateral Basal Ganglia Infarction**

Jacques Donald Tournier[1], Alison Rowan[1], Fernando Calamante[1], Alan Connelly[1], Torsten Baldeweg[1], Faraneh Vargha-Khadem[1], David G. Gadian[1]
[1]Insitute of Child Health, University College London, London, UK

The relationship between language function and MR imaging abnormalities was investigated in 17 patients with acquired unilateral basal ganglia infarctions. Analysis of 3D structural MRI images and diffusion tensor images revealed that poor language performance is associated with decreased grey matter density in Broca's and Wernicke's areas, decreased diffusion anisotropy and white matter density in deep left frontal white matter, and decreased diffusion anisotropy in the internal capsule. Perfusion abnormalities were found in and around Wernicke's area in 3 patients with the poorest language performance.

12:18 ***402***. **Diffusion Tensor MRI and Fiber Tractography of Cerebellar Atrophy in Phenytoin Users**

Seung-Koo Lee[1], Susumu Mori[2], Dong Ik Kim[1], Dong Joon Kim[1]
[1]Yonsei University College of Medicine, Seoul, Republic of Korea; [2]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

The authors used diffusion-tensor MR imaging (DT-MRI) to examine cerebellar atrophy induced by long-standing phenytoin use and olivoponto-cerebellar atrophy. DT-MRI showed normal fractional anisotropy (FA) of cerebellar peduncles and transverse pontine fibers of phenytoin users while primary cerebellar degeneration group showed decreased FA values. Fiber tractography demonstrated decreased volume and altered fiber integrity of peduncles and transverse pontine fibers in primary cerebellar atrophy group, while phenytoin users showed nearly the same fiber intactness as normal controls, suggesting phenytoin affects cerebellum directly with preserved interconnecting fibers.

Pulmonary MR: Perfusion, Embolism, and Lung Masses

Room 716 A/B 10:30 - 12:30 Chairs: Qun Chen and Peter M. Jakob

10:30 ***403***. Young Investigator Awards Finalist: **Quantitative Assessment of Regional Pulmonary Perfusion in the Entire Lung using 3D Ultra-fast Dynamic Contrast-enhanced Magnetic Resonance Imaging: Preliminary Clinical Experience in 22 Subjects**

Yoshiharu Ohno[1], Hiroto Hatabu[2], Kenya Murase[3], Takanori Higashino[1], Hideaki Kawamitsu[4], Hirokazu Watanabe[1], Daisuke Takenaka[5], Masahiko Fujii[4], Kazuro Sugimura[1]
[1]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [2]Beth Israel Deconess Medical Center, Boston, Massachusetts, USA; [3]Osaka University, Suita, Osaka, Japan; [4]Kobe University Hospital, Kobe, Hyogo, Japan; [5]Kobe Ekisaikai Hospital, Kobe, Hyogo, Japan

The purpose of the present study is to assess the regional differences in quantitative pulmonary perfusion parameters, i.e., mean transit time (MTT) and pulmonary blood flow (PBF) on a pixel by pixel basis in the entire lung on normal volunteers and pulmonary hypertension (PH) patients from 3D ultra-fast dynamic CE-MR data. Regional PBF and MTT showed significant differences in the gravitational directions ($p<0.05$). RBF and MTT maps demonstrated significant differences between normal volunteers and PH patients ($p<0.05$). In conclusion, 3D ultra-fast dynamic CE-MR imaging was feasible to assess the regional quantitative pulmonary perfusion parameters in normal volunteer and PH patients.

10:50 ***404***. **Comparison Arterial Spin Labeling and First-Pass Gd-DTPA Dynamic Method for Pulmonary Perfusion Imaging in Healthy Volunteers: The inflow Spin-Tracer Saturation Effect.**

Yi-Ru Lin[1], Teng-Yi Huang[1], Ming-Ting Wu[2], Shang-Yueh Tsai[1], Hsiao-Wen Chung[1], Vu M. Mai[3], Cheng-Yu Chen[4], Huay-Ben Pan[2]
[1]National Taiwan University, Taipei, Taiwan; [2]Kao-Hsiung Veterans General Hospital, Kao-Hsiung, Taiwan; [3]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [4]Tri-Service General Hospital, Taipei, Taiwan

To see if arterial spin labeling perfusion imaging is applicable to pulmonary perfusion, we applied both FAIR and Gd-DTPA dynamic imaging method on healthy volunteers. Our results showed that FAIR performed well in posterior slice portion but huge error was found in middle slice portion of three subjects. It may be caused by inflow spin-tracer saturation effect, which may underestimate perfusion significantly. We concluded that FAIR method for pulmonary perfusion imaging should be carefully applied to avoid misleading diagnosis.

11:02 *405*. Investigation of the Influence of Smoking on Pulmonary Perfusion using ^{1}H MR Spin Labeling Perfusion Technique

Tungte Wang[1], Georg Schultz[1], Dietbert Hahn[1], Peter M. Jakob[1]
[1]University of Würzburg, Würzburg, Bavaria, Germany

Recently, the noninvasive quantitative 1H MR perfusion mapping based on spin labeling has been successfully demonstrated to obtain the pulmonary perfusion rates in healthy subjects and patients with cystic fibrosis (CF). Using this approach, we calculated the pulmonary perfusion rates both before and after smoking in six “healthy” smokers. In comparison, six healthy nonsmokers were also studied under the same conditions, but without smoking. The resulting pulmonary perfusion rates increased after smoking.

11:14 *406*. Central vs. Peripheral Pulmonary Blood Velocity, and Blood Volume Mismatch in Patients with Pulmonary Arterial Hypertension as Determined by First Pass DCE-Pulmonary Perfusion MR

Jeffrey P. Goldman[1], Andrew Shih[1], Erik Altman[1], Michael Poon[1]
[1]Mount Sinai Medical Center, New York, New York, USA

Pulmonary arterial hypertension (PAH) is a disease that has common end pathology of narrowing of the pulmonary vasculature which results in increased pulmonary pressure and ultimately right sided heart failure. First pass DCE-MR pulmonary perfusion imaging enables us to directly measure the effects of pulmonary artery narrowing on the pulmonary microcirculation. We have found an increased enhancement rate in the central vs. the peripheral pulmonary microcirculation in patients with PAH. First pass DCE pulmonary perfusion MR offers the potential of monitoring the direct effects of therapy to pulmonary micro vascular perfusion.

11:26 *407*. Assessment of Experimentally Induced Pulmonary Hypertension using High-Resolution MR Flow Measurements in Pigs

Nasreddin D. Abolmaali[1], Uwe Seitz[2], Martin Kock[3], Daniel Radeloff[1], Volker Hietschold[4], Thomas J. Vogl[1]
[1]JW Goethe University, Frankfurt am Main, Germany; [2]Institute for Pediatric Cardiology, Frankfurt am Main, Germany; [3]Center for Animal Research, Frankfurt am Main, Germany; [4]Institute for Radiology, Dresden, Germany

This study evaluated up-to-date MR-flow-measurements (MRvenc) in the main pulmonary artery (MPA) to estimate the blood pressure. Six pigs were instrumented for invasive blood pressure measurement (IPM) within the MPA. Stepwise pulmonary hypertension was induced by iv-application of ThromboxanA2. Using an unsegmented phase-contrast flash-sequence with high temporal resolution (TE/TR=2.4/9.5ms; Sonata), MRvenc was simultaneously performed with IPM. MRvenc derived parameters were correlated with IPM. A very high correlation with IPM was reached for the linear combination of the absolute acceleration time and the maximum flow velocity (r=0.92). Non-invasive assessment of pressure in the MPA appears to be feasible with this technique.

11:38 *408*. Drug-Induced Fast Resolution of Established Lung Inflammation in Rats Detected Non-Invasively by MRI

Bruno Tigani[1], Catherine Cannet[1], Stephan Zurbruegg[1], John R. Fozard[1], Nicolau Beckmann[1]
[1]Novartis Institute for Biomedical Research, Basel, Switzerland

The effects of two compounds, budesonide, a gluco-corticosteroid, and NVP-ABE171, a selective phospho-diesterase-4 (PDE4) inhibitor, on established acute pulmonary inflammation induced by intra-tracheal (i.t.) instillation of allergen (ovalbumin, OA), were followed non-invasively in the rat lung by MRI. A fast resolution of lung edematous signals was observed following post-treatment with the compounds. The MRI observations were confirmed by perivascular edema quantified histologically. However, there was no concomitant reduction of inflammatory parameters assessed ex vivo in the broncho-alveolar (BAL) fluid, indicating that BAL fluid parameters may not necessarily always be useful indicators of anti-inflammatory effects of compounds.

11:50 *409*. Magnetic Resonance Elastography of the Lung: Initial Feasibility

Brian C. Goss[1], Kiaran P. McGee[1], Scott A. Kruse[1], Armando Manduca[1], Richard L. Ehman[1]
[1]Mayo Clinic and Foundation, Rochester, Minnesota, USA

Many diseases affect pulmonary function by altering both dynamic and static lung compliance. Conventional pulmonary testing provides an averaged estimate of overall lung compliance, but no regionally-specific information. We evaluated the feasibility of measuring the elastic properties of lung tissue through MR-based phase-contrast imaging of propagating shear waves. Initial results in porcine lung specimens inflated with air indicate that the shear modulus in lung is within the range of values previously reported in the literature.

12:02 *410*. Biomechanical Analysis of the Lung: A Feature-Based Approach Using Customized Finite Element Meshes

Tessa A. Sundaram[1], James C. Gee[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

We describe a feature-based approach to non-rigid registration of two-dimensional pulmonary MR images. Finite element meshes are constructed to highlight anatomical features evident on a sagittal lung view. Resulting displacements are compared to dense fields extrapolated from manually placed vascular landmarks. Results achieved using customized meshes demonstrate better correspondence to the landmark fields than those acquired using quadrilateral grids. Landmark constraints further improve the solution’s correspondence to the expected result. This work demonstrates the advantages of using feature-based techniques to capture lung deformation, and lays the groundwork for biomechanical modeling of the lung using the finite element method.

12:14 ***411***. **Oxygen-enhanced MR Imaging of the Lung: Utility for Assessment of COPD and Prediction of Postoperative Lung Function in Lung Cancer Patients**

Yoshiharu Ohno[1], Takanori Higashino[1], Hideaki Kawamitsu[2], Daisuke Takenaka[3], Marc van Cauteren[4], Hiroto Hatabu[5], Kazuro Sugimura[1]
[1]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [2]Kobe University Hospital, Kobe, Hyogo, Japan; [3]Kobe Ekisaikai Hospital, Kobe, Hyogo, Japan; [4]Philips Medical Systems, Tokyo, Japan; [5]Beth Israel Deconess Medical Center, Boston, Massachusetts, USA

The purpose of the present study is to determine the utility of oxygen-enhanced MR imaging for assessment of the degree of COPD, and prediction of postoperative lung function in lung cancer patients. Over all oxygen-enhancement were correlated with the degree of COPD (COPD index,). Predicted postoperative FEV1 by oxygen-enhanced MR imaging (ppoFEV1) was correlated with actual postoperative FEV1. Overall oxygen-enhancement had good correlation with COPD index (r2=0.55). Correlation between ppoFEV1 and actual postoperative FEV1 was excellent (r2=0.76). In conclusion, oxygen-enhanced MR imaging was useful for evaluation of the degree of COPD and prediction of postoperative lung function.

Hepatobiliary MR Imaging

Room 713 A/B 10:30 - 12:30 Chairs: Riccardo Manfredi and Caroline Reinhold

10:30 ***412***. **Accuracy of MRCP vs. ERCP in the Evaluation of Patients with Bile Duct Obstruction in the Setting of a Randomized Clinical Trial**

Josephine Pressacco[1], Caroline Reinhold[1], Alan N. Barkun[1], Jeffrey S. Barkun[1], Eric Valois[1], Lawrence Joseph[1]
[1]McGill Univeristy Health Centre, Montreal, Quebec, Canada

Endoscopic retrograde cholangiopancreatography (ERCP) is a well-established diagnostic test used in the evaluation of patients with suspected bile duct obstruction. However, it carries a morbidity of 1-7% and mortality of 0.2-1%. Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive modality that could identify those patients that do not require a therapeutic ERCP. Two hundred and fifty-eight patients at intermediate risk for bile duct obstruction were randomized to either MRCP or ERCP. Results for MRCP and ERCP were similar for determining bile duct obstruction, choledocholithiasis and normal studies, and for determining the actual diagnosis.

10:42 ***413***. **MRCP: Imaging Pitfalls and Improvement with Morphine Administration**

Alvin C. Silva[1], Amy K. Hara[1], Jeremy L. Friese[2], Patrick T. Liu[1]
[1]Mayo Clinic Scottsdale, Scottsdale, Arizona, USA; [2]Mayo Clinic Rochester, Rochester, Minnesota, USA

Purpose: MRCP evaluation of biliary and pancreatic ductal anatomy and pathology is challenging with nondistended ducts. IV morphine is often used in nuclear scintigraphy to improve biliary duct visualization. The purpose of this study is to determine if IV morphine administration improves biliary and pancreatic duct dilatation at MRCP. Methods: 20 patients, 10 patients with normal biliary or pancreatic ducts and 10 patients with diseased biliary or pancreatic ducts, will undergo MRCP before and after administration of 0.04 mg/kg of IV morphine. 2D and 3D MRCP images will be acquired before and after morphine administration on a 1.5-T scanner (Philips

10:54 ***414***. **Secretin MRCP Derived Quantification of Function in Chronic Pancreatitis**

Alice Gillams[1], William Lees[1]
[1]The Middlesex Hospital, London, UK

Introduction We have previously reported the use of Secretin MRCP to quantify pancreatic function. We have now studied a group of normal patients and patients with chronic pancreatitis. Methods and Materials 74 patients referred with suspected or known pancreatic pathology underwent SSFSE MRCP both before and after 0.1ml/kg IV Secretin. All images were obtained on a 1.5T clinical MR system (Siemens Vision) gradient strength 22mT/m. The exact same sequence with identical positioning and receiver gain was performed prior to Secretin and at 2 minute intervals post Secretin to a mean of 7 minutes. All patients also underwent parenchymal pancreatic imaging

11:06 ***415***. **Physiological Function of the Pancreas with Secretin Enhanced MRCP: A Prospective Evaluation**

Alex M. Aisen[1], Glen A. Lehman[1], Stuart Sherman[1], Evan Fogel[1], Benedict Devereaux[1], Tao Li[1], Clare Sukey[1]
[1]Indiana University, Indianapolis, Indiana, USA

Elevated pressures in the pancreatic sphincter, related to dysfunction of the Sphincter of Oddi, have been implicated as an etiologic factor in pancreatis. We evaluated the efficacy of secretin-enhanced MRCP to diagnose el elevated pancreatic pressure in 38 patients with suspected Sphincter of Oddi dysfunction; who also underwent clinical ERCP with manometric measurement of pressures. However, in this small trial, we did not find that our MRCP measurements were able to predict the manometric findings.

11:18 ***416***. **Gadophrin-2 Enhancement of Fatty Tissue Necroses in Rabbits – Can Improvement of the Differential Diagnosis between Fatty Tissue Necrosis and Edema in Acute Pancreatitis Be Achieved?**

Sabine Fenchel[1], Karin Koretz[1], Hans-Juergen Brambs[1], Elmar Max Merkle[2]
[1]University of Ulm, Ulm, Germany; [2]University Hospitals of Cleveland, Cleveland, Ohio, USA

This study aims to determine if Gadophrin-2, a necrosis-specific contrast agent, accumulates in fatty tissue necroses and can help to differentiate fatty tissue necroses from edema in acute pancreatitis. Fatty tissue necroses were induced in nine rabbits by subcutaneous injection of pancreatic enzymes; Gadophrin-2 enhancement was measured by MRI (T1-w FS FLASH). Histopathologically proven necroses showed a distinctive Gadophrin-2 enhancement one and 24 hours post-contrast (SNR 55.4±16.1 and 52.0±16.4). There was a good correlation in size and shape between contrast-enhancing regions and necroses. Therefore, Gadophrin-2 may improve the differential diagnosis between fatty tissue necroses and edema in acute pancreatitis.

11:30 ***417***. **Magnetic Resonance Imaging Follow-Up of Small Arterially Enhancing Liver Lesions Detected with Gadolinium-Enhanced 3D Interpolated Technique in Patients at Risk for Hepatocellular Carcinoma**

Pornpim Fuangtharnthip[1], John R. Leyendecker[2], Vamsri Narra[1], Hak-Yu Jeong[1], Kyongtae T. Bae[1]
[1]Mallinckrodt Institute of Radiology, St. Louis, Missouri, USA; [2]University of Texas, San Antonio, Texas, USA

Liver MRI is frequently performed for surveillance of hepatocellular carcinoma (HCC) in cirrhotic patients. The diagnosis of HCC is elicited when a liver lesion demonstrates early arterial enhancement on gadolinium-enhanced T1-weighted images and high signal intensity on T2-weighted images. However these findings are not 100% specific for HCC. In particular, differentiating HCC from other benign pathologies is very difficult in small lesions (<20mm) that lack other helpful morphologic features. The purposes of this study are to evaluate the signal characteristics and usefulness of follow-up imaging for diagnosis of HCC and to estimate an appropriate time interval for follow-up MRI.

11:42 ***418***. **Preliminary *In Vivo* Studies of Microbubbles as MRI Susceptibility Contrast Agent**

Kelvin K. Wong[1], Ingjye Huang[2], Haiying Tang[3], Young R. Kim[4], Iris Y. Chen[4], Kenneth K. Kwong[4], E S. Yang[1], Ed X. Wu[3]
[1]University of Hong Kong, Hong Kong; [2]National Taiwan University, Taipei, Taiwan; [3]College of Physicians and Surgeons, Columbia University, New York, New York, USA; [4]Massachusetts General Hospital, Charlestown, Massachusetts, USA

Microbubble has been used as ultrasound contrast agent for years. Its application in MRI as a unique susceptibility contrast agent is not fully explored. In this abstract, the use of microbubble contrast agent, Optison, as a MR susceptibility contrast agent in vivo is demonstrated for the first time by rat liver imaging at horizontal 9.4T and mouse liver imaging at vertical 9.4T. In vitro measurements of $\Delta R2$ and $\Delta R2^*$ of Optison are presented at 9.4T.

11:54 ***419***. **Intra-Individual Comparison of Gadobenate Dimeglumine (Gd-BOPTA) and Mangafodipir Trisodium (Mn-DPDP) for the Distinction of Hepatic Adenoma (HA) and Liver Adenomatosis (LA) from Focal Nodular Hyperplasia**

G Morana[1], L Grazioli[2], M Testoni[1], L Rubin[1], L Romanini[2], C Procacci[1]
[1]University of Verona, Verona, Italy; [2]University of Brescia, Brescia, Italy

Gadobenate dimeglumine (Gd-BOPTA) and mangafodipir trisodium (Mn-DPDP) are two contrast agents with liver specific properties. However, while mangafodipir can be administered only as a slow infusion and used in conjunction with delayed phase imaging, Gd-BOPTA can be administered as a bolus and used for both dynamic and delayed phase imaging. The present intra-individual study compares these two agents in nine patients for the detection and differential diagnosis of hepatic adenoma (HA) and liver adenomatosis (LA) and concludes that Gd-BOPTA is better able to detect and differentiate the detected lesions from the more common focal nodular hyperplasia.

12:06 ***420***. **Gadobenate dimeglumine (Gd-BOPTA) versus SH U 555 A – Two Different MR Contrast Agents for the Detection and Differential Diagnosis of Hypervascular Liver Tumors**

G Schneider[1], R. Seidel[1], P Fries[1], W Loytved[1], B Kramann[1], F Ahlhelm[1]
[1]Universitaetskliniken des Saarlandes, Homburg, Saar, Germany

Gadobenate dimeglumine (Gd-BOPTA) is a gadolinium-based MR contrast agent with high T1 relaxivity which, unlike other gadolinium agents, can be used for both dynamic and delayed MR imaging of the liver. SHU 555 A is an ultrasmall iron oxide agent with T1 and T2 relaxation properties which can also be used for dynamic and delayed imaging. Blinded intra-individual comparison of the two agents in 32 patients with hypervascular hepatic tumors revealed an overall preference for Gd-BOPTA on dynamic images due to greater increases of signal intensity. Detection and delineation of HCC and FNH was also superior on dynamic Gd-BOPTA images.

12:18 ***421.*** **Detection and Characterisation of the Biliary Metabolism of the Anti-Cancer Agent Ifosfamide using *In Vivo* and Analytical ^{31}P MRS and Mass Spectrometry**

Geoffrey S. Payne[1], Andrzej S K Dzik-Jurasz[1], Laura Mancini[1], Bernard Nutley[1], Florence Raynaud[1], Martin O. Leach[1]
[1]Royal Marsden Hospital and Institute of Cancer Research, Sutton, Surrey, UK

Biliary excretion is a significant component in the metabolism of many drugs. Using 31P 3d-CSI it is shown that Ifosfamide and its metabolites can be detected in the gall bladder in a guinea pig model. Analysis of extracted bile using high-resolution MRS and mass spectrometry identifies peaks to include Ifosfamide, carboxyifosfamide, and a major contribution from a previously unreported glutathione conjugate of Ifosfamide. These results may help to identify causes of oxazophosphorine-related cholecystitis reported in patients.

RF Coils

Room 715 A/B 10:30 - 12:30 Chairs: Ed B. Boskamp and Patrick J. Ledden

10:30 ***422.*** **Optimization of an RF Microstrip Resonator for High Field Imaging**

Gene Bogdanov[1], Tim Fisher[1], Reinhold Ludwig[1]
[1]Worcester Polytechnic Institute, Worcester, Massachusetts, USA

Optimization of MRI RF coils has been difficult in the past, since simulation tools only approximated the inductive behavior and did not predict losses. Recently, the multiconductor transmission line model has proved reasonably accurate in simulating the transverse electromagnetic resonator. This method allows detailed calculation of inductive, capacitive and loss characteristics of the unloaded coil within the constraints of the quasi-TEM approximation. This work presents a case study in strip width optimization for a microstrip TEM resonator using the MTL model. The resulting strip width optimizes the coil quality factor, filling factor and field uniformity.

10:42 ***423.*** **A Circular-Polarized Double-Tuned (^{31}P and ^{1}H) TEM Coil for Human Head MRI/MRS at 7T**

Xiaoliang Zhang[1], Xiao-Hong Zhu[1], Hongyang Qiao[1], Haiying Liu[1], Thomas Vaughan[1], Kamil Ugurbil[1], Wei Chen[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

A double-tuned human head TEM coil is designed for in vivo proton and 31P MR applications at 7T. 3D 31P CSI acquired from the whole brain using this coil and high-resolution human head image are presented. A superior SNR of 91:1 of 31P spectra from 4-cc voxels in the human brain is achieved within 18-minute data collection in vivo. The results of in vivo MR experiments and bench test indicate i) excellent performance of this double-tuned large volume coil design for human proton and 31P MR studies; ii) great advantages of 31P MRS at ultra-high fields.

10:54 ***424.*** **300MHz Quadrature Shielded Birdcage Head Coil For 7 Tesla**

Ronald D. Watkins[1], Kenneth W. Rohling[1]
[1]GE Global Research, Schenectady, New York, USA

Since the introduction of the Birdcage Coil , it has by far become the most popular solution for volume coils in MRI imaging systems up to 4T. Small bore systems have employed bird cage coils up to 750MHz . Commercial whole body systems are now available employing large volume birdcages at 3T. We will present a design of a quadrature birdcage transmit receive head coil at 300MHz, for a 7Tesla system. We will present methods of extending the useful frequency range above 4 tesla, where other coil topologies such as TEM coils are more common.

11:06 ***425.*** **The Technology and Techniques of 4T Body Imaging**

Thomas Vaughan[1], Carl Snyder[1], Gregor Adriany[1], Lizann Bolinger[2], Haiying Liu[1], Alan Stolpen[2], Kamil Ugurbil[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA; [2]University of Iowa, Iowa City, Iowa, USA

To make whole body imaging possible at 4T, new understanding, technology, and techniques have been developed. New understanding was required to update initial impressions that practical 4T body imaging was not feasible. RF technology including a body coil, front end, and specialty receiver technology was developed to make 4T body imaging possible. New techniques such as RF shimming were implemented to correct for artifacts not observed at lower field strengths. The result of bringing together new technology, techniques and understanding is a demonstration of the feasibility of 4T whole body MRI with examples from brain, breast, abdomen and heart.

11:18 ***426.*** **Cable Routing in MRI Phase Array Coils**

Derek Seeber[1], Jovan Jevtic[1], Ashok Menon[1], Veilibor Pikelja[1], William Johnson[1]
[1]IGC Medical Advancs, Inc., Milwaukee, Wisconsin, USA

A method of routing RF cables along low electric field areas of a local coil in a predictable and reliable manner is presented. A conductive ring is introduced into proximity with the coil loops and connected to the ground shield of the RF cables creating a low electric field area. The RF cables are attached to the conductor along the ring to a point where they exit together as a unified cable. The ring, by defining an area of low electromagnetic field, reduces interference on the cables and coupling between loops allowing for a controlled cable layout.

11:30 **427. Eigenmode Analysis for Understanding Phased Array Coils and Their Limits**

Scott B. King[1], G. Randy Duensing[2]
[1]National Research Council of Canada, Winnipeg, Manitoba, Canada; [2]MRI Devices Corporation, Gainesville, Florida, USA

A resistance matrix eigenvector/value decomposition is performed on an RF coil array to enable visualization of regional variation of SNR changes caused by the introduction of non-sample losses. It is found that for a particular array, introduction of a non-sample loss that reduces individual coil SNR by 14% results in SNR losses ranging from 6% to 28%. This method provides a simplified means for estimating the effect of regional SNR changes due to various loss mechanisms.

11:42 **428. Design Guidelines for the Capacitive Decoupling Networks**

Jovan Jevtic[1], Velibor Pikelja[1], Ashok Menon[1], Derek Seeber[1], Nunez Tatum[1], William Johnson[1]
[1]IGC-Medical Advances, Inc., Milwaukee, Wisconsin, USA

The coupling between any two loops in an MRI RF phased-array coil may be reduced by using a capacitive decoupling network (CDN.) CDN is compatible with parallel imaging, transmit receive operation, and other decoupling techniques. A generalized CDN may be significantly simplified in many cases of practical interest by selecting only a portion of the full generalized circuit. We will present an efficient and simple design procedure for the CDN, including an overview of practical layouts, closed form expressions for the capacitor values, iterative calculation strategy, as well as the results of numerical modeling and coil measurements.

11:54 **429. Transmit-Receive Phased Array for Neurovascular Imaging at 3T**

Uli Gotshal[1], Jeffrey R. Fitzsimmons[2]
[1]MRI Devices Corp., Gainesville, Florida, USA; [2]University of Florida, Gainesville, Florida, USA

A new transmit-receive phased array coil is presented for neurovascular imaging at 3T. A transmit-receive configuration was chosen in order to minimize the required RF power, reduce the deposited average SAR, and avoid the safety issues that are typically related to the use of whole body coils at high frequency. A power splitter was designed, optimized and implemented to obtain uniform excitation. B1 maps (as flip angle maps) are shown on volunteer images in 3 slice orientations. The high SNR and high-resolution capabilities of the 3T Neurovascular array are demonstrated in a short acquisition time MRA study of the carotids.

12:06 **430. Improved High Resolution Imaging with 4-Element Liquid Nitrogen Phased Array Coil and VD-AUTO-SMASH at 1.5T**

Wingchi Kwok[1], Zhigang You[1], Jianhui Zhong[1]
[1]University of Rochester, Rochester, New York, USA

We have recently developed liquid-nitrogen (LN2) cooled phased array RF coils that improve SNR significantly over similar room-temperature array coils and provide larger field-of-view coverage over single coils. In this study, we investigate the feasibility of combining LN2 phased array coils with parallel imaging that saves imaging time by several folds. We built a 4-coil element LN2 phased array and imaged using VD-AUTO-SMASH parallel imaging technique. Our phantom, animal and in vivo imaging tests show that the combined technique improves SNR and saves imaging time. The new technique may be useful for high-resolution imaging of human extremities and small animals.

12:18 **431. A 32-Channel Coil for Phased Array Imaging at 1.5 Tesla**

Charles L. Dumoulin[1], Randy O. Giaquinto[1], Kenneth W. Rohling[1], Charles J. Rossi[1], Ronald D. Watkins[1], Christopher J. Hardy[1], Robert D. Darrow[1]
[1]General Electric Global Research Center, Niskayuna, New York, USA

A 32-channel phased array coil for use at 1.5 Tesla was constructed and used for lumbar spine imaging. The phased-array coil design has two halves, each containing 16 active coils. Each coil in the array was designed to have minimal mutual inductance with its nearest neighbors. Baluns were used for each coil to further isolate the coils and to minimize cable interactions. The SNR and sensitivity profile of this design were evaluated with high-resolution Fast Spin Echo imaging.

^{1}H MR Spectroscopy of Human Brain: Techniques and Insights

Room 717 A/B 10:30 - 12:30 Chairs: Hoby P. Hetherington and Ivan Tkac

10:30 **432. Suppression of Creatine and Macromolecules in GABA Spectral Editing**

Changho Choi[1], Nicholas J. Coupland[1], Peter S. Allen[1]
[1]University of Alberta, Edmonton, Alberta, Canada

A spectral editing strategy for the detection of GABA in brain with negligible contamination (0.1% and 4%, respectively) from creatine (Cr) and macromolecules (MM) is reported. A target doublet peak of GABA at 3.0 ppm is brought about by longitudinal-scalar-order-coherence-difference editing with a theoretical efficiency of 50%. Excellent suppression of Cr and MM is achieved using a frequency selective inversion pulse during the longitudinal order period on alternate scans. Phantom test results of this method are presented.

10:42 *433*. *In Vivo* Measurement of GABA in the Human Brain using One- and Two-Dimensional Selective Multiple Quantum Spectroscopy at 3 Tesla

In-Young Choi[1], Sang-Pil Lee[1], Hellmut Merkle[2], Craig A. Branch[1], Jun Shen[2]
[1]The Nathan Kline Institute, Orangeburg, New York, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

In vivo measurements of GABA in the human brain have been achieved with effective suppression of creatine and glutathione using a selective multiple quantum filter. Signals from macromolecules, one of the compounding factors in the GABA measurement *in vivo*, can be separated from that of GABA using a two-dimensional multiple quantum spectroscopy method. In this study, we demonstrate the feasibility of a two-dimensional multiple quantum spectroscopy for the GABA measurement and the efficiency of the suppression of overlapping signals at around 3 ppm in the human brain at 3 Tesla.

10:54 *434*. Comparison of Metabolite T_1 Relaxation Times in Different Brain Regions at 1.5 and 3 Tesla

Thomas Ethofer[1], Irina Mader[2], Uwe Seeger[2], Albert Ludolph[1], Wolfgang Grodd[2], Uwe Klose[2]
[1]University of Ulm, Ulm, Germany; [2]University of Tuebingen, Tuebingen, Germany

Accurate values of metabolite relaxation times are necessary for absolute quantification in magnetic resonance spectroscopy (MRS) and for comparing spectroscopic data obtained at different field strengths. Metabolite T1 relaxation times have been determined for different regions of the human brain in several studies at 1.5 T, but data on T1 values at 3.0 T are available only for occipital grey matter (GM) and white matter (WM). The objective of this study was to compare T1 relaxation times of brain metabolites in six different brain regions in normal adults at 1.5 T and 3 T.

11:06 *435*. Age-Related Changes of Cerebral Metabolite Concentrations: A Quantitative Proton MR Spectroscopic Study

Noriaki Hattori[1], Kazuo Abe[1], Masahiro Umeda[2], Masaki Fukunaga[3], Noriko Inoue[3], Yoshiaki Someya[3], Mieko Matsui[3], Saburo Sakoda[1], Tohru Sawada[3]
[1]Osaka University Graduate School of Medicine, Suita, Osaka, Japan; [2]Meiji University of Oriental Medicine, Hiyoshi, Kyoto, Japan; [3]BF Research Institute, Suita, Osaka, Japan

The heterogeneity of the tissue composition of the region of interest (ROI) may cause the inaccuracy in the quantitative analysis of single voxel MRS studies. The presented approach was based on a multiple regression analysis and incorporated the tissue composition as a predictive variable. Spectra were acquired from four ROIs in the gray matter and the white matter of each of the 75 healthy subjects (range 22-76 years old). The results showed that the concentrations of N-acetyl group and glutamate were decreased and the concentrations of *myo*-inositol and creatine+phoshocreatine were increased with different spatial distribution with aging.

11:18 *436*. Proton MRS of the Cervical Spinal Cord: Protocol Optimisation and Control Metabolite Ratios.

Fraser Cooke[1], Andrew Blamire[1], Bheeshma Rajagopalan[1], David Manners[1], Tom Cadoux-Hudson[2], Peter Styles[1]
[1]MRC MRS Unit, Oxford, Oxfordshire, UK; [2]Department of Neurosurgery, Oxford, Oxfordshire, UK

Proton MRS of the spinal cord is technically challenging. We investigated how to minimize the difficulties posed by the small size of the cord, movement with physiological cycles and field inhomogeneities characteristic of this anatomical area. Conventional imaging and Bo mapping of the region led us to choose a 35x9x7mm voxel positioned high in the cord to achieve reasonable sensitivity and acceptable lineshape. Acquisition was gated to the cardiac cycle. This protocol gave consistent and reliable spectra from the cervical cord. The metabolite levels were compared with those in the cortex, cerebellum and brainstem in 6 control subjects.

11:30 *437*. Predicting Future Development of Mild Cognitive Impairment using H-1 MRS; Optimizing Echo Time and Voxel Placement

Kejal Kantarci[1], Ronald C. Petersen[1], Bradley F. Boeve[1], David S. Knopman[1], Glenn E. Smith[1], Robert J. Ivnik[1], Eric G. Tangalos[1], Clifford R. Jack, Jr.[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

We sought to determine the optimal 1H MRS voxel placement and TE for a specific clinical application; predicting future development of Alzheimer's Disease (AD) in cognitively normal elderly and people with mild cognitive impairment (MCI). We evaluated posterior cingulate gyri, superior temporal lobe and medial occipital lobe VOIs and TEs of 30 and 135ms. Metabolite measurements from the posterior cingulate gyri with TE=30ms were the best predictor of conversion to MCI and AD. Baseline MI/Cr and Cho/Cr may be useful for predicting progression to MCI in normal elderly and NAA/Cr may be useful for predicting progression to AD in MCI.

11:42 *438*. Short TE Proton Spectroscopy in Variant and Familial Creutzfeldt Jakob Disease

Rebecca Cordery[1], David MacManus[1], John Collinge[1], Martin Rossor[1], Adam Waldman[2]
[1]Institute of Neurology, London, England, UK; [2]Institute of Neurology and Charing Cross Hospital, London, England, UK

We describe novel quantitative short TE proton MRS findings in the thalami, caudate nuclei and frontal white matter in patients with prion diseases; variant CJD, sporadic CJD and familial prion disease. Our results: 1) Reveal differing patterns of metabolite abnormality in these prion diseases, 2) show striking myo-inositol and NAA abnormalities which may reflect severe thalamic astrogliosis and neuronal loss in vCJD, 3) demonstrate regional disease involvement not seen on structural imaging sequences, 4) emphasise the importance of short TE measurements for detection of myo-inositol, and 5) suggest a potential role for MRS in clinical diagnosis of prion diseases.

11:54 *439*. Frontal Lobe and Cerebellar Choline Signals in Alcoholic Patients Increase with Abstinence

Gabriele Ende[1], Sigi Walter[1], Helga Welzel[1], Wolfgang Weber-Fahr[1], Andreas Heinz[1], Karl Mann[1]
[1]Central Institute of Mental Health, Mannheim, Germany

We performed a longitudinal 1H multislice MRSI study of the frontal lobe and cerebellum in alcoholic patients and healthy controls. CSF-corrected metabolite values are reported. We found decreased signals of choline containing compounds in the cerebellum of alcoholics compared to controls and increasing signals of choline containing compounds in frontal lobe white matter and the cingulate gyrus of abstinent patients. No changes in NAA could be detected, neither in the longitudinal design nor in comparison with healthy controls.

12:06 *440*. Absolute Quantification of Metabolic Changes in the Frontal Brain of Depressive Patients before and after Treatment: A Proton MRS Study at 3 T

Stephan Gruber[1], Richard Frey[1], Andreas Stadlbauer[2], Vladimir Mlynarik[1], Siegfried Kasper[1], Ewald Moser[1]
[1]University of Vienna, Vienna, Austria; [2]University of Erlangen-Nürnberg, Erlangen, Germany

Localized ^{1}H-MRS was used to measure 18 previously untreated depressive patients before and after treatment with Citalopram. Absolute values (mmol/kg wet weight) of the measured metabolites were calculated using LCModel. Compared to controls, depressive patients showed significantly higher absolute concentrations of tCr left-frontally and right-frontally. Four weeks after treatment tCr in patients was lower compared to baseline left-frontally and right-frontally. For both voxels tCr in patients was significantely lower after treatment compared to baseline. To our best knowledge, this is the first proton MRS study sucessfully monitoring the effect of drug treatment on depressive patients.

12:18 *441*. Acute Hyperketonemia Raises Brain Lactate Levels

Jullie W. Pan[1], Catherine Nadal[1], Jong-Hee Hwang[1], Hoby P. Hetherington[1]
[1]Albert Einstein College of Medicine, Bronx, New York, USA

We have previously reported that the brain can readily take up and consume b-hydroxybutyrate (BHB), the major ketone body. However, the quantitative extent to which brain takes up BHB and how it may affect lactate concentrations has not been examined in human brain. We used adiabatic homonuclear editing applied with a surface coil to detect occipital lobe BHB and lactate. This was performed in conjunction with infusion induced hyperketonemia, achieving plasma levels of up to 4.5mM. All studies were performed using a Varian 4T Inova whole body MR system with a 7cm 1H surface coil

GOLD CORPORATE MEMBER LUNCHTIME SYMPOSIUM
Amersham Health
Platforms and Protocols: The Great Debate

Hall F/G 12:30 - 13:30

Speaker: *Thomas M. Grist, M.D.*
University of Wisconsin Medical School, Madison, Wisconsin, USA

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
Artifact Correction

Room 718A 13:30 - 15:30 Chairs: Matt Bernstein and Jeffrey L. Duerk

Please see page 214 for details.

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
New Frontiers in Cardiovascular MR

Room 718B 13:30 - 15:30 Chairs: Frederick H. Epstein and Michael Horn

Please see page 314 for details.

CLINICAL SCIENCE FOCUS SESSION
Musculoskeletal MR Imaging: Feasibility Studies

Room 716 A/B 13:30 - 15:30 Chairs: Christopher F. Beaulieu and William B. Morrison

13:30 ***442*.** **High Resolution Quantitative Imaging of Patellar Cartilage Defects at 1.5T**

Rob HH van der Rijt[1], Harrie van den Bosch[1], Adrian Knowles[2], Joost HJPM Kortman[1], John HM Wondergem[1]
[1]Catharina Hospital, Eindhoven, Noord Brabant, Netherlands; [2]Philips Medical Systems, Best, Noord Brabant, Netherlands

Repetitive, direct blunt trauma or high-energy joint loading can cause cartilage damage without visible tissue disruption. In this abstract we demonstrate the feasibility of performing high resolution quantitative T2 mapping of patellar cartilage defects, and DWI on a clinical system, within clinically acceptable scan times. 16 Subjects were scanned on a 1.5T system using a 47mm surface coil. A GRASE multi-echo sequence was used for T2 mapping. T2 values corresponded with those reported in literature. 3D spiral imaging best demonstrated pathology.

13:40 ***443*.** **High-Resolution Cartilage Imaging in the Knee using FEMR: Comparison of Sequences**

Garry Gold[1], Ann Shimakawa[2], Brian Hargreaves[1], Shreyas Vasanawala[1], Jean Brittain[2], Christopher Beaulieu[1]
[1]Stanford University Stanford, California, USA; [2]GE ASL West, Menlo Park, California, USA

Fluctuating Equilibrium MR (FEMR) is a new rapid cartilage imaging technique based on steady state free precession (SSFP). We compared FEMR to 3D Spoiled Gradient-Recalled Echo (3D-SPGR) and 2D Fast Spin Echo (2D-FSE) in imaging articular cartilage in the knee. We imaged 10 normal volunteers and compared signal-to-noise (SNR) and SNR efficiency. FEMR may allow rapid cartilage screening in routine knee MRI, or faster high-resolution imaging for cartilage volume or thickness measurements.

13:50 *444*. Combined 4-Tesla MRI, 3-D CT and Arthroscopy in Subjects with Early Osteoarthritis

Joanna C. Suan[1], Alexandra Kirkley[2], J Robert Giffin[2], Chris J. Norley[1], Joseph S. Gati[1], Lisa M.F. Thain[2], Alison R. Spouge[2], David W. Holdsworth[1]
[1]Robarts Research Institute, London, Ontario, Canada; [2]University of Western Ontario, London, Ontario, Canada

Arthroscopy is the standard reference for the evaluation of cartilage, however this technique is invasive and lacks assessment of deep cartilage, early cartilage and subchondral bone alterations, and longitudinal evaluations. The need for non-invasive imaging techniques has driven the development of magnetic resonance imaging (MRI) and computed tomography (CT), but is limited in sensitivity and specificity by signal-to-noise ratio and image resolution at 1.5 Tesla. In this study, we have imaged arthroscopy patients with early osteoarthritis (OA) using 4-Tesla MRI and high-resolution 3-D CT. We have found that high-resolution MR images can detect changes in cartilage associated with early OA.

14:00 *445*. Do Clinical Symptoms Correlate with Abnormal Cartilage T_2?

Timothy J. Mosher[1], Yi Liu[1], Bernard J. Dardzinski[2], Michael B. Smith[1]
[1]Penn State University College of Medicine, Hershey, Pennsylvania, USA; [2]University of Cincinnati College of Medicine, Cincinnati, Ohio, USA

The purpose of the study is to determine if patients' symptoms of osteoarthritis correlate with the degree of abnormality identified on MRI T2-maps of knee articular cartilage. Patient symptoms as measured using the WOMAC Osteoarthritis Index were compared to regional T2 abnormalities identified on quantitative MRI T2 maps of knee articular cartilage. There was weak correlation between patient symptoms and MRI T2 scores.

14:10 *446*. $T_{1\rho}$ Relaxation Mapping: Quantitative *In Vivo* Assessment of Early Degenerative Changes in Symptomatic OA Subjects

Ravinder Reddy Regatte[1], Sarma V.S. Akella[1], Gwen Lech[1], Arijitt Borthakur[1], John Bruce Kneeland[1], Ravinder Reddy[1]
[1]University of Pennsylvania, Philadelphia, PA, USA

The purpose of the work was to demonstrate the feasibility of quantifying the early degenerative changes in patellofemoral joint, in vivo, using T1r relaxation mapping. Five early symptomatic osteoarthritic (OA) subjects were studied using 3D-T1r weighted MRI at 1.5T. In all these subjects, either lateral facets or medial facets of patellar cartilage showed elevated T1r. T1r relaxation times computed in elevated regions of interest (ROI) on cartilage vary from 63±3ms to 75±6ms, which represents a 26-50% increase in T1r when compared to that in healthy control subjects.

14:20 *447*. *In Vivo* dGEMRIC Observations of Cartilage in the Knee

Ashley Williams[1], Brian McKeon[2], Lyle Micheli[3], Amy Gillis[1], Martha Gray[1], Deborah Burstein[1]
[1]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA; [2]New England Baptist Hospital, Boston, Massachusetts, USA; [3]Brigham and Womens Hospital, Boston, Massachusetts, USA

We examined in vivo dGEMRIC images of articular knee cartilage in 22 asymptomatic and sympotomatic individuals. The dGEMRIC index (T1) varied over a range from 350 ms to 550 ms, with focal areas below 350 ms; these results provide some guide for the identification of high, mid, and low ranges of the dGEMRIC index in vivo. Differences between the lateral and medial compartments were observed, as were increases in the dGEMRIC index in volunteers who were post-arthroscopy and on glucosamine supplements.

14:30 *448*. Measurement of Gd-DTPA Pharmacokinetics in the Pediatric Knee using Perfusion-Weighted MR Imaging

Dagnachew W. Workie[1], Bernard J. Dardzinski[2], Tal Laor[3], Kathleen L. Emery[3]
[1]University of Cincinnati, Cincinnati, Ohio, USA; [2]Cincinnati Children's Medical Center, Cincinnati, Ohio, USA; [3]University of Cincinnati College of Medicine, Cincinnati, Ohio, USA

Open two-compartment pharmacokinetic modeling was applied to quantify Gd-DTPA dynamic contrast enhanced MR imaging in the knee of children with a history of osteochondritis dessicans (OCD, Group I) or juvenile rheumatoid arthritis (JRA, Group II). A specific enhancement pattern was observed for each individual. Besides other kinetic parameters, a parameter which is a function of permeability surface area product was found to show significant variation among individuals. This model may be used to evaluate disease activity and assess therapeutic efficacy.

14:40 449. Measurement of Skeletal Muscle Perfusion in Normal Volunteers During Reactive Hyperemia: Validation of a "Step Input" Gadolinium Enhanced Method using Arterial Blood Flow Techniques

Richard B. Thompson[1], Venkatesh K. Raman[1], Alexander J. Dick[1], Robert S. Balaban[1], Elliot R. McVeigh[1], Robert J. Lederman[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Skeletal muscle (calf) blood flow is measured in eight normal volunteers during post-ischemic reactive hyperemia. Regional muscle blood flow is measured with Gd-DTPA inflow enhancement using a step input of Gd-DTPA concentration achieved with the release of the occlusive thigh cuff used for inducing hyperemia. Additionally, global calf blood flow during hyperemia is measured both in the popliteal artery, with real-time phase contrast MRI, and with conventional venous occlusion strain-gauge plethysmography. The phase-contrast flows have a correlation of r2 = .82 with the Gd-DTPA inflow results, while the plethysmographic flow had an r2 < .25 with either method.

14:50 *450*. *In-Vivo* T_1 and T_2 Measurements of Muskuloskeletal Tissue at 3T and 1.5T

Eric Han[1], *Garry Gold*[2], *Jeffrey Stainsby*[3], *Graham Wright*[3], *Christopher Beaulieu*[2], *Jean Brittain*[1]
[1]GE Medical Systems ASL West, Menlo Park, California, USA; [2]Stanford University, Stanford, California, USA; [3]Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada

T1 and T2 values of muskuloskeletal tissues were measured in 5 normal volunteers at 1.5T and 3T. Look-Locker and T2 preparation methods were used to acquire images at different points on the T1 and T2 relaxation curves. A mono-exponential fit of the sampled points yielded T1's and T2's that were in the range of published values. Knowledge of 3T relaxation time constants is critical for the development of optimized muskuloskeletal imaging protocols at the higher field strength.

15:00 *451*. Proton Imaging of Periosteum and Cortical Bone with Ultrashort TE (Ute) Pulse Sequences

Ines Reichert[1], *Peter D. Gatehouse*[2], *David N. Firman*[1], *Karyn E. Chappell*[1], *Amy H. Herlihy*[1], *Joanne Holmes*[1], *Ian R. Young*[1], *Graeme M. Bydder*[1]
[1]Imperial College, London, UK; [2]MRRS, Guildford, Surrey, UK

Adult periosteum and cortical bone have very short T2's and characteristically produce no signal with virtually all pulse sequences used in clinical practice. This lack of signal has meant that these tissues have been poorly determined in MR terms. The use of ultrashort TE (Ute, TE = 80 msecs) pulse sequences produces detectable signal from these tissues. Changes in this signal can then be observed after contrast enhancement and proximal to fractures probably as a result of increased blood flow. Ute sequences may be of particular value in characterizing the organic matrix of cortical bone.

15:10 *452*. Simultaneous Acquisition of 3D µ-MR Images of Trabecular Structure in the Distal Tibia and Calcaneus

Aranee Techawiboonwong[1], *Hee Kwon Song*[1], *Felix W. Wehrli*[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Micro-MRI is able to generate images at a resolution sufficient to quantify trabecular bone network architecture at such peripheral sites as the distal radius, calcaneus and distal tibia. However, it is currently not known which sites are most predictive of architectural changes occurring at the common fracture sites in response to treatment. The goal of this work was to image two nearby locations in a single scan. For this purpose a 3D FLASE was modified to simultaneously acquire images from the tibia and the calcaneus in an interleaved fashion, thus essentially halving total scan time of performance with successive scans.

15:20 *453*. A Registration-Based MR Method for Calculating *In-Vivo* 3-D Knee Joint Motion: Validating Finite Element Simulations

Avril D. McCarthy[1], *Steven Wood*[2], *David C. Barber*[1], *D. Rodney Hose*[2], *David Chan*[3], *Derek R. Bickerstaff*[3], *Gail Darwent*[1], *Iain D. Wilkinson*[2]
[1]Sheffield Teaching Hospitals Trust, Sheffield, Yorkshire, UK; [2]University of Sheffield, Sheffield, Yorkshire, UK; [3]Sheffield Centre of Sports Medicine, Sheffield, Yorkshire, UK

A registration-based method to calculate in-vivo knee joint motion from MR data has been developed. Its purpose is to permit validation of finite element (FE) simulations of knee joint motion. High resolution T2* volumes, and quasi-dynamic T1-weighted cine images of the knee under load, were acquired and segmented. A rigid transformation method was developed to map the segmented volume onto the sparse dynamic segments and the Levenberg-Marquardt non-linear least squares minimisation method used to decompose the resultant matrix into its Euler rotation components. Calculated joint angles of the tibia relative to the femur demonstrate the knee's screw-home mechanism.

CLINICAL SCIENCE FOCUS SESSION
Functional Abdominal and Pelvic MR Imaging

Room 713 A/B 13:30 - 15:30 Chair: Kaori Togashi

13:30 *454*. MR Lymphangiography for Detection of Minimal Nodal Disease in Patients with Prostate Cancer: Does Postcontrast Imaging Alone Suffice for Accurate Characterization

Mukesh G. Harisinghani[1], *Ralph Weissleder*[1], *Peter F. Hahn*[1], *Mansi Saksena*[1], *Shahin Tabatabei*[1], *Peter Mueller*[1]
[1]Massachusetts General Hospital, Boston, Massachusetts, USA

Ultrasmall superparamagnetic iron oxide [USPIO; (Combidex™] is a relatively new RES targeted MR contrast agent that is known for lymph node uptake. The current imaging technique with USPIO involves imaging pre- and 24 hours after contrast administration. The purpose of this study was to evaluate the utility of USPIO enhanced images alone in characterizing lymph nodes in staging patients with prostate cancer

13:40 *455*. Comparison of Techniques for Measuring T_1 under Flow Conditions: Implications for Assessment of Renal Function

Sara K. Alford[1], Orhan Unal[1], Frank R. Korosec[1], Thomas M. Grist[1]
[1]University of Wisconsin - Madison, Madison, Wisconsin, USA

Measuring T_1 differences in the renal artery and vein following gadolinium contrast media injection may be used to assess renal function; however the accuracy of the T_1 measurements is critical. In this study, we validated T_1 measurements for a fast steady state free precession (SSFP) sequence and an echo planar Look-Locker (EPI LL) sequence under static and flowing conditions. Our results suggest that SSFP and EPI LL methods provide accurate and rapid T_1 measurements for calculation of extraction fraction.

13:50 *456*. Color R_2* Map to Access Renal R_2* Changes during Water Diuresis

Chun Zuo[1], Neil Rofsky[2], Houman Mahallati[2], Jeongsik Yu[2], Ming Zhang[3], Scott Gilbert[2], Frank Epstein[2]
[1]McLean Hospital, Belmont, Massachusetts, USA; [2]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA; [3]Medonline Co., Lexington, Massachusetts, USA

BOLD MRI has previously been used to study renal function. The method of data analysis in previous studies utilized a number of ROIs in medulla and cortex throughout the renal R2* maps to estimate changes in renal oxygenation during water diuresis. Owing to the complicated anatomy of the human kidney and the arbitrary nature of ROI placement, a large variance of the averaged R2* values may limit the application of renal BOLD MRI. This study investigated the use of color R2* map as a graphic alternative to access the changes in renal oxygenation in human kidneys during water diuresis.

14:00 *457*. Diffusion-Weighted Imaging of the Abdomen Within a Single Breath-Hold

Roland Bammer[1], Lawrence C. Chow[1], F. Graham Sommer[1], Michael E. Moseley[1]
[1]Stanford University, Stanford, California, USA

A diffusion-weighted single-shot EPI (DW-sshEPI) pulse sequence was designed to generate high-quality diffusion-weighted images and corresponding isotropic ADC maps with full coverage of the solid organs of the abdomen in a single breath-hold. DWIs of high quality were obtained in 12 healthy subjects and 12 patients with various abdominal masses and corresponding isotropic diffusion coefficients were calculated. For the first time in-vivo it was found that diffusivity is markedly decreased in obstructive kidney disease.

14:10 *458*. Application of a GRASE Multi-Echo Sequence for Rapid High Resolution T_2 Mapping of the Prostate

Frank van Megen[1], Adrian Knowles[2], Eric Vrijhof[1], John HM Wondergem[1], Harrie van den Bosch[1]
[1]Catharina Hospital, Eindhoven, Noord Brabant, Netherlands; [2]Philips Medical Systems, Best, Noord Brabant, Netherlands

Using a new clinically available GRASE multi-echo sequence we investigate its application for quantitative T2 mapping of the prostate. Fifteen subjects were scanned on a clinical 1.5T system. Eighteen images, each with a different TE (12ms, 24 ms..204ms), were acquired in a scantime of 2:40 minutes. The in-plane resolution was 1.6mm2 with a slice thickness of 3.5mm. Signal-to-Noise was adequate even at the long TE's allowing accurate curve fitting to be performed. This sequence allows rapid, accurate, T2 mapping to be performed in the clinical environment for determination of prostate cancer, thus providing the possibility of monitoring treatment response.

14:20 *459*. Correlation Between Endorectal MRI and Diffusion Weighted Imaging (DWI) in Cancerous and Normal Prostate

Keya Hosseinzadeh[1], Samuel Schwarz[1]
[1]University of Maryland, Baltimore, Maryland, USA

This study determined the relationship of DWI and ADC values between normal and cancer tissue in patients with prostate cancer. 11 patients with biopsy proven cancer were studied by endorectal MRI and DWI. Using a grid system, regions in the prostate gland were denoted as "cancer" and "normal" on T2 images and corresponding ADC values calculated. The difference in mean ADC values for cancer and normal tissue were statistically significant. Conclusion: DWI demonstrates a complimentary role in tumor detection in prostate cancer.

14:30 *460*. Diffusion Tensor Imaging of the Prostate

Daniel Tozer[1], Peter Gibbs[2], Lindsay W. Turnbull[2]
[1]University College London, London, UK; [2]University of Hull, Hull, Yorkshire, UK

Diffusion tensor imaging is applied to the prostate to measure properties of prostatic tissues such as the principle diffusion eigenvector and fractional anisotropy. It is thought that structures such as the acini, which run craniocaudally, may result in diffusion along them being easier. It was found that diffusion is indeed greater along the craniocaudal direction, however due to the large nature of the ADC's this may be due to flow in the acini as opposed to anisotropic diffusion. It was also found that Prostatic Carcinoma has a significantly higher fractional anisotropy than the other two tissue types.

14:40 ***461***. ***In Vivo* Determination of the Microvascular Characteristics of Prostate Cancer using Dynamic Contrast-Enhanced MRI**

David L. Buckley[1], Caleb Roberts[1], Geoff J.M. Parker[1], John P. Logue[2], Charles E. Hutchinson[1]
[1]University of Manchester, Manchester, England, UK; [2]Christie Hospital, Manchester, England, UK

Tumour angiogenesis is a recognised prognostic indicator in patients with prostate cancer treated with external beam radiotherapy. Using rapid dynamic contrast-enhanced 3D MRI and a distributed parameter tracer kinetic model the microvascular characteristics of prostate cancer were assessed in a group of patients prior to treatment with radiotherapy. Blood flow was higher in the tumours than in normal peripheral zone but there were no significant differences in PS product or blood volume. This novel approach may prove valuable as a prognostic tool and the patients will be studied post-treatment to assess tissue response.

14:50 ***462***. ***In-Vivo* Perfusion and T_1 Measurements in the Female Pelvis during the Normal Menstrual Cycle**

Caroline Hoad[1], Jon Fulford[1], Nick Raine-Fenning[2], Bruce Campbell[2], Ian Johnson[2], Penny Gowland[1]
[1]Nottingham University, Nottingham, UK; [2]University Hospital, Nottingham, UK

Uterine perfusion and T_1 were measured in healthy, ovulatory women using a FAIR EPI sequence at three different times during the normal menstrual cycle (follicular, peri-ovulatory and luteal phases). The statistically significant changes in the data were: increase in perfusion in the myometrium between the follicular and peri-ovulatory phases, lower perfusion in the endometrium compared to the myometrium for the follicular and peri-ovulatory phases and a decrease in T_1 in the endometrium between peri-ovulatory and luteal phases. Overall this technique showed potential for these two parameters in investigating the female pelvis.

15:00 ***463***. **Endometrial and Junctional Zone Volume Measurements in Unexplained Infertility: The Effect of Sildenafil Citrate (Viagra™)**

Caroline Hoad[1], Jon Fulford[1], Nick Raine-Fenning[2], Bruce Campbell[2], Ian Johnson[2], Penny Gowland[1]
[1]Nottingham University, Nottingham, UK; [2]University Hospital, Nottingham, UK

Sildenafil citrate (Viagra™) was used in a double blind cross-over trial to determine its effect on endometrial and junctional zone volumes in both unexplained infertility and a control group of apparently fertile women. Tissue development was assessed using T_2-weighted magnetic resonance imaging of the pelvis, at three different time points in the menstrual cycle (early follicular phase, ovulation, mid-luteal phase). There was no difference in volumes between the placebo and Viagra™ cycles. At ovulation endometrial and junctional zone volumes were smaller in the infertility compared to the control group although the difference was not statistically significant (P>0.1).

15:10 ***464***. **Circadian Rhythm of Uterine Peristalsis**

Aki Kido[1], Kaori Togashi[1], Asako Nakai[1], Masako Kataoka[1], Takatoshi Fujiwara[1], Ari Kobayashi[1], Shingo Fujii[1], Junji Konishi[1]
[1]Kyoto University, Kyoto, Japan

The uterus has an inherent contractility. Recent investigations have shown subtle and wave-like movement of the subendometrial myometrium and endometrial striping in women of reproductive age using cine mode MR imaging. These movements have been called uterine. Literatures have indicated close relationship between uterine peristalsis and menstrual cycle phases, indicating its possible role in sperm transport, discharge of menstrual blood. However, there has been no investigation on the possible fulctuation of peristalsis during the day. Our purpose is to confirm the presence or absence of the circadian change of the uterine peristalsis in women of reproductive age.

Coil Array Design for Parallel Imaging

Room 718A 16:00 - 18:00 Chairs: Daniel K. Sodickson and Steven M. Wright

16:00 ***465***. **New RF Coil Topology for High Performance SENSE in 3D**

Derek Seeber[1], Veilibor Pikelja[1], Jovan Jevtic[1]
[1]IGC Medical Advancs, Inc., Milwaukee, Wisconsin, USA

It has been recognized that RF coil geometry plays a crucial role in SENSE performance. However, to date, only minor modifications to conventional loop layout have been proposed, such as the use of non-overlapping loops. We propose a radically new coil topology using triangular loops, specifically tailored for SENSE acceleration along all three orthogonal axes. Our design allows for an additional 2-fold acceleration in the z-direction, without compromising the SENSE performance in the transverse plane, and, most importantly, without increasing the number of channels. SENSE g-factor maps and the new coil layout will be presented.

16:12 ***466***. **Sixteen Channel Gapped SENSE Array for Brain Imaging at 3T**

Patrick Ledden[1], Jacco de Zwart[2], Peter Gelderen[2], Jerzy Bodurka[2], Jeff Duyn[2]
[1]Nova Medical, Inc, Wakefield, Massachusetts, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

We demonstrate a sixteen channel whole-brain surface coil array for functional brain imaging at 3T. A combination of capacitive isolating circuits and ultra-low impedance preamplifiers decoupled the gapped array elements and provided a high degree of isolation between channels. Sensitivity was increased over a conventional whole brain coil by up to 6 fold in the cortex and 2 fold in the deep brain structures. G factor maps showed excellent SENSE performance at rates 2-4.

16:24 *467*. A 16-Channel Transmit/Receive Volume Lattice Array (VLA) for High Acceleration in Parallel Imaging

Ray F. Lee[1], Eddy B. Boskamp[2], Randy O. Giaquinto[1], Michael A. Ohliger[3], Daniel K. Sodickson[4]
[1]GE Global Research Center, Niskayuna, New York, USA; [2]GE Medical System, Milwaukee, Wisconsin, USA; [3]Harvard-MIT, HST, Boston, Massachusetts, USA; [4]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

An analytic relationship between coupled and decoupled array structures was derived in the context of a volume lattice array (VLA) consisting of encircling strips and a cylindrical ground plane. A 16-channel transmit/receive volume lattice array (VLA) and a 16-way transceive RF front-end were constructed. Parallel MRI experiments with the VLA tuned to its 0th-mode achieved double-digit (up to 16-fold) acceleration factors, demonstrating that not only decoupled but also appropriately coupled arrays can be used for parallel imaging.

16:36 *468*. A Novel SENSE-Optimized 8-Channel Hybrid Transmit/Phased Array Receive Head Coil for 3T and 4T Horizontal Systems

Yun-Jeong Yang[1], Xiaoyu Yang[1], Labros S. Petropoulos[1]
[1]USA Instruments, Inc, Aurora, Ohio, USA

A novel SENSE-optimized 8-channel Hybrid head coil consisting of; a) a 16-leg transmit birdcage resonator, and b) an 8- channel array of non-overlapping but mutually decoupled elements is presented. The transmit and receive coils are electrically separated entities but mechanically integrated. Average and local SAR of the hybrid structure using commercially available software on the head model were calculated at 3T and 4T, respectively. In vivo SENSE and GRAPPA imaging of a human volunteer with a constructed hybrid prototype coil was performed on a 3.0 T whole body scanner, providing exceptionally good images for reductions factors up to R=4.

16:48 *469*. Depth Penetration of RF Coil Arrays for Sequential and Parallel MR Imaging

D. K. Sodickson[1], R. F. Lee[2], R. O. Giaquinto[2], C. M. Collins[3], C. A. McKenzie[1], M. A. Ohliger[4], A. K. Grant[1], J. D. Willig-Onwuachi[1], E. N. Yeh[4], H. Y. Kressel[1]
[1]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, USA; [2]GE Global Research Center, Niskayuna, New York, USA; [3]Pennsylvania State University College of Medicine, Hershey, Pennsylvania, USA; [4]Harvard-MIT Division of Health Sciences and Technology, Boston, Massachusetts, USA

In order to address concerns about depth penetration of arrays with large numbers of small elements, SNR was evaluated as a function of depth and parallel imaging acceleration factor in arrays with varying numbers of elements but the same total physical extent. Theory and electrodynamic simulations confirmed that, at fixed acceleration factor, larger numbers of smaller elements yield higher SNR at arbitrary depth than their fewer-element counterparts. Experimental results in four-, two-, and one-element arrays showed similar behavior. An eight-element array showed modest relative decreases in depth penetration at low accelerations (likely due to coupling) but gains at higher accelerations.

17:00 *470*. Simulations with Optimized SENSE-coil Arrays

Peter Mazurkewitz[1], Volkmar Schulz[2], Hermann Singer[3]
[1]TUHH Technologie GmbH, Hamburg, Germany; [2]Philips Research Laboratories, Hamburg, Germany; [3]Technische Universität Hamburg Harburg, Hamburg, Germany

For the design of RF-coil-arrays for parallel imaging techniques like SENSE and SMASH, correlated noise and sensitivity profiles are important. The electromagnetic field of each coil of an array can be considered as weighted linear combination of a set of known fields from simple coils, called base coils. Based on this idea, a numerical method is presented, which calculates the current pattern of optimized SENSE-coil profiles with arbitrary accuracy, including simulated noise and sensitivity data. Simulations of an optimized SENSE-coil, investigations of SNR and geometry-factor are shown.

17:12 *471*. Real-Time Large-FOV MRI with a Massively Parallel 32-Channel MRI System and Detector Array

Christopher J. Hardy[1], Robert D. Darrow[1], Manojkumar Saranathan[2], Randy O. Giaquinto[1], Kenneth W. Rohling[1], Charles L. Dumoulin[1], Yudong Zhu[1], Paul A. Bottomley[3]
[1]GE Global Research Center, Niskayuna, New York, USA; [2]GE Medical Systems, Waukesha, Wisconsin, USA; [3]Johns Hopkins University, Baltimore, Maryland, USA

The advantages of very large array sizes for high-speed 2D MRI were explored using a 32-channel parallel-MRI torso array and a custom 32-channel 1.5 T MRI system. Real-time large field-of-view (FOV) imaging was performed using an interleaved echo-planar pulse sequence, and body survey imaging with a repeated single-shot fast-spin-echo (SSFSE) sequence. Variable FOV shifting and parallel imaging techniques were used to accelerate image acquisition. The use of a high number of coils allowed expansion of the FOV during rapid imaging while maintaining relatively high frame rates and spatial resolution.

17:24 *472*. A 64 Channel Planar RF Coil Array for Parallel Imaging at 4.7 Tesla

Mary Preston McDougall[1], Steven M. Wright[1], David G. Brown[1]
[1]Texas A&M University, College Station, Texas, USA

Dynamic MR imaging is becoming an invaluable diagnostic tool while simultaneously physiological and instrumentation limitations are being approached for gradient based fast sequences. The ability of multiple receiver coils to decrease scan time without increasing gradient demands is therefore an area greatly necessary to develop and explore. Using arrays of four to eight elements, it is becoming common to obtain accelerations of two to three in a clinical setting. This abstract describes the development and design of the first 64 channel RF receive coil array that has been used to obtain images in as little as a single echo.

17:36 *473*. **SENSE Imaging with Multi-Port TEM Coils at Ultra High Field**

Amir M. Abduljalil[1], Petra Schmalbrock[1], Ryan Gilbert[1], Donald W. Chakeres[1]
[1]The Ohio State University, Columbus, Ohio, USA

Parallel imaging using SENSE or SMASH with data from multiple receive surface coils has been used at low field strength (<3 T) to reduce scan times for a variety of applications. This work implements the SENSE processing method to unfold images acquired with an 8 Tesla (T) magnet and using a volume transverse electromagnetic (TEM) head resonator. Four independent receiver channels were utilized successfully enabling a four -fold reduction in acquisition time for ultra high resolution imaging at 8T.

17:48 *474*. **Transceive Stripline Arrays for Ultra High Field Parallel Imaging Applications**

Gregor Adriany[1], Pierre-Francois Van de Moortele[1], Florian Wiesinger[2], Peter Andersen[1], John Strupp[1], Xiaoliang Zhang[1], Carl J. Snyder[1], Wei Chen[1], Klaas P. Pruessmann[2], Peter Boesiger[2], J. Thomas Vaughan[1], Kamil Ugurbil[1]
[1]University of Minnesota Medical School, Minneapolis, USA; [2]University and ETH Zurich, Switzerland

We present four and eight channel transceive stripline arrays for ultra high field parallel imaging applications. Good coil decoupling between stripline array elements was achieved without preamplifier decoupling. With the four channel array as well as the eight channel array we achieved high reduction factors and excellent average g-factors. Our results confirm the prediction that the maximal achievable reduction factor increases with field strength.

MR PHYSICS AND TECHNIQUES FOR CLINICIANS

Room 718B 16:00 - 18:00 Chairs: Frank R. Korosec and Joseph C. McGowan

Educational Objectives

Upon completion of this course, participants should be able to:

- Define and describe the fundamental principles of MR imaging, including the definition of spin magnetization, the Larmor relationship, relaxation phenomena, and the process of using the spin magnetization to produce an image;
- Explain imaging pulse sequences based upon spin and gradient echoes, incuding fast spin echo and echo planar techniques;
- Design MR imaging protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio, and artifacts;
- Describe the principles and capabilities of various advanced MR techniques including diffusion, cardiac and functional MRI and spectroscopy.

16:00 **Image Quality and Acquisition Speed**
Norbert J. Pelc

16:40 **Ultrafast Imaging**
Marcus Alley

17:20 **Diffusion Imaging**
Konstantinos Arfanakis

Image Reconstruction

Room 701A 16:00 - 18:00 Chairs: Peter Börnert and John Pauly

16:00 *475*. **Partial k-Space Reconstruction for Under-Sampled Variable-Density Spiral Trajectories**

Jin Hyung Lee[1], John Pauly[1], Dwight Nishimura[1]
[1]Stanford University, Stanford, California, USA

A modified POCS algorithm for partial k-space reconstruction was applied to spiral trajectories. Using variable-density spiral trajectories, low resolution phase maps can be acquired while the outer k-space region is under-sampled. The phantom experiment result shows significant improvement using POCS reconstruction compared to the regular gridding reconstruction.

16:12 *476*. Conjugate Phase Reconstruction with Spatially Variant Sample Density Correction

Douglas C. Noll[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

A modification to the conjugate phase reconstruction for spiral image reconstruction in which the density compensation function depends on both time and space for objects with a spatially variant magnetic field inhomogeneity is proposed. This density compensation is based on local k-space trajectories that are distorted by spatially variant in-plane gradients resulting from magnetic field inhomogeneities. We demonstrate that the use of a spatially variant density compensation function results in a reduction in hyper and hypo-intensities that result from non-uniform sampling of the local k-space, confirmed using both simulated and experimentally acquired spiral data.

16:24 *477*. Determination of the Sampling Density Compensation Function Using a Point Spread Function Modeling Approach and Gridding Approximation

Alexei A. Samsonov[1], *Eugene G. Kholmovski*[1], *Chris R. Johnson*[1]
[1]University of Utah, Salt Lake City, Utah, USA

Reconstruction of MRI images from data sampled on arbitrary k-space trajectories requires determination of the sampling density compensation function (DCF) that is used to compensate for nonuniform sampling density. We propose a new method for finding the DCF based on a point-spread function (PSF) modeling approach and gridding approximation of the resulting matrix equation. The proposed method for DCF determination was tested on simulated and real MRI data sampled on radial and spiral trajectories and was demonstrated to provide smaller reconstruction errors than other iterative DCF estimation techniques.

16:36 *478*. Combined ΔB_0 and T_2* Correction for Radial Multi-Gradient-Echo Imaging

Holger Eggers[1], *Tobias Schaeffter*[1], *Bernd Aldefeld*[1], *Peter Boesiger*[2]
[1]Philips Research, Hamburg, Germany; [2]Swiss Federal Institute of Technology Zurich and University of Zurich, Zurich, Switzerland

An enhanced reconstruction method for radial multi-gradient-echo imaging is proposed. The inherent oversampling of the central k-space is exploited to derive ΔB_0 and T_2* maps from the measured data. Both of them serve the correction of off-resonance and relaxation artifacts, for which an extended time-segmented conjugate phase reconstruction is employed. The benefit of this correction is illustrated by phantom experiments. Its moderate computational complexity makes the enhanced reconstruction appear suitable for real-time imaging.

16:48 *479*. Dynamic Field Map Estimation Using a Single Spiral In/ Spiral Out Acquisition

Bradley P. Sutton[1], *Douglas C. Noll*[1], *Jeffrey A. Fessler*[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

Single-shot acquisitions and high field strengths used in functional MRI scans make it sensitive to main magnetic field inhomogeneities. The ability to measure and compensate for these inhomogeneities on an individual time-point basis may lead to better image registration, motion compensation and correction for dynamic respiratory-induced variations in the field and main field drift during a study. We propose a simultaneous estimation scheme whereby the field map and field-corrected image are estimated at each time point using a single spiral in/ spiral out acquisition. Simulation and human results are presented that compare our approach to conventional field map estimation.

17:00 *480*. Rapid Correction for Concomitant Gradient Field Effects in Spiral Scans

Christopher T. Sica[1], *Craig H. Meyer*[1]
[1]University of Virginia, Charlottesville, Virginia, USA

A rapid image reconstruction method employing a linear fit to correct for concomitant gradients was developed to reduce blurring in spiral scans. An analysis was performed to determine the effect of concomitant gradients in oblique spiral scans, including the effects of physical offsets and fitting selective parts of the field map. The method was tested on spiral scans with physical offsets and compared with a frequency-segmented reconstruction. The worst-case orientation is halfway between sagittal and coronal. Image results show the linear fit alone is a quick method to provide good correction for concomitant gradients in non-isocenter scans.

17:12 *481*. Inverse Methods for Reduced k-space Acquisition

Oleg Portniaguine[1], *Carlos Bonifasi*[1], *Edward DiBella*[1], *Ross Whitaker*[1]
[1]University of Utah, Salt Lake City, Utah, USA

We used a regularized inverse method to reconstruct cardiac dynamic MR images from incomplete data. A specially selected minimum gradient support penalty functional was used to constrain the reconstruction non-uniqueness. Images nearly identical to those from fully sampled acquisitions were obtained with 10% of the phase encodes.

17:24 *482*. The Use of Robust Methods to Reduce Image Artefacts

Mark Bydder[1]
[1]University of Western Australia, Crawley, Western Australia, Australia

Partially parallel imaging has made apparent the high degree of over-determination in data sets acquired using multiple coils. Reconstruction into a final image is usually performed in a way that is optimal in the least squares sense, however least squares tends to give undue emphasis to outliers such as may be caused by artefacts. The use of robust reconstruction techniques, like simple outlier rejection or the Huber estimator, reduces the influence of outliers and hence attenuates artefacts.

17:36 *483*. Noise Performance Study of Symmetric Three Point Dixon Method

Zhifei Wen[1], Scott B. Reeder[1], Angel R. Pineda[1], Gary H. Glover[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA

The "3-point Dixon" method is used to extract water, fat and resonance offset images from three echo data. We describe the noise performance of the symmetric 3-point Dixon method. The noise performance is characterized by the effective NSA (Number of Signals Averages). For the analytical solution, the NSA is shown strongly dependent on the water/fat ratio and the fat-water phase increment per echo. Monte-Carlo simulation is used to verify the relation between the NSAs and the phase increment angle. The noise performance deteriorates significantly when water/fat ratio is 1. This singularity situation is explained from a geometric perspective.

17:48 *484*. MR Angiography at High Acceleration using Feedback Regularized SENSE and Variable Density *k*-space Sampling

Jeffrey Tsao[1], Peter Boesiger[1], Klaas P. Pruessmann[1]
[1]ETH and University of Zurich, Zurich, Switzerland

Feedback regularization significantly improves the performance of SENSE, especially for sparse data sets such as MR angiograms. However, it requires a faithful image estimate. To improve the image estimate, we propose to use variable density *k*-space sampling. The image estimate is obtained from the denser *k*-space center, while the regularized reconstruction is obtained from data on a sparser sampling grid. By using grid-like sampling patterns in both cases, Cartesian SENSE can be used for fast reconstruction. We show with 3T MRA that feedback-regularized SENSE produces good image quality at acceleration factors that may even exceed the number of receiver coils.

fMRI Data Analysis II

Room 701B 16:00 - 18:00 Chairs: Thomas T. Liu and Dietmar Cordes

16:00 *485*. Independent Component Analysis Applied to Self-paced Functional MRI Paradigms

Chad H. Moritz[1], John D. Carew[1], M Elizabeth Meyerand[1]
[1]University of Wisconsin-Madison Medical School, Madison, Wisconsin, USA

Self-paced fMRI paradigms, in which the task timing is determined by the subject's performance, can offer several advantages for clinical studies over commonly applied paradigms with predetermined stimulus timing. Independent component analysis (ICA) should be an advantageous method of deriving results from fMRI datasets with varying response timings and durations. This study reports preliminary results of ICA applied to self-paced motor and cognitive fMRI paradigms.

16:12 *486*. Neural Networks for Language Processing Determined via Group Independent Component Analysis Performed Simultaneously on FMRI Data From Separate Tasks

Vincent Jerome Schmithorst[1], Scott Kerry Holland[1]
[1]Children's Hospital Medical Center, Cincinnati, Ohio, USA

Group Independent Component Analysis (ICA) of functional magnetic resonance imaging (fMRI) data across subjects has been shown to be a powerful data-driven methodology for generating random-effects statistical inferences across subjects. By concatenating the data not only across subjects but across tasks as well, the method may be expanded to detect neural networks common to a specific set of tasks with increased statistical power. We apply the method to a set of language processing tasks: passive listening to stories, silent verb generation, and word-picture matching.

16:24 *487*. A Comparison of Three Methods for Generating Group Statistical Inferences from Independent Component Analysis of fMRI Data

Vincent Jerome Schmithorst[1], Scott Kerry Holland[1]
[1]Children's Hospital Medical Center, Cincinnati, Ohio, USA

Independent Component Analysis (ICA) is increasingly being used as a data-driven methodology for the post-processing of functional magnetic resonance imaging (fMRI) data. Several methods have been proposed for generating random-effects inferences from group ICA analysis, including concatenation of data across subjects, averaging of data across subjects, and concatenation of data across time series. The relative effectiveness of each method is investigated using simulated fMRI data.

16:36 *488*. Independent Component Analysis of fMRI Power Spectra: Spatial Grouping and Latency Estimation

Vince D. Calhoun[1], Tulay Adali[2], James J. Pekar[3], Godfrey D. Pearlson[1]
[1]Olin Neuropsychiatry Research Center/Yale University, Hartford, Connecticut, USA; [2]University of Maryland Baltimore County, Baltimore, Maryland, USA; [3]Johns Hopkins, FM Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA

A limitation of the independent component analysis (ICA) model is that a given component is required to have the same time course at every voxel. We propose a straightforward approach for reducing this limitation by performing ICA on the power spectrum of the original fMRI data (thus removing latency information). A latency map is then estimated for the components. We show that voxels with similar time courses, but different delays, are grouped into the same component. The resulting time course, component map, and latency map may provide a useful tool for the analysis of fMRI data.

16:48 *489*. Canonical Correlation Analysis and a Novel Assignment Scheme for fMRI Activation

Rajesh Ranjan Nandy[1], Dietmar Cordes[1]
[1]University of Washington, Seattle, Washington, USA

Multivariate statistical analysis has recently become popular in fMRI analysis as such methods can capture better the spatial dependencies between neighboring voxels. One such method is canonical correlation analysis where one looks at the joint timecourses of a group of neighboring voxels. Typically the maximum canonical correlation is taken as a measure of activation and is assigned to the center voxel. This assignment scheme has a severe weakness of being prone to false activations. Here we propose an alternate novel assignment scheme where the *p*-values are dynamically updated for different voxels. This method rectifies the weakness mentioned above.

17:00 *490*. Robust Ordering of Independent Components for Temporal Event-Related fMRI Data Analysis

Tamer Youssef[1], Stephen LaConte[2], Xiaoping Hu[2], Yasser M. Kadah[1]
[1]Cairo University, Giza, Egypt; [2]Emory Universty, Atlanta, Georgia, USA

We present a robust method for ranking the outcome of independent component analysis (ICA) of event-related fMRI data based on canonical correlation analysis. The new method works by observing the correlation between the initial components and a special function derived from the activation paradigm to order the resultant components.

17:12 *491*. Volterra Kernel Analysis of Event-Related fMRI Data Using Laguerre Basis Functions

Yashar Behzadi[1], Khaled R. Restom[1], Thomas T. Liu[1]
[1]UCSD, La Jolla, California, USA

Volterra kernels provides a nonparametric framework for characterizing the dynamic nonlinearities of the BOLD signal measured in fMRI experiments. However, unbiased estimates of the kernels exhibit low statistical efficiency due to the large number of parameters. In order to reduce the dimensionality of the problem, a basis expansion of the kernels can be used at the cost of increased bias. Using data from event-related fMRI experiments, it is shown that the discrete-time Laguerre functions provide an effective basis expansion with minimal bias.

17:24 *492*. A Novel ROC Type Method Based on Real (Non-Simulated) fMRI Data

Rajesh Ranjan Nandy[1], Dietmar Cordes[1]
[1]University of Washington, Seattle, Washington, USA

ROC methods are popular tools to test the efficiency of a particular fMRI method in accurately detecting the active voxels in fMRI data. It is customary to use simulated fMRI data for the ROC methods so that we have prior information about the truly active voxels. A common drawback for most simulation methods is the oversimplification of the model. In fMRI, the simulation methods also neglect the spatial dependence between neighboring voxels. Here we introduce a novel ROC method using real fMRI data which automatically takes care of the spatial dependence and has broader applicability including multivariate statistical analysis.

17:36 *493*. Validation of the Random Field Theory-based Cluster Size Test in Single-subject fMRI Analyses

Satoru Hayasaka[1], Thomas E. Nichols[1]
[1]The University of Michigan, Ann Arbor, Michigan, USA

Because of its increased sensitivity, cluster size inference is often used in single and multi-subject fMRI analyses. The random field theory (RF) theory-based cluster size test, though widely used, has only been validated for smooth, PET-like images. In this work we examined the performance of the RF cluster size test with simulated and real null fMRI data. We find that the RF test is quite conservative, with null hypothesis rejection rates never exceeding half of the nominal 0.05.

17:48 *494*. Predicting Motor Tasks in fMRI Data with Support Vector Machines

Stephen LaConte[1], Stephen Strother[2], Vladimir Cherkassky[2], Xiaoping Hu[1]
[1]Emory University/Georgia Tech, Atlanta, Georgia, USA; [2]University of Minnesota, Minneapolis, Minnesota, USA

The support vector machine (SVM) is introduced to fMRI as a method for classifying temporal scans. The SVM is found to perform comparably to canonical variates analysis (CVA) in terms of misclassification error. We examine the interpretation of the SVM model in the context of fMRI, and find that removing model-related scans enhances the statistical difference between those scans.

Cerebral Fine Structure: DTI and Manganese-induced Contrast

Room 714 A/B   16:00 - 18:00   Chairs: Afonso C. Silva and Anne-Marie van der Linden

16:00 *495*. Mn-Enhanced MRI of Neural Activity in the Mouse Midbrain

Xin Yu[1], Youssef Zaim Wadghiri[1], Clement Moreno[1], Daniel Rubin[1], Dan H. Sanes[1], Daniel H. Turnbull[1]
[1]NYU, New York, New York, USA

Manganese (Mn)-Enhanced MRI (MEMRI) has been proposed as a method to visualize neuronal activity in animals, taking advantage of the permeability of voltage-gated calcium channels to Mn2+. We tested the sensitivity of MEMRI to detect activation of the mouse auditory system, imaging mice with 3D T1-weighted spin echo MRI at defined time points after intra-peritoneal (IP) injection of MnCl2 and exposure to repetitive auditory stimulation. This easily-implemented protocol resulted in significant (10-15%) MEMRI enhancement in the auditory midbrain, compared to deafened control mice, showing the efficacy of MEMRI for detecting auditory-evoked neural activity in the mouse brain.

16:12 *496*. Cortical Laminar Architecture Revealed by Manganese-Enhanced MRI

Afonso C. Silva[1], Jung Hee Lee[1], Ichio Aoki[1], Alan P. Koretsky[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

A significant push for improving the spatial resolution of fMRI has recently allowed mapping of elemental functional units in the cortex. In order to establish the proper spatial localization of functional hemodynamics, it is important to compare functional maps with anatomical markers of cortical architecture. The goal of the present study was to use high-resolution manganese-enhanced MRI (MEMRI) to detect the neuroarchitecture of the somatosensory cortex in rodent brain. Results show that systemic administration of Mn^{2+} clearly enhances specific laminae in the cortex, allowing these images to serve as anatomical markers for functional maps.

16:24 *497*. Mn-Enhanced MRI of the Neonatal Mouse Brain

Youssef Zaim Wadghiri[1], Clement Moreno[1], Xin Yu[1], Alexandra L. Joyner[1], Daniel H. Turnbull[1]
[1]Skirball Institute - NYU, New York, New York, USA

Manganese (Mn)-Enhanced MRI (MEMRI) has recently been shown to selectively enhance a number of adult mouse brain regions following subcutaneous injection of MnCl2. We tested the sensitivity of a similar MEMRI approach in the early postnatal mouse brain. Postnatal day 1-10 (P1-P10) mice were injected intra-peritoneally with MnCl2, and imaged after 24-h with 3D T1-weighted spin echo MRI. Compared to previous results in adult mice, we observed maximum MEMRI enhancement in the cerebellum and hippocampus, but not in olfactory bulb or midbrain. MEMRI provides a new approach to image the developing cerebellar foliation patterns in the neonatal mouse.

16:36 *498*. Tracing Cortico-Fugal Projections *In Vivo* using High-Resolution MRI with Mn^{2+} Induced Contrast.

Peter R. Allegrini[1], Christoph Wiessner[1]
[1]Novartis Pharma AG, Basel, Switzerland

The aim of this study was to investigate the potential of *in vivo* MRI detection of Mn^{2+} transport for tracing neuronal projections originating in the sensorimotor cortex in healthy and lesioned rat brains. Special attention was given to the potential of visualizing neuronal sprouting of central nervous system across the midline. Beside the cortico-spinal tract, the cortico-thalamic fibres were also visualized by anterograde Mn^{2+} transport. Interhemispheric connections were found in healthy rat brains but highly enhanced fiber tract contrast connecting both hemispheres was visible 16 weeks after onset of focal photothrombotic cortical injury.

16:48 *499*. Longitudinal Studies by Dynamic Manganese Enhanced-MRI Demonstrate Differential Effects of Testosterone on HVC Neurons Projecting to RA and to Area X in Female Starlings.

Vincent Van Meir[1], Marleen Verhoye[1], Philippe Absil[1], Marcel Eens[1], Jacques Balthazart[2], Annemie Van der Linden[1]
[1]University of Antwerp, Antwerp, Belgium; [2]University of Liège, Liège, Belgium

Dynamic Manganese Enhanced MRI was used to study the effect of Testosterone on the dynamics of Mn2+ accumulation in the nucleus robustus archistriatalis (RA) and area X of female starlings that had been injected with MnCl2 through a permanent cannula implanted in the high vocal center (HVC) which is monosynaptically connected to these two nuclei. Repeated MRI six weeks apart demonstrated that the dynamics of MnCl2 accumulation was altered by Testosterone treatment in area X, but not in RA. This opens new perspectives for long term studies of functional responses of specific brain circuits to changes in endocrine conditions.

17:00 *500*. Brain Development During Metamorphosis: A 3D MRI Study of *Manduca Sexta* at 1 nl Resolution

Thomas Michaelis[1], Takashi Watanabe[1], Oliver Natt[1], Susann Boretius[1], Jens Frahm[1], Sandra Utz[2], Joachim Schachtner[2]
[1]Biomedizinische NMR Forschungs GmbH, Göttingen, Germany; [2]Philipps-Universität Marburg, Marburg, Germany

This feasibility study demonstrates that T_1- and T_2-weighted high-resolution MR images with an isotropic resolution of 100 µm identify the antennal lobe, optical lobe, and central brain of the male sphinx moth *Manduca sexta* during metamorphosis. The results suggest that repeated non-invasive 3D MR microscopy of insects can serve for a better understanding of neuronal connectivity and architecture within the developing brain.

17:12 ***501***. **High Resolution Diffusion Tensor Imaging in Study of Postnatal Mouse Brain Development**

Jiangyang Zhang[1], Linda Richards[2], Paul Yarowsky[2], Michael I. Miller[1], Peter van Zijl[1], Susumu Mori[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]University of Maryland, Baltimore, Maryland, USA

Postnatal mouse brain development was studied using fixed ex-vivo C57BL/6J mouse brain samples ranged from birth to adulthood. High-resolution diffusion tensor (DT) and T2 images were acquired using 3-D multiple spin echo sequence. We measured FA and T2 and volume changes over development. During postnatal development, T2 decreased throughout the brain, with T2 drop in white matter more significant. DT images revealed more sub-structural changes, such as cortex, hippocampus and cerebellum. We then parameterized mouse brain growth using landmark based deformation maps, to quantitatively study brain development.

17:24 ***502***. **Conventional DTI versus Slow and Fast Diffusion Tensors in Cat Brain at 9.4T**

Itamar Ronen[1], Kamil Ugurbil[1], Dae- Shik Kim[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

In this work, multidirectional diffusion MRI data were collected from a cat brain and decomposed into slow and fast diffusion tensors, and directly compared with conventional DTI data. The fractional anisotropy of the slow diffusion component was significantly higher than the anisotropy measured by conventional DTI while reflecting a similar directionality, and appeared to account for most of the anisotropy observed in gray matter, where the fiber density is notoriously low. Preliminary results of fiber tracking based on the slow diffusion component are shown. DslowTI may provide a way for increasing the sensitivity to anisotropic structures in cortical gray matter.

17:36 ***503***. **Morphological Studies of Embryonic Mouse Brain Development Using Three Dimensional Diffusion Tensor Micro-Imaging**

Jiangyang Zhang[1], Hao Huang[1], Paul Yarowsky[2], Linda Richards[2], Susumu Mori[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]University of Maryland, Baltimore, Maryland, USA

We acquired three dimensional (3D) high-resolution diffusion tensor (DT) and T2 images of ex-vivo embryonic C57BL/6J mouse brain samples from E12 to P0. We have successfully delineated critical developing structures such as neuroepithelium, cortical plate, and emerging axonal tracts at each developmental stage, and located the onset and temporal course of morphological changes underwent by these structures. Our results showed 3D whole brain characterization of developing morphological phenotype and the effectiveness of DT imaging in such studies.

17:48 ***504***. **Field Dependence of ^{17}O T_1, T_2 and SNR - *In Vitro* and *In Vivo* Studies at 4.7, 11 and 17.6 Tesla**

Peter E. Thelwall[1], Stephen J. Blackband[1], Wei Chen[2]
[1]McKnight Brain Institute at the University of Florida, Gainesville, Florida, USA; [2]University of Minnesota School of Medicine, Minneapolis, Minnesota, USA

In vivo detection of $H_2{}^{17}O$ produced metabolically from $^{17}O_2$ gas has been proposed to monitor tissue oxygen consumption rate. The short T_1 of ^{17}O allows a high degree of signal averaging per unit time. We measured ^{17}O T_1 and T_2 and performed SNR measurements at 4.7, 11 and 17.6 T. ^{17}O CSI datasets at natural abundance $H_2{}^{17}O$ concentrations were acquired from *in vivo* rat brain at 4.7 and 11 T. ^{17}O T_1 and T_2 were unaffected by B_0, the increased SNR afforded by high fields will allow improved spatial and/or temporal resolution in ^{17}O CSI of metabolically produced $H_2{}^{17}O$.

Imaging Hyperpolarized Gases

Room 716 A/B 16:00 - 18:00 Chairs: Ivan E. Dimitrov and Edwin J.R. Van Beek

16:00 ***505***. **Hyperpolarized ^3He Imaging of Human Respiratory Airways and Quantification of Airway Diameters**

Tina A. Lewis[1], Erin McKinstry[1], Angela Tooker[1], Zachary Handler[1], Joey Mansour[1], Mitchell Albert[1]
[1]Brigham & Women's Hospital, Boston, Massachusetts, USA

We have developed a novel method for imaging respiratory airways with hyperpolarized ^3He MRI, using only a single breath of hyperpolarized ^3He, while also eliminating the need for a specially programmed pulse sequence. To investigate whether the technique can be useful in diagnosing and quantifying bronchoconstriction, the dynamic multi-slice coronal lung images of six healthy adult volunteers were interrogated. The resulting airway generation diameter values were comparable to those of the Weibel model, establishing hyperpolarized ^3He MRI's clinical potential for diagnosing airway diseases.

16:12 **506.** Dynamic Radial Projection MRI of Inhaled ^{3}He Gas in Human Lungs

Jim M. Wild[1], Martyn NJ Paley[1], Larry Kasuboski[2], Andrew J. Swift[1], Stan Fichele[1], Neil Woodhouse[1], Edwin JR van Beek[1]
[1]University of Sheffield, Sheffield, UK; [2]Philips Medical, Cleveland, Ohio, USA

Radial projection imaging of ventilation dynamics using 3He gas is demonstrated in human lungs for the first time. The combination of angular undersampling and short repetition times of the radial sequence enable a rapid update in image contrast with sliding window reconstruction. Controlled flow phantom experiments using 3He gas demonstrate the temporal resolution of the method. In-vivo studies in a range of 6 healthy normals and 6 patients with a variety of lung diseases (emphysema, sarcoidosis, hemi diaphragm and early COPD) show gas flow down the trachea and bronchi and in to the lungs with a high temporal resolution.

16:24 **507.** Indirect Detection of Lung Perfusion using Hyperpolarized ^{3}He

Ivan Dimitrov[1], Erik Insko[1], Rahim Rizi[1], John S. Leigh[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

High-resolution MRI of the lung pulmonary network is noise limited because of the small voxel size being imaged and because of the problems associated with signal loses at magnetically inhomogeneous sites. We present a new approach that capitalizes on the extremely strong signal generated by hyperpolarized (HP) gases, to be used as a high-resolution remote biosensor of regional blood perfusion. Specifically, our studies show that injection of paramagnetic gadolinium into the diamagnetic blood pool creates changes in the local magnetic susceptibility. We shown that this change can be detected, remotely, using the extreme sensitivity of HP gas.

16:36 **508.** Quantitative Measurement of Regional Ventilation and Perfusion from Static Images of Hyperpolarized Gas MRI

Rahim R. Rizi[1], James E. Baumgardner[1], Jiangshang Yu[1], Masaru Ishii[2], Johan M. Edvinsson[1], Aman Jalali[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

The purpose of this study is to assess regional VA/Q using hyperpolarized (HP) 3He MRI. The theory presented is based on well-established gas exchange equations and the PAO2 obtained from the HP 3He MRI and the VA/Q is calculated without doing a perfusion measurement proper. The technique was tested in a normal porcine model with promising results.

16:48 **509.** Determination of Intrapulmonary Oxygen Partial Pressure and Oxygen Uptake by 3Helium-MRI in a Model of Pulmonary Embolism

Klaus Kurt Gast[1], Balthasar Eberle[1], Klaus Markstaller[1], Wolfgang Günter Schreiber[1], Sebastian Ley[1], Claus-Peter Heussel[1], Joerg Schmiedeskamp[2], Manfred Thelen[1], Hans-Ulrich Kauczor[1]
[1]Klinikum Universitaet Mainz, Mainz, Germany; [2]Institut fuer Physik der Universitaet Mainz, Mainz, Germany

To evaluate whether oxygen sensitive measurements in 3He-MRI detect the regional impairment of gas exchange induced by pulmonary artery occlusion, six anesthetized ventilated pigs underwent measurements before and after unilateral pulmonary artery occlusion. Oxygen sensitive 3He-MRI demonstrated local impairment of O2 uptake into pulmonary capillary blood. It offers a rapid and non-invasive approach to assess regional ventilation-perfusion equilibrium.

17:00 **510.** Assessment of Regional Lung Perfusion from Regional ^{3}He MR Ventilation Images: Potential Application to Pulmonary Emboli

Aman Jalali[1], Johan M. Edvinsson[1], Maxim Itkin[1], Victor Gil[1], Masaru Ishii[2], Ryotaro Kime[1], Joohee Im[1], Jiangshang Yu[1], Liang Guan[1], James E. Baumgardner[1], Rahim R. Rizi[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

The purpose of this study is to demonstrate indirect detection of an acute pulmonary embolism (APE) utilizing an established regional pulmonary Po2-assessing 3He MR ventilation imaging technique. We test the hypothesis that said technique will prove useful in detecting the established APE consequence of regional PAo2 elevation.

17:12 **511.** Imaging of He-3 Gas Diffusion and Distribution in the Lung at Very Low Field

Christopher P. Bidinosti[1], Jamal Choukeife[2], Pierre-Jean Nacher[2], Geneviève Tastevin[2], Alexandre Vignaud[3]
[1]Simon Fraser University, Burnaby, Canada; [2]Laboratoire Kastler Brossel, Paris, France; [3]Université Paris Sud, Orsay, France

There are several compelling arguments for wanting to utilize hyperpolarised He-3 for lung imaging at low magnetic fields (well below 1.5 T). To assess the potential of this idea, we have made in-vivo MR measurements at 3mT using a whole-body scanner (operating at reduced current) combined with home-built transmit and receive coils for operation at 100 kHz. We present good quality 1-D projection images of He-3 distribution and diffusion in the lung, as well as initial efforts with 2-D RARE imaging.

17:24 *512*. Magnetization Tagging Decay and Long-range ^{3}He Diffusion in Healthy and Emphysematous Canine Lungs

Jason C. Leawoods[1], Dmitriy A. Yablonskiy[1], Kimiaki Chino[1], Joel D. Cooper[1], Mark S. Conradi[1]
[1]Washington University, St. Louis, Missouri, USA

Diffusion of hyperpolarized ^{3}He gas has been measured by the decay of tagged longitudinal magnetization (MT) in dogs with one healthy and one emphysematous lung. This diffusivity D_{MT} measures displacements over seconds and centimeters—much larger scales than the previous methods (times of 2 ms and distances of fractions of a mm). D_{MT} in the emphysematous lungs is increased by an average factor of 2.8, while the 2-b-value ADC increase is only a factor of 1.6. This suggests D_{MT} is indeed sensitive to airway expansion and tissue destruction and may be used as a probe of long-range tissue connectivity.

17:36 *513*. MRI of Hyperpolarized He-3 Gas in Porcine Paranasal Sinuses

Masaru Ishii[1], Johan M. Edvinsson[2], Aman Jalali[2], Iman Khodaei[2], Jiangshang Yu[2], Mitchell Schnall[2], John S. Leigh[2], Rahim R. Rizi[2]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Determining paranasal sinus ostial patency plays an important role in managing sinus disease. We hypothesize that hyperpolarized 3He MRI can be used to determine paranasal sinus ostial patency. We tested this hypothesis on a porcine animal model. Our results show that He3 MRI can be used to infer ostial patency. This suggests that 3He MRI may lead to a novel diagnostic tool for treating sinus disease.

17:48 *514*. Novel Low-Pressure Production Method for Hyperpolarized Xenon

I. C. Ruset[1], S. Ketel[1], M. B. Leuschner[1], F. W. Hersman[1]
[1]University of New Hampshire, Durham, New Hampshire, USA

Due to the broad (>1nm) bandwidth of diode lasers, most xenon polarizers operate at higher pressures to broaden the rubidium absorption line. We have developed a strategy for polarizing xenon at low pressure with high efficiency, exploiting the high polarization transfer rate of Rb-Xe molecular formation. Orientation of the flow of mixed gases opposite to the laser propagation direction in a long cell allows full utilization of the laser intensity. Condensation of the rubidium in the illuminated region eliminates subsequent depolarization. Xenon polarization greater than 22% at flow rates of 3 liter/hour were achieved with less than 125W laser power.

Spectroscopic Localization and Imaging

Room 713 A/B 16:00 - 18:00 Chairs: Fernando E. Boada and Oded Gonen

16:00 *515*. Efficient k-space Sampling by Density-weighted Phase-encoding

Andreas Greiser[1], Markus von Kienlin[1]
[1]University of Würzburg, Würzburg, Germany

Acquisition-weighting of k-space reduces the ringing of the spatial-response-function. A variable number of accumulations per phase-encoding step, however, diminishes the attainable field-of-view. A new concept is to cover k-space with a variable sampling density. Density-weighting combines the advantageous side-lobe suppression of acquisition-weighting with an extended FOV, at identical resolution and sensitivity. A fast, non-iterative algorithm is presented to compute the density-weighted sampling patterns. The localization quality of density weighting is compared to accumulation-weighting and to uniform sampling, introducing the new criterion "field-of-view efficiency". The superior performance of density-weighting is demonstrated in three-dimensional phosphorous spectroscopic imaging of the human heart.

16:12 *516*. Spiral-Out Spiral-in CSI

Dong Hyun Kim[1], Elfar Adalsteinsson[1], Daniel M. Spielman[1]
[1]Stanford University, Stanford, California, USA

Spiral out-in readout sequence was used for reducing motion artifacts in CSI. In MR imaging, spiral sampling methods have been shown to have reduced motion artifacts compared to 2DFT since low spatial frequency samples are collected for every view. For the case of CSI which has relatively long readout time, spiral based readouts can accumulate phase due to the gradient moments. In this study, we used spiral out-in readout trajectory which maintains gradient moment nulling characteristics to minimize any phase modulation due to motion for CSI applications.

16:24 *517*. Improved Spatial and Temporal Resolution in Spectroscopic RARE

Wolfgang Dreher[1], Dieter Leibfritz[1]
[1]Universität Bremen, Bremen, Germany

Two modifications of the fast spectroscopic imaging (SI) method spectroscopic RARE are described. First, the matrix size in one spatial direction can be doubled if only two consecutive spin echoes are phase encoded uniformly instead of four as in the original sequence. Second, the minimum total measurement time can be halved because two consecutive echoes with identical gradient phase encoding sample the k-space at opposite k_ω-values. Both modifications require a good B_1 homogeneity, precise sequence adjustments and/or additional postprocessing. The method was implemented at 4.7T, tested on phantoms and used for proton SI of the rat brain.

16:36 *518*. Refocused Echo Amplitudes of J-Coupled Spin Systems: Effects on RARE Based Spectroscopic Imaging Sequences

Dirk Mayer[1], Wolfgang Dreher[2], Dieter Leibfritz[2], Daniel M. Spielman[1]
[1]Stanford University, Stanford, California, USA; [2]Universität Bremen, Bremen, Germany

A numerical simulation tool was developed to calculate the echo amplitudes of J-coupled resonances within a series of RF refocused echoes. The presented data show that for a refocusing flip angle < 180° the echo amplitudes oscillate around a constant value > 0 even if the chemical shift difference of the coupled resonances is larger than the pulse rate. Therefore, when the pulse interval falls short of the fast pulse rate regime, spectroscopic U-FLARE provides an improved spatial impulse response in phase encoding direction compared to spectroscopic RARE.

16:48 *519*. CPRESS with Variable Refocusing Flip Angles

Martin Buechert[1], Juergen Hennig[1]
[1]University of Freiburg, Freiburg, Germany

The principle signal behavior regarding j-coupled multiplet signals acquired with standard Press, CPress, CPress with reduced refocusing flip angles and CPress with TRAPS respective hyper echo spin preparation were compared. It is shown that the reduction of j-coupling effects is preserved under the various flip angle schemes. Therefore even at higher field strengths it is possible to acquire spectra not suffering from phase evolution effects of j-coupled substances with a considerable reduction in SAR compared to standard CPress methods while maintain the S/N. The principle of hyper echo spin preparation may be used to realize j-coupling selective methods.

17:00 *520*. High Resolution NMR Spectra in Inhomogeneous Fields via Intermolecular Double Quantum Coherences

Jianhui Zhong[1], Zhong Chen[2], Zhiwei Chen[2], Scott D. Kennedy[1]
[1]University of Rochester, Rochester, New York, USA; [2]Xiamen University, Xiamen, Fujian, People's Republic of China

Intermolecular double quantum coherence (iDQC) technique is used to yield high-resolution NMR spectra in inhomogeneous magnetic fields. The method is based on the long-range dipolar interactions between solvent and solute spins. The technique was applied to a mixture of isopropanol and dimethyl sulfoxide, a mixture of major brain metabolites, and a sample of homogenized brain tissue from a rat. Experimental results showed that the chemical shifts, coupling constants, and relative intensities obtained in an inhomogeneous field are in agreement with those in a homogeneous field. This technique may find potential applications in in-vivo MR spectroscopy.

17:12 *521*. Chemical Shift Imaging of Glutathione in the Human Brain *In Vivo*

In-Young Choi[1]
[1]The Nathan Kline Institute, Orangeburg, New York, USA

In vivo chemical shift imaging (CSI) of glutathione (GSH) in the human brain was achieved in ~5 mL volume using a selective multiple quantum filter. Both *in vivo* and phantom tests in CSI and single voxel measurements were consistent with excellent suppression of overlapping signals from creatine, GABA and macromolecules. This GSH CSI method allows us to address regional differences of GSH in aging and neurodegenerative diseases.

17:24 *522*. Measurement of Brain Glycogen Metabolism by Localized ^{13}C MR Spectroscopy in Humans

Gulin Oz[1], Pierre Gilles Henry[1], Elizabeth R. Seaquist[1], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Brain glycogen was detected in three conscious humans with ^{13}C MR spectroscopy after infusion of [1-^{13}C]glucose. The signal was localized by the use of a non-echo, outer volume suppression method that reduced the signals from outside the voxel by more than 100-fold, thereby minimizing contamination from the higher concentrated muscle glycogen. Based on the rate of ^{13}C label incorporation into glycogen and the isotopic enrichment of plasma glucose, the flux through glycogen synthase was estimated at 0.17 ± 0.05 µmol/g/h indicating that brain glycogen metabolism is very slow in the conscious human brain.

17:36 *523*. Comparison of Localised BINEPT and Cross-Polarization for PME and PDE Detection in Human Brain at 1.5T.

Laura Mancini[1], Geoffrey S. Payne[1], Martin O. Leach[1]
[1]The Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, UK

A localized cross-polarization sequence has been implemented and applied *in vivo* and *in vitro* to enhance the phosphorus sensitivity of phosphomonoester (PME) and phosphodiester (PDE) compounds for applications in oncology. It has been assessed by comparing CP-CSI with BINEPT-CSI, a localized polarization transfer (PT) sequence that achieves higher peak amplitudes than conventional CSI. Although CP is more sensitive to B_1 inhomogeneities, it achieves similar or higher enhancements than BINEPT, reaching up to twice the BINEPT signal when the Hartman-Hahn condition is well matched, with lower power deposition in tissues, presenting advantages over existing PT methods.

17:48 *524.* Chemical Shift Artifact Free Volume Selection for ^{31}P MRS

Mark Julius Albers[1], Napapon Sailasuta[2], Thomas Raidy[3], Marvin D. Nelson[1], Stefan Bluml[1]
[1]Children's Hospital-Los Angeles, Los Angeles, California, USA; [2]GE Medical Systems, Fremont, California, USA; [3]GE Medical Systems, Milwaukee, Wisconsin, USA

Very Selective Suppression (VSS) pulses with an excitation bandwidth of 11kHz were incorporated in a 31P MRS spin-echo sequence to minimize chemical shift artifacts. The VSS pulses' suppression performance of the MR signal within the suppression band and their insensitivity to chemical shift was validated in phantom experiments. In vivo spectra of excellent quality were obtained from three volunteers. Localized 31Pwith VSS volume selection is feasible and provides spectra with minimal chemical shift artifacts. Minimizing chemical shift artifacts are of importance for studying focal diseases such as brain tumors with proton decoupled 31P MRS (31P[1H]).

Clinical Cancer MR Imaging

Room 715 A/B 16:00 - 18:00 Chairs: Martin O. Leach and Wolfhard Semmler

16:00 *525.* Single and Triple Quantum Sodium MRI of Primary Human Brain Tumors

Fernando Emilio Boada[1], Denise Davis[1], Kevin Walter[1], Alejandro Torres-Trejo[1], Douglas Kondziolka[1], Walter Bartynski[1], Frank Lieberman[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

We demonstrate the use of triple quantum (TQ) filtered sodium MRI in a group of patients undergoing clinical evaluation for primary brain tumors. The TQ images were acquired using a twisted-projection readout in tandem with a three-pulse triple quantum filter. Our results demonstrate that TQ sodium MRI provides a source of contrast that it is not biased by the large sodium content of the extracellular pool and is, therefore, better suited for monitoring the changes in intracellular sodium content associated with the development of neoplastic changes

16:12 *526.* Noninvasive Monitoring of Gene Therapy in Recurrent Gliomas with Dynamic MR Imaging

Axel Gossmann[1], Christopher Bangard[1], Jürgen Voges[1], Andreas Jacobs[1], Klaus Lackner[1]
[1]University of Cologne, Cologne, Germany

MR imaging assessed data allow the determination of surrogate markers of angiogenic tumor activity; i.e. tumor fractional plasma volume (fPV) and microvascular permeability (KPS). The purpose of this study was to investigate in a prospective gene-therapy trial the safety of an intratumorally infused liposome–gene complex (LIPO-HSV-1-tk) followed by systemic ganciclovir administration. Findings demonstrate that ganciclovir but not the liposome-gene complex increases tumor microvascular permeability values, indicating the increased disintegration of the blood-brain-barrier. Changes in tumor vessel permeability provide an assay that could prove useful for clinical monitoring of gene therapies in brain tumors.

16:24 *527.* Prognostic Factors in Astrocytoma WHO II after Radiotherapy – Role of MRI Follow-Up in Therapy Outcome

Christian Plathow[1], Matthias Philipp Lichy[2], Daniela Schulz-Ertner[3], Ivan Zuna[2], Peter Bachert[2], Jürgen Debus[1]
[1]German Cancer Research Center/ University of Heidelberg, Heidelberg, BW, Germany; [2]German Cancer Research Center, Heidelberg, BW, Germany; [3]University of Heidelberg, Heidelberg, BW, Germany

MRI follow-up was performed in 139 patients with astrocytoma WHO II after fractionated stereotactic radiotherapy (FSRT). Pre-therapeutic contrast-enhancement (CM-enhancement) in the MRI proved to be a significant predictor for progression-free survival (PFS) and overall-survival (OS). Pre-therapeutic CM-enhancement must be interpreted as a sign of higher-malignisation. MRI provides the opportunity to identify regions of higher-malignisation prior to radiation therapy treatment planning. This offers the possibility to adapt therapy (RT+/- CHT). Whether additional diagnostic examinations like FDG-PET and MRI spectroscopy contribute to the diagnostic specifity remains to be shown.

16:36 *528.* The Predictive Value of Metabolic and Functional MR Parameters for Malignant Glioma Patients Undergoing Gamma Knife Radiosurgery

Antoinette A. Chan[1], Andrea Pirzkall[1], Susan M. Chang[1], Sarah J. Nelson[1]
[1]University of California San Francisco, San Francisco, California, USA

Twenty-six patients with recurrent grade IV gliomas undergoing Gamma Knife radiosurgery were evaluated using MRSI, DW-MRI and PW-MRI. Parameters considered for evaluation of the predictive value of these techniques included the choline-to-NAA index (CNI), normalized apparent diffusion coefficient (nADC), and relative cerebral blood volume (rCBV) within the target. The patients were evenly divided into groups and assessed using survival analysis techniques. The group with high CNI exhibited shorter survival times (Ä=3.8 months, p=0.025). The group with high nADC also exhibited shorter survival times (Ä=6.5 months, p=0.039). These prognostic indicators may play a role in patient management and therapy planning.

16:48 *529*. Comparison of Quantitative Histologic Micro Vessel Density and 8 Tesla MR Imaging in Patients with Gliomas

Donald William Chakeres[1], Greg A. Christoforidis[1], Abhik RayChaudhury[1], Amir Abduljalil[1], Alayar Kangarlu[1], Ming Yang[1]
[1]The Ohio State University College of Medicine and School of Public Health, Columbus, Ohio, USA

This study compares the quantitative histologic density of micro vessels ranging from 10-200 microns in five human glioma subjects to the 8 Tesla (T) gradient echo (GE) MR images. High-resolution axial GE images of the whole brain MR images were acquired. A substantial increase in the histologic density of vessels ranging from 10-100 microns was observed in the higher grade tumors. This correlated with an increase in the visiblity of the vasculature on some of the 8 T images.

17:00 *530*. A Combined Gradient-Echo/Spin-Echo DSC Method: A Surrogate Marker for Brain Tumor Histologic Grade and Angiogenesis in Patients

Kathleen M. Schmainda[1], Scott D. Rand[1], Allen M. Joseph[2], Rebecca Hanson[2], Barney D. Ward[1], Arvind P. Pathak[3], Michael A. Badruddoja[4], Hendrikus G J Krouwer[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA; [2]Marquette University, Milwaukee, Wisconsin, USA; [3]Johns Hopkins, Baltimore, Maryland, USA; [4]Duke University, Durham, North Carolina, USA

In 45 patients, diagnosed with gliomas, a simultaneous GE/SE EPI sequence was used to obtain GE (“total”) and SE (“microvascular”) relative-cerebral-blood volume (rCBV) maps and the GE:SE ratio, a marker of mean vessel diameter (mVD). A significant correlation between GE-rCBV and grade, and mVD and grade is observed for whole tumor. Only when evaluating rCBV “hot-spots” is a significant correlation between SE-rCBV and grade observed. Combined GE/SE data results in a distinct classification boundary between lower grade (II/III) and high grade (IV) tumors suggesting that this approach will provide relevant information regarding grade and potentially angiogenesis on a per-patient basis.

17:12 *531*. Evaluation of Prostate Gland Hypoxia with Quantified BOLD MRI: Initial Results from a Correlated Histological Study

N Jane Taylor[1], Dawn M. Carnell[1], Rowena E. Smith[1], Peter J. Hoskin[1], J James Stirling[1], James A. D'Arcy[2], Martin O. Leach[2], Anwar R. Padhani[1]
[1]Mount Vernon Hospital, Northwood, Middlesex UK; [2]Royal Marsden Hospital, Sutton, Surrey, UK

A study investigating prostate cancer hypoxia was performed using BOLD-MRI in conjunction with DCE-MRI and verification using pimonidazole immunostaining of co-registered histological sections. R2* alone best reflected the oxygenation status of tumours and incorporating blood volume reduced sensitivity and negative predictive value (NPV) without adding specificity. On average a positive MRI result is at least twice as likely to indicate tumour hypoxia as not. These early data provide evidence supporting the hypothesis that unstimulated BOLD-MRI can indicate the oxygenation status of human prostate cancer.

17:24 *532*. Multiparametric Proton, Sodium, And Metabolic Spectroscopic Magnetic Resonance Imaging of Human Breast Cancer

Michael A. Jacobs[1], Ronald Ouwerkerk[1], Paul A. Bottomley[1], Peter B. Barker[1], Antonio Wolff[1], Nancy Davidson[1], Zaver Bhujwalla[1], David A. Bluemke[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Combined clinical proton (1H) imaging and spectroscopy, and sodium (23Na) imaging of the breast are reported for the first time. We demonstrate that both MRSI and sodium MR can give additional information that may assist in the diagnosis of breast cancer.

17:36 *533*. Correlation of Chemotherapeutic Response with the Apparent Diffusion Coefficient of Water (ADCw) of Liver Metastases

Rebecca J. Theilmann[1], Guowei Xia[2], Alison Stopeck[2], Eric Outwater[3], Robert J. Gillies[2]
[1]VA San Diego Medical Center, San Diego, California, USA; [2]Arizona Cancer Center, Tucson, Arizona, USA; [3]University Medical Center, Tucson, Arizona, USA

The liver is a common site for breast cancer metastases. Because there are choices with regard to therapeutic approaches, an early surrogate marker of response will allow clinicians to make informed decisions regarding continuance/discontinuance of a particular therapeutic protocol. In our pilot trial in breast cancer, we are examining the apparent diffusion coefficient of water (ADCw) of liver metastases to determine if changes in the ADCw can be used as an early response indicator of successful chemotherapy.

17:48 ***534***. **Images of the Fourier Components of the Water Resonance in Breast**

Gregory S. Karczmar[1], Milica Medved[1], Weiliang Du[1], Xiaobing Fan[1], Marta Zamora[1], Peter MacEneaney[1], Yiping Du[2], Frederick Kelcz[3], Gillian Newstead[1]
[1]University of Chicago, Chicago, Illinois, USA; [2]University of Colorado, Denver, Colorado, USA; [3]University of Wisconsin, Madison, Wisconsin, USA

High spectral and spatial resolution (HiSS) MR imaging has been used to improve the quality of anatomic and functional images. HiSS datasets provide detailed water and fat spectra associated with each voxel. In many voxels, distinct components of the water and fat lineshapes can be identified. Here we demonstrate that in breast, the different Fourier components of the water resonance and the fat resonance give rise to qualitatively different images.

Pediatric Neuro MR Imaging

Room 717 A/B 16:00 - 18:00 Chairs: Alan Connelly and Ellen Grant

16:00 ***535***. **Pediatric Perfusion Imaging Using Pulsed Arterial Spin Labeling**

Jiongjiong Wang[1], Daniel J. Licht[2], Chia-Shang Liu[1], Geon-Ho Jahng[3], John Haselgrove[2], John Detre[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA; [3]University of California San Francisco, San Francisco, California, USA

Arterial spin labeling (ASL) perfusion MRI is ideally suited for pediatric imaging because it is entirely noninvasive and provides improved ASL effects due to increased cerebral blood flow (CBF) in child population. In this study, we compared pulsed ASL (PASL) perfusion imaging in neurologically normal children and healthy adults. In this cohort, the child results showed 70% increase in the ASL signal and 30% increase in absolute CBF compared to adult data. A significant linear decrease in the ASL signal with age was observed. Applications of PASL also demonstrated its feasibility in diagnosis of pediatric cerebrovascular disease.

16:12 ***536***. **Detection and Visualization of Corpus Callosum Deficits in Autistic Children using Novel Anatomical Mapping Algorithms**

Christine N. Vidal[1], Timothy J. DeVito[2], Kiralee M. Hayashi[1], Dick J. Drost[2], Peter C. Williamson[2], Beth Craven-Thuss[2], David Herman[1], Yihong Sui[1], Arthur W. Toga[1], Rob Nicolson[2], Paul M. Thompson[1]
[1]UCLA, Los Angeles, California, USA; [2]University of Western Ontario, London, Ontario, Canada

We developed a novel computational strategy to detect and map, for the first time, the spatial pattern of corpus callosum abnormalities in autistic children. By contrast with volumetric approaches, we created a statistical brain atlas, based on anatomical surface meshes, to encode morphological variability in the shape and thickness of the corpus callosum in normal and autistic children. Statistical criteria were developed to pinpoint local regions of abnormal callosal thinning. This revealed the spatial pattern of deficits in autistic children, with substantially greater discriminatory power than volumetric measures. The resulting maps may reconcile previously conflicting volumetric findings in autism.

16:24 ***537***. **Diffusion-Tensor MR Imaging in the Evaluation of Treatment-Induced Neurotoxicity in Medulloblastoma Survivors**

Pek-Lan Khong[1], Lucullus HT Leung[1], Godfrey CF Chan[1], Dora LW Kwong[1], Clara GC Ooi[1], Guang Cao[2], Fu-Luk Chan[1]
[1]Queen Mary Hospital, The University of Hong Kong, Hong Kong, Hong Kong; [2]GE Medical Systems China, People's Republic of China

We use DTI to evaluate treatment-induced neurotoxicity in medulloblastoma survivors. Fractional anisotropy (FA) of supratentorial white matter (WM) in thirteen medulloblastoma survivors was measured and compared to healthy age-matched controls. Reduction in FA was compared with deterioration in school performance. FA of patients was reduced compared to controls and this was statistically significant in the parietal WM and corona radiata (p=0.011 and p=0.040 respectively). FA reduction was greater in children with moderate/severe, compared to those with mild deterioration in school performance (60.6% and 19.9% respectively, p=0.041). DTI, using FA, is useful in the detection and monitoring of treatment-induced neurotoxicity.

16:36 ***538***. **High-Resolution Diffusion Tensor Imaging of White Matter Tract Development in Premature Infants**

Savannah C. Partridge[1], Pratik Mukherjee[1], Roland G. Henry[1], Steven P. Miller[1], Jeffrey Berman[1], Ying Lu[1], Srivastha Veeraraghavan[1], Orit Glenn[1], Donna Ferriero[1], A James Barkovich[1], Daniel B. Vigneron[1]
[1]UCSF, San Francisco, California, USA

In this study, a custom MR compatible incubator with a novel high sensitivity neonatal head coil and improved acquisition techniques were used to improve the image quality and spatial resolution for diffusion tensor imaging of premature infants. We employed the new system to acquire serial DTI exams in 8 premature newborns with normal clinical findings. From the resulting images, we were able to visualize smaller white matter tracts than previously possible, to characterize DTI parameters in these tracts, and to detect significant temporal changes in diffusion parameters of white matter pathways in the developing premature brain.

16:48 *539*. Functional Organization of Somatosensory Cortex in children: A Magnetic Source Imaging Study

Jing Xiang[1]
[1]The Hospital for Sick Children, Toronto, Ontario, Canada

Twenty children have been studied using a Magnetoencephalography(MEG) system and a 1.5 Tesla MRI system. The sources represented by the neuromagnetic signals were estimated using synthetic aperture magnetometry (SAM). Frequency-related changes were localized, and three-dimensional neuromagnetic activity was reconstructed. The extent of the reconstructed functional area in the left hemisphere was larger than that in the right hemisphere. Furthermore, the neurons related to 30 – 60 Hz and 60-120 Hz bands were clearly separated in left hemisphere in six subjects, but not in the right hemisphere.

17:00 *540*. Anisotropy Loss during Development of Cerebral Cortex in Premature Newborns is Due to Decreasing Water Diffusion Perpendicular (But Not Parallel) to the Cortical Surface

Pratik Mukherjee[1], *Kanwar Gill*[1], *Srivathsa Veeraraghavan*[1], *Roland G. Henry*[1], *Steven P. Miller*[1], *Daniel B. Vigneron*[1], *A. James Barkovich*[1]
[1]University of California San Francisco, San Francisco, California, USA

Diffusion tensor imaging can detect the radial architecture of the developing cerebral cortex in premature newborns. We measured the age-dependent changes in the 3 diffusion tensor eigenvalues within 4 regions of the neocortex in preterm neonates ages 28-37 weeks. We show that the maturational loss of diffusion anisotropy is primarily due to decreasing water diffusion in the direction perpendicular to the cortical surface, with relatively little age-related change in diffusion along the plane of the cortex. The sensitivity of DTI to microstructural features of cortical organization may aid the clinical evaluation of brain development and brain injury in premature newborns.

17:12 *541*. Developmental Functional Neuroimaging of Neonates with MR-Compatible Incubator

Stephan G. Erberich[1], *Stefan Blüml*[1], *Philippe Friedlich*[1], *Istvan Seri*[1], *Marvin D. Nelson*[1]
[1]Childrens Hospital Los Angeles, University of Southern California, Los Angeles, California, USA

FMRI of neonates and infants is a promising method to understand brain development, because of its non-invasiveness and good spatial and temporal resolution. Neonatal fMRI without incubator implies the risk of infection, hypothermia and dehydration. Therefore neonatal fMRI is currently limited by imaging time and by signal-to-noise ratio especially in the small brain of a neonate. We used a novel MR-compatible incubator in combination with a optimized neonatal volume head coil specifically developed for the small head diameters and RF-power requirements of neonates to investigate pre-term neonates using fMRI paradigms for the sensory-motor and visual areas.

17:24 *542*. Quantitative Volumetric Analysis of the Premature Neonatal Brain Following IVH by using 3T MRI

G T. Vasileiadis[1], *N Gelman*[1], *V K. Han*[1], *L A. Williams*[1], *P A. Picot*[1], *R Mann*[1], *R T. Thompson*[1]
[1]University of Western Ontario, London, Ontario, Canada

A prospective case control study was conducted to test our hypothesis that uncomplicated intraventricular hemorrhage (IVH) in very low birth weight (VLBW) premature infants, results in a reduction of cortical gray matter (CGM) volume. Volumes of brain regions were measured using three dimensional (3D) magnetic resonance images acquired using a specialized neonatal 3 T IMRIS system. Volumes of cortical gray matter at 34.6-37.1 postmenstrual weeks were found to be significantly reduced in the IVH group compared to controls ($p = 0.03$).

17:36 *543*. MR Features of Glial Cell Migration in the Preterm Infant Brain

Kazuyuki Ohgi[1], *Takashi Furukawa*[1], *Akiyoshi Yamashita*[1], *Masayuki Motonishi*[1], *Kouichirou Murata*[2], *Katsuhito Gotoh*[3], *Tomoko Matsubara*[3], *Minako Higashi*[3]
[1]Japanese Red-Cross Medical Center, Shibuya-ku, Tokyo, Japan; [2]Kitasato-Institute Hospital, Minato-ku, Tokyo, Japan; [3]Toshiba Medical Corp., Kyobashi, Chuo-ku, Tokyo, Japan

Glial cell migration (GCM) in the frontal region is observed in infants over 30 weeks' gestation, and can be potential markers of white matter maturation in preterm infant. This study illustrates MR appearances of GCM in preterm infant brain in various MR images including T1- and T2-weighted images, FLAIR, diffusion weighted imaging (DWI), apparent diffusion coefficient (ADC) and fractional anisotropy (FA) maps.

17:48 *544*. Functional MRI of Fetal Alcohol Syndrome

Krisztina Malisza[1], *Ava-Ann Allman*[1], *Deborah Shiloff*[1], *Patrick Stroman*[1], *Lorna Jakobson*[2], *Sally Longstaffe*[2], *Albert Chudley*[2]
[1]Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]University of Manitoba, Winnipeg, Manitoba, Canada

Functional Magnetic Resonance Imaging (fMRI) was used to assess differences between Fetal Alcohol Syndrome (FAS) or Alcohol Related Neurological Disorders (ARND) diagnosed individuals (adult and child) and controls. The results were correlated with standard psychological tests. In general, activations were decreased in regions of the brain associated with working memory, attention and executive function (frontal lobe and cingulate) in FAS subjects. Greater latency and incorrect responses were observed during fMRI tasks for FAS individuals, especially FAS children, compared to controls. FMRI may be a useful tool to assist in diagnosis of FAS/ARND.

MORNING CATEGORICAL COURSE
Controversies and Advances in Musculoskeletal MRI

Room 713 A/B 07:00 - 08:00 Chairs: Garry E. Gold and Lawrence M. White

Educational Objectives
Upon completion of this course, participants should be able to:
- Compare MRI with other advanced imaging modalities;
- Explain the role of interventional MRI in the musculoskeletal system;
- Explain the role of high-field MRI in the musculoskeletal system;
- Describe the technical issues related to high-resolution joint imaging;
- Evaluate options for open MRI scanners for musculoskeletal imaging.

07:00 **CT vs MRI in the Postoperative Joint: CT**
Christopher Beaulieu

07:25 **Technical Considerations: MRI in the Postoperative Orthopedic Patient**
Lawrence M. White

07:50 **Questions and Discussion**

MORNING CATEGORICAL COURSE
Parallel Imaging

Room 714 A/B 07:00 - 08:00 Chairs: Neil M. Rofsky and Daniel K. Sodickson

Educational Objectives
Upon completion of this course, participants should be able to:
- Explain the basic principles of parallel imaging, including elements both of RF coil array design and image reconstruction;
- Survey promising applications of parallel MRI in cardiovascular imaging and body imaging;
- Describe new developments in image reconstruction and coil array design, and outline emerging parallel imaging applications;
- Identify the key steps in a practical parallel imaging examination and compare the nuts-and-bolts features of various MR vendors' existing implementations.

New Developments
07:00 **Recap of Basics and Applications**
Daniel K. Sodickson

07:10 **New Developments in Image Reconstruction and Sequence Design**
Charles A. McKenzie

07:35 **New Developments in Array Design and New Applications**
David J. Larkman

MORNING CATEGORICAL COURSE
Emerging Body MR: From Structure to Function

Room 715 A/B 07:00 - 08:00 Chairs: Vivian S. Lee and Riccardo Manfredi

Educational Objectives
Upon completion of this course, participants should be able to:
- Recognize and implement recent technical advances in body MRI including BOLD and perfusion techniques, fast T_2-weighted imaging methods, and new contrast agents;
- Describe recent advances in the assessment of liver and breast for tumor, structural and functional studies of the biliary system, and MR measurements of renal function;
- Identify applications of MR to the evaluation of large and small bowel disease;
- Compare the information provided by MR elastography in the assessment of organ pathologies, such as in the breast and prostate, to conventional MR imaging techniques.

Genitourinary
07:00 **Functional Kidney MRI**
P.V. Prasad

07:30 **MR Elastography: Prostate and Breast**
Richard L. Ehman

MORNING CATEGORICAL COURSE
fMRI Experimental Methods

Room 718 B 07:00 - 08:00 Chairs: R. Todd Constable and Mathias Hoehn

Educational Objectives
Upon completion of this course, participants should be able to:
- Explain the latest developments in fMRI with respect to understanding the underlying physiology leading to the BOLD response and its relationship to neuronal activity and the influence of pharmacological substances on activation;
- Describe the factors influencing paradigm design and the optimum acquisition strategy for event-related versus block designs;
- Recognize which analysis approach is most appropriate for a particular experimental design;
- Describe the spatial limits of fMRI and factors influencing resolution.

Data Analysis
07:00 **Model-Driven Analysis**
Keith J. Worsley

07:30 **Exploratory Data Analysis**
James J. Pekar

MORNING CATEGORICAL COURSE
Diffusion Tensor Imaging

Room 718A 07:00 - 08:00 Chairs: Gareth J. Barker and Scott D. Swanson

Educational Objectives
Upon completion of this course, participants should be able to:
- Describe how/why the proton diffusion pathway in tissue can be explained by a tensor;
- Explain how the tensor is acquired, measured, and mapped;
- Describe the limitations of such diffusion tensor imaging;
- Describe more advanced diffusion measurement techniques, such as q-space and diffusion spectrum imaging;
- Appreciate the multi-exponential and/or multi-compartmental nature of diffusion;
- List and describe important clinical applications of DTI.

Research Frontiers In DTI

07:00 **Multi-exponential Decay**
Greg J. Stanisz

07:30 **Beyond Tensor Imaging**
Daniel Alexander

MORNING CATEGORICAL COURSE
Advanced MR Angiography Techniques

Room 716 A/B 07:00 - 08:00 Chairs: James Meaney, Martin Prince and Stefan Schoenberg

Educational Objectives
Upon completion of this course, participants should be able to:
- Identify the challenges of MRA implementation in anatomic areas with high technical demands;
- Compare the advantages and disadvantages of different technical approaches in these areas;
- Recognize the clinical benefit of advanced MRA protocols for a comprehensive, non-invasive work-up of vascular disease.

Approaches to Total Body MRA

07:00 **Angiosurf**
Stefan G. Ruehm

07:15 **Continuous Table Motion**
David G. Kruger

07:30 **Jumping VIPR with Continuous Table Motion**
Sean B. Fain

07:45 **Discussion**

MORNING CATEGORICAL COURSE
Spectroscopy Beyond NAA

Room 717 A/B 07:00 - 08:00 Chairs: Peter Allen, Rolf Gruetter, John Griffiths, Stephen Williams

Educational Objectives

Upon completion of this course, participants should be able to:

- List the major metabolites in addition to NAA, Crn, Cho that can be detected *in vivo* in the brain by MRS;
- Describe the biological and clinical importance of these metabolites;
- List the key factors to achieve good spectra;
- Describe the principles of data analysis in both frequency and time domain;
- Explain how MRS can be used to measure metabolic fluxes as well as steady-state concentrations;
- List the advantages and disadvantages of $^{13}C/^{15}N$ with respect to ^{1}H.

07:00 **^{1}H MRS at 1.5/2T**
Petra Pouwels

07:30 **Potential and Promise of ^{15}N NMR**
Keiko Kanamori

07:45 **^{13}C MRS at 1.5T**
Stefan Bluml

PLENARY LECTURES
Evaluation of Ischemic Heart Disease by MRI

Hall F/G 8:15 - 9:30 Chairs: Zahi A. Fayad and P.V. Prasad

Educational Objectives

Upon completion of this session, participants should be able to:

- Define current state of the art in the evaluation of ischemic heart disease by MRI;
- Select appropriate protocols for the evaluation of ischemic heart disease;
- Interpret MRI data used in the evaluation of ischemic heart disease;
- Appraise future developments in MRI applications to the evaluation of ischemic heart disease;
- Recommend appropriate tests for the evaluation of ischemic heart disease by MRI.

8:15 ***545.*** **Current State of the Art**

Steven D. Wolff[1]
[1]Lenox Hill Hospital, New York, New York, USA

During a single 30-minute MRI examination, it is possible to quantify ventricular and valvular function, assess myocardial perfusion and viability, and evaluate coronary artery anatomy. No other single imaging modality can evaluate the heart so comprehensively. Cardiac MRI is on its way to becoming a routine clinical test for the assessment of patients with ischemic heart disease.

8:40 ***546.*** **What's on the Horizon?**

Richard D. White[1]
[1]The Cleveland Clinic foundation, Cleveland, Ohio, USA

At the expense of pursuing comprehensive histological, gross anatomic and functional assessment of effects of atherosclerosis on coronary arteries and cardiac chambers, the near future for cardiac MRI should reconsider its need to provide "one-stop shopping". The cardiac MRI community must recognize the exciting developments in other imaging modalities that make pursuit of important targets of MRI (e.g. coronary plaque instablility, myocardial hibernation/stunning) a high priority and more practical. Consequently integrated imaging efforts, with other modalities supplying vital information about certain aspects of coronary artery disease/ischemic heart disease, are already being experienced at large cardiovascular centers.

9:05 547. Evaluation of Ischemic Heart Disease by MRI: What Does the Future Behold?

Elliot R. McVeigh[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

As cardiology moves more towards molecular approaches to the diagnosis and treatment of heart disease, new MRI techniques to support this effort become imperative. Direct delivery of agents such as VEGF to promote revascularization, and stem cells to promote the recovery of damaged myocardium, increase the effective dose to the target region. MRI is in a unique position to develop laboratories which can measure the function pre and post therapy, precisely target the soft tissue that should receive the injection, titrate the amount of material injected, and perform sequential follow-up tests to monitor the effect of the therapy.

Novel MRI Sequences

Room 718A 10:30 - 12:30 Chairs: James G. Pipe and Martin J. Graves

10:30 548. Fat Suppressed Steady-State Free Precession Imaging using Phase Detection

Brian A. Hargreaves[1], *Shreyas S. Vasanawala*[1], *Krishna S. Nayak*[1], *Jean H. Brittain*[2], *Bob S. Hu*[3], *Dwight G. Nishimura*[1]
[1]Stanford University, Stanford, California, USA; [2]G.E. Medical Systems, Menlo Park, California, USA; [3]Palo Alto Medical Foundation, Palo Alto, California, USA

We present a phase-based SSFP technique that provides fat-suppression without additional complexity or scan time in a standard SSFP sequence. The SSFP signal is refocused halfway between radio-frequency (RF) pulses, with the signal phase alternating as a function of resonant frequency. Selection of the repetition time as the reciprocal of the chemical shift frequency between water and lipid results in water and lipid signals having opposite signs. By simply choosing the positive or negative signal, water-only or lipid-only images can be generated

10:42 549. Robust Magnetic Field Mapping with Arbitrary Acquisition Parameters for Automated Shimming

Leonard Martyn Klassen[1], *Ravi S. Menon*[2]
[1]University of Western Ontario, London, Ontario, Canada; [2]Robarts Research Institute, London, Ontario, Canada

Increasing main magnetic field strengths and quantitative MRI techniques require improved field homogeneity. Automated methods of setting optimum shim currents rely on fitting shim coil field maps to measured main magnetic field, requiring high precision field mapping techniques. A 3D multi-echo sequence has been developed to measure main magnetic field with high precision. Automatic compensation for hardware timing errors, gradient propagation delays, gradient balance, and eddy currents enables creation of field maps with any field of view, bandwidth, or acquisition orientation without custom optimization of sequence parameters, which is particularly beneficial in functional and cardiac MRI.

10:54 550. Dispersion Measurements from Simultaneous Multi-Frequency MR Elastography

Armando Manduca[1], *David S. Lake*[1], *Jennifer L. Kugel*[1], *Phillip J. Rossman*[1], *Richard L. Ehman*[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Magnetic resonance elastography (MRE) data can be acquired at multiple frequencies simultaneously by designing the mechanical excitation and motion encoding waveforms to be the sum of harmonics at the desired frequencies. This can greatly simplify measurements of dispersion, by increasing the acquisition efficiency and by guaranteeing registration and similar experimental conditions for the different frequency data sets. Results are shown demonstrating accurate depiction of a phantom object from 100 and 200 Hz data collected simultaneously and calculations of local dispersion properties from this data.

11:06 551. T-One Insensitive Steady State Imaging (TOSSI): Obtaining TrueFISP images with Pure T_2 Contrast

Peter Schmitt[1], *Peter M. Jakob*[1], *Axel Haase*[1], *Mark A. Griswold*[1]
[1]University of Würzburg, Würzburg, Germany

A new concept is proposed for generation of purely T2 weighted images, even in the presence of signal from longitudinal relaxation. This is accomplished by imaging in between non-equally spaced 180 -pulses which alternatively flip the magnetization into states parallel and antiparallel to B_0. With optimized timing, magnetization courses are identical for different T1s, which removes T1 contrast, leaving only T2 contrast. This general idea was realized with TrueFISP readout between the 180 -pulses. Experiments on phantoms and volunteers confirmed the theory: TrueFISP images with essentially pure T2 contrast were obtained. More complex implementations are possible, e.g. by using varying timing patterns.

11:18 552. Correction and Calculation of T_1 and T_2 Maps Based on IR Balanced SSFP using an Analytical Expression of the Transient SSFP Response

Klaus Scheffler[1]
[1]University of Basel, Basel, Switzerland

A correction method to calculate T1 and T2 relaxation times from inversion prepared (IR) balanced SSFP is proposed. The method is based on an analytical description of the initial or transient phase of IR-prepared balanced SSFP, which is a function of T1, T2, TR, and flip angle α.

11:30 *553*. Multiple-Contrast and Parametric Imaging with RAD-GRASE

Arthur F. Gmitro[1], *Maria I. Altbach*[1], *Zhiqiang Li*[1], *Eric W. Clarkson*[1], *Theodore P. Trouard*[1]
[1]University of Arizona, Tucson, Arizona, USA

In RAD-GRASE different radial lines of k-space data are collected with signal magnitude and phase variations that arise due to T2 decay, T2* decay, field inhomogeneity, and chemical shift. Such variations can lead to artifacts in images reconstructed from complete data sets. However, because of the oversampling of k-space near the origin, partial data can be used to reduce data inconsistency as well as select image contrast. Furthermore, multiple images reconstructed using different partial data sets can be combined to estimate parameter maps such as T2, T2*, and fat and water content images – all from one RAD-GRASE data set.

11:42 *554*. Mathematical Analysis of MP-SSFP Gradient Refocused Echoes

Ken-Pin Hwang[1], *Jonathan S. Lewin*[2], *Jeffrey L. Duerk*[1]
[1]University Hospitals of Cleveland and Case Western Reserve University, Cleveland, Ohio, USA; [2]University Hospitals of Cleveland, Cleveland, Ohio, USA

Prior work in MP-SSFP has analyzed the spin echo signal. Here, mathematical expressions were derived for each of the four distinct gradient echoes. Phantom and volunteer head images were acquired with these sequences; image signal measurements were compared with signal predicted by the expressions. Correlation between measured and predicted signal was excellent for the phantom, white matter, and gray matter. Unexpected attenuation in fluid signal was observed for some echoes, suggesting motion or diffusion sensitivity. This work is an examination of complex steady state sequences with varying flip angles and interpulse durations to explore alternative methods for contrast in MRI.

11:54 *555*. Spatial Excitation Using Variable Density Trajectories for Imaging in a Reduced FoV

Christoph Schröder[1], *Peter Börnert*[1], *Bernd Aldefeld*[1]
[1]Philips Research Laboratories, Hamburg, Germany

The use of variable density k-space trajectories to define spatially selective excitation pulses is studied. By using variable density trajectories, unwanted aliasing-like signal excitation outside the excitation field of view can be reduced. Thus, fold-over artifacts that could arise in reduced field-of-view imaging are suppressed. Results of phantom and in vivo measurements are presented. It is shown that, with the variable density technique, a significant reduction of fold-over artifacts in multi-dimensional RF pulses can be achieved at the expense of only slightly longer pulse durations.

12:06 *556*. PSF-Choice: A Novel Method for Shaping Point-Spread-Functions in Phase-Encoding Dimensions

Lawrence P. Panych[1], *Lei Zhao*[1], *Robert V. Mulkern*[2]
[1]Brigham and Women's Hospital, Boston, Massachusetts, USA; [2]Children's Hospital, Boston, Massachusetts, USA

An imaging method, PSF-Choice, is described for obtaining arbitrary point-spread-functions (PSF) in phase-encoding dimensions. The method is particularly relevant for applications such as spectroscopic imaging where only a very few phase encodes are acquired and ringing artifact can be a serious problem. PSF-Choice uses partial 2D RF excitation to produce aliased excitations that are phase encoded. The PSF of the reconstructed result depends on the RF excitation profile which can be designed to produce any desired PSF. Phantom experiments with a Gaussian excitation demonstrate that ringing can be completely eliminated.

12:18 *557*. A Novel Pulse Sequence for Multi-Slice $T_{1\rho}$ MRI

Arijitt Borthakur[1], *Sridhar R. Charagundla*[1], *Andrew J. Wheaton*[1], *Ravinder R. Regatte*[1], *Sarma VS Akella*[1], *Ravinder Reddy*[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

A 2D multi-slice $T_{1\rho}$-weighted MRI pulse sequence is developed and implemented on a 4.7T horizontal bore MR scanner. Artifacts resulting from a non-selective spin-lock pulse are removed when the pulse is divided into an even number of pulses with alternating phases. Images of a phantom are obtained with the new pulse sequence to demonstrate its capability for multi-slice $T_{1\rho}$-weighted MRI.

CLINICAL CATEGORICAL COURSE
Cardiovascular MRI

Room 718B 10:30 - 12:30 Chairs: Zahi A. Fayad, Christopher Kramer, and P.V. Prasad

Educational Objectives
Upon completion of this course, participants should be able to:
- Describe basic areas of routine and promising clinical use of MR in assessing cardiovascular disease;
- Apply MR protocols for determination of cardiac morphology, dynamic function, flow, and physiologic status;
- Describe methodologies that help in the interpretation of results for cardiac MR assessment of acquired and congenital cardiac disease;
- Compare approaches for optimal presentation and analysis of cardiac MR results.

10:30 **Fast Imaging and Real-Time Cardiac MRI**
Frederick H. Epstein

10:55 **Atherosclerotic Plaque Characterization**
Chun Yuan

11:20 **Cardiovascular MRI in Congenital Heart Disease**
Tal Geva

11:45 **Determining Myocardial Viability**
Joao A.C. Lima

12:10 **Discussion**

fMRI Insights into Language and Cognition

Room 701A 10:30 - 12:30 Chairs: Richard W. Briggs and Patrick Stroman

10:30 ***558.*** **Deactivation of Peripheral Vision and Auditory Areas during Visual Attention Tasks**
Dardo Tomasi[1], Thomas Ernst[1], Sheeba Arnold[1], Elisabeth Castro Caparelli[1], Linda Chang[1]
[1]Brookhaven National Laboratory, Upton, New York, USA

Visual attention tasks produced a remarkably robust deactivation in the visual (rostro-medial V1) and auditory (left A1 & A2) cortices; the extent of deactivation increased with task difficulty. Findings suggest concomitant inhibition of peripheral vision (V1) and other sensory input (A1 & A2) brain areas in order to minimize competition and maximize resources for the activation of the visual attention network.

10:42 ***559.*** **Computational Roles of Temporo-Parietal Cortex in Reading Low Frequency Words**
Jie Huang[1], Thomas H. Carr[1], Lucia Colombo[2], Yue Cao[1]
[1]Michigan State University, East Lansing, Michigan, USA; [2]University of Padova, Padova, Italy

FMRI was used to investigate the role of Wernicke's area and adjacent temporoparietal cortex in reading low frequency words. Angular and supramarginal gyri are involved in generating phonology, as indicated by sensitivity to regularity of spelling-to-pronunciation mapping. However, these regions do not appear to rely on retrieval from associative memory, as indicated by a lack of sensitivity to repetition priming. Wernicke's area is also sensitive to regularity, but in addition sensitive to priming, suggesting that this region tries to integrate word-specific knowledge with the rules or patterns that generalize over larger portions of the lexicon.

10:54 *560*. A Three-Tiered Design for Elucidating the Neural Substrates of Reading

Laurie E. Cutting[1], Jeanne Wilkins[2], Joanna G.B. Schafer[2], Stewart H. Mostofsky[1], Abigail A. Flower[2], Susan M. Courtney[3], Martha Bridge Denckla[1], James J. Pekar[1]
[1]Kennedy Krieger Institute / Johns Hopkins School of Medicine, Baltimore, Maryland, USA; [2]Kennedy Krieger Institute, Baltimore, Maryland, USA; [3]Johns Hopkins University, Baltimore, Maryland, USA

FMRI has been used to examine the neural mechanisms underlying sentence comprehension; however, few studies have accounted for activation attributable to two fundamental components of sentence comprehension, single word reading (SWR) and working memory (WM). To tease apart these components of sentence comprehension, a three-tiered design was used in which five adult normal readers completed a sentence comprehension task alternated with either a SWR or a WM task; in a third experiment, the WM and SWR tasks were contrasted. Results were consistent with the hypothesis that different aspects of sentence comprehension are subserved by different neural circuits.

11:06 *561*. Gender Differences in Brain Activation during Visual Attention Processing

Sheeba Arnold[1], Thomas Ernst[1], Dardo Tomasi[1], Elisabeth Castro Caparelli[1], Linda Chang[1]
[1]Brookhaven National Laboratory, Upton, New York, USA

Sixteen healthy volunteers (9 men and 7 women) were evaluated with fMRI to study possible sex-differences during visual attention processing. Our findings demonstrate gender-specific brain activation during tasks that require selective visual attention. While cerebellar activation was predominant in men, suggesting a more automated processing strategy, frontal and PPC activation were more evident in women suggesting a more controlled or attentive process. Findings also emphasize that gender-matching or stratification is required for fMRI studies.

11:18 *562*. Hemodynamic and Electromagnetic Correlates of Verbal Working Memory: Integrating Functional Magnetic Resonance Imaging and Event-Related Brain Potentials.

Ryan D'Arcy[1], Lawrence Ryner[1], Wolfgang Richter[2], Sara Sullivan[3], Elisabet Service[4], John Connolly[4]
[1]National Research Council Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]Princeton University, Princeton, New Jersey, USA; [3]National Research Council Institute for Biodiagnostics (Atlantic), Halifax, Nova Scotia, Canada; [4]Dalhousie University, Halifax, Nova Scotia, Canada

We explored functional magnetic resonance imaging (fMRI) and event-related brain potential (ERP) correlates of verbal working memory (WM). WM load was varied during semantic processing and the spatio-temporal nature of multimodal activation was examined in the left inferior parietal lobe. The results revealed co-localization of activity in BA 40 and a coherent temporal picture of WM effects across modalities (i.e., hemodynamic, electromagnetic, and behavior). The WM activation in this study occurred during semantic processing and it will be critical to determine whether fMRI correlates of semantic ERP components exist (i.e., N400).

11:30 *563*. FMRI based Models of Learning and Memory in Normal Volunteers and Stroke Patients

Deborah M. Little[1], Raymond Klein[2], Donna M. Shobat[1], Keith R. Thulborn[1]
[1]University of Illinois at Chicago, Chicago, Illinois, USA; [2]Dalhousie University, Halifax, Nova Scotia, Canada

Normal subjects have been trained on a unique semantic memory task derived from classification of systematically distorted random dot patterns into prototype groups. BOLD fMRI was used to examine both semantic memory and the transfer of learning to procedural memory before, during and after training. Activation in untrained subjects consisted of large regions of distributed activation in regions involved in eye movement and memory which rapidly decreased in size while retaining the distributed pattern as performance improved. The untrained procedural memory task was also enhanced. This “network specialization” may reflect the biological basis for improved performance during learning.

11:42 *564*. Functional Abnormalities Associated with Mutation of the FOXP2 (SPCH1) Gene in an Inherited Speech and Language Disorder: An Overt Speech fMRI Study

Frederique Liegeois[1], Torsten Baldeweg[1], David G. Gadian[1], Faraneh Vargha-Khadem[1], Alan Connelly[1]
[1]Institute of Child Health, London, UK

Half the members of the KE family suffer from a verbal and orofacial dyspraxia caused by a point mutation in the FOXP2 gene. An fMRI paradigm involving overt word repetition and verb generation was used to examine functional brain abnormalities associated with this mutation. Compared to unaffected family members, those affected recruited mainly bilateral posterior regions, and showed significant underactivation bilaterally in the inferior frontal gyrus and in motor-related cortical and subcortical regions. These results are consistent with previously reported bilateral structural abnormalities in the frontostriatal system, and suggest that the FOXP2 gene plays an important role in its development.

11:54 *565*. Basic Brain Activities for Phonologically Ambiguous Syllables: An fMRI Study Using Japanese Speakers

Chika Sumiyoshi[1], Kayako Matsuo[2], Toshiharu Nakai[2], Chikako Kato[3]
[1]Fukushima University, Fukushima, Japan; [2]Life Electronic Research Center, AIST, Osaka, Japan; [3]Toyohashi Sozo College, Toyohashi, Aichi, Japan

The purpose of the present study was to investigate neural activities in the memory process for phonologically ambiguous graphemes, specifically when the orthography-based strategy was not available. We focused on the memory process for graphemes containing "l" and "r" in Japanese speakers. The syllable working memory tasks were applied preventing subjects from visual matching between targets and probes. The result from the fMRI experiment revealed augmented activation in the right IFG, the right MFG and the right cerebellum, suggesting that the areas were basically important for the memory process of phonologically ambiguous graphemes in Japanese speakers.

12:06 *566*. Neural Systems of Second Language Reading are Shaped by Native Language

Ching-Mei Janet Feng[1], Li Hai Tan[2], John A. Spinks[2], Wai Ting Siok[3], Charles A. Perfetti[4], Jinhu Xiong[1], Peter T. Fox[1], Jia-Hong Gao[1]
[1]UTHSCSA, San Antonio, Texas, USA; [2]University of Hong Kong, Hong Kong, People's Republic of China; [3]Stanford University, Stanford, California, USA; [4]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

We used functional magnetic resonance imaging (fMRI) to visualize Chinese(L1)-English(L2) bilinguals' brain activity in phonological processing of logographic Chinese and alphabetic English. We found that phonological processing of Chinese characters involved spatial information representation, spatial working memory and coordination of cognitive resources. In another important observation, when our bilingual subjects performed a phonological task on English words, this neural system was most active, whereas brain areas mediating English monolinguals' fine-grained phonemic analysis were only weakly activated. This suggests that our brain imaging findings lend strongest support to the idea that language experience tunes the cortex.

12:18 *567*. Identification of the Site and Source of Inhibition: An Event Related fMRI Study

Andre Chevrier[1], Russell Schachar[1], Michael D. Noseworthy[1]
[1]The Hospital for Sick Children, Toronto, Ontario, Canada

The goal of this experiment was to identify brain activations specifically attributable to the source and site of response inhibition. We used event related fMRI to measure significant BOLD signal changes associated with inhibition of an ongoing motor response during performance of the stop signal task (SST). The SST is unique in inhibition tasks in that it requires withdrawal of a prepotent motor response thereby clearly taxing inhibition. Our data indicates that caudate and anterior cingulate are strong candidates for the source, and motor area 6 for the site of inhibition.

Brain Metabolism: Carbon-13 and Beyond

Room 701B 10:30 - 12:30 Chairs: Rolf Gruetter and Stefan Bluml

10:30 *568*. Statistical Evaluation of ^{1}H-MR Spectra of the Brain *In Situ* for Quantitative Determination of Postmortem Intervals (PMI)

Eva Scheurer[1], Michael Ith[2], Daniel Dietrich[1], Roland Kreis[2], Juerg Huesler[1], Richard Dirnhofer[1], Chris Boesch[2]
[1]University Berne, Berne, Switzerland; [2]University & Inselspital Berne, Berne, Switzerland

Estimation of the time since death (postmortem interval PMI) is a crucial yet unsolved problem in forensic medicine, particularly in the later postmortem period. In situ 1H-MR spectroscopy of a sheep brain model reveals unequivocal concentration changes of metabolites during the decomposition process. We propose relatively simple mathematical functions that describe the time courses of ten metabolite concentrations within reasonable confidence intervals. The inverse functions allow a determination of the PMI including statistical numbers by a single MRS measurement. Weighted combinations of time predictions from five metabolites correlate well with true times up to 250 h postmortem.

10:42 *569*. 3D Imaging of $CMRO_2$ in Rat Brain at Different Temperature using High-field ^{17}O NMR Approach

Xiao-Hong Zhu[1], Yi Zhang[1], Kamil Ugurbil[1], Wei Chen[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Measurement of cerebral metabolic rate of oxygen (CMRO2) is important for understanding the basic role of oxidative metabolism in brain function and cerebral physiology. Excellent sensitivity of 17O MRS obtainable at ultra-high fields allows repeatable three-dimensional imaging of CMRO2 within a short 17O2 inhalation in the rat brain. In this study, we applied the 3D 17O MRS imaging approach at 9.4 Tesla to measure CMRO2 changes noninvasively in the rat brain at two different brain temperatures. Our results show a significant decrease of CMRO2 across the entire brain when the brain temperature dropped several degrees from the normal brain temperature.

10:54 *570*. The Distribution of ^{2}H in Plasma Glucose as Measured by either Mass Spectrometry or ^{2}H NMR Provides a Quantitative Measure of the Sources of Plasma Glucose

Shawn C. Burgess[1], Visvanathan Chandramouli[2], Bernard R. Landau[2], A Dean Sherry[1], Craig R. Malloy[1]
[1]University of Texas Southwestern Medical Center, Dallas, Texas, USA; [2]Case Western Reserve, Cleveland, Ohio, USA

The contribution of gluconeogenesis to overall glucose production may be determined by measuring the distribution of deuterium in plasma glucose. Traditionally, this measurement is performed by chemical degradation of glucose followed by mass spectrometry (MS). This approach has achieved acceptance for a wide range of clinical applications. Here, we demonstrate that 2H NMR yields identical quantitative results as MS and discuss the advantages and disadvantages of each method

11:06 *571*. *In Vivo*, Localized ^{13}C MR Spectroscopy of Glucose Metabolism in the Developing Neonatal Rat Brain

Chardonnay Julia Vance[1], Raghavendra Rao[1], Ivan Tkac[1], Michael Georgieff[1], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Presented is a protocol which measured, for the first time *in vivo* and at 9.4 Tesla, the uptake of [^{13}C-1]-glucose through the blood brain barrier in neonatal rat pups, and the development of neuronal glutamate and glutamine metabolism. Twelve pups, aged 4-26 days, were studied during mild to severe hyperglycemia (10-65mM [glucose]plasma). Resolved, localized ^{13}C NMR spectra were acquired from 140µL of brain tissue (mainly hippocampus). In these pups, the plasma:brain [glucose] ratio was 3:1, as it is for adult rats. Label incorporation from [^{13}C-1]-glucose into glutamate developed rapidly after the pups' eyes and ears open at day 13 postpartum.

11:18 *572*. Glial Uptake of Neurotransmitter Glutamate from the Extracellular Fluid Studied *In Vivo* by Microdialysis and C-13 NMR

Keiko Kanamori[1], Brian D. Ross[1], Richard W. Kondrat[2]
[1]Huntington Medical Research Institutes, Pasadena, California, USA; [2]University of California, Riverside, California, USA

Excess extracellular glutamate is neurotoxic. In vivo ^{13}C NMR was combined, for the first time, with ^{13}C-enrichment analyses of neurotransmitter glutamate (GLU) in the *extracellular* fluid by microdialysis/mass-spectrometry, to estimate the rate of its astroglial uptake. The vesicular neurotransmitter GLU C5 was *selectively* ^{13}C-enriched by intravenous [2,5-^{13}C]glucose infusion followed by ^{12}C-chase. Post-chase extracellular GLU had significantly higher ^{13}C-enrichments than the intracellular. The neurotransmitter provided 80-90% of the substrate GLU for glutamine synthesis; the rate was 6.4 micromol/g/h. Hence, at steady-state, this represents a reasonable estimate for the rate of glial uptake of neurotransmitter GLU.

11:30 *573*. Turnover of the H3 Hydrogens of (2-^{13}C) Glutamate and (2-^{13}C) Glutamine during the Cerebral Metabolism of (1-^{13}C) Glucose as Detected by ^{13}C NMR.

Alejandra Sierra[1], Tiago Brandao Rodrigues[1], Marina Benito[1], Paloma Ballesteros[2], Sebastián Cerdán[1]
[1]Consejo Superior de Investigaciones Científicas, Madrid, Spain; [2]Universidad Nacional Educacion a Distancia, Madrid, Spain

We report on the turnover of the H3 hydrogens of cerebral glutamate and glutamine as detected in the (2-13C) resonances of these metabolites during (1-13C) glucose infusion, in rats receiving 50% 2H2O in the drinking water for ten days. The time course of deuteration of the H3 hydrogens in (2-13C) glutamate and (2-13C) glutamine followed the sequence of events (2-13C) glutamate-(2-13C) glutamine-(2-13C, 3-2H) glutamine-(2-13C, 3-2H) glutamate -(2-13C, 3-2H2) glutamine - (2-13C, 3-2H2) glutamate, allowing to resolve in time the traffick of cerebral glutamate and glutamine between neurons and astrocytes.

11:42 *574*. Multinuclear NMR Analysis of the Contribution of Extracellular Glutamine to Oxidative Metabolism and Ammonia Detoxification in Cultured Neurons and Astrocytes

Touraj Shokati[1], Claudia Zwingmann[2], Roger F. Butterworth[2], Dieter Leibfritz[1]
[1]University of Bremen, Bremen, Germany; [2]CHUM Hopital Saint-Luc, Montreal, Quebec, Canada

In the brain, a substrate cycle involving glucose consumption by astrocytes, and formation and export of glutamine to neurons as precursor for neurotransmitter glutamate, has been the matter of great debate during the last decades. Experimental evidence points to a cellular compartmentation of glutamate- and glutamine metabolism as well as intracellular mitochondrial heterogeneity [5,6]. In the present study, multinuclear (13C-, 31P- and 1H)-NMR studies using primary cell cultures and [1-13C]glucose as substrate were applied, to obtain further information on the competition between glucose and glutamine as precursor for neuronal glutamate and the involvement of exogenous nitrogen sources.

11:54 *575*. Acute and Subacute Response of Cultured Human Glioma Cells to Temolozomide Detected with ^{13}C and ^{31}P NMR

Aizhi Zhu[1], Nancy Jean Beardsely[1], Anthony Mancuso[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

The effect of temozolomide (TMZ) on metabolism of human glioma cells was examined with 13C and 31P NMR spectroscopy and polarographic oxygen probes. Cells cultured in porous collagen microcarriers, inside the spectrometer, were continuously monitored before, during and after treatment. Carbon spectroscopy was performed during infusion with [1,6-13C2] glucose. Consumption of glucose and oxygen, and formation of lactate and glutamate were all decreased by TMZ. 31P-Glycerophosphorylcholine, increased significantly after treatment. These changes may serve as a useful basis for the design of methods to acutely detect delivery of TMZ to gliomas and for monitoring sub-acute response to therapy.

12:06 *576.* Combination of ^{13}C NMR Spectroscopy with ^{18}FDG Detection Reveals Similar Oxidative and Glycolytic Metabolism Increases in the Rat Brain under Physiological Stimulation

Julien Valette[1], Gilles Bonvento[2], Françoise Vaufrey[1], Laurent Besret[2], Pierre Gilles Henry[3], Frédéric Pain[4], Fawzi Boumezbeur[1], Philippe Hantraye[1], Gilles Bloch[1], Vincent Lebon[1]
[1]CEA - SHFJ, Orsay, France; [2]CNRS URA2210 - SHFJ, Orsay, France; [3]University of Minnesota, Minneapolis, Minnesota, USA; [4]IPN, Orsay, France

Ex vivo 13C NMR spectroscopy and in vivo 18FDG detection were used in parallel in order to determine the TCA cycle flux (VTCA) and the glycolytic flux (CMRglc) associated with cerebral activation. Partial volume effect was minimized due to the high spatial resolution achieved by these 2 methods (less than 10 ml). Analysis of NMR data demonstrated a 20% increase in VTCA upon activation. 18FDG detection under identical experimental conditions showed a 23% increase in CMRglc in the same cortical area, suggesting a metabolic coupling between oxidative and glycolytic metabolisms during cerebral activation.

12:18 *577.* Regional ^{1}H-[^{13}C]-NMR Spectroscopy of Glutamatergic Neurotransmission and Glucose Metabolism in Rat Brain

Robin A. de Graaf[1], Graeme F. Mason[1], Douglas L. Rothman[1], Kevin L. Behar[1]
[1]Yale University, New Haven, Connecticut, USA

The formation of [4-13C]-glutamate and [4-13C]-glutamine following infusion of [1,6-13C2]-glucose is measured in three regions of rat brain. Three-compartment (blood, neuron, astrocyte) modeling in combination with T1-based tissue segmentation was used to obtain metabolic fluxes in cerebral cortex, corpus callosum and ?subcortex?. The neuronal TCA cycle flux is roughly 4x and 2x lower in the corpus callosum and ?subcortex? respectively, when compared to the flux in cortical gray matter. The glutamatergic neurotransmitter cycling flux is circa 40% of the neuronal TCA cycle flux in gray matter, but represents less than 10% in white matter.

Elastography and Diffusion: New Developments

Room 714 A/B 10:30 - 12:30 Chairs: Donald B. Plewes and Derek D. Steele

10:30 *578.* MR Elastography of Prostate Cancer

M. Alex Dresner[1], John C. Cheville[1], Robert P. Myers[1], Richard L. Ehman[1]
[1]Mayo Foundation, Rochester, Minnesota, USA

We report on a prospective study of prostate specimens with cancer using MR Elastography (MRE). A series of 17 specimens resected for adenocarcinoma were assessed with shear waves in order to obtain shear modulus measurements for the entire organ. Each specimen was then reviewed with whole-mount pathology and the sections matched to MR anatomical images. Comparison of the shear modulus of tumor regions with that of normal tissue segments showed significantly higher shear modulus for tumors than for normal prostate tissue or BPH. Shear modulus maps demonstrated high sensitivity and specificity for prostate cancer in this study.

10:42 *579.* Diffusion Tensor Imaging of the Prostate Following Therapy

Albert P. Chen[1], Duan Xu[1], Roland Henry[1], Aliya Qayyum[1], John Kurhanewicz[1], Daniel B. Vigneron[1]
[1]University of California, San Francisco, California, USA

A single-shot diffusion tensor imaging sequence was applied in 33 post-therapy prostate cancer patient exams and compared with a prior study of pretherapy patients. Following hormone/radiation therapy, when cancer is typically poorly delineated on T2 MRI, the DTI data demonstrated significant differences between cancer and benign prostatic-tissues. In 18 post-therapy patients with residual/recurrent cancer, ADC values were significantly reduced ($p=0.00003$) in areas of residual/recurrent cancer compared to benign prostate peripheral zone. In 13 post-therapy patients with complete metabolic atrophy on MRSI, the ADC values were significantly higher ($p=0.003$) than regions of residual/recurrent cancer in the 18 post therapy patients.

10:54 *580.* Stiffness-Weighted Imaging: A Novel Contrast Mechanism in MRI

Kevin Glaser[1], Joel Felmlee[1], Richard Ehman[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Intravoxel phase dispersion due to phase accumulation during an MR elastography acquisition is shown to affect image contrast in a way that can reflect the stiffness distribution in an object - a technique called "stiffness-weighted imaging". This method can detect small stiff objects using low-frequency shear wave motion. In an agarose gel phantom, 100-Hz shear waves delineated cylindrical plugs 17-, 7-, and 3-mm in diameter 2.5-times stiffer than the surrounding medium. In a post-mortem breast specimen with a 15-mm focused ultrasound ablated region, 50-Hz shear waves were used to distinguish the stiff ablated region from the surrounding tissue.

11:06 *581*. Diffusion Measurements Free of Motion Artifacts Using Intermolecular Dipole-Dipole Interactions

Scott D. Kennedy[1], Barak Razavi[1], Zhong Chen[2], Jianhui Zhong[1]
[1]University of Rochester, Rochester, New York, USA; [2]Xiamen University, Xiamen, People's Republic of China

Acquisition of diffusion-weighted images using Stejskal-Tanner pulsed-gradient spin-echo methods in the presence of motion exhibit distortions. The distortions occur because the object moves relative to the magnetic gradient coils during the diffusion time. Diffusion-weighted images can also be acquired by using signals formed in the presence of a distant dipolar field (DDF) where the amount of diffusion-weighting depends on the dipolar correlation distance and the time allowed for signal formation. Here we demonstrate that measurements and images made using the DDF as a diffusion-weighting mechanism are insensitive to motion of the object.

11:18 *582*. Attenuation Models in MR-Elastography

Thomas Nisius[1], Ralph Sinkus[1], Mickael Tanter[2], Jeremy Bercoff[2]
[1]Philips Research, Hamburg, Germany; [2]Laboratoire Ondes et Acoustique, ESPCI, Paris, France

Dynamic MR-Elastography is capable of providing information about the elastic as well as the viscous properties of tissue. There are different approaches to introduce viscosity into the partial differential equation governing the wave propagation phenomenon, e.g. via the addition of a Maxwellian term or a Voigt term. Results from simulations demonstrate the feasibility of the reconstruction method to properly recuperate the Maxwellian attenuation coefficient. In-vivo results suggest, that the Voigt model seems to be the better representation describing living tissue. Measurements of a ductal carcinoma show increased values of viscosity.

11:30 *583*. Stimulated Echo Sequence for Parallel Acquisition of Two Displacement Directions in Static MR Elastography

Peter Siegler[1], Jan Boese[1], Lothar Schad[1]
[1]Deutsches Krebsforschungszentrum, Heidelberg, Baden-Wuerttemberg, Germany

Static MR elastography requires long scan times and large number of necessary deformations, especially if several displacement components are measured. In this work, a method is presented to measure two displacement directions simultaneously. By replacing the second 90 pulse in the standard STEAM sequence by two 45 pulses with a different phase encoding displacement gradient, two separate echoes with corresponding displacement direction are generated. In phantom studies, the modified STEAM sequence shows the same results as the standard sequence. However, SNR is reduced due to the 45 pulses and longer echo times.

11:42 *584*. Biomaterial Mechanical Properties Revealed by Magnetic Resonance Elastography

Bao Zhang[1], Garth M. Beache[1], Peter A. Hardy[2]
[1]University of Maryland, Baltimore, Maryland, USA; [2]University of Kentucky, Lexington, Kentucky, USA

Elastic modulus (E) has been explored as a means of identifying diseased tissue. Previous studies calibrating magnetic resonance elastography vs. static testing have implicitly assumed that E is strain rate independent. We tested a more general dependence of E on strain rate, characterized by a modified power law. We obtained a parameter characterizing strain rate sensitivity over the examined dynamic range, in phantoms. Our data did not exclude the possibility of a cut-off, signaling a transition in mechanical properties. More complete strain rate sampling will be required to test whether these materials can be characterized in terms of these constants.

11:54 *585*. Development of a Bioartificial Pancreas: High Resolution MR Analysis of Water Relaxation and Diffusion in Alginate Beads

Samuel C. Grant[1], Nicholas E. Simpson[1], Stephen J. Blackband[1], Ioannis Constantinidis[1]
[1]University of Florida, Gainesville, Florida, USA

Alginates are unbranched polysaccharides with properties that vary depending on composition. In the presence of multivalent cations, alginates gel to encapsulate a variety of biological materials. In this study, NMR relaxation and diffusion data are presented for alginate microbeads used in the development of a bioartificial pan-creas. This data demonstrate that the water T_2 within the gel depends on the guluronic acid content and alginate porosity, whereas the T_1 and ADC do not. Fur-thermore, the gellating effect of Ca^{+2} ions is hindered by the application of a poly-L-lysine layer, which is used to provide mechanical support and immunoprotection.

12:06 *586*. *In-Vivo* Prostate MR-Elastography

Ralph Sinkus[1], Thomas Nisius[1], Jörn Lorenzen[2], Jörn Kemper[2], Michael Dargatz[1]
[1]Philips Research, Hamburg, Germany; [2]University Hospital Eppendorf, Hamburg, Germany

In-vivo MR-Elastography of the prostate is expected to provide valuable clinical information, because the diagnostic importance of elasticity for prostate cancer is well established. Dynamic sinusoidal MR-Elastography is performed with the patient in prone position ensuring good contact to the mechanical transducer, which pushes from below against the pubic bone in A-P direction. First in-vivo results demonstrate good penetration of the mechanical wave into the prostate. Reconstructed elasticity images depict the prostate of a healthy volunteer homogeneously with a harder centre and a softer boundary region.

12:18 ***587***. **Simulation of *In Vivo* MR Elastography Wave Patterns of Skeletal Muscles using a Transverse Isotropic Elasticity Model**

Ingolf Sack[1], Abbas Samani[1], Don Plewes[1], Juergen Braun[2]
[1]University of Toronto, Sunnybrook & Women's College Health Sciences Centre, Toronto, Ontario, Canada; [2]Free University Berlin, University Hospital Benjamin Franklin, Berlin, Germany

In vivo elasticity studies of skeletal muscles show a complex correlation of tissue structure and elastic parameters. Muscle has been shown to exhibit anisotropic features that can be resolved by MR Elastography. We introduce a transverse isotropic elasticity model that exactly reproduces the experimentally observed shear waves of the biceps brachii. Simulations were conducted using a coupled harmonic oscillator (CHO) and finite element (FEM) formalisms to study wave propagation. These models reflect anisotropy by a correlation factor that relates transverse and longitudinal Youngs moduli with respect to the muscle fiber axis. Finally we illustrate the feasibility of isotropic wave-image inversion.

Diffusion Analysis II: Beyond the Tensor

Room 716 A/B 10:30 - 12:30 Chairs: Daniel Alexander and Peter J. Basser

10:30 ***588***. **Combining DT and q-Space MRI: A New Model of White Matter in the Brain**

Yaniv Assaf[1], Peter J. Basser[2]
[1]Tel Aviv Sourasky Medical Center, Tel Aviv, Israel; [2]National Institutes of Health, Bethesda, Maryland, USA

The signal decay in diffusion experiments is affected by many factors, including tissue microstructure and compartmentalization. When performing diffusion experiments at high b (or q) values, non-monoexponential signal decay is observed, especially in white matter rich areas. Here we propose a mathematical model that accounts for different modes of anisotropic diffusion (restricted and hindered) and the relative orientations of the nerve fiber axis and the diffusion gradient vectors. The model was used to fit high b value experimental diffusion data from human brain, and distinguishes between diffusion in restricted and hindered compartments.

10:42 ***589***. **Analysis of Microstructures Using MRI Q-space and K-space Diffractograms**

Jun-Cheng Weng[1], Ching-Po Lin[1], Li-Wei Kuo[1], Jyh-Horng Chen[1], Wen-Yih Isaac Tseng[1]
[1]National Taiwan University, Taipei, Taiwan

The purpose of this paper is to use two different MR diffraction methods, high spectral resolution q-space diffusion imaging (QSI) and high spatial resolution k-space imaging, to evaluate the dimension of microstructures. The two MR diffraction methods have been developed for years to obtain structural information in material science and biological system. However, the validity of these two methods with reference to a common standard has not been explored yet. This paper aimed to validate the MR diffraction methods and to clarify the meaning of the diffraction patterns.

10:54 ***590***. **Visualisation of Displacement-Distribution Parameters in q-Space Imaging**

Jimmy Lätt[1], Sara Brockstedt[2], Ronnie Wirestam[1], Elna-Marie Larsson[2], Freddy Ståhlberg[1]
[1]Lund University, Lund, Sweden; [2]Lund University Hospital, Lund, Sweden

Structural information of the confining geometry of water molecules can be revealed by q-space analysis of highly diffusion encoded images. An advantage of q-space analysis based on high b-values is that data contain information about different compartments; extra- and intracellular water. Calculations of the mean displacement and the probability of zero displacement, from the average propagator, obviously reveal information on diffusion in different areas of the brain. In this study, we propose that the shape of the displacement distribution curve should be taken into considerations, and therefore the kurtosis, a measure of the deviation from a Gaussian distribution, was assessed.

11:06 ***591***. **Numerical Analysis of the Feasibility of Human q-Space MRI in the Case of Finite-Duration Diffusion-Encoding Gradients**

Nicolas Francisco Lori[1], Thomas Edward Conturo[2], Denis Le Bihan[1]
[1]Service Hospitalier Frederic Joliot, Orsay, France; [2]Washington University School of Medicine, Saint Louis, Missouri, USA

We analyze the limitations in doing q-space imaging using finite-duration diffusion encoding gradients typical in modern human MRI systems. Random walk simulations show that, even in the presence of restricted domains, q-space brain MRI is often feasible in human subjects.

11:18 ***592***. **Mean Diffusivity and Anisotropy Index Mapping of Diffusion Spectrum Imaging in a Stroke Model**

Li-Wei Kuo[1], Sheng-Kwei Song[2], Van J. Wedeen[3], Ching-Po Lin[1], Jyh-Horng Chen[1], Wen-Yih Isaac Tseng[4]
[1]National Taiwan University, Taipei, Taiwan; [2]Washington University, St. Louis, Missouri, USA; [3]MGH Martinos Center for Biomedical Imaging, Harvard Medical School, Charlestown, Massachusetts, USA; [4]National Taiwan University College of Medicine, Taipei, Taiwan

Non-Gaussianity of water molecular diffusion arising from intravoxel heterogeneity of fiber orientations may cause bias in diffusion tensor imaging (DTI). Indices derived from DTI such as trace ADC and fractional anisotropy may be insufficient to provide contrast in non-Gaussian regions. In this study, we derived two indices from diffusion spectrum imaging (DSI) data, mean squared length and anisotropy of displacement probability. Index maps of DSI and DTI were obtained from a rat stoke model and compared. DSI had higher contrast-to-noise ratio in lesion detection and was able to reveal more structures in the cortical gray matter obscured in DTI.

11:30 *593*. Circular Spectrum Mapping for Intravoxel Fiber Structures Based on High Angular Resolution Apparent Diffusion Coefficients

Wang Zhan[1], Hong Gu[1], Su Xu[2], David Silbersweig[1], Emily Stern[1], Yihong Yang[1]
[1]Weill Medical College of Cornell University, New York, New York, USA; [2]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

A method is developed for mapping the intravoxel fiber structures based on high angular resolution ADC. Our analysis suggests that the 0th, 2nd, and 4th order harmonic components of the ADC distribution on the circle spanned by the major and median eigenvectors of the diffusion tensor provide quantitative indices for isotropic, linear, and fiber crossing diffusion respectively. Simulation and in vivo experiment results indicated that the 0th and 2nd order circular spectrum maps exhibited a strong consistency with the DTI-based mean diffusivity and linear indices respectively, and the 4th order circular spectrum map was validated to identify the fiber crossings.

11:42 *594*. The Potential Role of the Cytoskeleton and Intracellular Tortuosity in Altering ADC: A Model Study Using Fibrinogen/Fibrin Solutions

Andrew M. Blamire[1], Daniel J. Stuckey[1], Peter Styles[1], Bheeshma Rajagopalan[1]
[1]University of Oxford, Oxford, UK

To determine how rapid decreases in ADC could occur in neuronal cells, we modelled restricted diffusion in the cell as due to the cytoskeleton with a protein/electrolyte containing cytosol. Using an equation for signal attenuation in pulsed gradient diffusion experiments we show that a 2 to 3 fold decrease in permeability can reduce ADC by 40 to 60 %. Experimental measurements in a biological solution:gell system of fibrinogen to fibrin transition (as in a blood clot), show that such changes in permeability are easily obtained by relatively simple alterations in microstructure.

11:54 *595*. Biexponential Analysis of Diffusion Related Signal Decay in Human Cortical Grey Matter

Stephan E. Maier[1], Hatsuho Mamata[1], Robert V. Mulkern[2]
[1]Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA; [2]Children's Hopital, Harvard Medical School, Boston, Massachusetts, USA

ADC values of gray (GM) and white (WM) matter obtained with conventional diffusion imaging exhibit no difference. This study explored differences in GM and WM water diffusion in normal human brain with CSF signal attenuated, high b-factor line scan imaging. Biexponential analysis of the diffusion data resulted in two diffusion coefficients ADC1 and ADC2 and their respective volume fractions. While ADC1 and volume fractions for GM and WM appeared to be similar, ADC2 in GM was found to be up to three times higher than in WM. Fundamental differences in tissue architecture may explain the different ADC2 values.

12:06 *596*. Theory of Bi-Exponential Diffusion Attenuation in a Single Homogeneous Cell

Alexander L. Sukstanskii[1], Joseph J.H. Ackerman[1], Dmitriy A. Yablonskiy[1]
[1]Washington University, St. Louis, Missouri, USA

Recent studies of incoherent displacement of water in brain tissue documented a bi-exponential diffusion attenuation of MR signal. These data are usually interpreted in the framework of a two-compartment physical model. We show that such a behavior can be observed even in a one-compartment system for short diffusion times. This effect is due to the presence of restrictive barriers that lead to a strong inhomogeneous transverse magnetization resulting in non-mono-exponential diffusion signal attenuation. The latter can be described remarkably well in terms of bi-exponential behavior. The theory is applied to MR signal from axon fibers.

12:18 *597*. A Model of Temporal Dependence in Therapy-Induced ADC Change

Thomas L. Chenevert[1], Timothy D. Johnson[1], Victor D. Schepkin[1], Brian D. Ross[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

Diffusion MRI has the potential to monitor therapy-induced necrosis by way of increased water mobility. Several animal model studies [1-4] have shown a significant ADC increase following therapy before tumor shrinkage. Translation to human studies is ongoing but has shown mixed results [5-9]. The objective of this work is to model processes of tumor growth, necrosis production, and the removal of excess extracellular water within the context of ADC change and tumor shrinkage.

Breast MR

Room 713 A/B 10:30 - 12:30 Chairs: Gillian Newstead and Nola Hylton

10:30 *598*. System for Co-registration of MR/US Breast Images: Preliminary *In Vivo* Evaluation of Accuracy

Cameron Piron[1], Petrina Causer[1], Roberta Jong[1], Rhonda Walcarius[1], Chris Luginbuhl[1], Sarah Walters[1], Donald Plewes[2]
[1]Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada; [2]University of Toronto, Toronto, Ontario, Canada

We have developed a system capable of co-registration of MR and Ultrasound (US) breast images. Here we present preliminary in vivo results confirming the accuracy of this technique. Our primary objective is to use this system to enable a real-time hybrid (MR/US) core biopsy strategy, however there may emerge a role as an adjunct to contrast-enhanced MRI. We have used this system to target cysts (N=10), and solid lesions (N=3) in a series of patients (N=10). After correction for speed of sound deviations, we have established this technique to be accurate within 3.6 ± 1.6 mm (SD).

10:42 *599*. Combined Spectroscopic and Dynamic Breast MR Imaging; A Preliminary Study

Michael A. Jacobs[1], Peter B. Barker[1], Zaver Bhujwalla[1], David A. Bluemke[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

A combination of dynamic magnetic resonance (MR) imaging and proton spectroscopy of the breast has been used for the differential diagnosis of enhancing lesions of nine patients. In 3/4 malignant and 3/3 benign cases with equivocal (type 2) enhancement patterns MRSI was useful in providing additional diagnostic information.

10:54 *600*. Clinically Practical MRI/MRS Protocol for Improved Specificity in Breast Cancer Diagnosis

Alina Tudorica[1], Paul Fisher[1], Khaldoon Dulaimy[1], Brian O'Hea[1], Terry Button[1], Wei Huang[1]
[1]State University of New York, Stony Brook, New York, USA

The goal of this study was to determine if a combined MRI/MRS protocol of dynamic contrast enhancement (DCE) T1-weighted MRI, 1H MRS, and perfusion MRI improves specificity in detection of breast malignancy. 61 patients with positive mammography findings were studied. After DCE MRI showed fast contrast enhancement, single-voxel 1H MRS and perfusion MRI examinations were performed. DCE MRI showed 100% sensitivity and 76% specificity in detection of breast cancer. The specificity improved to 89% with the addition of 1H MRS, and to 96% with the further addition of perfusion MRI.

11:06 *601*. Neoadjuvant Chemotherapy in Breast Cancer: Early Prediction of Response Using a Combination of DCE-MRI, ADC Mapping And Proton Spectroscopic Imaging

Martin Lowry[1], David J. Manton[1], Daniel Tozer[2], Antony Maraveyas[1], Amulya Chaturvedi[3], John Greenman[1], Lynn Cawkwell[1], Ann Hubbard[3], Anupam Modi[3], Michael Lind[1], Lindsay W. Turnbull[1]
[1]University of Hull, Hull, East Yorkshire, UK; [2]University College London, London, England, UK; [3]Hull and East Yorkshire Hospitals NHS Trust, Hull, East Yorkshire, UK

This study investigates the potential offered by quantitative MR imaging and spectroscopy for early prediction of ultimate tumour response to chemotherapy. Prediction of non-response would have great clinical benefit both in avoiding unnecessary toxicity and permitting early change to alternative treatments. Twenty-three breast cancer patients were imaged before, after their second and after their final courses of chemotherapy. Results suggest that a combination of parameters from spectroscopy (relative fat and water signal strength and water T2) and imaging (tumour volume and extracellular tissue volume fraction) can be used to achieve highly accurate prediction of ultimate tumour response.

11:18 *602*. Contrast Enhancement Profile vs. Malignant Lesion Size in Gadolinium-Enhanced Breast MRI

Frederick Kelcz[1], Debra L. Berridge[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

We analyzed the signal intensity (SI) vs. time profile as a function of lesion size for 48 breast malignancies. For 11 - 20 mm lesions, all 17 lesions showed washout. For 3 lesions measuring 4-5 mm, none showed washout. Lesions larger than 20 mm displayed a mixed SI vs. time pattern with only 3 of 6 showing washout. We conclude that washout is most sensitive for malignant tumors measuring 11 - 20 mm. Tumors larger and smaller than this range may commonly not show washout and may not even show rapid contrast uptake.

11:30 *603*. Quantification of Endothelial Permeability, Leakage Space and Blood Volume in Breast Cancer Using Dynamic T_1/T_2* Gradient Dual Echo Sequence

Yong-min Huh[1], Jin-suck Suh[1], Eun-kyung Kim[1], Dae Hong Kim[1], Eun Joo Kim[1], Hyun Cheol Chung[1], Sun Young Rha[1], Byeong-Woo Park[1], Woo Ick Yang[1], Se Hoon Kim[1]
[1]Yonsei University College of Medicine, Seoul, Republic of Korea

The purpose of this study is to determine rBV using corrected R2* curve in breast cancer and Ktrans and ve using R1 curve simultaneously and to compare them with immunostain for microvessel density (ITVD). Eleven women underwent MRI with mixed sequence for T1 map and T1/T2* gradient dual-echo sequence. Ktrans(fp) was highly correlated with rBV, which may be indicators macroscopic vascular status of breast cancer. Ktrans(fp) and rBV may serve as tests for measuring antiangiogenic effect in vivo situation. None of Ktrans(fp), ve(fp), Ktrans(ep), ve(ep), and rBV were correlated with ITVD (microscopic aspect) as has been expected.

11:42 *604*. High Temporal and Spatial Resolution Dynamic Bilateral Breast Imaging with Optimized Fat Suppression

Manojkumar Saranathan[1], Thomas K.F. Foo[1], Pelin Aksit[1], Marcela B. Montequin[1], Peter L. Choyke[2]
[1]GE Medical Systems, Baltimore, Maryland, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

A fat suppressed high temporal and spatial resolution bilateral breast imaging sequence is proposed for dynamic contrast enhanced studies. By acquiring central k-space data more frequently than outer k-space data, temporal resolution of the order of 20-30s is achieved with sub mm in-plane spatial resolution. Uniform fat suppression is effected by using individually optimized shim and transmitter frequency settings for each breast. Both the left and right breasts can be imaged simultaneously in separate 3D multiphase volumes. Preliminary data demonstrate excellent fat suppression with high spatial and temporal resolution on sagittal acquisition planes.

11:54 *605*. Diagnostic Performance of High-Resolution Back-Projection Imaging of the Breast

Lawrence Dougherty[1], Linda White Nunes[2], Hee Kwon Song[1], Jessica J. Runyon[1], Mitchell D. Schnall[1]
[1]Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]MCP Hahnemann University, Philadelphia, Pennsylvania, USA

A back-projection method for dynamic contrast enhanced imaging of the breast was evaluated using an architectural interpretation model. Predictions were correlated with histopathologic findings and compared to past performance of the model. Forty-three lesions were identified with corresponding histopathologic diagnosis. The diagnostic performance characteristics of the interpretation model using the BP breast images were: sensitivity = 100%, specificity = 67%, PPV = 57%, NPV = 100% and overall accuracy = 77%. Contrast enhanced images of the breast acquired using an interleaved back-projection method have the same diagnostic quality as those obtained with a standard 3DFT acquisition.

12:06 *606*. Virtual Dissection MRI of Internal Mammary Lymphadenopathy

Steven B. Halls[1], Avisha Narnaware[1]
[1]Cross Cancer Institute, Edmonton, Alberta, Canada

MRI of Internal Mammary lymph nodes can detect lymphadenopathy in breast cancer patients, which implies a higher cancer stage and worse prognosis for the patient. The MRI scanning technique is described, including an image post-processing method using Photoshop layers and the Eraser tool, dubbed "virtual dissection", which facilitates the depiction of anatomic structures that cross between MRI slices. MRI of 40 stage II breast cancer patients shows 18% with lymphadenopathy.

12:18 *607*. Low-Field versus High-Field MRI in Diagnosing Breast Disorders

Eija Pääkkö[1], Heli Reinikainen[1], Eija-Leena Lindholm[2], Tarja Rissanen[1]
[1]University of Oulu, Oulu, Finland; [2]Oulu City Hospital, Oulu, Finland

The performance of low- and high-field MRI in diagnosing breast disorders was compared in 28 patients (34 breasts). Biopsy results were available from 27 breasts. Low-field MRI showed equal performance with a sensitivity of 100%, specificity 82% and accuracy 93% compared to 100%, 73% and 89%, respectively, at high-field.

Image Processing: Brain

Room 715 A/B 10:30 - 12:30 Chairs: Henr;y Rusinek and Norbert Schuff

10:30 *608*. fMRI Connectivity Measured by Mutual Information and Correlation: Linear Dependence vs. General Dependence

Vince D. Calhoun[1], Jin-suh Kim[1], Godfrey D. Pearlson[1]
[1]Olin Neuropsychiatry Research Center/Yale University, Hartford, Connecticut, USA

Functional connectivity is typically measured by computing the correlation between two time-courses. Correlation is a measure of linear dependence and will not detect other types of dependencies (e.g. non-linear). The mutual information between two time-courses is a measure of general dependence and will detect both linear and non-linear dependencies. We propose 1) a normalized mutual-information measure for assessing connectivity, and 2) a new measure which provides increased detectability to linear dependencies while still capturing non-linear dependencies. Both simulations and results on motor fMRI studies are presented and show increased ability to capture functional relationships which are not predicted a priori.

10:42 *609*. Cortical Thickness Measurements of Human Auditory Cortex

Xiaojian Kang[1], Bill Yund[2], David Woods[1]
[1]University of California Davis, Martinez, California, USA; [2]NCHCS, Martinez, California, USA

A new method is described to perform the thickness measurement of auditory cortex based on the anatomically normalized population maps of auditory cortex. The new method can measure the mean thickness to sub-millimeter precision. Two correlations are also studied, that between the mean thickness and gray/white matter surface curvature and that between the mean thickness and functional activations in different regions of auditory cortex.

10:54 *610*. Segmenting Brain Sulci for Cortical Thickness Measurements in MRI

Chloe Hutton[1], Enrico De Vita[1], Robert Turner[1]
[1]UCL, London, UK

The thickness of the cerebral cortex can provide valuable information about normal and abnormal neuroanatomy. Accurate cortical thickness measurements from brain MRI require precise segmentation of the grey matter. Here we specifically address the problem of extracting the deep cortical folds or sulci, which can be difficult to resolve in MRI. We propose a method that iteratively solves Laplace's equation for adjacent sub-layers of the cortex. This approach preserves the laminar structure of the cortex and provides clear definition of deep sulci. The implementation is computationally efficient. We present inter-subject and intra-subject results that are consistent with the literature.

11:06 *611*. Automated Measurement of Medial Temoral Lobe Atrophy Rate

Henry Rusinek[1], Susan DeSanti[1], Dina Frid[1], Wai-Hon Tsui[1], Chaim Tarshish[1], Antonio Convit[1], Mony J. de Leon[1]
[1]New York University School of Medicine, New York, New York, USA

Structural imaging studies consistently show vulnerability of the medial temporal lobe (MTL) structures in normal aging and Alzheimer's Disease. Hippocampal size, obtained using manual tracing, correlates with memory performance in normal elderly. However, manual volumetry of MTL structures is time-consuming and susceptible to intra- and inter-operator differences. We have implemented and validated an automated procedure for monitoring MTL atrophy rates from serial MR. The method was applied to a longitudinal study of normal aging. We have investigated if MTL atrophy, assessed over the two-year interval, was predictive of the cognitive decline at the six-year time point.

11:18 *612*. Characterisation of Morphometric Changes in Lateral Ventricles Due to Schizophrenia Using 3 Dimensional Point Distribution Models

Kolawole Oluwole Babalola[1], Jim Graham[1], Lili Kopala[2], Robert Vandorpe[2]
[1]University of Manchester, Manchester, UK; [2]Dalhousie University, Halifax, Nova Scotia, Canada

Recent work in 3D morphometric analysis has sought to determine whether specific shape changes in the lateral ventricles are associated with its noted enlargement in schizophrenia. Using MR images of schizophrenics and matched controls, we characterise shape changes of ventricles using 3D PDMs. We normalise for brain shape to augment discrimination, and seperation into schizophrenic and control groups is performed in a reduced dimensional "shape space", by projecting PDM parameters onto the vector maximising Fisher's criterion. Our findings suggest the associated shape changes are localised to the temporal and frontal horns and the central parts of the ventricle.

11:30 *613*. A Novel Method for Deriving Grey and White Matter CBF Using Multi-Spectral MR

Robert A. Brown[1], Jessica E. Simon[1], Hong Lu[1], Michel Louis Lauzon[2], Richard Frayne[1], Joseph Ross Mitchell[1]
[1]University of Calgary, Calgary, Alberta, Canada; [2]Seaman Family MR Research Centre, Foothills Medical Centre, Calgary, Alberta, Canada

Quantified cerebral perfusion measurement is being developed for use in clinical practice such as in the investigation of ischemic stroke. We present a method for determining tissue-specific cerebral blood flow (CBF) at high spatial resolution (7.8 mL voxels) compared to positron emission tomography. We used automatic segmentation, co-registration and multi-spectral MR images at 3 T.

11:42 *614*. Time Series Analysis of MRI Intensity Profiles

Dominik S. Meier[1], Charles R.G. Guttmann[1]
[1]Brigham & Women's Hospital / Harvard Medical School, Boston, Massachusetts, USA

A method for systematic analysis of time domain information, derived from serial MRI, is presented and validated. Goal is the characterization of inflammatory, degenerative and reparatory tissue changes. Normalized temporal intensity profiles of multiple sclerosis lesions are presented as examples of achievable sensitivity from standard clinical protocols. No external phantoms or a priori calibration is required. Data from large longitudinal studies served as basis for a tissue-specific intensity normalization model. We compared and validated different approaches to image registration, partial volume correction and intensity normalization. Results suggest that MRI intensity dynamics contain information of interest for studies of MS pathophysiology.

11:54 *615*. Covariance Matrix Based Elastic Multi-Channel Image Registration

Gustavo K. Rohde[1], Sinisa Pajevic[1], Carlo Pierpaoli[1], Peter J. Basser[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

With the advent of new MR imaging modalities such as DT-MRI, MRA, and CSI, demand for image registration procedures capable of dealing with multi-channel image data has increased. A novel method based on multivariate linear correlation is proposed to align two multi-channel images each containing an arbitrary number of channels. Results obtained using diffusion tensor MRI data of the human brain show that image registration based on different channels generates different alignment results. In addition, we show that multi-channel image registration is more accurate to registration based on a single channel.

12:06 *616*. Incorporating Gradient and *a priori* Information into Automated Segmentation of Therapy-Induced Leukoencephalopathy

John Otis GLass[1], Wilburn E. Reddick[1], Ching-Hon Pui[1]
[1]St. Jude Children's Research Hospital, Memphis, Tennessee, USA

The automated quantification of therapy-induced leukoencephalopathy is a very difficult issue because its imaging properties are between those of normal white and gray matter. FLAIR images add additional information, but also introduce unsaturated ventricular areas with high signal intensities, which are often incorrectly identified as leukoencephalopathy. The technique presented in this study proposes the use of normalized apriori atlas maps combined with a gradient threshold applied to FLAIR images to reduce the misclassification of leukoencephalopathy. An example is provided to illustrate the reduction of misclassifications by the new automated segmentation algorithm.

12:18 *617*. Conductivity Tensor Mapping of the Rat Brain Using Diffusion-Weighted MRI

Masaki Sekino[1], Kikuo Yamaguchi[1], Norio Iriguchi[2], Shoogo Ueno[1]
[1]Graduate School of Medicine, University of Tokyo, Bunkyo-ku, Tokyo, Japan; [2]University of Kumamoto, Kurokami, Kumamoto, Japan

Conductivity tensor images of the rat brain were obtained by a method based on diffusion-weighted MRI. MPGs were applied in three directions with the b factor being arrayed from 0 to 3600 s/mm^2. Conductivities in each MPG direction were calculated from the fast component of the ADC and the fraction of the fast component, and two-dimensional conductivity tensor was estimated. ROIs were selected in the cortex and the corpus callosum. The mean conductivities in each ROI were 0.014 S/m and 0.018 S/m, respectively. Conductivity of the corpus callosum varied up to 75 % depending on the direction.

Cancer: MR Spectroscopy of Model Systems

Room 717 A/B 10:30 - 12:30 Chairs: Harish Poptani and Franklyn A. Howe

10:30 *618*. Mechanisms of Indomethacin-Induced Alterations in Choline Phospholipid Metabolism of Non-Malignant versus Malignant Human Mammary Epithelial Cells

Kristine Glunde[1], Vaddapuram P. Chacko[1], Zaver M. Bhujwalla[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Distinct differences characterize the choline metabolite profile of malignant human mammary epithelial cells (HMECs) compared to normal HMECs. Treatment with the non-steroidal anti-inflammatory agent indomethacin changes this profile toward a pattern more typical of non-malignant HMECs. Metabolites produced from [1,2-^{13}C]-choline using ^{1}H and ^{13}C NMR spectroscopy, and gene expression levels using microarray technology were analyzed following indomethacin treatment of breast cancer cells. Indomethacin induced diverse changes at the gene expression level. Enzymes involved in choline metabolism were not affected at the transcriptional level. Changes in choline phospholipid metabolites following indomethacin treatment were most likely due to increased membrane turnover.

10:42 *619*. Gene Expression Inhibition of Choline Kinase in Breast Cancer Cells using RNA Interference detected by ^{1}H NMR Spectroscopy

Venu Raman[1], Noriko Mori[1], Yelena Mironchik[1], Kristine Glunde[1], Zaver M. Bhujwalla[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

The elevation of phosphocholine and total choline, a widely-established characteristic of cancer cells, has been linked to malignant transformation, invasion and metastasis [1]. Increased choline kinase (CK) activity and expression have been observed with malignant changes [2] qualifying it as a unique target for cancer cells. Chemicals inhibiting choline kinase activity are anti-proliferative and anti-mitogenic, but exhibit in vivo toxicity [3]. Here we have developed a molecular biology based attack on choline kinase using small interfering RNA (siRNA) against choline kinase. ^{1}H NMR spectroscopy was used to detect the effect of siRNA(CK) in malignant and nonmalignant human mammary epithelial cells.

10:54 *620*. An ^{19}F MR-Based Assay of Solid Tumor Methotrexate Resistance: Proof of Principle

William M. Spees[1], Maria Belen Rubio[1], William G. Bornmann[1], Jason A. Koutcher[1]
[1]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

A non-invasive *in vivo* ^{19}F MR-based assay of methotrexate (MTX) resistance using a fluorine-labeled analog of MTX (FMTX) is presented. This assay can discriminate between MTX-sensitive and MTX-resistant xenograft tumors. Pharmacokinetic parameters measured via ^{19}F MR predict tumor response to therapy.

11:06 *621*. Assignment of Polyunsaturated Lipids in the BT4C Gliomas Undergoing Gene Therapy -Induced Programmed Cell Death by ^{1}H NMR Spectroscopy

Piia K. Valonen[1], Julian L. Griffin[2], Kimmo K. Lehtimäki[1], Olli H J Gröhn[1], Mikko I. Kettunen[1], Seppo Ylä-Herttuala[1], Jeremy Nicholson[2], Risto A. Kauppinen[1]
[1]University of Kuopio, Kuopio, Finland; [2]Imperial College of Science, Technology and Medicine, London, UK

In a rat BT4C glioma, gene therapy –induced programmed cell death (PCD) causes accumulation of the 1H NMR visible polyunsaturated fatty acids (PUFA). Here we have further characterised PUFAs in tumour samples ex vivo and lipid extracts using multidimensional magic angle spinning (MAS) 1H MRS. PUFAs increased 2.5-fold comprising 70% of the elevation of NMR visible lipids in vivo. HMBC from tumour extracts demonstrated that PUFA peak at 2.8 ppm was mainly due to 18:1 and 18:2 lipids. These data indicate that 1H NMR detected PUFAs arise from membrane lipid breakdown products.

11:18 *622*. MR Visible Modulation of Choline Containing Metabolites by Oncogenic Signaling in HT29 Cells

Sabrina M. Ronen[1], L. Elisabeth Jackson[1], Nada M. Salman-Al Saffar[1], Paul Workman[1], Martin O. Leach[1]
[1]Institute of Cancer Research, Sutton, Surrey, UK

Transfection with ras results in an MRS visible increase in PC which is reversed by inhibition of the MAPK pathway. Treatment with the Hsp90 inhibitor 17AAG - leading to inhibition of the MAPK and PI3K pathways - resulted in an increase, not a drop, in PC and an increase in GPC. To explain these results we investigated the effects of specific inhibitors. We show that the effect of 17AAG on PC levels is independent of either of the MAPK or the PI3K pathways. Its effect on GPC is associated with inhibition of PI3K signaling.

11:30 *623*. 6-Trifluoromethyl Pyridoxol, a Novel Reporter Molecule for Tumor Extracellular pH

Weina Cui[1], Peter Otten[1], Jianxin Yu[1], Vikram Kodibagkar[1], Ralph P. Mason[1]
[1]UT Southwestern Medical Center at Dallas, Dallas, Texas, USA

6-trifluoromethyl pyridoxol, a derivative of vitamin B6, was evaluated as an extracellular pH indicator. 19F NMR spectroscopy shows that the chemical shift difference of this molecule between acid and base is 1.65ppm, and pKa is 6.82 ideal for physiological condition. We present titration curves at different temperatures, together with measurements in solution, whole blood, perfused heart, rat breast and prostate tumors, showing the efficacy of 6-trifluoromethyl pyridoxol as a novel pH indicator.

11:42 *624*. "ISUCA": A Novel Indicator for Extracellular pH Measurements in Tumors by ^{1}H Magnetic Resonance Spectroscopy

Pilar López-Larrubia[1], Marina Benito[1], Susana Garrido[1], Patricia Sánchez[1], Paloma Ballesteros[2], Sebastián Cerdán[1]
[1]Consejo Superior de Investigaciones Científicas, Madrid, Spain; [2]UNiversidad Nacional Educacion a Distancia, Madrid, Spain

We describe the synthesis, physicochemical, pharmakokinetic and toxicological properties of ISUCA (2-imidazol-1-ylsuccinic acid disodium salt), a novel indicator for in vivo and in vitro extracellular pH (pHe) measurements by 1H NMR spectroscopy. ISUCA is produced by Michael addition of imidazole to dithethylsuccinic ester followed by basic hydrolysis. Like its earlier analog IEPA (3-etoxicarbonyl-2-imidazol-1-ylpropionic acid), ISUCA accumulates in the extracellular space of suspensions of C6 cells and erythrocytes, revealing pHe only. The pKa of ISUCA H2 (37oC, rat plasma) is 7.07, closer to the region of pHe in most tumours (ca. 7.0), than other previously used 1H NMR imidazol alkanoic probes.

11:54 *625*. Effects of 17AAG on the C-neu/HER2 Mammary Carcinomas in Oncomice® as Monitored by *In Vitro* ^{31}P and ^{1}H MRS

Loreta M. Rodrigues[1], Paul Workman[2], Yuen Li Chung[1], Ian R. Judson[2], Martin O. Leach[3], John R. Griffiths[1]
[1]St George's Hospital Medical School, London UK; [2]Institute of Cancer Research, Surrey, UK; [3]Royal Marsden NHS Trust, Surrey UK

The action of 17AAG, an inhibitor of HSP90 molecular chaperone function, on the spontaneous c-neu/HER2 carcinomas developed in transgenic oncomice® was monitored by 31P and 1H MRS. The drug caused significant regression in tumour volume and 31P MRS of extracts showed a significant decrease in phosphocholine and phosphoethanolamine. There was no change in lactate or Pi. The reduction in choline metabolites may be indicative of reduced cell proliferation.

12:06 *626*. Glucose Stimulated Lactate Metabolism in C6 Glioma Cells

Marina Benito[1], Purificación Hernández[1], Alejandra Sierra[1], Susana Garrido[1], Paloma Ballesteros[2], Sebastián Cerdán[1]
[1]Consejo Superior de Investigaciones Científicas, Madrid, Spain; [2]UNiversidad Nacional Educacion a Distancia, Madrid, Spain

We investigated the simultaneous metabolism of lactate and glucose in cultures of C6 glioma cells. With lactate as substrate, C6 cells consumed (U-13C3) lactate with Km (mM)/Vmax (micromol.h-1.mg protein-1) 19.4 /2.1. With glucose as substrate, C6 cells consumed (1-13C) glucose with Km/Vmax 3.3/ 2.8 and produced (3-13C+3-12C) lactate with Km/Vmax 1.8/1.7. However, when (1-13C) glucose and (U-13C) lactate were present simultaneously, the parameters of (U-13C3) lactate consumption improved significantly to Km/Vmax 3.8/7.9, while production of (3-13C) lactate from (1-13C) glucose decreased to Km/Vmax 10.9/0.7. This suggests lactate oxidation as a competitive pathway with aerobic glycolysis in sufficiently oxygenated tumour zones.

12:18 *627*. Simultaneous Metabolic, Histopathologic, and Genetic Analysis of Prostate Biopsy Tissues.

Mark Gunnard Swanson[1], Z. L. Tabatabai[1], Rajveer Purohit[1], Katsuto Shinohara[1], Christopher M. Haqq[1], Andrew S. Zektzer[1], Daniel B. Vigneron[1], John Kurhanewicz[1]
[1]University of California San Francisco, San Francisco, California, USA

A protocol was developed for ^{1}H high resolution magic angle spinning (HR-MAS) spectroscopic analysis of prostate biopsy samples and optimized to preserve tissue integrity for subsequent histopathologic and genetic analyses of the same tissues. Prostate cancer tissues (n=3) demonstrated significantly higher (GPC+PC)/Cr (p=0.0001), and significantly lower citrate/Cr (p=0.03) and polyamine/Cr (p=0.0002) ratios relative to benign tissues (n=16). Additionally, lactate was not appreciably observed in any biopsy tissues, indicating minimal tissue degradation during harvesting and data acquisition. Sufficient levels of RNA were also obtained from biopsy tissues following HR-MAS analysis to perform cDNA gene expression arrays on the same tissues.

GOLD CORPORATE MEMBER LUNCHTIME SYMPOSIUM
Philips Medical Systems
Changing How the World Looks at MR. . .Everywhere.

Hall F/G 12:30 - 13:30

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
Brain Perfusion: New Methods and Issues

Room 701B 13:30 - 15:30 Chairs: Joseph A. Helpern and John A. Detre

Please see page 434 for details.

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
ESR, Oxygenation, and Sodium

Room 714 A/B 13:30 - 15:30 Chairs: Harold M. Swartz and Cees J.A. van Echteld

Please see page 186 for details.

CLINICAL SCIENCE FOCUS SESSION
Ischemic Heart Disease

Room 718A 13:30 - 15:30 Chairs: Andrew E. Arai and Victor A. Ferrari

13:30 ***628.*** **Comprehensive Application of 3D Coronary MR Angiography and First-Pass Perfusion in Coronary Artery Disease**

Liuquan Cheng[1], Yuangui Gao[1], Wei Sun[2], Fugeng Sheng[1], Ningyu An[1], Youquan Cai[1]
[1]PLA General Hospital, Beijing, People's Republic of China; [2]GE(China) Co.,Ltd. - Medical Systems, Beijing, People's Republic of China

A single breath-hold fat-suppressed 3D-FIESTA coronary MR angiography and Gd-DTPA first-pass myocardial perfusion were comprehensively used to evaluate the coronary artery disease on 17 patients and verified with conventional angiography. A sensitivity of 100% and a specificity of 80% indicated the potential application of the two imaging protocols combination in coronary artery disease evaluation.

13:40 ***629.*** **Detection of Ischemic Heart Disease by Dipyridamole Perfusion and Delayed Hyperenhancement: Analysis by Coronary Perfusion Region and by Patient**

Kenneth L. Rhoads[1], Wiphada Patricia Ingkanisorn[1], Christopher K. Dyke[1], Anthony H. Aletras[1], Andrew E. Arai[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Dipyridamole stress myocardial perfusion and delayed hyperenhancement were performed in 70 subjects and analyzed qualitatively. With ischemic heart disease (IHD) defined as a coronary stenosis >50% or myocardial infarction, the sensitivity and specificity of stress perfusion images were 93% and 86%when analyzed by coronary perfusion region and 92% and 86% on a per patient analysis. Dipyridamole stress cardiac MRI is highly accurate for detection of all stenoses except those of borderline hemodynamic significance (50-69% stenosis), and is superior to delayed hyperenhancement for the detection of ischemic heart disease (sensitivity 54%).

13:50 *630*. Contrast-Enhanced Cardiac MRI in the Prediction of Functional Recovery after Revascularization in Coronary Artery Disease - Comparison with [^{18}F]-FDG-PET

Peter Hunold[1], Katja Brandt-Mainz[1], Florian Matthias Vogt[1], Holger Eggebrecht[1], Stephan Knipp[1], Jörg Felix Debatin[1], Jörg Barkhausen[1]
[1]University Hospital, Essen, Germany

Aim of the study was to evaluate MRI and PET for the assessment of myocardial viability in CAD and to compare the preoperative prediction of functional recovery after revascularization. In 12 patients, [18F]-FDG-PET as well as TrueFISP Cine MRI and contrast-enhanced turboFLASH ("late enhancement") scans were performed before CABG operation. 1008 myocardial segments were analyzed with both techniques for the extent of myocardial scars. After CABG, repeated Cine MRI revealed functional improvement in 150 of 406 (37%) formerly dysfunctional segments. Concerning the prediction of functional recovery of viable Myocardium, MRI revealed higher specificity and positive predictive value than PET.

14:00 *631*. Assessment of Myocardial Viability using Contrast-Enhanced Magnetic Resonance Imaging - Comparison to Thallium-201 Single-Photon Emission Computed Tomography

Matthias Regenfus[1], Michaela Schmidt[2], Christian Schlundt[1], Niels Oesingmann[2], Werner G. Daniel[1]
[1]FAU Erlangen-Nuernberg, Erlangen, Germany; [2]Siemens Medical Solutions, Erlangen, Germany

Contrast-enhanced MRI and TI-201 SPECT were compared for assessment of myocardial viability in 53 patients with left ventricular dysfunction. Segmental defect size in SPECT, and infarct size in MRI correlated closely for patients with recent and remote infarction. However, SPECT failed to detect 20% of segments showing hyperenhancement and 6 patients with small infarcts by MRI. Moreover, only 51% of segments nonviable in SPECT exhibited transmural hyperenhancement in MRI. MRI and SPECT show close overall correlation concerning defect location and extent with MRI offering higher spatial resolution to visualize the transmural extent of myocardial infarction and to detect small infarcts.

14:10 *632*. Robust Determination of Inversion Delay in Myocardial Viability Imaging Using the Look Locker Approach

Raja Muthupillai[1], Scott D. Flamm[2]
[1]Philips Medical Systems and Baylor College of Medicine, Houston, Texas, USA; [2]St. Luke's Episcopal Hospital, Houston, Texas, USA

Myocardial viability assessment using the delayed enhancement imaging approach relies on correct nulling of signal from normal myocardium to identify regions of irreversible injury. We present a Look-Locker based imaging approach to determine the appropriate inversion delay directly eliminating the heuristic, iterative, operator dependent approach that is currently used. Results from the phantom and patient studies demonstrate the role for this approach in routine clinical use.

14:20 *633*. Localization of Anterior Myocardial Infarction: Correlation between Delayed Enhancement, "Scar" Magnetic Resonance Imaging and Electrocardiographic Findings

Margit Nemeth[1], J. Michael Wilson[1], Raja Muthupillai[2], Scott D. Flamm[1], Robert J. Hall[1]
[1]St. Luke's Episcopal Hospital, Houston, Texas, USA; [2]Phillips Medical Systems, Bothell, Washington, USA

ECG localization of myocardial infarction (MI) is widely used despite its limitations. Delayed enhancement (DE) myocardial imaging provides a means for non-invasive identification of irreversibly injured myocardium with high spatial resolution. This study evaluated the spatial localization, size and extent of MI as determined by ECG criteria, compared to DE cardiac MRI in 23 patients with isolated anterior MI. The results confirm that absence of Q-waves does not exclude prior myocardial infarction or scar tissue. In addition, ECG's have high sensitivity for identifying anterior wall MI, but poor specificity for identifying basal, septal, and apical regions of infarction.

14:30 *634*. Measurements of Relaxivity (R1) Post Contrast in Patients with Prior Myocardial Infarction

Puneet Sharma[1], Salil Patel[2], Roderic I. Pettigrew[2], John N. Oshinski[2]
[1]Georgia Institute of Technology, Atlanta, Georgia, USA; [2]Emory University, Atlanta, Georgia, USA

The purpose of this study is to quantify relaxation rates (R1) in normal myocardium, blood and infarct after Gd-DTPA injection in order to: 1) determine the variability that exists in selecting the inversion time (TI) to null normal myocardium at selected time points; and 2) to establish whether these tissues can be distinguished uniquely. The measured R1s show that the TI values early post-contrast are more variable than at later time points. It also appears that physiological influences play a major role in TI selection, as suggested by the large R1 variances between patients.

14:40 *635*. Late Enhancement without Infarction - Different Myocardial Diseases Presenting with Late Enhancement in Contrast-Enhanced Cardiac MRI

Peter Hunold[1], Florian Matthias Vogt[1], Sandra Massing[1], Walter Oskar Schüler[2], Oliver Bruder[2], Jörg Felix Debatin[1], Jörg Barkhausen[1]
[1]University Hospital, Essen, Germany; [2]Elisabeth Hospital, Essen, Germany

Scars after myocardial infarction can be identified by late enhancement (LE) in contrast-enhanced cardiac MRI. However, LE after administration of Gd-DTPA is not specific for ischemic heart disease. This study was performed to assess different non-ischemic entities of myocardial disease accompanied by LE. A total of 18 patients with angiographically excluded coronary artery disease presented LE. Fibrotic, inflammatory, and iatrogenic causes for LE were identified, and its pattern and distribution within the myocardial wall were compared. In the late phase after Gd-DTPA administration, different primary and secondary myocardial diseases could be detected.

14:50 ***636***. **Comparison of Echocardiography and MRI Regional Wall Motion Assessment in Patients with Acute Myocardial Infarction**

Wiphada Patricia Ingkanisorn[1], Kenneth L. Rhoads[1], Christopher Kent Dyke[1], Andrew Ernest Arai[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Twenty-eight patients underwent cardiac MRI study and a technically adequate standard 2-D echocardiogram within the two days following acute myocardial infarction. Delayed hyperenhancement images were used as the gold standard for defining the location of the infarct. Sensitivity of MRI in the detection of a regional wall motion abnormality (RWMA) was 100%; the sensitivity of echocardiography was 82%. Echocardiography detected larger sized infarct RWMA (average 23 ± 5 g) but missed smaller sized infarcts (average 9 ± 7 g on delayed hyperenhancement). MRI is superior to echocardiography in the detection of RWMA, even after excluding technically difficult echocardiographic studies.

15:00 ***637***. **Functional MR Angiography in Heart Failure**

Stephanie M. Shors[1], William G. Cotts[1], Biljana Pavlovic-Surjancev[1], Mihai Gheorghiade[1], James C. Carr[1], F. Scott Pereles[1], J. Paul Finn[1]
[1]Northwestern University Medical School, Chicago, Illinois, USA

It recently has become possible to image dynamic changes in the heart and great vessels with subsecond temporal resolution using MR angiography (MRA). In this study, we report a novel, clinical application of dynamic, 3D MRA in heart failure. Rapid, time-resolved MRA was performed in thirty heart failure patients for the derivation of cardiopulmonary transit times, left atrial volumes, and pulmonary arterial dimensions. All parameters were significantly increased in patients compared to controls, and transit time correlated strongly with left-sided volumes and ejection fraction. Thus, time-resolved, 3D MRA provides functional and anatomical information that may be useful in heart failure.

15:10 ***638***. **Coenzyme Q10 and Vitamin E Treatment of Patients with Friedreich Ataxia. A 4 Year Clinical and ^{31}P-MRS Follow Up Study**

Raffaele Lodi[1], Bheeshma Rajagopalan[2], Anthony HV Schapira[3], Paul E. Hart[3], Jenifer G. Crilley[2], Jane L. Bradley[3], Andrew M. Blamire[2], David Manners[2], Peter Styles[2], Mark J. Cooper[3]
[1]University of Bologna, Bologna, Italy; [2]Oxford University, Oxford, UK; [3]Royal Free Hospital, London, UK

It has recently been shown that the human pathology of Friedreich ataxia, the most common form of autosomal recessive spino-cerebellar ataxia which is often associated with a cardiomyopathy, is characterised by mitochondrial iron accumulation, increased sensitivity to oxidative stress, deficit of respiratory chain complex activities and in vivo deficit of tissue energy metabolism. We present here neurological, echocardiographic and 31P-MRS 4 year follow up findings in ten patients that underwent antioxidant therapy. Antioxidant therapy resulted in a sustained improvement in cardiac and skeletal muscle bioenergetics in FA patients associated with lack of progression of both neurological and echocardiographic signs.

15:20 ***639***. **Infarct Morphology on MR Viability Identifies Patients with Inducible Ventricular Tachycardia**

David S. Fieno[1], F. Scott Pereles[1], Gina K. Song[1], Eugene J. Huo[1], David Bello[1], Anish B. Zachariah[1], J. Paul Finn[1]
[1]Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA

To evaluate whether infarct morphology on MR viability identifies patients with substrate for inducible ventricular tachycardia, 48 patients with coronary artery disease undergoing electrophysiologic studies (EPS) underwent cine trueFISP and viability imaging. Planimetry of the contrast images was used to measure infarct mass and surface area by two readers blinded to EPS results. MR infarct characteristics were found to differ in patients with monomorphic ventricular tachycardia versus those without inducible arrhythmias. Further studies will determine if MR-determined infarct characteristics have independent predictive value for sudden death and utility in defining populations who would benefit from implantable defibrillator therapy.

Myocardial Perfusion and Viability

Room 718A 16:00 - 18:00 Chairs: Michael Jerosch-Herold and Robert M. Judd

16:00 ***640***. **T_2-Prepared TrueFISP BOLD Imaging of Myocardial Perfusion in a Dog Stenosis Model**

Steven M. Shea[1], David S. Fieno[1], Xiaoming Bi[1], Brian E. Schirf[1], Richard Tang[1], Kathleen R. Harris[1], Reed A. Omary[1], Debiao Li[1]
[1]Northwestern University, Chicago, Illinois, USA

First-pass perfusion techniques are limited to low spatial resolution and reduced coverage due to temporal resolution constraints. Using the blood oxygen level dependent (BOLD) effect to measure myocardial perfusion reserve would alleviate some of these problems. We used a T2-prepared TrueFISP BOLD sequence to image a dog stenosis model at rest and during stress-stenosis. An average change of 18±4.3% in SNR was observed between non-stenosed and stenosed areas in the myocardium, which was found to be significant ($p<0.05$). T2-prepared TrueFISP BOLD imaging demonstrated the ability to accurately identify an area of stenosed flow in an animal model.

16:12 *641*. Dynamic Assessment of Myocardial Flow Reserve: A BOLD Approach

Jie Zheng[1], Jinghua Wang[1], Mark Nolte[1], Faith E. Rowold[1], Pamela K. Woodard[1], Robert J. Gropler[1]
[1]Washington University in St. Louis, St. Louis, Missouri, USA

Dynamic assessments of myocardial flow reserve (MFR) will allow consecutively monitoring dose-responses of myocardium to various therapeutic interventions and may provide important information on the myocardial viability. A myocardial BOLD method was proposed and developed to measure myocardial oxygenation and MFR dynamically during hyperemia using the Fick's law. This approach was validated in normal dogs by blood sampling. In stenotic dogs, the calculated MFR values were highly correlated with those obtained by first-pass perfusion imaging. Such technical advancement may permit repeatable measurements of MFR in a clinical setting.

16:24 *642*. Directional Anisotropy of the Vascular Structure Detected with the Intra Voxel Incoherent Motion (IVIM) Effect in the Canine Heart

Virginie Callot[1], Han Wen[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

To our knowledge, the intra voxel incoherent motion (IVIM) effect, largely investigated in the brain, has never been applied in the heart where the diffusion-weighted sequences sensitivity to motion artifacts is higher. Our purpose was therefore to develop a careful protocol to overcome this problem and investigate the potential of the method to provide directional diffusion and perfusion information in the myocardium: three-dimensional perfusion index, intravascular volume fraction, as well as diffusion measurements have been obtained. The method and accuracy of the results are presented and discussed in the following work.

16:36 *643*. Investigation of the Microstructure of the Heart: Comparison between T_2* Imaging and Diffusion-Weighted Imaging

Sascha Köhler[1], Karl-Heinz Hiller[1], Wolfgang R. Bauer[2], Axel Haase[1], Peter M. Jakob[1]
[1]Physikalisches Institut, Wuerzburg, Germany; [2]Medizinische Universitätsklinik, Wuerzburg, Germany

Recently, a number of studies [1] have indicated that diffusion-weighted imaging may be used to determine the muscle fiber orientation of tissues. However, the myocardial fiber orientation is also observable in T2* maps as demonstrated in a previous study [2]. The purpose of the present study was twofold: to give a more quantitative description of the T2* based myocardial fiber contrast and to compare the fiber structure obtained with T2* imaging with high-resolution diffusion-weighted images of the isolated rat heart at 11.75 T. As demonstrated experimentally, diffusion-weighted imaging and T2* mapping yielded almost equivalent information about myocardial fiber structure.

16:48 *644*. Identification and Characterization of Collateral-Dependent Myocardium with Albumin-Binding Intravascular Contrast Agent

Michael Jerosch-Herold[1], Xudong Hu[1], Naveen S. Murthy[1], Xiaoen Wang[1], Carsten Rickers[1], Cory M. Swingen[1], Ravi Teja Seethamraju[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Myocardial perfusion in collateral-dependent and remote myocardial segments was assessed with an intravascular albumin-binding contrast agent (MS-325) in a porcine model (N=13) to determine the accuracy, sensitivity and specificity of MR perfusion imaging in the characterization of collateral-dependent myocardium. Impairment of the vasodilator response in collateral-dependent segments could be detected with MS325-based perfusion imaging with 83% sensitivity and 95% specificity. Changes in dynamic distribution volume between rest and vasodilation were significantly different for collateral-dependent segments, compared to remote segments ($p<0.01$).

17:00 *645*. Correlating Left-Ventricular Infarction Zone Versus Function in a Murine Model of Myocardial Infarction by Cardiac Manganese Enhanced MRI (MEMRI)

Tom C-C Hu[1], Weike Bao[1], Stephen C. Lenhard[1], Thomas R. Schaeffer[1], Tian-Li Yue[1], Beat M. Jucker[1], Robert N. Willette[1]
[1]GlaxoSmithKline, King of Prussia, Pennsylvania, USA

Manganese ion has been used as a myocardial image contrast agent due to its signal enhancement of viable well perfused tissue. In this study, we examined the correlation between left ventricular infarction zone versus function by cardiac Manganese Enhanced MRI (MEMRI). A good correlation was observed between the Mn^{2+} determined infarction volume versus conventional histological TTC staining. There was also a strong negative correlation between MEMRI determined infarction % and ejection fraction ($r = -0.94$). The signal enhancement may also provide insight into calcium homeostasis after myocardial infarction (MI) in the mouse.

17:12 *646*. Evaluating the Specificity of MRI for Viability Determination in a Canine Model of Significant Coronary Artery Stenosis

Katie S. Lekx[1], Frank S. Prato[1], Gerald Wisenberg[2], Jane Sykes[1]
[1]Lawson Health Research Institute, London, Ontario, Canada; [2]University of Western Ontario, London, Ontario, Canada

The underlying assumption in delayed enhancement or constant infusion techniques to detect infarcted myocardial tissue is that the partition coefficient (λ) of Gd-DTPA significantly increases only in permanently damaged tissue. This assumption is supported in canine models of stunned and infarcted myocardium but has not been adequately tested in models of chronic, reversibly damaged tissue. Here we report that λ is not increased in a canine model of significant coronary artery stenosis maintained over 10 weeks. We conclude that increases in λ likely do not occur in reversibly damaged tissue and are specific for permanently damaged myocardium.

17:24 *647*. Determining the Extent to which Delayed Enhancement Images Reflect the Partition-Coefficient of Gd-DTPA in Canine Studies of Acute and Chronic Myocardial Infarction

Rebecca E. Thornhill[1], Frank S. Prato[1], Gerald Wisenberg[1], Gerald R. Moran[2], Jane Sykes[1]
[1]Lawson Health Research Institute, London, Ontario, Canada; [2]McMaster University, Hamilton, Ontario, Canada

MRI after a constant infusion (CI) of Gd-DTPA has been used to identify myocardial infarction. However, 'delayed enhancement imaging' (DE), performed after a single bolus, is faster than CI. Both were applied to canine models of acute and chronic infarction and the estimates of the partition-coefficient of Gd-DTPA obtained with DE were compared with those made following a 60min CI. In acute animals, concordance (Rc) between the techniques was reasonable for DE times 15-25min. Although Rc deteriorated with day/wk post-infarction in the acute animals, there was an improvement over time for the chronic animals studied.

17:36 *648*. Unchanged Gd-DTPA-Enhanced T_1 during Edema Is Due to Simultaneous Expansion of Intra- and Extracellular Compartments

Gang Li[1], Bo Xiang[1], Jiankang Sun[1], Guangping Dai[1], Roxanne Deslauriers[1], Ganghong Tian[1]
[1]Institute for Biodiagnostics, NRC, Winnipeg, Manitoba, Canada

The present study was to determine the effect of edema on intra- and extracellular volumes. Changes in total water space and extracellular space were monitored by measuring the areas of dimethyl methylphosphonate (DMMP) and phenylphosphonate (PPA) peaks using 31P MRS. It was found that tissue edema in viable myocardium resulted in water accumulation in both intra- and extracellular compartments. On the other hand, infarcted hearts showed a significant increase in extracellular marker accessible space during edema due to loss of cell membrane integrity.

17:48 *649*. *In Vivo* T_1 Mapping of Canine Hearts Using Gd(ABE-DTTA) in an Ischemia-Reperfusion Model

Pal Kiss[1], Pal Suranyi[1,2], Tamas Simor[1,2], Nada Saab-Ismail[1,2], Ada Elgavish[1,2], Laszlo Hejjel[1,2], Gabriel A. Elgavish[1,2]
[1]University of Alabama at Birmingham, Birmingham, Alabama, USA; [2]Elgavish Paramagnetics Inc, Birmingham, Alabama, USA

To determine the level and distribution of the MRI signal enhancement induced by the contrast agent Gd(ABE-DTTA) in myocardial tissue, T_1 mapping experiments were carried out using an ischemia-reperfusion model in seven dogs. Exploiting the relatively long tissue life time of this contrast agent, no fast T_1 measurement technique was needed. Myocardial perfusion was determined with non-radioactive dye microspheres. Excellent correlation was found between the myocardial perfusion, T_1, and wall thickening values in the same areas.

MR PHYSICS AND TECHNIQUES FOR CLINICIANS

Room 718B 16:00 - 18:00 Chairs: Frank R. Korosec and Joseph C. McGowan

Educational Objectives

Upon completion of this course, participants should be able to:

- Define and describe the fundamental principles of MR imaging, including the definition of spin magnetization, the Larmor relationship, relaxation phenomena, and the process of using the spin magnetization to produce an image;
- Explain imaging pulse sequences based upon spin and gradient echoes, incuding fast spin echo and echo planar techniques;
- Design MR imaging protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio, and artifacts;
- Describe the principles and capabilities of various advanced MR techniques including diffusion, cardiac and functional MRI and spectroscopy.

16:00 **Cardiac MRI**
Frank R. Korosec

16:40 **Functional MRI**
M. Elizabeth Meyerand

17:20 **Hardware**
Richard G.S. Spencer

fMRI of Human Sensory Motor and Visual Systems

Room 701A 16:00 - 18:00 Chairs: James S. Hyde and Keith Thulborn

16:00 ***650.*** **Short Term Accommodation in the fMRI of Pain**

James William Ibinson[1], Robert H. Small[1], David Clark[1], Antonio Algaze[1], Petra Schmalbrock[1]
[1]The Ohio State University, Columbus, Ohio, USA

Using BOLD FMRI, this study investigated two serial pain tasks separated by 4 minutes to determine whether a significant difference existed in their activation maps due to accommodation to the first pain task. A complete 3 factor model was analyzed by ANOVA using SESSION (first or second), TASK (tingling or pain), and TE (40 or 60 ms) as factors. Only the TASK main effect proved significant. The lack of a SESSION x TASK interaction effect is important because it implies that short-term accommodation is not present in normal, healthy individuals.

16:12 ***651.*** **Imaging the Human Heat/Capsaicin Model of Neuropathic Pain: An fMRI study**

Jonathan Brooks[1], Bill Bimson[2], Neil Roberts[2], Turo Nurmikko[2]
[1]University of Oxford, Oxford, UK; [2]University of Liverpool, Liverpool, UK

Primary hyperalgesia is an enhanced response to normally painful stimuli and one of the major symptoms of neuropathic pain. To investigate this phenomenon we used a model of primary hyperalgesia, which synergistically combines mild warming of the skin and topical application of 0.075% capsaicin ointment. Using FMRI, we compared brain activity to a physiologically painful hot stimulus delivered to the hand, to thermal stimulation of the same site following treatment with capsaicin, which produced the same pain perception. Despite this matching of pain perception, regional brain activity in response to primary hyperalgesia demonstrated significantly increased prefrontal and parietal activation.

16:24 ***652.*** **Activation of the Secondary Somatosensory Cortex Elicited by Electrical Stimulation of the Median Nerve at Non Painful and Painful Stimulus Intensities: An fMRI Study**

Cosimo Del Gratta[1], Anotnio Ferretti[1], Massimo Caulo[1], Armando Tartaro[1], Claudio Babiloni[2], Gian Luca Romani[3]
[1]University of Chieti, Chieti, Italy; [2]University of Rome, La Sapienza, Rome, Italy; [4]INFM, L'Aquila, Italy

The activation of the secondary somatosensory cortex (SII) was studied while electrically stimulating the right median nerve at various stimulus intensities, ranging from slightly above the motor threshold up to a subjective painful level. fMRI was performed according to a block paradigm comparing stimulation and control conditions. At the highest stimulus intensity, activation was observed bilaterally in the perisylvian area, in two distinct spots on each hemisphere. One, more anterior, was also observed at lower stimulus intensities. Another, more posterior was observed only at painful intensity. This suggests that sensitive and pain fibers project to different areas in SII.

16:36 *653*. High-Frequency Stimulation of the Human Primary Motor Cortex: An Interleaved Transcranial Magnetic Stimulation (TMS) and Functional MRI Study

Sven Bestmann[1], Jurgen Baudewig[1], Hartwig R. Siebner[2], John C. Rothwell[2], Jens Frahm[1]
[1]Biomedizinische NMR Forschungs GmbH am Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany; [2]Institute of Neurology, London, UK

Interleaved TMS/fMRI (4Hz,10s) was used to visualise cortical hemodynamic changes following magnetic brain stimulation. In each block, TMS was applied at intensities above, around or below individual motor thresholds, respectively, over the left motor cortex. Signal increases in left primary motor cortex were only evoked after suprathreshold TMS, thus indicating a strong linkage between hemodynamic changes and afferent feedback in the directly stimulated area. Furthermore, weak activations were observed in PMd and SMA after low-intensity stimulation, suggesting hemodynamic modulation in cortically connected regions. We propose interleaved TMS/fMRI as a useful technique to visualise functional connectivity.

16:48 *654*. Sequential Cerebro-Cerebellar fMRI Activation in a Delayed Response Task

Wolfgang Grodd[1], Michael Erb[1], Ernst Huelsmann[1]
[1]Dept. of Neuroradiology, Tuebingen, Germany

The cerebellum is involved in numerous motor-related functions. Recent observations suggest that it also performs fundamental operations on non-motor functions. This was tested by using fMRI in a delayed response task. The results revealed cerebral and cerebellar activation accompanying the process within a time frame of six seconds. The cerebral activations spread from the anterior cingulate cortex through the SMA and pre-motor area to primary motor and sensory cortex. These activation were in parallel to cerebellar activations propagating from the neo- to the spinocerebellum, indicating that various areas are involved at multiple times during the intention and planning of movements.

17:00 *655*. Brain Areas Associated with the Self-Generated Timing of Movements

Kayako Matsuo[1], Masahiro Ozawa[2], Toshiharu Nakai[1], Keiichiro Toma[3], Shunsuke Sato[2]
[1]National Institute of Advanced Industrial Science and Technology, Ikeda, Osaka, Japan; [2]Osaka University, Toyonaka, Osaka, Japan; [3]Institute of Biomedical Research and Innovation, Kobe, Hyogo, Japan

In order to investigate the mechanisms for the timing of movements, the brain activation under self-paced finger movements (1Hz) against temporally irregular visual cues was compared with activation under the same self-paced finger movements guided by periodical cues. In the irregular condition, the SMA, PMA, and IFG were more intensively activated than in the periodical condition. It was suggested that these areas are engaged in the movements driven by the self-generated timing. The activation in the IFG may indicate that the timing of movements may share the neuronal mechanism with that of the auditory rehearsal.

17:12 *656*. Plastic Change of Motor Cortex Induced by Transcutaneous Electric Nerve Stimulation

Keiichiro Toma[1], Toshiharu Nakai[2], Tasuya Mima[3], Kayako Matsuo[2], Dinh Ha Duy Thuy[3], Tatsuhide Oga[3], Masahiro Ozawa[4], Hiroshi Shibasaki[3], Hidenao Fukuyama[3]
[1]Institute of Biomedical Research and Innovation, Kobe, Hyogo, Japan; [2]National Institute of Advanced Industrial Science and Technology, Ikeda, Osaka, Japan; [3]Kyoto University Graduate School of Medicine, Kyoto, Japan; [4]Osaka University Graduate School of Engineering Science, Toyonaka, Osaka, Japan

To investigate if motor cortical representation shows plastic change after short-term somatosensory stimulation, the brain activation during the right thumb movement was compared before and after transcutaneous electric nerve stimulation (TENS) by using fMRI. The activation in the primary motor area (M1) decreased after the intervention with TENS. This reduction lasted for 30 min. The fact that the same motor outputs were achieved by the activation of smaller volume in the M1 suggested that the M1 works more efficiently after peripheral somatosensory stimulation. Short-term somatosensory stimulation may be useful to rehabilitate motor-disabled patients after brain damages.

17:24 *657*. Investigation of Cortical Dynamics using Simultaneous GE and SE EPI

Susan Francis[1], Sarah Gutteridge[1], Francis McGlone[2], Edward Kelly[3], Richard Bowtell[1]
[1]Magnetic Resonance Centre, Nottingham, UK; [2]University of Wales, Bangor, UK; [3]University of North Carolina, Chapel Hill, North Carolina, USA

EEG and Optical Imaging Spectroscopy investigations of brain responses to vibrotactile stimulation of digit tips have revealed topographic cortical dynamics within the primary somatosensory cortex. The site of activity in area 3b(SI) is hypothesized to become more focal and shift down the posterior wall of the central sulcus over the stimulus period, as the activity evolves from one representing whole digit to 'pure' digit tip. We investigate this robust model using high resolution simultaneous gradient (GE) and spin echo (SE) fMRI to study a long duration (27 s) vibrotactile stimulus applied to the thumb tip and base.

17:36 *658*. Correspondence of Structurally and Functionally Determined Human Visual Cortex

Stuart Clare[1], Holly Bridge[1], Peter Jezzard[1], Andrew J. Parker[1], Paul M. Matthews[1]
[1]University of Oxford, Oxford, UK

Regions corresponding to the layer of myelination within the striate cortex were identified from high resolution (0.3 x 0.3 x 1.5 mm^3) MR images. Using a standard retinopy paradigm, V1 was functionally mapped for the same subjects. Alignment of the two data sets indicates a significant overlap between the functionally and structurally determined V1 regions, demonstrating the ability of high resolution structural MRI to delineate myelinated striate cortex.

17:48 *659*. Study of Illusion Effect in Human Primary Visual Cortex (V1) Using Dynamic fMRI

Nanyin Zhang[1], Wei Chen[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Dynamic functional magnetic resonance imaging with paired-stimuli paradigm was used to study the fast neuronal interaction, happening within tens of milliseconds, between the neuronal groups from visual and auditory cortices. Experimental data show that the BOLD response in V1 to single flash accompanied with two beep sounds is significantly larger than that to single flash only. The result demonstrates that dynamic fMRI can provide temporal information of neuronal interaction between visual and auditory systems that happens within tens of milliseconds.

ASL Brain Perfusion: Technical Issues

Room 701B 16:00 - 18:00 Chairs: Xavier G. Golay and Richard B. Buxton

16:00 *660*. MT is Symmetric but Shifted with Respect to Water

Scott D. Swanson[1], Yuxi Pang[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

Magnetization transfer (MT) is not symmetric about the water proton resonance, requiring different offsets or RF power levels in arterial spin labeling (ASL) control experiments. This study reports MT spectra for hydrated corn starch, cross-linked albumin, and in vitro brain samples. We find that the MT spectra are symmetric, but offset from water. The frequency difference is different for different materials and is caused by the chemical shift difference between water and macromolecules. Detailed knowledge of tissue MT spectra will eliminate guess work in ASL experiments.

16:12 *661*. Comparison of Single-Coil Continuous Arterial Spin Labeling (CASL) Techniques *In Vivo*

Weiying Dai[1], H. Michael Gach[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

Three single-coil continuous arterial spin labeling (CASL) techniques: the traditional single-slice alternating proximal and distal irradiation (APDI); and the multislice simultaneous proximal and distal irradiation (SPDI) and double adiabatic inversion (DAI) were applied in vivo in the same subjects to compare their residual magnetization transfer (MT) effects and labeling efficiencies.

16:24 *662*. QUIPSS II Multi-Slice Perfusion Imaging with Improved Saturation Profile

Gaby S. Pell[1], David P. Lewis[2], Roger J. Ordidge[3], Craig A. Branch[2]
[1]Brain Research Institute, Heidelberg, Victoria, Australia; [2]Nathan Kline Institute, Orangeburg, New York, USA; [3]University College London, London, Middlesex, UK

A novel implementation of the QUIPSS II method for quantitative multi-slice perfusion imaging is demonstrated with an optimized saturation scheme based on a double adiabatic pulse combination. The improved saturation profile is largely insensitive to B1 inhomogeneities and allows minimization of the gap between the inversion and imaging slabs.

16:36 *663*. Simulation of Adiabatic Spin Inversion for Local Surface Coils

Robert Trampel[1], Thies H. Jochimsen[1], Toralf Mildner[1], David G. Norris[2], Harald E. Möller[1]
[1]Max-Planck-Institute of Cognitive Neuroscience, Leipzig, Germany; [2]FC Donders Centre for Cognitive Neuroimaging, Nijmegen, Netherlands

A new method for the prediction of the labeling efficiency in continuous arterial spin labeling experiments under various experimental conditions is demonstrated. For simulation the exact solution of the Bloch equations including spin relaxation is utilized. The approach is especially useful in the case of labeling at the carotid artery with a surface coil, because the realistic course of the B1 field can be included. Under certain conditions the results show significant differences to simulations that assume a constant B1 field along the carotid artery. Other conditions, such as deviations from a constant labeling gradient, may also be considered.

16:48 *664*. Pulsed ASL using FOCI Pulses Combined with Prospective Motion Correction

Joost Kuijer[1], Stefan Thesen[2], Edgar Mueller[2]
[1]VU University Medical Centre, Amsterdam, Netherlands; [2]Siemens Medical Solutions, Erlangen, Germany

Arterial spin labeling (ASL) is becoming a popular technique for the assessment of brain perfusion. Combining pulsed ASL with prospective motion correction may be beneficial for perfusion FMRI as it reduces task-correlated head motion. Furthermore, prospective correction may improve the robustness of clinical ASL applications. This work demonstrates the feasibility of real-time prospective motion correction in combination with arterial spin labeling using FOCI pulses. The real-time correction of the slab position of a FOCI pulse is addressed and the technique is demonstrated with data of a healthy volunteer.

17:00 *665*. Simulations of the Effects of Flow on the 2D RF Pulses used in Selective-ASL

Nigel Paul Davies[1], *Peter Jezzard*[1]
[1]University of Oxford, Oxford, UK

The feasibility of perfusion territory mapping using 2D RF pulses to label selected vessels has been demonstrated. Development of the technique to allow quantitation of perfusion and comparison across individuals requires understanding of potential confounding factors. The aim here was to investigate the effects of flow on 2D RF labelling pulses using simulations. Results show that pulsatile flow has a small effect on the total inversion efficiency of the pulses, but a large impact on the spatial spread of the bolus within the artery and therefore on transit times. Spurious excitations caused by flow were not evident.

17:12 *666*. The Effect of Vascular Signal on the Measurement of Percent CBF Change in Brain Activation

Frank Q. Ye[1], *Marta Maieron*[1], *Peter A. Bandettini*[1]
[1]National Institutes of Mental Health, Bethesda, Maryland, USA

The percent CBF change during visual activation was measured using arterial spin tagging with different parameter settings to test whether the value sensitive to vascular artifacts. In the absence of a gradient flow crusher, the percent CBF change did not vary when measured with or without the QUIPS II approach. However, with the QUIPS II approach the percent CBF change was significantly larger in the presence of a gradient flow crusher than in the absence of a gradient flow crusher.

17:24 *667*. Regional Differences in Transit Times in the Normal and Hypoperfused Rat Brain: Implications for the Quantification of Cerebral Blood Flow with continuous Arterial Spin Labelling

David L. Thomas[1], *Mark F. Lythgoe*[1], *Louise van der Weerd*[1], *John S. Thornton*[1], *David G. Gadian*[1]
[1]University College London, London, UK

Continuous arterial spin labelling with a range of post-tagging delay times was used to measure cerebral blood flow and arterial transit times in the rat brain. Regional variations in both parameters were observed. In the normal rat brain, grey matter CBF was in the range 135-215 ml/100g/min and transit times in all regions were less than 500ms. However, following bilateral common carotid artery occlusion, CBF decreased overall and transit times increased to up to 850ms. These results highlight the importance of knowledge of transit times in the design of CASL experiments.

17:36 *668*. Effect of the Apparent Transverse Relaxation Time on Cerebral Blood Flow Measurements obtained using Arterial Spin Tagging: A Theoretical Investigation.

Keith St. Lawrence[1]
[1]Lawson Health Research Institute, London, Ontario, Canada

With arterial spin tagging (AST) methods a significant fraction of the signal originates from the capillaries. A previously defined model (St Lawrence MRM 2000;44:440-449) was used to determine if differences in T2* values for tissue and capillary blood could cause errors in the observed CBF values. At higher fields (> 4 T), the model predicts that CBF can be underestimated due to the stronger susceptibility effects of deoxygenated blood.

17:48 *669*. What is the Longitudinal Relaxation Time (T_1) of Blood at 3.0 Tesla?

Hanzhang Lu[1], *Chekasha Clingman*[1], *Xavier Golay*[1], *Peter van Zijl*[1]
[1]Johns Hopkins University & F.M. Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA

The longitudinal relaxation time (T1) of blood was measured at 3.0 T under physiological conditions in a blood perfusion system. At physiological temperature of ~37 C, blood T1 values ranged from 1504ms to 1684ms, depending on hematocrit (Hct: 0.46-0.38). Temperature significantly affected T1: a 10 C decrease corresponded to a 130ms reduction in T1. In contrast to the influence of Hct and temperature, blood oxygenation effects were small. In our perfusion setup at 3.0 T, effects of radiation damping caused a drop of ~20ms in measured T1 values.

MR Spectroscopy: Compounds and Signals

Room 714 A/B 16:00 - 18:00 Chairs: Sebastian Cerdan and Melissa J. Terpstra

16:00 *670*. Brain Metabolite Discrimination in Proton Spectroscopy: Illustration with Myo-Inositol

Hyeonjin Kim[1], *Peter S. Allen*[1]
[1]University of Alberta, Edmonton, Alberta, Canada

This abstract demonstrates, by means of the myo-Inositol discrimination example, the potential role of optimizing the phase dependence of the multiple quantum coherence generating pulse in a multiple quantum filter sequence. This methodology will find application in brain where many of the target metabolites contain strongly-coupled spins. Since the responses of the various metabolites to the phase dependence are different, it also expands the toolbox for differentiating between metabolites with strongly-coupled spins.

16:12 671. A Modified STEAM Sequence Designed for Strongly-Coupled Spin Systems in Proton MRS

Atiyah Yahya[1], Hyeonjin Kim[1], Peter S. Allen[1]
[1]University of Alberta, Edmonton, Alberta, Canada

In-vivo proton NMR spectra of brain metabolites are difficult to interpret because of the many overlapping peaks. We demonstrate here that by applying a 90° hard pulse with appropriate phase at the echo time of a standard STEAM sequence, only signal arising from strongly-coupled spins is detected, thereby simplifying the spectrum. Echo time dependent experiments conducted at 3T on a phantom consisting of citrate, lactate, and creatine demonstrate this effect.

16:24 672. High-Resolution ^{1}H Metabolite Spectroscopy using Multiple-Echo PHORMAT

Jian Z. Hu[1], Robert A. Wind[1]
[1]Pacific Northwest National Laboratory, Richland, Washington, USA

PHORMAT with sample spinning rates as low as 1Hz can be used to enhance the resolution of 1H metabolite spectra in biological samples without destroying their integrity. However, a problem with PHORMAT is its relatively low sensitivity. It is shown that for excised rat liver multiple-echo acquisition increases the sensitivity per unit time by a factor 2.3 while reducing the measuring time by a factor 2. This, combined with a reduction in the spectral width in the evolution dimension makes it possible to acquire a PHORMAT spectrum with a good sensitivity in only 8 minutes.

16:36 673. Measurement of Undistorted Satellite Transitions Lineshapes of ^{23}Na in Ordered Tissues using a New Method for Suppressing the Central Transition.

Uzi Eliav[1], Keren Keinan-Adamsky[1], Gil Navon[1]
[1]Tel Aviv University, Tel Aviv, Israel

The splitting and the lineshape of the satellite transitions of ^{23}Na is a measure of the residual quadrupolar interaction and its distribution, which are related to the degrees of order and binding in biological tissues. However, these transitions are often masked by the stronger signals of the central transition and the isotropic sodium ions. A way to suppress the central signals while preserving the single pulse lineshape of the satellites is suggested and tested on articular cartilage.

16:48 674. Novel *In Vivo* Gene Reporter Molecule Using Fluorinated Vitamin B6 as ^{19}F NMR indicator

Jian-Xin Yu[1], Ralph Peter Mason[1]
[1]UT Southwestern Medical Center at Dallas, Dallas, Texas, USA

A novel in vivo gene reporter molecule GFPOL was designed, synthesized and evaluated. The 19F NMR spectra indicate that beta-galactosidase was able to efficiently activate GFPOL releasing the pH indicator 6-fluoropyridoxol.

17:00 675. Probing Mitochondrial Disorders through ^{13}C and ^{31}P NMR Analysis of Extracts

Nicholas E. Simpson[1], Zongchao Han[1], Joshua C. Harrison[1], James R. Rocca[1], Peter W. Stacpoole[1], Ioannis Constantinidis[1]
[1]University of Florida, Gainesville, Florida, USA

Disorders of mitochondrial energetics have dire consequences for afflicted individuals. In this study we grew cell cultures from patients with mitochondrial disorders and labeled metabolic intermediates by incubating the cells in U-13C-glucose. By performing NMR 31P and 13C spectroscopy on the cell extracts, information relevant to the cellular defect can be obtained. This study examines spectroscopic data generated from cell lines in the presence and absence of a compound to enhance carbon entry into the TCA cycle. It illustrates the potential for using NMR spectroscopic techniques to provide information relating to metabolic disorders.

17:12 676. Disordered Astrocytic-Neuronal Metabolic Trafficking Contributes to Selective Neuronal Energy Failure in Manganese Neurotoxicity

Claudia Zwingmann[1], Alan Hazell[1], Dieter Leibfritz[2]
[1]Hospital Saint-Luc, Montreal, Canada; [2]University of Bremen, Bremen, Germany

To gain insight into the mechanism(s) leading to energy failure in manganese neurotoxicity, we investigated [1-13C]glucose metabolism coupled to oxidative phosphorylation in manganese-exposed rats and cell cultures by NMR-spectroscopy. In frontal cortex, MnCl2 stimulated glycolysis and mitochondrial glucose oxidation. Increased glutamine synthesis suggests astrocytic changes. In globus pallidus, reduced NAA, glutamate and aspartate indicates to neuronal dysfunction. Comparison with [2-13C]acetate metabolism revealed decreased glutamine synthesis and reuptake of [13C]glutamate and [13C]GABA by astrocytes. A selective energy failure of neurons and disorder of the intercellular metabolic balance leading to deterioration of neuronal mitochondrial function was supported by cell-culture experiments.

17:24 ***677***. **MRS Assessment of Glutamate Clearance in a Novel Pain Model**

Giulio Gambarota[1], Marielle Philippens[1], Brian E. Cairns[2], KlaasJan W. Renema[1], Jeroen Pikkemaat[1], Arend Heerschap[1]
[1]UMCN, Nijmegen, Netherlands; [2]Children's Hospital, Harvard Medical School, Boston, Massachusetts, USA

Injection of 1.0 M glutamate into the masseter muscle is a novel experimental model of acute muscle pain, employed in human and animal studies. Elevated levels of glutamate evoke a burning/aching muscle pain, which lasts 5-10 min. The present study used localized 1H MRS to monitor glutamate clearance from rat masseter muscle. After injection, the glutamate signal amplitude decayed rapidly, and became indistinguishable from the baseline within ~10 min. This result suggests that glutamate clearance correlates well with the time course of glutamate-evoked pain in human subjects.

17:36 ***678***. **Isotopomer Analysis with ^{13}C MAS of Tissue Biopsies**

Matthew Merritt[1], Shawn Burgess[1], Dean Sherry[1], Craig Malloy[1]
[1]University of Texas Southwestern Medical Center, Dallas, Texas, USA

Magic-angle spinning (MAS) NMR was used to acquire ^{13}C spectra of a biopsy sample of a rat heart obtained after Langendorff perfusion. A 50 mg sample (wet weight) from a heart perfused with [2-^{13}C] acetate yielded a ^{13}C spectrum with 2200 scans (2hr acquisition time) that showed typical ^{13}C spin-spin coupling patterns in glutamate.

17:48 ***679***. ***In Vivo*** **^{13}C NMR Detection of Labeled Serine and Glycolytic Intermediates in the Rat Brain during ^{13}C Glucose Infusion**

Pierre Gilles Henry[1], Gulin Oz[1], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Recent improvements in ^{1}H-localized ^{13}C spectroscopy allowed localized broadband detection of ^{13}C resonances over a 85ppm bandwidth in the rat brain *in vivo* with excellent sensitivity. These advances were exploited to detect of several resonances not previously observed *in vivo*, and their tentative assignment to [3-^{13}C]serine, [1-^{13}C]fructose and [1-^{13}C]glycerol-3-phosphate using high-resolution 1D and 2D NMR spectroscopy (HSQC-TOCSY) of brain extracts. These compounds are labeled due to reactions closely associated with glycolysis and thus open a new non-invasive window on glycolytic reactions.

Interventional MR Imaging

Room 716 A/B 16:00 - 18:00 Chairs: Jonathan S. Lewin and Timothy P.L. Roberts

16:00 ***680***. **Initial Clinical Experience using a Truly Hybrid X-ray/MR Imaging System**

Rebecca Fahrig[1], Zhifei Wen[1], Bruce L. Daniel[1], Kim Butts[1], Stephen T. Kee[1], Gary Heit[1], Huanzhou Yu[1], Ann Shimikawa[2], Arundhuti Ganguly[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA; [2]GE ASL West, Menlo Park, California, USA

Both X-ray fluoroscopy and MRI provide useful information during interventional procedures, with x-ray imaging providing precise, high-contrast, rapid real-time projections for guidance and MRI providing tomographic information, soft-tissue contrast, and physiologic data. To fully exploit the strengths of each modality, a truly-hybrid imaging system has been developed and characterized. Several patient studies have been carried out to shed insight into the potential utility of the hybrid system and to determine the limitations of the current implementation. Preliminary patient images and assessment of system performance in a clinical setting are presented.

16:12 ***681***. **Combining MR and X-ray Images for XMR Guided Cardiac Interventions**

Kawal Rhode[1], Philip Edwards[1], Sanjeet Hedge[1], Derek Hill[1], Reza Razavi[1]
[1]King's College London, London, UK

Our Philips XMR interventional facility incorporates a 1.5T MR scanner and mobile cardiac x-ray set in a single operating room, with seamless transfer of patients between the two modalities. Cardiac catheterisation can be performed using a combination of imaging modalities. The objective of this work was to combine the MR images with the x-ray images using a 2D-3D registration technique based on optical tracking. The technique was validated using a vascular phantom and patient images. For the phantom study, the 2D RMS fiducial registration error was 3.6mm. Our initial results suggest that our technique will assist in XMR interventional guidance.

16:24 ***682***. **Co-registration of X-ray and MR Fields of View in a Truly Hybrid System**

Huanzhou Yu[1], Rebecca Fahrig[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA

X-ray fluoroscopy and MRI are both used to guide interventions but have complementary strengths and weaknesses. To fully integrate an x-ray/MR hybrid system, a real-time x-ray/MR interface is proposed. A key step to implement this interface is co-registration of x-ray and MR fields of view (FOVs). In our method, sixteen fiducial markers are placed in the FOV. X-ray and MR measurements of the markers are then used to calibrate the system, thereby enabling the use of x-ray images as "scouts" to prescribe MR slices. Two sources of errors are studied and results from simulations and experiments are presented.

16:36 ***683***. **The Influence of Neurosurgeon Experience with Intra-Operative MRI on Time Efficiency and Impact of Imaging**

Jonathan S. Lewin[1], Robert J. Maciunas[1], Mariana L. Meyers[1], Jeffrey L. Duerk[1], Andrew K. Metzger[1], Michael Wendt[1], Arnulf Oppelt[2], Warren R. Selman[1]
[1]University Hospitals of Cleveland, Cleveland, Ohio, USA; [2]Siemens Medical Engineering Group, Erlangen, Germany

This study was performed to evaluate the time-efficiency and impact of intra-operative imaging in neurosurgical procedures, with evaluation of variation of these parameters with respect to operator experience. 130 neurosurgical procedures in 122 patients were analyzed in two sequential two-year epochs. Evaluation of the impact of imaging on surgery revealed additional surgery performed due to residual resectable tumor in 71% of cases. In comparison of initial versus subsequent two-year data epoch, the number of imaging sessions and total time spent imaging decreased significantly. Despite this decrease, the proportion of cases in which tumor was found and resected changed only slightly.

16:48 ***684***. **Neurophysiologic Monitoring in an IntraOperative MRI Setting.**

Stephen G. Hushek[1], Jesse E. Pearce[1], Steve M. Hennessy[1], Michael G. Higgs[1]
[1]Norton Hospital, Louisville, Kentucky, USA

Neurophysiologic monitoring is an essential component in many neurosurgical procedures. The monitoring involves the placement of electrodes into the nerves, skin or muscles, stimulation with electrical current and detection of a variety of responses. This monitoring must be demonstrated to be safe in order for these procedures to be performed in an intraoperative MR system. We measured insignificant temperature increases at electrode tips during simulated acoustic neuroma and tethered cord release surgeries, demonstrating the safety and validity of neurophysiologic monitoring in an intraoperative MR system for those procedures.

17:00 ***685***. **Simultaneous MR Temperature Mapping and Radiofrequency Ablation**

Karl Vigen[1], Jerry Jarrard[2], Vince Sullivan[3], James Culp[3], Viola Rieke[1], Bruce Daniel[1], Kim Butts[1]
[1]Stanford University, Stanford, California, USA; [2]Boston Scientific Corporation, San Jose, California, USA; [3]Stellartech Research Corporation, Sunnyvale, California, USA

Magnetic resonance imaging and temperature mapping can be difficult to perform concurrently with radio-frequency (RF) ablation due to interference between the RF generator and the MR imaging system. A commercially available RF generator system has been modified with a filtering and isolation network to allow simultaneous RF treatment and MR proton resonance frequency (PRF) shift temperature mapping at the higher RF powers needed for many types of ablative procedures.

17:12 ***686***. **Automatic Varactor Tuning of Interventional RF Receiver Coils**

Ross Venook[1], Garry Gold[1], Bob Hu[2], Greig Scott[1]
[1]Stanford University, Stanford, California, USA; [2]Palo Alto Medical Foundation, Palo Alto, California, USA

Small, flexible RF coils are well suited for interventional applications because of their locally-high SNR and deployability. These characteristics also make such coils easily detuned/mismatched, which can hamper imaging performance. This work displays the functionality of autotuning RF receive system electronics in a 1.5T GE scanner, and demonstrates the recovery of more than a factor of 1.5 in SNR with a tuning time under 1 second.

17:24 ***687***. **MRI Guided Intraprostatic Therapeutic Injections in a Closed, 1.5T Scanner**

Robert C. Susil[1], Axel Krieger[1], J Andrew Derbyshire[2], Louis L. Whitcomb[1], Gabor Fichtinger[1], Ergin Atalar[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

We present a method for performing MRI-guided intraprostatic therapeutic injections within a closed, 1.5 T scanner. Using a microcoil tracking method, a transrectal needle guide, and a rectal imaging coil, precisely targeted ethanol injections were performed within the canine prostate. To avoid inadvertent damage to the urethra, test injections of 6% gadolinium-DTPA solution were delivered and visualized before ethanol injection. Using this method, the ethanol distribution within the prostate could be predicted before ablation was performed. Target applications include treatment of benign prostatic hypertrophy (BPH) and prostate cancer.

17:36 ***688***. **Development and Application of an MR Compatible Electroporation System: *In Vivo* Comparison of Clamp and Needle Electrodes**

Ian J. Rowland[1], Helle J. Simonsen[1], Niels C. Broberg[1], Anders Stensgaard[1]
[1]Copenhagen University Hospital, Hvidovre, Denmark

In vivo electroporation is an established means of delivering DNA, drugs and other agents intracellularly by applying strong electric pulses to tissue. The aim of this study was to develop an MR compatible electroporation system for use in gene- and electrochemotherapy and apply the system to the study of the effects of electroporation in vivo. This study clearly demonstrates that MR methods can be applied to investigate the in vivo effects of high voltage pulses performed within a MR scanner and may be used for treatment planning and monitoring of tissue response to electroporation based gene- and chemotherapeutic strategies.

17:48 ***689***. **A Robotic Manipulator System for Breast Biopsies Inside a High-Field Whole-Body Scanner**

Stefan O.R. Pfleiderer[1], Jürgen R. Reichenbach[1], Christiane Marx[1], Jörg Vagner[2], Harald Fischer[2], Werner A. Kaiser[1]
[1]Friedrich-Schiller University, Jena, Germany; [2]Forschungszentrum Karlsruhe, Karlsruhe, Germany

14 patients with suspected cancer based on the findings of contrast-enhanced breast MRI underwent 14-G large core breast biopsies (LCBB) by using an MR-compatible robotic manipulator operating inside a 1.5 T whole-body magnet. 7 patients underwent surgery and the histological findings of LCBB and excisional biopsy were compared. In 5 patients biopsies were histopathologically confirmed. One tubular carcinoma was missed; one in-vasive cancer was underestimated as atypical ductal hyperplasia. 7 patients with benign findings are still in the follow-up period. The study demonstrates the possibility to perform MR-guided LCBB inside a scanner by using a robotic manipulator system.

New Frontiers in Body MR Imaging

Room 713 A/B 16:00 - 18:00 Chair: Stefan G. Ruehm

16:00 ***690***. **Pancreatic Perfusion Measurements using a 3D T_1-Weighted GE-Sequence with Bolus-Injection of Gd-DTPA: Comparison of Perfusion Parameters in Healthy Volunteers and Patients with Chronic Pancreatitis.**

Kenneth Coenegrachts[1], Hilde Bosmans[1], Werner Van Steenbergen[1], Dirk Vanbeckevoort[1], Didier Bielen[1], Feng Chen[1], Guy Marchal[1]
[1]Catholic Universities of Leuven, Leuven, Belgium

Gradual replacement of normal pancreatic parenchyma by scar tissue during the development of pancreatitis suggests perfusion MRI as monitor. Present study shows results in volunteers and patients with chronic pancreatitis. Series of 3D T1-weighted gradient-echo acquisition with time resolution 4.2s were perfomed during the injection of Gd-DTPA. Semi-quantitative perfusion data were calculated for pancreatic head, body and tail. Time-to-peak and brevity-of-enhancement (i.e. time between point of wash-in rate and wash-out rate) were significantly different between volunteers and patients. Maximal enhancement, maximal relative enhancement, and wash-out rate were not different. Present results indicate that larger scale studies may be very useful.

16:12 ***691***. **Functional Imaging of Pancreatic Islets**

Barjor S. Gimi[1], Mark Braun[1], Richard L. Magin[1], Brian B. Roman[1]
[1]University of Illinois at Chicago, Chicago, Illinois, USA

Type-I diabetes results from a decrease in insulin production attributable to a decrease in pancreatic islet ß-cell function. Research endeavors have focused on several alternatives for insulin supplementation, including transplantation of islets. Currently, there are no methods to non-invasively assess the function of these transplants. Assessing the location/functionality of transplanted islets currently relies on histological sectioning (post-mortem) and serum glucose sampling. The in-vivo identification of islet transplants, and direct imaging of their function, remains unrealized. We propose using manganese as an activation-based contrast agent to image islets. Upon glucose stimulation, manganese enters ß-cells through L-type calcium channels providing function-specific contrast.

16:24 ***692***. **Magnetic Resonance Hydrometry in the Assessment of Pancreas Graft Function after Simultaneous Pancreas-Kidney Transplantation**

Johannes T. Heverhagen[1], Hans-Joachim Wagner[2], Ebel Horst[2], Klaus J. Klose[2], Achim Hellinger[2]
[1]The Ohio State University, Columbus, Ohio, USA; [2]Philipps University, Marburg, Hessen, Germany

To provide a non-invasive method to assess graft dysfunction after pancreas-kidney-transplantation, measurement of exocrine graft-output with magnetic resonance hydrometry (MRH) was investigated. Three of ten included patients showed graft dysfunction according to clinical and lab data. All investigations were carried out in a 1.0T scanner. Graft function was assessed by IV application of secretin followed by a dynamic acquisition of fluid content of small bowel. Results demonstrate notable differences between both groups. Normal grafts produced a mean volume of 235mL compared to 38mL secreted by dysfunctional grafts. Our study indicated feasibility of MRH to differentiate between normal and dysfunctional grafts.

16:36 ***693***. **Full Body Cardiovascular and Tumor MR-Based Screening: Experience in over 300 Subjects**

Susanne C. Goehde[1], Mathias Goyen[1], Peter Hunold[1], Waleed Ajaj[1], Michael Forsting[1], Joerg F. Debatin[1], Stefan G. Ruehm[1]
[1]University Hospital, Essen, Germany

The results of a novel MR screening protocol on 298 non symptomatic volunteers are presented. A high number of unsuspected findings (cerebrovascular, cardiovascular, and peripheral vascular atherosclerosis, colonic polpys, pathologies of the spine or parenchymal organs) were encountered. MRI is technically suited for screening, but its role for the individual and the social community must be further evaluated.

16:48 *694*. Continuously Moving Table Axial Imaging with Radial Acquisitions at 3T

Ajit Shankaranarayanan[1], Robert Herfkens[2], Jean Brittain[1]
[1]GE Medical Systems, Menlo Park, California, USA; [2]Stanford University, Palo Alto, California, USA

A 3 T method is described for whole-body axial imaging using a continuously moving table and a projection reconstruction acquisition to generate a helical trajectory. The increase in SNR between 1.5 T and 3 T allows increased flexibility in image contrast while retaining the ease of patient positioning afforded by a body-coil exam. Images comparing SNR at 1.5 T and 3 T are presented. T1-weighted images at 3T using a gradient echo sequence with non-selective inversion-recovery preparation are also shown. The helical acquisition allows clinical spatial resolution in short scan times and images can be reconstructed at any desired plane.

17:00 *695*. Rapid Three-Dimensional Whole-Body Diffusion-Weighted Echo Planar Magnetic Resonance Imaging of Metastatic Neoplasia

Douglas Ballon[1], Richard Watts[1], Jonathan P. Dyke[1], Eric Lis[2], Ann A. Jakubowski[2]
[1]Weill Cornell Medical College, New York, New York, USA; [2]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

A technique is presented for whole-body evaluation of metastatic neoplasia in bone marrow at a spatial resolution of 56 mm3 in under 15 minutes without contrast agents using diffusion-weighted echo planar magnetic resonance imaging. The segmentation of metastatic disease relative to the strong overlying signals from water in other anatomy was achieved through the use of strong T2 and diffusion weighting combined with high quality lipid suppression. Three-dimensional projection displays were developed for image interpretation. The methods have potential application to the evaluation of tumor burden in hematologic and metastatic disease as well as to therapeutic monitoring.

17:12 *696*. Whole Body-MRI of Bone Marrow in Patients with Multiple Myeloma and Monoclonal Gammopathy in Comparison to Plain Films

Nadir Alexander Ghanem[1], Thorsten Bley[1], Oliver Springer[1], Oliver Schäfer[1], Christina Thürl[1], Mathias Langer[1]
[1]University Hospital Freiburg, Freiburg, Germany

The purpose of this study was to evaluate a new protocol for axial Whole Body-MRI imaging performed with a continuously moving table platform in comparison to Whole Body-MRI using a multi-station coronal Turbo-STIR as a staging and screening method in cancer patients.The first results of our study demonstrated that Whole Body-MRI as a fast and accurate examination in cancer patients in nearly 10 minutes is feasible and comparable to Whole Body-MRI using a turbo-STIR-sequence combined with a rolling table platform. Whole Body-MRI imaging may compete with the established imaging technique like skeletal scintigraphy and FDG-PET in cancer patients.

17:24 *697*. First Pass T_1w TrueFISP for Abdominal Perfusion MR: Optimization and Initial Clinical Experience

Jeffrey P. Goldman[1], Niels Oesingmann[2]
[1]Mount Sinai Med Cntr, New York, USA; [2]Siemens AG, Erlangen, Germany

The purpose of study was to test the applicablility of truefisp for T1W perfusion imaging. We have found that T1W IR-truefisp behaves very similarly to that of SR-turboflash in its ability to follow contrast enhancement. T1W IR-truefisp offers the advantage of a two fold increase in S/N over turboflash in perfusion imaging. Initial in vivo measurements of parameters describing the uptake curve of contrast enhancement show a narrow standard deviation between normal the values of the time to peak, and mean transit time of the liver, spleen, portal vein and kidneys.

17:36 *698*. Multi-Coil "Dixon" Fat-Water Separation with SSFP Imaging

Scott B. Reeder[1], Zhifei Wen[1], Garry E. Gold[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA

This work describes a new approach to multi-point "Dixon" fat-water separation that is amenable to multi-coil applications and steady-state free precession (SSFP) imaging. Using a novel iterative least squares method that decomposes water and fat images from source images acquired at short echo time increments, images with high SNR and uniform separation of water and fat are obtained at 1.5T. This algorithm extends naturally to multi-coil reconstruction with minimal additional complexity. Examples of multi-coil fat-water decompositions obtained from SSFP images acquired at 1.5T are shown.

17:48 *699*. Phosphorus Spectroscopic Imaging of the Regenerating Liver Permits Non-Invasive Assessment of Metabolic Derangement and Recovery after Partial-Hepatectomy

Kristen L. Zakian[1], Yuman Fong[1], Sandeep Malhotra[1], Howard Thaler[1], Lawrence Schwartz[1], William Jarnagin[1], Jason A. Koutcher[1]
[1]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

Three-dimensional P-31 spectroscopic imaging was used to study liver metabolism in patients following partial hepatectomy for colorectal cancer metastases. P-31 MRSI demonstrated that membrane phospholipid metabolites and ATP deviate from and then recover to normal values during liver regeneration. This window on hepatic regeneration could be useful in detecting defects in the regeneration process or determining when a patient's liver had the capacity to withstand chemotherapy.

Cardiovascular Image Processing

Room 715 A/B 16:00 - 18:00 Craig H. Meyer and Norbert J. Pelc

16:00 *700*. Accurate MR Cardiac Perfusion Analysis by using a Multiresolution B-splines Registration Algorithm

Christophe Dornier[1], Marko K. Ivancevic[1], Philippe Thévenaz[2], Mickael Unser[2], Jean-Paul Vallée[1]
[1]Radiology Department, Geneva, Switzerland; [2]Swiss Federal Institute of Technology, Lausanne, Switzerland

We acquire MR cardiac perfusion in free-breathing mode. Along the whole sequence, we observe large variations in the position of the left ventricle on short-axis views. We evaluate here an automatic and freely available registration algorithm for performing an accurate perfusion analysis. This algorithm automates the otherwise tedious and time-consuming shift of the different regions of interest, which is needed to reach sufficient accuracy in the perfusion analysis. We validate the accuracy of this algorithm by calculating the geometric residual displacements of the left ventricle and by fitting the data to a compartment model with 2 parameters.

16:12 *701*. 4D Multimodality Registration of Cardiac Gated MRI and Gated SPECT

Usaf E. Aladl[1], Gilbert A. Hurwitz[1], Damini Dey[2], Maria Drangova[3], Piotr J. Slomka[2]
[1]University of Western Ontario, London, Ontario, Canada; [2]Cedars-Sinai-Medical Center, Los Angeles, California, USA; [3]Robarts Research Institute, London, Ontario, Canada

An automatic gated cardiac MRI - gated SPECT registration technique is presented. Registration is performed following a pre-processing step, which automatically eliminates the irrelevant parts of the images and thereby isolating the left ventricle from the two 3D data sets. A mutual-information cost function is then used to register the volumes. The registration technique was used with 14 patient data sets and the results compared to manual registration by an expert. The pre-processing step significantly improved the accuracy of the registration, when compared to automatic registration performed without pre-processing.

16:24 *702*. Fast Registration of Cardiac Perfusion MRI

Mikkel B. Stegmann[1], Henrik B. W. Larsson[2]
[1]Technical University of Denmark - DTU, Kgs. Lyngby, Denmark; [2]Hvidovre Hospital, Copenhagen University Hospital, Hvidovre, Denmark

This abstract presents a novel method for registration of cardiac perfusion MRI sequences. By performing complex analyses of variance and clustering in an annotated training set off-line, our method provides real-time segmentation in an on-line setting. This renders the method feasible for live motion-compensation in MR scanners. Changes in image intensity during the bolus passage are modelled by an Active Appearance Model augmented with a cluster analysis of the training set. Preliminary validation carried out using five subjects showed acceptable segmentation accuracy produced very rapidly (below 40 ms per image).

16:36 *703*. Temporal Sampling of MRI Myocardial Perfusion Studies: Effects on Three Analysis Methods

Edward V.R. Di Bella[1], Harshali Bal[1]
[1]University of Utah, Salt Lake City, Utah, USA

The effects of different temporal samplings for contrast MRI measurement of myocardial perfusion were investigated using simulations and measured data. Flow related parameters (upslope, Ktrans from a two compartment model fit, and F from a modified compartment model which has not previously been used in cardiac applications) were obtained for the original and downsampled time curves. The results imply that the upslope parameter is least robust to decreased sampling rates in real data, and that the two compartment model may be more robust than the modified model as sampling rates decrease.

16:48 *704*. Discrete Model for Measuring Blood and Extravascular Extracellular Volumes via Dynamic Contrast-Enhanced MRI

William Sean Kerwin[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

A new method is presented for discrete-time kinetic modeling of dynamic contrast-enhanced (DCE) MRI. The model has two parameters: uptake per time frame (u) and retention per time frame (r). From u and r, the parameters of the Tofts/Kety model can be directly computed, or the fractional volumes of blood and extravascular extracellular space (EES) can be determined. Advantages of the discrete formulation include easier optimization, robustness to noise, and an intuitive interpretation of the results. The new model is demonstrated on DCE-MRI of carotid atherosclerosis.

17:00 *705*. Effect of Elastic Registration on Reliability of Cardiac Physiological Measurement

Nilesh Navnitlal Mistry[1], Garth M. Beache[1], Meiyappan Solaiyappan[2]
[1]University of Maryland, Baltimore, Maryland, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

Cardiac physiological assessment often requires estimation of differences between pre- and post - intervention states. Configuration or morphological changes, which are often observed on time series images that are used for quantification, limit accurate parameter estimation. Stress-induced T2* signal change was used to index vasodilator reserve. Elastic deformation was used to correct for configuration change, and the confidence interval (CI) of the repeated acquisition of each of the baseline and stress states was used as a metric of reliability. We documented marked reduction of the CI, supporting use of this registration in cardiac analysis.

17:12 ***706***. **Estimation of Myocardial Strain Parameters from Tagged MR Images Using Nonrigid Registration via Cylindrical FFDs**

Raghavendra Chandrashekara[1], Raad Mohiaddin[2], Daniel Rueckert[1]
[1]Imperial College of Science, Technology and Medicine, London, UK; [2]Royal Brompton and Harefield NHS Trust, London, UK

We present a novel method for tracking the motion of the myocardium in tagged magnetic resonance (MR) images of the heart using a nonrigid registration algorithm based on a cylindrical free-form deformation (FFD) model and the optimization of a cost function based on normalized mutual information (NMI). The novel aspect of our work is that we use a FFD defined in a cylindrical rather than a Cartesian coordinate system. This models more closely the geometry and motion of the left ventricle (LV). Validation results using a cardiac motion simulator and tagged MR data from 6 normal volunteers are also presented.

17:24 ***707***. **Rapid 3D LV Strain Reconstruction from Tagged Cardiac MR Images**

Xiang Deng[1], Thomas Stewart Denney Jr[1]
[1]Auburn University, Auburn, Alabama, USA

We present a rapid unsupervised method, called rapid UNTETHER, for computing three-dimensional (3D) myocardial strain from planar tagged cardiac MR images. Our method consisted of two steps: tag line tracking and strain reconstruction. The tag line tracking algorithm is based on a spatial tag detector and a modified 1D harmonic phase (HARP) π isocontour tracking algorithm. 3D myocardial strains are reconstructed using a cylindrical B-spline deformation model. Experimental results from ten human imaging studies (5 normal volunteers, 5 patients) demonstrate that our method is reproducible and can reconstruct 3D end-systolic circumferential shortening strain from tagged images accurately in 90 seconds.

17:36 ***708***. **Automated Correction of Background Intensity Variation and Image Scale Standardization in 4D Cardiac SPAMM-MRI**

Albert Montillo[1], Leon Axel[2], Dimitris Metaxas[3]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]New York University, New York, New York, USA; [3]Rutgers University, Piscataway, New Jersey, USA

Cardiovascular disease is the leading cause of death in the western world. However SPAMM-MRI, an imaging method that provides an in-vivo measurement of regional heterogeneity of myocardial contraction, can facilitate patient diagnosis and treatment planning. Widespread adoption of SPAMM-MRI is hindered by the 5+ hours required to analyze ~300 images per subject. This abstract presents methods that dramatically reduce SPAMM-MRI's salient artifacts: (1) severe intensity inhomogeneity from surface coils and (2) tissue intensity variation (intersubject and intrasubject during contraction). These methods open the door to fully automated algorithms for SPAMM analysis. Results are presented for normal subjects and ventricular hypertrophy.

17:48 ***709***. **Quantification of 3-D Curvature and Shape of the Interventricular Septum**

Daniel Aaron Moses[1], Leon Axel[1]
[1]New York University School of Medicine, New York, New York, USA

This paper describes a method to model the right ventricular (RV) surface of the interventricular septum for curvature measurements. A smoothing 2-D spline is constructed through the RV septal surface at regular times during the cardiac cycle and the principal curvatures as well as the Gaussian and mean curvatures and shape index are calculated. Vector and color surface maps and graphs of average indices are constructed. Consistent curvature patterns were seen in 4 normal subjects. This method provides potentially useful new information on the effects of RV disease on septal geometry.

RF: From Soup to Nuts

Room 717 A/B 16:00 - 18:00 Chairs: Lizann Bolinger and Michael B. Smith

16:00 ***710***. **Prepolarized RF Current Density Imaging**

Greig Scott[1], Kai Yu[1], Blaine Chronik[1], Steve Conolly[1]
[1]Stanford University, Stanford, California, USA

Our goal is to create an MRI modality that can image RF currents at standard RF ablation frequencies and elicit tissue electrical impedance contrast within the physiologically significant beta dispersion frequency range. We have augmented our pre-polarized MRI scanner with new electronics to perform the required phase synchronous injection of RF currents, and demonstrated our first working switched field current density images at 1.1 MHz.

16:12 ***711***. **A Scaleable Multi-Channel MR Data Acquisition System**

Renxin Chu[1], Patrick J. Ledden[2], Jerzy Bodurka[1], Peter van Gelderen[1], Peter Kellman[1], H. Douglas Morris[1], Jacco A. de Zwart[1], Jeff H. Duyn[1]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]Nova Medical, Inc., Wakefield, Massachusetts, USA

In order to perform high sensitivity brain MRI, a 16-channel, high speed, high dynamic range digital receiver system for use with a General Electric (GE) scanner was developed. Commercially available, PCI-based digital receiver boards were used in a Linux PC. The system was designed to sustain data throughput that allows continuous high bandwidth EPI acquisition, e.g. fMRI applications. It was evaluated at 3 T using a custom built 16-element gapped coil array, designed to achieve optimal image signal-to-noise ratio (SNR) and SENSE performance.

16:24 *712*. The MRI Eigencoil: 2N-Channel SNR with N-Receivers

Scott B. King[1], Steve M. Varosi[2], Feng Huang[2], G. Randy Duensing[2]
[1]National Research Council of Canada, Winnipeg, Manitoba, Canada; [2]MRI Devices Corporation, Gainesville, Florida, USA

MRI Eigencoils were constructed at 1.5T using an inline hardware combiner attached to the standard Siemens 8 Channel Head Array, producing the same SNR and parallel imaging benefits of the 8 channel receiver system using only 4 receive channels. In some cases, the SNR of a 2N channel array can now be obtained with only N receivers, maximizing SNR and minimizing g-factor for a given number of receivers, while reducing data flow rates and computation time by a factor two.

16:36 *713*. Geometry Preserving Flux Ducting by Magnetic Metamaterials

Michael CK Wiltshire[1], John B. Pendry[1], David J. Larkman[1], David J. Gilderdale[1], David Herlihy[1], Ian R. Young[1], Joseph V. Hajnal[1]
[1]Imperial College, London, UK

Micro-structured metamaterials provide a means of manipulating RF flux within the static magnetic field in MR scanners. In previous work we demonstrated RF flux ducting to transfer signal to a remote detector. In this work we have explored the capability of the material to transmit local flux patterns, so that spatial localisation is transferred directly rather than relying purely on Fourier encoding.

16:48 *714*. Dissipation of Radiated RF Power in Magnet Room: Implications for SNR Considerations

Christopher Michael Collins[1], Wanzhan Liu[1], Michael Bruce Smith[1], Qing X. Yang[1]
[1]Penn State College of Medicine, Hershey, Pennsylvania, USA

Analysis of how radiated power is dissipated can yield insight into its effect on SNR. We performed numerical calculations considering a shielded body-sized birdcage coil at 128MHz loaded with the human body, the stainless steel magnet casing, and the copper RF screen at the boundaries of the magnet room. In this case, 99.98% of the RF power was dissipated in the subject, as opposed to 88% dissipated in the subject and 12% radiated when the magnet casing and magnet room RF screen were removed, indicating that RF power radiated by the coil is typically absorbed by the body.

17:00 *715*. Compensation of Dielectric Resonance Effects by Means of Composite Excitation Pulses

Stefan Thesen[1], Gunnar Krueger[1], Edgar Mueller[1]
[1]Siemens Medical Solutions, Erlangen, Germany

Image quality in high field magnetic resonance imaging can significantly suffer from dielectric resonances. In samples with high dielectric constants the vacuum wavelength is shortened significantly and approaches at stronger fields such as 3T typical object dimensions. Even though object size and sample conductivity also play important roles, wave propagation often becomes non-uniform resulting in B1 field inhomogeneities. In this work it is shown that under certain conditions composite RF-pulses can be used to compensate for respective B1 inhomogeneities. Phantom studies with echo planar imaging at 3T exhibited an improved intensity homogeneity when using the proposed composite RF-excitation scheme.

17:12 *716*. Observation of B_1 Inhomogeneities on Large Biological Samples at 11.1 Tesla

B. L. Beck[1], K. A. Jenkins[1], K. Padgett[1], J. R. Fitzsimmons[1], S. J. Blackband[1]
[1]University of Florida, Gainesville, Florida, USA

A major drive in the development of MR has been towards higher magnetic fields to increase the signal to noise ratio, which can be traded for faster imaging and/or improved spatial resolution. Our institution has an 11.1 Tesla, 40 cm clear bore Magnex/Bruker imaging/spectroscopy system for which we have constructed large rf resonators for imaging large samples, including a fixed human brain and large piece of fresh beef. We report the observation of large image distortions arising from wave behavior within the sample and interactions between the coil and sample.

17:24 *717*. B_1 Inhomogeneity Compensation using 3D Tailored RF Pulses

Suwit Saekho[1], Fernando E. Boada[1], Douglas C. Noll[2], Victor Andrew Stenger[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [2]University of Michigan, Ann Arbor, Michigan, USA

This work presents a novel method using 3D tailored RF slab-select pulses to reduce the B1 inhomogeneity artifact at 3T and possibly higher fields. The 3D tailored RF pulses were designed using B1 inhomogeneity maps obtained from images acquired in-vivo as a pre-scan. Experiments were performed on a NiCl2 phantom and on human brains. We found that a two-shot pulse 14.5ms in length was adequate to remove a significant amount of the B1 inhomogeneity in a 10cm thick slab used for 3D imaging at 3T.

17:36 *718*. A Patient Friendly Head Coil for High Field MRI

Thomas Vaughan[1], Gregor Adriany[1], Matt Waks[2], Mark Watson[2], Tom Thompson[2], Haiying Liu[1], Gene Berghoff[2], Kevin Sundquist[2], Kamil Ugurbil[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA; [2]MR Instruments, Minneapolis, Minnesota, USA

The objective of this study was to design, prototype and prove a new head coil that is both patient friendly and high in performance for head imaging with the new high field strength MR systems. An ideal clinical head coil would lend itself to the easiest and most comfortable patient positioning, leave the patient's face uncovered once the patient is in position, and would include these access and comfort features without compromising coil performance, safety and reliability. This coil has been achieved.

17:48 ***719***. **A Volume RF coil using Inverted Microstrip Transmission Line (iMTL) for Human Head Imaging at 7T**

Xiaoliang Zhang[1], *Kamil Ugurbil*[1], *Wei Chen*[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

As an extension of the study of microstrip transmission line (MTL) RF coils, this work reports a volume RF coil design using inverted microstrip transmission line (iMTL) for human head imaging at 7 Tesla. Mineral oil phantom and human head images acquired using this coil are presented. The iMTL coil design method provides a simple and efficient solution to high-frequency volume coils with large coil size for human MR applications.

MORNING CATEGORICAL COURSE
Controversies and Advances in Musculoskeletal MRI

Room 713 A/B 07:00 - 08:00 Chairs: Garry E. Gold and Lawrence M. White

Educational Objectives
Upon completion of this course, participants should be able to:
- Compare MRI with other advanced imaging modalities;
- Explain the role of interventional MRI in the musculoskeletal system;
- Explain the role of high-field MRI in the musculoskeletal system;
- Describe the technical issues related to high-resolution joint imaging;
- Evaluate options for open MRI scanners for musculoskeletal imaging.

07:00 **High Field MRI: Technical Issues**
Garry E. Gold

07:25 **High Field MRI: Clinical Issues**
Timothy J. Mosher

07:50 **Questions and Discussion**

MORNING CATEGORICAL COURSE
Parallel Imaging

Room 714 A/B 07:00 - 08:00 Chairs: Neil M. Rofsky and Daniel K. Sodickson

Educational Objectives
Upon completion of this course, participants should be able to:
- Explain the basic principles of parallel imaging, including elements both of RF coil array design and image reconstruction;
- Survey promising applications of parallel MRI in cardiovascular imaging and body imaging;
- Describe new developments in image reconstruction and coil array design, and outline emerging parallel imaging applications;
- Identify the key steps in a practical parallel imaging examination and compare the nuts-and-bolts features of various MR vendors' existing implementations.

Vendor Implementations
07:00 **Recap of Basics, Applications, and New Developments**
Daniel K. Sodickson

07:10 **Philips Medical Systems**
Scott D. Flamm

07:25 **GE Medical Systems**
Robert R. Edelman

07:40 **Siemens Medical Solutions**
Stefan O. Schoenberg

07:55 **Discussion and Conclusion**

MORNING CATEGORICAL COURSE
Emerging Body MR: From Structure to Function

Room 715 A/B 07:00 - 08:00 Chairs: Vivian S. Lee and Riccardo Manfredi

Educational Objectives
Upon completion of this course, participants should be able to:
- Recognize and implement recent technical advances in body MRI including BOLD and perfusion techniques, fast T_2-weighted imaging methods, and new contrast agents;
- Describe recent advances in the assessment of liver and breast for tumor, structural and functional studies of the biliary system, and MR measurements of renal function;
- Identify applications of MR to the evaluation of large and small bowel disease;
- Compare the information provided by MR elastography in the assessment of organ pathologies, such as in the breast and prostate, to conventional MR imaging techniques.

Breast and Bowel

07:00 **Breast**
To Be Announced

07:20 **MRI of the GI Tract: Small Bowel**
Taro Takehara

07:40 **MRI of the GI Tract: Colon**
Jörg F. Debatin

MORNING CATEGORICAL COURSE
fMRI Experimental Methods

Room 718 B 07:00 - 08:00 Chairs: R. Todd Constable and Mathias Hoehn

Educational Objectives
Upon completion of this course, participants should be able to:
- Explain the latest developments in fMRI with respect to understanding the underlying physiology leading to the BOLD response and its relationship to neuronal activity and the influence of pharmacological substances on activation;
- Describe the factors influencing paradigm design and the optimum acquisition strategy for event-related versus block designs;
- Recognize which analysis approach is most appropriate for a particular experimental design;
- Describe the spatial limits of fMRI and factors influencing resolution.

Spatial Temporal Resolution Limitations

07:00 **Pharmacological Modulations of fMRI**
Mathias Hoehn

07:30 **Spatial Resolution Issues**
R. Todd Constable

MORNING CATEGORICAL COURSE
Diffusion Tensor Imaging

Room 718A 07:00 - 08:00 Chairs: Gareth J. Barker and Scott D. Swanson

Educational Objectives
Upon completion of this course, participants should be able to:

- Describe how/why the proton diffusion pathway in tissue can be explained by a tensor;
- Explain how the tensor is acquired, measured, and mapped;
- Describe the limitations of such diffusion tensor imaging;
- Describe more advanced diffusion measurement techniques, such as q-space and diffusion spectrum imaging;
- Appreciate the multi-exponential and/or multi-compartmental nature of diffusion;
- List and describe important clinical applications of DTI.

07:00 **Clinical and Medical Applications of DTI**
Carlo Pierpaoli

08:00 **Adjournment**

MORNING CATEGORICAL COURSE
Advanced MR Angiography Techniques

Room 716 A/B 07:00 - 08:00 Chairs: James Meaney, Martin Prince and Stefan Schoenberg

Educational Objectives
Upon completion of this course, participants should be able to:

- Identify the challenges of MRA implementation in anatomic areas with high technical demands;
- Compare the advantages and disadvantages of different technical approaches in these areas;
- Recognize the clinical benefit of advanced MRA protocols for a comprehensive, non-invasive work-up of vascular disease.

Coronary MRA

07:00 **Navigator**
Warren J. Manning

07:15 **Radial Image Breath-Hold**
Debiao Li

07:30 **Multi-Detector CTA vs MRA of the Coronaries**
Konstantin Nikolaou

07:45 **Discussion**

MORNING CATEGORICAL COURSE
Spectroscopy Beyond NAA

Room 717 A/B 07:00 - 08:00 Chairs: Peter Allen, Rolf Gruetter, John Griffiths, Stephen Williams

Educational Objectives
Upon completion of this course, participants should be able to:

- List the major metabolites in addition to NAA, Crn, Cho that can be detected *in vivo* in the brain by MRS;
- Describe the biological and clinical importance of these metabolites;
- List the key factors to achieve good spectra;
- Describe the principles of data analysis in both frequency and time domain;
- Explain how MRS can be used to measure metabolic fluxes as well as steady-state concentrations;
- List the advantages and disadvantages of $^{13}C/^{15}N$ with respect to ^{1}H.

07:00 **^{13}C NMR: Past and Present**
Peter G. Morris

07:30 **Indirect Detection of ^{13}C Label/Editing at 3 T**
Vincent P. Lebon

PLENARY LECTURES
The Tumor Microenvironment

Hall F/G 08:15 - 09:30 Chairs: Jeffrey L. Evelhoch and Michal Neeman

Educational Objectives
Upon completion of this session, participants should be able to:

- Describe several key physiological aspects of the tumor microenvironment and explain why it is important to be able to assess them;
- List several MRI, MRS, and EPR methods which have been used to examine key aspects of the tumor microenvironmental pathophysiology;
- Explain how results of studies using these magnetic resonance methods have impacted our understanding of tumor microenvironmental pathophysiology.

08:15 *720*. **Fundamental Mechanisms Underlying Development of Hypoxia in Tumors : Implications for Imaging**
Mark W. Dewhirst[1], Benjamin Moeller[1], Yiting Cao[1], Zeljko Vujaskovic[1], Chuan Y. Li[1]
[1]Duke University Medical Center, Durham, North Carolina, USA

Hypoxia is a common feature of tumors and is cause of treatment resistance and altered tumor phenotype. Results of several human clinical trials have confirmed the prognostic importance of hypoxia, for local tumor control after local therapy and as a predictor of likelihood for development of metastases. This presentation will emphasize current data on mechanims of oxygen transport and compare and constrast these data with classic theories regarding this critical defect in tumor physiology. Fundamental understanding of the physiologic components that lead to hypoxia will provide an underpinning for development and/or interpretation of methods to image this phenomenon in vivo.

08:40 *721*. **MR of the Tumor Microenvironment**
Robert J. Gillies[1]
[1]University of Arizona, Tucson, Arizona, USA

The microenvironment of human tumors is a hostile place. It contains large volumes that are hypoxic and acidic with reduced concentrations of substrates and growth factors. A primary cause for this environment is perfusion heterogeneity, which is most likely due to a dysregulation of angiogenesis. A direct consequence of perfusion heterogeneity is the generation of large volumes of tumors that are chronically hypoxic. In the absence of oxygen, tumor cells have to produce energy via anaerobic glycolysis. This leads to hyperacidosis of tumor tissues. Both hypoxia and acidosis lead to more aggressive tumor phenotypes.

09:05 *722*. **Electron Paramagnetic Resonance (EPR) Studies on Tumor Oxygenation**
Bernard Gallez[1]
[1]Catholic University of Louvain, Brussels, Belgium

The aim of this review is to show how Electron Paramagnetic Resonance (EPR) and related methods such as dynamic nuclear polarisation (DNP) can be used to detect, localize and quantify oxygen concentration in biological tissues. Several applications will be described with special emphasis on tumor oxygenation

Coronary MR Imaging

Room 718A 10:30 - 12:30 Chairs: Debiao Li and Matthias Stuber

10:30 *723*. **Near-Isotropic Whole-Heart Coronary MRA**
Oliver M. Weber[1], *Alastair J. Martin*[1], *Charles B. Higgins*[1]
[1]University of California San Francisco, San Francisco, California, USA

A high-resolution, near-isotropic coronary MR angiographic method was developed to image all coronary arteries in a single scan. The method consisted of a navigator-gated, magnetization-prepared, three-dimensional fully refocused steady state free precession (balanced turbo field echo; bTFE) sequence. The volume imaged covered the entire heart, resulting in an MRA of the full coronary tree. Coronaries were imaged over a significantly longer distance than using a thin-slab coverage of the individual vessels.

10:42 *724*. **Fast Isotropic Volume Imaging for Coronary MRA using 3D-PR**
Christian Stehning[1], *Peter Börnert*[2], *Kay Nehrke*[2], *Holger Eggers*[2], *Olaf Dössel*[1]
[1]University of Karlsruhe, Karlsruhe, Germany; [2]Philips Research Laboratories, Hamburg, Germany

Three-dimensional projection reconstruction (3D-PR) has recently been introduced. It offers an isotropic resolution and field of view, and significantly decreases scanning time for volume imaging by subsampling the k-space in all three dimensions. For phantom- and initial in-vivo experiments, we implemented and used a magnetization prepared balanced FFE 3D-PR sequence to image the entire cardiovascular tree with isotropic resolution. The main coronary arteries were reformatted from the volume data set.

10:54 *725*. **MR Angiography of the Entire Coronary System with a Very Small Iron Oxide Blood-Pool Contrast Medium: Results of a Phase Ib Clinical Trial**
Matthias Taupitz[1], *Susanne Wagner*[2], *Jörg Schnorr*[1], *Marc Dewey*[1], *Patrik Rogalla*[1], *Lasse Krug*[1], *Gerhard Laub*[3], *Dietmar Kivelitz*[1], *Herbert Pilgrimm*[2], *Irina Kravec*[4], *Bernd Hamm*[1]
[1]Charité, Berlin, Germany; [2]Ferropharm GmbH, Teltow, Brandenburg, Germany; [3]Siemens AG, Erlangen, Germany; [4]3ClinicalResearch, Berlin, Germany

The clinical use of coronary MRA (CMRA) is limited by low intrinsic contrast and the inability to cover the entire coronary system with a single 3D-data set. VSOP C-184 is a monomer-coated very small iron oxide blood-pool contrast medium that circulates in the vascular system for a long time. Furthermore it can be applied as a bolus and proved to be well-tolerated in a phase I clinical trial. In a group of six volunteers we demonstrate that navigator-based CMRA using VSOP C-184 yields high signal intensity and spatial resolution for imaging of the entire coronary system with one 3D-data set.

11:06 *726*. **Contrast-Enhanced MR Imaging of Coronary Arteries with Gadomer-17**
Joerg Barkhausen[1], *Michaela Schmidt*[2], *Christoph U. Herborn*[1], *Oliver Bruder*[3], *Peter Hunold*[1], *Kohkan Shamsi*[4]
[1]University Hospital, Essen, Germany; [2]Siemens, Erlangen, Germany; [3]Elisabeth Hospital, Essen, Germany; [4]Schering, Berlin, Germany

We evaluated the efficacy and safety of Gadomer-17, a recently introduced blood pool compound, in Magnetic Resonance Coronary Angiography (MRCA). 12 patients with angiographically proven coronary artery disease underwent breath-hold MRCA on a 1.5 T scanner. Following intravenous administration of Gadomer-17 (0.1mmol/kg) images were obtained using a 3D inversion recovery turboFLASH sequence. Gadomer-17 significantly improved contrast-to-noise ratio and image quality compared to unenhanced MRCA.

11:18 *727*. **High Resolution Breath-hold Contrast-Enhanced 3D FIESTA Coronary Artery Imaging**
Thomas K.F. Foo[1], *Vincent B. Ho*[2], *Liuquan Cheng*[3], *Hajime Sakuma*[4], *Dara L. Kraitchman*[5], *Katherine C. Wu*[5], *David C. Bluemke*[5]
[1]GE Medical Systems, Baltimore, Maryland, USA; [2]Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA; [3]PLA General Hospital, Beijing, People's Republic of China; [4]Mie University, Tsu, Japan; [5]Johns Hopkins University, Baltimore, Maryland, USA

A method for high spatial resolution breath-held 3D volume imaging of the coronary arteries using contrast-enhanced FIESTA is presented. With FIESTA, contrast enhancement persists for over 30 minutes using conventional extra-cellular Gd chelate contrast agents. This approach allows images of each coronary artery distribution to be acquired in a single breath-hold and can be integrated into a comprehensive cardiac examination that includes function, perfusion, and delayed hyper-enhancement. Using this approach, 12 partitions can be acquired in a short 24 heartbeat breath-hold.

11:30 ***728*.** **Cardiac Fat Navigator for Real-Time Motion Gated 3D Coronary MRA**

Thanh D. Nguyen[1], Anthony Nuval[1], Yi Wang[1]
[1]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA

Cardiac fat navigator detects coronary motion directly by exciting and sampling the epicardial fat that surrounds the proximal coronary arteries. The present study demonstrates that motion detected by the cardiac fat navigator at mid-diastole correlates with motion detected by the diaphragm navigator and that cardiac fat navigator is slightly more effective than the diaphragm navigator for free-breathing navigator gated coronary MRA.

11:42 ***729*.** **Adaptive Real-Time MR Coronary Angiography – Prospective Clinical Trial**

Patricia Nguyen[1], Juan Santos[1], Greig Scott[1], Jan Engvall[1], Michael McConnell[1], Graham Wright[2], John Pauly[1], Dwight Nishimura[1], Bob Hu[1], Phillip Yang[1]
[1]Stanford University, Stanford, California, USA; [2]General Electric Medical Systems, Menlo Park, California, USA

An adaptive real-time (aRT)architecture has been developed. This integrated real-time system addresses some of the limitations in MR coronary angiography (MRCA) today. Instantaneous selection of the desired element on a phase-array receiver coil and dynamic reconfiguration between the real-time (RT) and high-resolution (HR) imaging sequences are possible. A prospective clinical trial of 48 patients was conducted.

11:54 ***730*.** **Coronary MRA - A Comparison of Readout Strategies**

Oliver M. Weber[1], Sandra Pujadas[1], Alastair J. Martin[1], Charles B. Higgins[1]
[1]University of California San Francisco, San Francisco, California, USA

The right coronary artery was imaged in ten normal volunteers using six high-resolution, free-breathing, magnetization-prepared, bright-blood coronary MR angiography techniques. The sequences were quantitatively compared. Cartesian balanced turbo-field echo was found to be the most promising sequence, visualizing the vessel over the longest distance with excellent vessel sharpness and good signal to noise ratio. The other sequences performed significantly poorer in one or several of the parameters evaluated.

12:06 ***731*.** **Non-ECG-Triggered, High-Resolution Balanced Radial CMRA using Fully Adaptive Weighted Correlated Averaging (FAWCA)**

Ingmar Graesslin[1], Martin Mittelbach[2], Tobias Schaeffter[1], Peter Börnert[1], Holger Eggers[1], Otto Lange[3]
[1]Philips Research Laboratories, Hamburg, Germany; [2]Dresden University of Technology, Dresden, Germany; [3]Technical University Hamburg-Harburg, Hamburg, Germany

Coronary angiography still poses significant challenges with regard to cardiac and respiratory motion. The fast acquisition of high resolution images and reduction of motion-blurring artifacts is very demanding. In this work, a free-run balanced radial acquisition in combination with the fully adaptive weighted correlated averaging (FAWCA) approach is presented. It consists of an automatic pre-selection of 2D sub-sampled images, sub-pixel accurate registration, the combination of the selected interleaves to a high-resolution image and an adaptive weighted averaging (AWA) technique. FAWCA results in a significant reduction of residual motion effects and noise robust filtering.

12:18 ***732*.** **Radial Balanced FFE Imaging with Extended Sampling Windows for Fast Coronary MRA**

Christian Stehning[1], Peter Börnert[2], Kay Nehrke[2], Tobias Schäffter[2], Olaf Dössel[1]
[1]University of Karlsruhe, Karlsruhe, Germany; [2]Philips Research Laboratories, Hamburg, Germany

To increase the scan efficiency in coronary MRA it would be desirable to prolong the cardiac sampling window. For comparison, cardiac CT uses acquisition windows significantly longer than 100ms to reconstruct images of decent quality. Therefore, this work investigates on the impact of extended cardiac acquisition windows for free breathing 3D coronary MRA using a radial sampling scheme similar to CT acquisition. We found that coronary MRA is feasible in volunteers with acquisition windows greater than 200ms. This considerably reduces the total scanning time and allows for prospective motion correction within the cardiac cycle as a future refinement.

Functional Neuro MR Imaging Techniques

Room 718B 10:30 - 12:30 Chairs: Michael H. Buonocore and Douglas C. Noll

10:30 ***733*.** **Protocol to Determine the Optimal Intra-Oral Passive Shim for Susceptibility Minimization in Inferior Frontal Cortex**

James L. Wilson[1], Mark Jenkinson[1], Peter Jezzard[1]
[1]University of Oxford, Oxford, Oxfordshire, UK

At high B_0 the study of human inferior frontal cortex (IFC) by fMRI is hampered by susceptibility artifacts. Here we demonstrate the beneficial effect of five different intra-oral diamagnetic passive shims on B_0 homogeneity and EPI susceptibility artifacts within the IFC of six subjects. The optimal passive shim is shown to be subject- and study-specific, providing an average reduction in B_0 offset within the IFC of 57%, along with a concomitant reduction in image susceptibility artifact. A four minute protocol to determine the optimal passive shim from those available is described and shown to be accurate and reliable.

10:42 *734*. Mitigation of Susceptibility-Induced Signal Loss in Neuroimaging using Localized Shim Coils

Jung-Jiin Hsu[1], Gary H. Glover[1]
[1]Stanford University School of Medicine, Stanford, California, USA

In brain fMRI and NMR spectroscopy, signal loss due to the magnetic susceptibility effect is severe in the inferior frontal cortex (IFC). The present work studies the signal recovery in the IFC by active shimming device with adjustable parameters. Preliminary success of using the magnetic field generated by the current in a circular coil held in the mouth of a human subject is reported.

10:54 *735*. Excitation UNFOLD using 3D Tailored RF Pulses

Marius S. Giurgi[1], Fernando E. Boada[1], Douglas C. Noll[2], Victor Andrew Stenger[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [2]University of Michigan, Ann Arbor, Michigan, USA

This work extends the UNFOLD method to the excitation domain to help address the problem of long pulse lengths in 3D tailored RF pulse applications. Two-shot 3D tailored RF pulses were designed such that each shot could be alternated every TR in a dynamic imaging application. The complex 4D (xyzt) image data can then be filtered in the temporal frequency dimension. Phantom and human experiments are presented.

11:06 *736*. Single-Shot Spiral-In-and-Out Functional Image Acquisition with Embedded z-Shimming for Susceptibility Signal Recovery

Hua Guo[1], Allen W. Song[1]
[1]Duke University, Durham, North Carolina, USA

Functional MRI investigation often uses gradient-recalled fast imaging methods, however, they are vulnerable to the static inhomogeneity near air/tissue interface, which is often manifested as significant signal losses. Recently, the z-shimming technique has been introduced in fMRI image acquisition, seeking to recover the susceptibility induced signal losses. One significant drawback of such approach is its time-consuming nature. In this report, an effective and efficient single-shot spiral imaging method that can recover the signal losses near air/tissue interface is proposed and demonstrated.

11:18 *737*. Application of SENSE to fMRI Studies of Higher Cognitive Functions

Conny Frauke Schmidt[1], Nadia Degonda[2], Katharina Henke[2], Peter Boesiger[1]
[1]University and ETH Zurich,, Zurich, Switzerland; [2]Psychaitric University Hospital, University of Zurich, Zurich, Switzerland

This study investigates the application of the SENSE technique to fMRI studies exploring higher cognitive functions. Especially regions exhibiting pronounced susceptibility distortions might profit from the reduction of in-plane artifacts due to shorter echo-trains. A learning task was used to specifically activate the medial temporal region. This region is of high clinical interest; however, it is difficult to assess by fMRI due to susceptibility distortions. Different SENSE factors were tested and compared with respect to image quality, activation sensitivity in areas of interest and SFNR. A SENSE reduction factor of 2.0 is determined the most advisable choice.

11:30 *738*. Minimizing Susceptibility Artifacts in BOLD fMRI using 3D Dual-Echo Spiral In (DSPIN) Acquisition

Tie Qiang LI[1], Atsushi Takahashi[2], Yang Wang[1], Vincent P. Mathews[1], Gary H. Glover[3]
[1]Indiana Univeristy School of Medicine, Indianapolis, Indiana, USA; [2]John P. Robarts Research Institute, University of Western Ontario, London, Ontario, Canada; [3]Stanford University School of Medicine, Stanford, California, USA

The signal dropout in gradient recalled echo acquisition limits the capability of BOLD fMRI to study cognitive tasks that involve the orbital frontal, temporal, and basal areas of the brain. Among the various proposed methods, the spiral in/out acquisition by Glover1 is so far most effective. In this study, we extended further the spiral in/out approach to 3D acquisition and tested different spiral in/out combinations to optimize the BOLD contrast-to-noise ratio (CNR). Our results from whole brain studies in healthy volunteers showed that the acquisition using dual-echo spiral in/in (DSPIN) trajectory produced far less signal dropout artifacts than expected.

11:42 *739*. A Fast Perfusion Measurement for Functional Imaging Using Double-Coil AST

Gregory Lee[1], Luis Hernandez-Garcia[1], Alberto Vazquez[1], Douglas Noll[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

Because of the strong interest in perfusion-based Functional MRI, we have developed a faster two-coil acquisition scheme that permits collection of a multi-slice subtraction pair approximately every three seconds. The method consists of acquisition of both the control and tag images immediately after a reduced labeling time. The method relies on a quick estimation of arterial transit time prior to the experiment. In this work, we present the theoretical basis for the methodology, as well as experimental data from both blocked design and event related activation paradigms demonstrating the technique and its characteristics.

11:54 *740*. **A PRESTO SENSE Sequence with Alternating Partial Fourier Encoding for Rapid 3D MRI Time Series**

Markus Klarhöfer[1], Bixente Dilharreguy[1], Peter van Gelderen[2], Chrit Moonen[1]
[1]Université Bordeaux2, Bordeaux, France; [2]National Institutes of Health, Bethesda, Maryland, USA

A 3D sequence for dynamic susceptibility imaging is proposed which combines PRESTO, sensitivity encoding and partial-Fourier acquisition. Full brain coverage is obtained with a 500ms temporal resolution. The proposed sequence uses an acceleration factor of 2 and takes advantage of an alternating partial k-space acquisition which allows an iterative reconstruction using high resolution phase estimates. The obtained image time series show higher temporal stability than those obtained with full-Fourier acquisitions that use higher SENSE factors to keep the time per dynamic scan constant.

12:06 *741*. **Detection of Neuronal Currents *In-Vitro* with MRI**

Natalia Petridou[1], Jerzy Bodurka[1], Dietmar Plenz[1], Peter A. Bandettini[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Current functional MRI brain mapping techniques rely on assessment of hemodynamic changes associated with neuronal activity. In this study we examine the feasibility of mapping neuronal currents directly using MRI. Rat brain slices were imaged in-vitro, in active and inactive states. Phase images were acquired using single-shot spin-echo EPI at 3T. The power spectrum was obtained for each voxel. Principal component analysis was employed to identify significant spectral components. Correlation analysis on those components between active and inactive states consistently identified activation current-induced phase shifts at frequencies corresponding to the spontaneous firing rate inherent to the slices.

12:18 *742*. **Vascular-Space-Occupancy (VASO) Dependent fMRI**

Hanzhang Lu[1], Xavier Golay[1], James Pekar[1], Peter van Zijl[1]
[1]Johns Hopkins University & F.M. Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA

We introduce a new fMRI methodology that maps blood volume changes during brain activation, without need for exogenous contrast agents. Vascular water is selectively labeled by nulling its signal independent of inflow and oxygenation. During visual activation, these vascular-space-occupancy (VASO) dependent fMRI signal changes show a negative cross-correlation with the stimulus paradigm, consistent with increased blood volume and reduced tissue volume in the parenchyma. We derive the theory describing the effect, characterize its spatial characteristics and hemodynamic response, and compare it to the BOLD effect and to a blood flow based method. Results show high spatial and temporal specificity.

New Concepts in Magnets and Gradients

Room 701A 10:30 - 12:30 Chairs: Robert W. Brown and William A. Edelstein

10:30 *743*. **Gradient Coil Design with 3D Geometry and Variable Field-of-View**

Shmaryu M. Shvartsman[1], Michael A. Morich[1], Gordon D. DeMeester[1]
[1]Philips Medical Systems, Cleveland, Ohio, USA

A shielded transverse gradient coil with 3D geometry (some turns on the primary and shield are interconnected) is designed to provide selectable or variable FoV. The method selects all or some turns of the primary coil and shields with two different shield coils. One mode uses the whole primary coil and its shield. In two other modes, selected turns of the primary coil are used together with both shield coils that were optimally designed for the selection. Depending upon the power supplies and switch arrangement available one can choose between three different imaging volumes/FoVs or a continuously variable FoV.

10:42 *744*. **A High-Efficiency Asymmetric Gradient Coil**

Johan A. Overweg[1], Juergen Weizenecker[1]
[1]Philips Research, Hamburg, Germany

The magnetic stored energy of a gradient coil can be reduced considerably by placing its conductors closer to the patient. A coil has been designed in which the unused space below the patient bed has been used to move the conductors of the lower half of the coil inward, keeping the shape of the upper half of the coil the same. In all three channels the resulting asymmetric coil has approximately 40% less stored energy than the comparable cylindrical coil, without compromising image quality or available patient space.

10:54 *745*. **A Novel MRI Gradient Coil Structure for Passive Acoustic Noise Attenuation**

Martin Bencsik[1], Richard Bowtell[1]
[1]University of Nottingham, Nottingham, Nottinghamshire, UK

The acoustic noise generated by MR scanners can cause discomfort to both patient and operator and is a limiting factor in the further improvement of scanner performance. Most of the acoustic noise results from the vibrations of the gradient coil body. In this work we present a novel gradient coil construction, allowing proper mechanical support of longitudinal gradient coil wires, whilst achieving pronounced passive attenuation of the wire-generated displacement wave in the main body of the coil. Experimental results from a small prototype coil showing > 25dB sound reduction in the ~ [690 – 830] Hz frequency range are described.

11:06 *746*. The Spatial Distribution and Prediction of Gradient Induced Acoustic Noise in a 4T MRI Scanner

Weidong Li[1], Chris K. Mechefske[1], Carl Gazdzinski[2], Brian K. Rutt[2]
[1]Queen's University, Kingston, Ontario, Canada; [2]Robarts Research Institute, London, Ontario, Canada

This paper presents the results of acoustic noise measurements in a 4 T MRI scanner that spatially map the sound pressure level (SPL) within the scanner bore. The frequency response functions (FRFs) are derived from the acoustic responses. These spatially distributed FRFs aid in understanding the sound field inside the scanner. To validate the FRFs, comparisons were made between the measured and estimated responses using EPI input sequences. The comparisons show that the responses are close to each other. The derived FRFs will enable us to estimate the acoustic response inside the bore due to other input sequences.

11:18 *747*. Acoustic Noise Analysis of the Gradient Coil Insert for a 4T MRI Scanner

Guozho Z. Yao[1], Chris K. Mechefske[1], Carl Gazdzinski[2], Andrew Alejski[2], Brian K. Rutt[2]
[1]Queen's University, Kingston, Ontario, Canada; [2]Robarts Research Institute, London, Ontario, Canada

High magnetic field strength and high gradient switching rate are becoming ever more commonplace in Magnetic Resonance Imaging (MRI) scanners. These and other factors are combining to yield high acoustic sound pressure levels in MRIs. Based on a previous study involving finite element analysis modeling of the gradient coil, a computational vibro-acoustic model was developed in this study. Noise measurement was conducted to verify the accuracy of the vibro-acoustic model. Comparisons show that the computational model can estimate the acoustic properties of the gradient coil in the frequency range of interest.

11:30 *748*. Problems with Equating E to -dA/dt in Assessing Peripheral Nerve Stimulation Due to Switched Magnetic Field Gradients

Martin Bencsik[1], Richard Bowtell[1], Roger Bowley[1]
[1]Nottingham University, Nottingham, Nottinghamshire, UK

Time varying magnetic field gradients can cause peripheral nerve stimulation in human subjects, as a result of the electric fields induced in tissue. The electric field, E, depends on the temporal derivative of the vector potential, A, produced by the gradient coil and on the gradient of the electric potential, f, due to charges accumulated at boundaries between regions of different conductivity. We show that the effect of f on the electric field is highly significant, and that consequently estimates of the spatial distribution and magnitude of the electric field produced using just the vector potential can be highly misleading.

11:42 *749*. Far Field Spherical Harmonic Expansion for MRI Main Magnet Design

Nicholas R. Shaw[1], Richard E. Ansorge[1]
[1]University of Cambridge, Cambridge, UK

We present a novel, accurate and rapid means of calculating the fringe field from axially-symmetric magnet designs. Our method is particularly applicable to stochastic optimization problems and arose out of work to improve the design of short bore, whole-body MRI magnets and split coil magnets for combined modality PET/NMR imaging. Several direct calculation methods currently exist for determining the field at arbitrary points, but these retain some element of numerical integration. The method presented here however uses decomposition of the fringe field into orthogonal spherical harmonic functions, avoiding any numerical integration, thus speeding up the calculations.

11:54 *750*. Design and Testing an Open, Human MRI system for Orientational Lung Study

Bill Hersman[1], Mirko I. Hrovat[2], Ross W. Mair[3], Iga Muradyan[1], Sam Patz[4], Matthew S. Rosen[3], Iulian Ruset[1], Leo L. Tsai[3], Ronald L. Walsworth[3]
[1]University of New Hampshire, Durham, New Hampshire, USA; [2]Mirtech, Inc., Brockton, Massachusetts, USA; [3]Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, USA; [4]Brigham and Women's Hospital & Harvard Medical School, Boston, Massachusetts, USA

Considerable anecdotal evidence suggests gravity plays a significant role in lung development, and that adaptive mechanisms contribute to lung structure and function. Laser-polarized ^{3}He MRI provides a powerful method to study lung function and inhalation, but in traditional MRI systems, patients are restricted to lying in a horizontal position. We have designed an open access, human MRI system that operates at very low applied magnetic fields and allows for complete two-dimensional rotation of subjects within the applied field. Demonstration two-dimensional images, ^{1}H and ^{3}He, of phantoms similar in size to human lungs have been obtained from the MRI system.

12:06 *751*. Mouse MRI Systems using Dipole Ring Permanent Magnets

Tomoyuki Haishi[1], Shin Utsuzawa[1], Toru Shirai[2], Yoshimasa Matsuda[2], Katsumi Kose[2], Steve Altobelli[3], Eiichi Fukushima[3], Shigemasu Okada[4]
[1]MRTechnology, Inc., Tsukuba, Ibaraki, Japan; [2]University of Tsukuba, Tsukuba, Ibaraki, Japan; [3]New Mexico Resonance, Albuquerque, New Mexico, USA; [4]Sumitomo Special Metals Company, Tokyo, Japan

Two mouse MRI systems were developed using 1.0 T dipole ring permanent magnets and compact MRI consoles. The installation spaces were less than 2 m2. Imaging experiments were performed using a chemically fixed adult mouse and live adult mice. The results have shown that 300 micron cube voxel resolution can be obtained for a chemically fixed adult mouse and 300 micron in-plane resolution can be obtained for live adult mouse within practical imaging times.

12:18 ***752***. **Magnetic Resonance Imaging at Microtesla Fields**
Andreas H. Trabesinger[1], Robert McDermott[1], SeungKyun Lee[1], John Clarke[1], Alexander Pines[1]
[1]UC Berkeley and Lawrence Berkeley National Laboratory, Berkeley, California, USA

Performing MR imaging of humans without the need for powerful magnets would open new aspects in terms of instrumentation simplicity, mobility and cost. Our work towards MRI in microtesla fields include SQUID detection and prepolarizion in transient fields of a ~10 mT. An MRI system operated in a laboratory environment was built. Here we present first images of water and mineral oil phantoms, acquired at fields of 11 – 36 mT in ~40 minutes. The spatial resolution is on the order of one millimeter. These first results are encouraging with regard to imaging of human subjects.

Cancer: Clinical MR Spectroscopy Comes of Age

Room 701B 10:30 - 12:30 Chairs: Peter S. Allen and Rama Jayasundar

10:30 ***753***. **Reliable Estimate of Lactate and Lipid for Newly-Diagnosed Gliomas Patients using Lactate-Edited 3D ^{1}H-MRSI with Ellipsoidal k-Space Sampling**
Xiaojuan Li[1], Edward E. Graves[2], Daniel B. Vigneron[1], Soonmee Cha[1], Tracy R. McKnight[1], Sarah J. Nelson[1]
[1]University of California at San Francisco, San Francisco, California, USA; [2]Massachusetts General Hospital, Boston, Massachusetts, USA

A robust and practical acquisition was developed in order to reliably estimate lactate and lipid levels in glioma patients. This combined J-difference modulation and reduced k-space sampling to obtain 3D 1H- MRSI data. Thirteen pre-treatment glioma patients were studied. Preliminary results concerning the spatial distribution of lactate and lipid are presented and compared with estimates of rCBV obtained using dynamic perfusion weighted MR imaging.

10:42 ***754***. ***In Vivo*** **Lipid T_2 Relaxation Time Measurements in High-Grade Tumors: Differentiation of Glioblastomas and Metastases**
Kirstie S. Opstad[1], John R. Griffiths[1], B. Anthony Bell[2], Franklyn A. Howe[1]
[1]St George's Hospital Medical School, London, UK; [2]Atkinson & Morleys Hospital, London, UK

Glioblastomas and solitary metastases are difficult to diagnose from radiological appearance alone, hence we have investigated the 1H MRS characteristics of these tumors using quantitative short echo 1H MRS. Our findings indicate a significant difference in the ratio of the 1.3 ppm to 0.9 ppm lipid/macromolecule peaks between these tumor groups, which provided for tumor characterisation with specificity and sensitivity of 80% (n=59). In a subset of tumors (n=10) we determined the T2 of the 1.3 ppm resonance to be significantly higher in metastases compared to glioblastomas, which is consistent with our finding of different lipid ratios in these tumors.

10:54 ***755***. **^{1}H MRS *In Vivo* and HRMAS Spectroscopy of Glial Tumors: *Myo-Inositol* Content in Different Tumor Types and Physiological Conditions**
Goran Vucurevic[1], Ingo Schnell[2], Joachim Gawehn[1], Karin Thieme[2], Nico Hopf[3], Juergen Bohl[4], Peter Stoeter[1]
[1]Institut of Neuroradiology, Mainz, Germany; [2]Max Planck Institute for Polymer Research, Mainz, Germany; [3]University Clinic, Mainz, Germany; [4]Institute of Neuropathology, Mainz, Germany

1H single-voxel spectroscopy in vivo (1H MRS), high resolution magic angle spinning (HRMAS) spectroscopy of biopsy samples and patohistological analysis of samples after HRMAS were performed in brain tumors of glial origin. Goals of this study were to look for the specific metabolic changes in different tumor types and different spectroscopy profiles in tumors of the same type but in the different physiological microenvironment. Significant differences, useful for differential diagnosis, were found in both cases, demonstrating that myo-inositol is a reliable astrocyte marker with an important role in cell volume regulation.

11:06 ***756***. **An Exploratory Survival Analysis of Malignant Glioma Patients using Pre-Surgery MRI and 3D ^{1}H-MRSI dData with Recursive Partitioning**
Xiaojuan Li[1], Hua Jin[1], Ying Lu[1], Susan Chang[1], Sarah J. Nelson[1]
[1]University of California at San Francisco, San Francisco, California, USA

In order to characterize the pre-surgery metabolic properties of brain tumors and identify its prognostic importance, MRI and 3D 1H-MRSI (MR spectroscopic imaging) parameters for 43 malignant glioma patients were studied prior to surgery. A Survival tree was generated with a recursive partitioning method. The survival functions for groups of patients with different metabolic activities were compared and significant differences were observed between groups.

11:18 *757.* Correlation Between Magnetic Resonance Spectroscopy, Apparent Diffusion Coefficients, and Image-Guided Histopathology in Patients with Malignant Glioma and Radiation Necrosis

David Hearshen[1], Lisa Scarpace[1], Jack Rock[1], Jay Fisher[2], Suresh Patel[1], Donald Peck[1], Tom Mikkelsen[1]
[1]Henry Ford Health System, Detroit, Michigan, USA; [2]Ohio State University, Columbus, Ohio, USA

MRI does not adequately discriminate between recurrent tumor and radiation necrosis in previously treated patients with malignant glioma. In this study we analyzed proton MR spectroscopic imaging in conjunction with apparent diffusion coefficients (ADC) directly correlated with image guided stereotactic surgical biopsies, subsequently characterized as pure tumor, pure necrosis, or mixed necrosis/tumor. In some combinations, ADC measurements added information statistically independent from spectral measures. ADC and spectral measurements were able to distinguish pure tumor, normal, and radiation necrosis, and in some combinations, pure necrosis from mixed specimens. These results are useful in constructing clinical algorithms to manage these patients

11:30 *758.* *In Vivo* Monitoring Response to Neoadjuvant Chemotherapy in Breast Cancer: A Quantitative Comparison between High Field MRI/MRS and Immunohistochemistry (Ki67)

Sina Meisamy[1], Patrick John Bolan[1], Krista Warren[1], Evin Gulbahce[1], Eva H. Baker[1], Joseph C. Lin[1], Michael Nelson[1], Doug Yee[1], Todd Tuttle[1], Michael Garwood[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

The purpose of this study is to predict whether levels of total choline-containing compounds (tCho) measured by single voxel ^{1}H MRS can predict clinical response in breast cancer (BC) patients undergoing neoadjuvant chemotherapy (CT). Tumor size and tCho concentrations were compared to an immunohistochemical marker for cell proliferation, Ki67. The results show that tCho concentrations obtained before and after CT correlate significantly with Ki67 ($p=0.0009$, $R2=0.91$). Therefore, measuring changes in tCho concentrations may provide a noninvasive technique in evaluating BC response to neoadjuvant CT.

11:42 *759.* Multivariate Analysis of 2D Correlated Breast Spectra

Nathaniel Wyckoff[1], Nader Binesh[1], Hyun-Kyung Chung[1], Kenneth Yue[1], Nanette DeBruhl[1], M. Albert Thomas[1]
[1]David Geffen School of Medicine at UCLA, Los Angeles, California, USA

The goal of this work was to differentiate the localized 2D COSY spectra from malignant and benign breast tumor patients and healthy controls, using linear discriminant analysis and logistic regression. Spectra were recorded using an L-COSY sequence optimized on a 1.5-T MRI scanner. The study sample included 23 healthy women, 12 malignant tumor patients and 2 benign tumor patients. Our preliminary results clearly indicate that an accuracy of 90% can be achieved using the stepwise logistic regression classifier, compared to 80% accuracy using the linear classifier, in distinguishing between healthy fatty tissue and invasive carcinoma.

11:54 *760.* Optimizing Citrate Detection at 3 Tesla

Andreas H. Trabesinger[1], Dieter Meier[1], Ulrike Dydak[1], Rolf Lamerichs[2], Peter Boesiger[1]
[1]ETH and University of Zurich, Zurich, Switzerland; [2]Philips Medical Systems, Best, Netherlands

Citrate is an important metabolic marker for health of prostate tissue. Whereas acquisition schemes were extensively optimized for citrate detection at 1.5 T, few studies were done for finding optimum parameters for 3 T. Here we use analytical methods for optimizing PRESS based sequences. For the PRESS sequence at 3 T, an echo time of 263 ms is shown to yield pure in-phase signal. The JPRESS sequence can be used for specific timings: JPRESS with an echo time of 180 ms produces completely refocused citrate spectra. These results will be useful for the design of MRS and MRSI protocols.

12:06 *761.* The Utility of Proton MRSI in Predicting Biochemical Outcome in Prostate Cancer Patients Treated with Neoadjuvant Chemotherapy

Darko Pucar[1], Jason A. Koutcher[1], Ankoor Shah[1], Jonathan P. Dyke[2], Hui-Ni Chen[1], Lawrence Schwartz[1], William K. Kelly[1], Hedvig Hricak[1], Kristen L. Zakian[1]
[1]Memorial Sloan-Kettering Cancer Center, New York, New York, USA; [2]Weill Cornell Medical College, New York, New York, USA

A clinical trial of neo-adjuvant chemotherapy combined with androgen ablation therapy prior to definitive surgery or radiation therapy was conducted at our institution with the aim of improving outcome in high-risk prostate cancer patients. The goal of this study was to determine whether Proton Magnetic Resonance Spectroscopic Imaging (MRSI) could predict outcome in patients treated with neoadjuvant chemo-hormonal therapy. Patients were stratified based on MRSI criteria to low or high likelihood of relapse. In this preliminary analysis of high risk patients, MRSI predicted 18-month PSA relapse-free survival while clinical parameters such as stage, Gleason score and PSA did not.

12:18 *762.* Regression Analysis of Defined Mixtures of Cancer and Benign Tissue in Prostate Biopsies

Ray Somorjai[1], Roger Bourne[2], Alexander Nikulin[1], Brion Dolenko[1], Stephen Fairy[2], Peter Russell[2], Carolyn Mountford[2]
[1]INational Research Council, Winnipeg, Manitoba, Canada; [2]Institute for Magnetic Resonance Research, Sydney, New South Wales, Australia

For *in vivo* MRS the assessment of disease extent and progression is limited by the relatively poor spatial resolution of the method. Many of the voxels from which spectra are derived contain a mixture of tissues of different pathological status. To address this problem we performed a regression analysis on ^{1} H MR spectra (8.5 T) of prostate biopsy tissue in which the partial volumes of malignant and benign tissue were estimated by histopathology of serial sections. Linear regression analysis enabled the prediction of cancer volume with an overall accuracy of 97% for an independent test set.

Neck and Spine MR Imaging: The Cutting Edge

Room 714 A/B   10:30 - 12:30   Chairs: Joseph A. Frank and Thomas H. Mareci

10:30 *763*. Cellular MR Imaging of Magnetically Labeled Encephalitogenic T-Cells in the Mouse Spinal Cord

Stasia Ann Anderson[1], Jacqueline Shukaliak-Quandt[1], Elaine Kay Jordan[1], Ali Syed Arbab[1], Roland Martin[1], Henry McFarland[1], Joseph Alan Frank[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

The purpose of this study is to detect and monitor encephalitogenic T-cells by MRI in the mouse model of multiple sclerosis. Experimental autoimmune encephalomyelitis (EAE) was induced in mice by adoptive transfer of myelin peptide specific T-cells intracellularly labeled with superparamagnetic iron-oxide nanoparticles (SPIO). The phenotype, proliferative and encephalitogenic properties of magnetically labeled cells were compared to non-labeled cells. MRI was performed on the spinal cord in vivo and by ex vivo MR microscopy (MRM) and hypointense lesions were visualized in labeled mouse cords. Histology confirmed that iron-labeled T-cells present in EAE lesions were detected on MRM.

10:42 *764*. Characterization of Radiation Damage in Rat Spinal Cord using USPIO Enhanced CPMG MR Imaging to Quantify T_2 and ΔR_2.

Marielle Philippens[1], Giulio Gambarota[1], Jeroen Pikkemaat[1], Wenny Peeters[1], Albert van der Kogel[1], Arend Heerschap[1]
[1]University Medical Center, Nijmegen, Netherlands

The characterization of late radiation lesions in rat spinal cord was investigated in vivo by contrast enhanced Carr Purcell Meiboom Gill (CPMG) MR imaging using ultra small dextran coated particles of iron oxide (USPIO). T2 and ΔR2 maps of irradiated and non-irradiated gray and white matter are correlated to histological data. T2 and ΔR2 values of both GM and WM lesions were increased compared to regions in control animals and non-irradiated regions. The T2 and ΔR2 values in WM lesions show an inverse correlation

10:54 *765*. Brachial Plexus Injury: Evaluation of Nerve Roots with MR Myelography using Fast Imaging Employing Steady State Acquisition (FIESTA)

Takeharu Yoshikawa[1], Naoto Hayashi[1], Yasuhito Tajiri[1], Tomohiko Masumoto[1], Harushi Mori[1], Akira Kunimatsu[1], Haruyasu Yamada[1], Yoshitaka Masutani[1], Osamu Abe[1], Shigeki Aoki[1], Yusuke Inoue[1], Kohki Yoshikawa[1], Kuni Ohtomo[1]
[1]University of Tokyo, Tokyo, Japan

To examine clinical feasibility of MR myelography using fast imaging employing steady state acquisition (FIESTA) to assess traumatic brachial plexus injuries (BPI), 10 volunteers and 11 BPI patients underwent MR myelography using FIESTA. We evaluated visibility of nerve roots of the volunteers and condition of nerve roots in the patients. MR myelography was compared to CT myelography if available. MR myelography using FIESTA demonstrated clearly most nerve roots in the volunteer studies. Most nerve roots were fairly evaluated with MR myelography in the BPI patients. MR myelography can replace some of the myelographic examinations in evaluation of BPIs.

11:06 *766*. The Use of DCE-MRI in the Assessment of Lacrimal and Salivary Glands in Sjogren's Syndrome Patients

Caleb Roberts[1], Alan Jackson[1], Vivian Rushton[1], Geoff J. M. Parker[1]
[1]University of Manchester, Manchester, Greater Manchester, UK

We explored the microvascular characteristics of Sjogrens Syndrome using Dynamic Contrast Enhanced MRI (DCE-MRI). Application of pharmacokinetic modelling allows the extraction of information such as vascular volume and capillary wall permeability. These methods provide a new window on the physiology of this condition and provide a potential tool for the monitoring of treatment. Our study suggests that high quality, high resolution parametric maps can be obtained routinely and provide quantitative descriptions of the microvascular characteristics of the disease.

11:18 *767*. Quantification of Cerebrospinal Fluid Flow Abnormalities in Chiari I Patients

Mark F. Quigley[1], Victor M. Haughton[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

We have developed analytical algorithms based upon localized measurements of CSF flow (i.e., velocity/flow in individual voxels) to derive novel parameters to quantify the degree of abnormality in CSF flow in Chiari I patients and normal subjects. Preliminary study indicates the flow parameters thus derived have the potential to serve as diagnostic indices.

11:30 *768*. The Effect of Experimental Parameters on the Appearance of High b Value q-Space MR Images of Rat Spinal Cord

Revital Nossin-Manor[1], Revital Duvdevani[2], Yoram Cohen[1]
[1]Tel-Aviv University, Tel-Aviv, Israel; [2]D-Pharm Company, Rehovot, Israel

We investigated the effect of different experimental parameters on the q-space MR images of the normal rat spinal cord (SC). The experimental parameters that we decided to study were: the diffusion time (Δ), the gradient duration (δ) and the echo time (TE). The aim was to find the set of experimental parameters that produce the best gray/white matter (GM/WM) contrast and to evaluate the effect of the different experimental parameters on the q-space extracted MR parameters. These studies were used to determine the effect of the different experimental parameters on the structural information obtained from the q-space analysis.

11:42 *769*. Diffusion in the Extracellular Space as Proved by High b Values q-Space Diffusion MRS of Tetramethylammonium Chloride

Inbal E. Biton[1], Adi Mayk[2], Yaniv Assaf[3], Yoram Cohen[1]
[1]Tel-Aviv University, Tel-Aviv, Israel; [2]TEVA Pharmaceutical Industries Ltd. and Sackler School of Medicine, Tel Aviv University, Tel-Aviv, Israel; [3]Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel

The size and the geometry of the extracellular space (ECS) influence the diffusion of neuroactive substance. It has been shown that the release of neurotoxic levels of glutamate into the ECS, which takes place in ischemia, trauma, and hypoxia, affects the size and geometry of the ECS (1,2,3). In this study we have used diffusion MRS of deuterated tetramethyl ammonium chloride (TMA-d12), which is restricted to the ECS, to study the diffusion characteristics of the ECS before and after application of glutamate.

11:54 *770*. Evolving White Matter Injury in Mouse Spinal Cord Evaluated using DTI

Joong Hee Kim[1], Shiow-Jiuan Lin[1], Gyeong-Moon Kim[2], Jeffrey J. Neil[1], Chung Y. Hsu[1], Sheng-Kwei Song[1]
[1]Washington University, St. Louis, Missouri, USA; [2]Samsung Medical Center, Seoul, Republic of Korea

In the present study, we examined the temporal and spatial evolution of DTI parameters in the whole cord, dorsal and ventral white matter, and whole white matter after SCI. Both RA and radial diffusivity demonstrate the injury more effectively than T2WI and both show more marked abnormalities on day 7 than day 1 after injury. Our result supports the previous finding that radial diffusivity reflects myelin integrity and can be used to reflect SCI.

12:06 *771*. Diffusion Weighted MRI *Ex-Vivo* Follow Up of Spinal Cord Degeneration Following Trauma

Shahar Molshanski-mor[1], Uri Nevo[2], Ehud Hauben[1], Solange Akselrod[2], Michal Neeman[1], Michal Schwartz[1]
[1]Weizmann Institute of Science, Rehovot, Israel; [2]Tel Aviv University, Tel-Aviv, Israel

Secondary degeneration is a major cause of neuronal loss following insult in the CNS. In this work an ex-vivo follow-up of the temporal dynamics of degeneration following spinal cord injury in rats, was performed by diffusion weighted MRI. We measured the apparent diffusion coefficients and the related spatial anisotropy at a few time points following the insult. We demonstrate that the dynamics of degeneration around the site of lesion can be well documented by DW-MRI, and that the obtained diffusion and anisotropy indices can provide a reliable comparison of the dynamics of spinal cord damage among different experimental groups.

12:18 *772*. Stress-Field Analysis in TMJs with Normal and Anteriorly Displaced Discs

Luigi M. Gallo[1], Dominik B. Goessi[1], Sandro Palla[1]
[1]University of Zurich, Zurich, Switzerland

In order to investigate the mechanical etiology of TMJ degenerative diseases, it is important to know how the articular disc is stressed. Dynamic variations of the intraarticular space indicate how stress-fields act on the TMJ disc. They can be determined in vivo by coupling the reconstructed TMJ anatomy obtained from MR scans with the corresponding kinematic data. Aim of this study was to investigate stress-field paths and aspect variations in asymptomatic TMJs and in joints with anterioy disc displacement during functional jaw movements.

Image Processing: New Techniques

Room 716 A/B 10:30 - 12:30 Chairs: Derek L.G. Hill and Armando Manduca

10:30 *773*. Constrained Non-linear Elasticity Reconstruction Technique for Breast MRI Elastography

Abbas Samani[1], Ingolf Sack[1], Donald Plewes[1]
[1]University of Toronto, Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada

To increase the displacement SNR in breast MR elastography, tissues are compressed significantly. As a result, breast tissues undergo large deformations. This leads to significant geometric and material nonlinearities. In this study, methods for treating these nonlinearities are presented and their impact on elasticity reconstruction is investigated. For elasticity reconstruction, a constrained elastography method is used where tissues are treated as hyperelastic materials. The tissue hyperelastic parameters are calculated using inversion techniques with a nonlinear finite element (FE) model for forward modeling. Simulations indicate the feasibility of reconstructing the tissue hyperelastic parameters using displacement data with moderate SNR.

10:42 *774*. Quantification of MR Breast Tissue Changes using Texture Analysis

Catherine S. Klifa[1], Savannah C. Partridge[1], Ying Lu[1], Nola M. Hylton[1]
[1]University of California, San Francisco, California, USA

In this study we quantified breast tissue compositional changes from Magnetic Resonance Imaging (MRI) data using texture analysis. MRI allows a complete visualization of breast tissue patterns. We studied various compositions of healthy breast tissue patterns from 8 normal volunteers who were scanned each week during their menstrual cycle, and quantified variations of breast textural patterns from week to week. We also performed a visual assessment of breast density on these MR data. The ultimate goal of this study is to understand the relationship between breast tissue compositional changes (for example due to treatment) and breast cancer risk.

10:54 *775*. 3D Spline-Based Registration and Interpolation Algorithm for MR Volume Measurement

Theresa Meganne Mawn[1], Andrew J. Wheaton[1], Luke Bloy[1], Arijitt Borthakur[1], Ravinder Reddy[1], John S. Leigh[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

A combination of cubic spline interpolation and rigid body registration was applied to MR images data to demonstrate the feasibility of reconstructing a 3D volume from sets of 2D slices to minimizing volume measurement error per unit imaging time. The algorithm was applied to the volume measurement of an in vivo MR data set of articular cartilage. The 3D interpolation algorithm produced approximately five-fold less error than an analogous 2D interpolation scheme.

11:06 *776*. 3D Visualization of Cartilage Thickness in Knee Joint Using Bezier Spline Segmentation

Eugene Ozhinsky[1], Sharmila Majumdar[1]
[1]University of California at San Francisco, San Francisco, California, USA

Spline-based segmentation has been implemented to improve the performance of knee joint cartilage segmentation for patients with osteoarthritis. The thickness map of segmented cartilage has been calculated and visualized in 3D with polygonal model of the joint.

11:18 *777*. Tensor Scale: A New Method for Quantifying Structural Anisotropy in Trabecular Bone Images

Punam K. Saha[1], Felix W. Wehrli[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Trabecular bone (TB) is a network of interconnected struts and plates. During remodeling the bone responds to the forces to which it is subjected and the trabeculae thus follow major stress lines (Wolff's law). Trabecular anisotropy can be expressed in terms of the fabric tensor. Next to volume fraction, structural orientation (fabric) is the largest contributor to bone strength. Here, we present a new method, based on the recently conceived notion of tensor scale, to quantify regional TB orientation and anisotropy in high-resolution in vivo images of TB bone.

11:30 *778*. Dense Motion Estimation in Tagged MRI Sequence

Ying Sun[1], Yi-jen Lin Wu[1], Kazuya Sato[1], Chien Ho[1], Jose M. F. Moura[1]
[1]Carnegie Mellon Univeristy, Pittsburgh, Pennsylvania, USA

We develop an affine model based method to estimate the motion of the myocardium pixels and to produce dense displacement fields for a cardiac tagged MR sequence. We also propose an energy minimization algorithm to automatically detect the tag lines. Our method incorporates the spatial correlation between adjacent tag lines and prevents two tag lines from occupying the same physical position. Experiments show that the detection algorithm is robust to noise and bad contrast. Our tests in a rat heart transplantation study show that we successfully extract the tag lines and reconstruct the motion of the heart.

11:42 *779*. 3D Segmentation of Mouse Organs from MR Images using Deformable Simplex Mesh Models

Ghassan Hamarneh[1], Herve Delingette[2], Mark Henkelman[1]
[1]Hospital for Sick Children, Toronto, Ontario, Canada; [2]INRIA, Rocquencourt, France

We are using magnetic resonance imaging to screen mice for morphological phenotypes. To detect organ anomalies in images of randomly mutagenized mice, we need to quantify typical organ shape variations in a normal population, which in turn necessitates the identification of organ boundaries. Towards this goal, we demonstrate the use of deformable simplex-mesh models for segmenting mouse brains and kidneys from MR images. Algorithmic details and 3D segmentation results are presented.

11:54 *780*. Noise Normalization by Variable Filtering in Parallel Imaging and Conventional Imaging with Inhomogeneous Coils

Jeffrey Tsao[1], Peter Boesiger[1], Klaas P. Pruessmann[1]
[1]ETH and University of Zurich, Zurich, Switzerland

For images acquired with inhomogeneous coils (e.g. phased-array coils), it is often desirable to minimize coil-dependent intensity variations by reconstruction. However, this leads to a spatially varying noise level, which is particularly pronounced in parallel imaging due to additional inhomogeneous noise amplification. In this work, we propose an efficient variable filtering scheme that adjusts the amount of filtering adaptively on a voxel-by-voxel basis. The proposed method benefits from data with a large number of spatial and non-spatial dimensions, since the filtering can be spread among the dimensions, thus keeping the resolution degradation along each dimension to a minimum.

12:06 *781*. Post-processing Background Suppression in Time-resolved MRA Without Mask Acquisitions or Operator Intervention

Arjun Arunachalam[1], Walter F. Block[1]
[1]University of Wisconsin-Madison, Madison, Wisconsin, USA

3D contrast-enhanced MR angiography (3D CE-MRA) image volumes are interpreted by generating MIPs of multiplanar reformats that exclude static tissue. While time-resolved 3D CE-MRA provides useful information on general and delayed flow patterns, the time course of each pixel can be used to identify unwanted static tissue also. We present an algorithm for suppressing the low spatial frequency component of static tissue in time-resolved image volumes that requires no operator intervention such as drawn regions of interest (ROI). The resultant image volumes have higher contrast relative to the background and are easier to interpret.

12:18 *782*. A Robust and Efficient Method to Unwrap MR Phase Images

Lei Ying[1], Jim Xiuquan Ji[1], David C. Munson, Jr.[1], Zhi-Pei P. Liang[1], Ralf Koetter[1], Brendan J. Frey[2]
[1]University of Illinois at Urbana - Champaign, Urbana, Illinois, USA; [2]University of Toronto, Toronto, Ontario, Canada

Phase unwrapping finds many important applications in MRI, ranging from field mapping to flow imaging. In this paper, we propose a novel approach to 2-D phase unwrapping, which models the true phase as a Gaussian Markov random field. The phase is unwrapped using the maximum a posteriori (MAP) rule. The underlying optimization problem uses a form of two-dimensional dynamic programming, which is efficient and robust to noise. The proposed algorithm has been tested using various MRI data (spin echo and gradient echo), yielding excellent phase maps.

Musculoskeletal MR: Functional Imaging and Spectroscopy

Room 713 A/B 10:30 - 12:30 Chairs: Graeme M. Bydder and Chris Boesch

10:30 *783*. Characterization of Elite Endurance and Sprint Runners Using Multiparametric Functional NMR Imaging and Spectroscopy

Sandrine Duteil[1], Jean-Sébastien Raynaud[1], Cyprien Bourhillon[2], Claire Wary[1], Anne Leroy-Willig[1], Jean-Claude Jouanin[2], Yannick Guezennec[2], Pierre G. Carlier[1]
[1]Institute of Myology, Paris, France; [2]IMASSA CERMA, Bretigny sur Orge, France

Endurance or sprint training implies specific adaptations of the skeletal muscle, in particular of capillary and mitochondrial densities [1], which in turn might affect perfusion, oxygenation and energy metabolism patterns. Two groups of 7 runners highly trained in endurance (marathon – group E) or sprint (100 and 200 m – group S), with identical VO2max, were compared at the recovery phase of an ischemic exercise performed until exhaustion. The objective was to identify metabolic or physiological differences between E and S athletes, which might be related to training and condition performance

10:42 *784*. Effects of Short-Duration Skeletal Muscle Exercise on Glycogen Synthesis in Obesity during Hyperinsulinemia. A Study using ^{13}C-Magnetic Resonance Spectroscopy

Jacco H. de Haan[1], Alexandra Mulder[1], Paul Smits[1], Cees J. Tack[1], Arend Heerschap[1]
[1]UMC Nijmegen, Nijmegen, Gelderland, Netherlands

During hyperinsulinemia, exercise strongly stimulates glycogen synthesis in skeletal muscle of healthy subjects. However, little is known about the additional effect of exercise in obesity upon insulin stimulated glucose uptake. Ten obese subjects underwent a euglycemic hyperinsulinemic clamp for 150 min, with simultaneous measurement of glycogen in skeletal muscle. A short exercise increased the rate of glycogen synthesis rate ~165% compared to ~317% in healthy subjects. Blood flow had no relation with these increases. The glycogen synthesis rate after exercise under hyperinsulinemic condition is reduced in obesity, independent of age. These results indicate that in humans, insulin and exercise mediated glucose uptake are interrelated.

10:54 *785*. A Comparison of Muscle Glycogen Metabolism in Type 2 Diabetic and Matched Normal Subjects

D. K. Deelchand[1], J. Halliday[1], J. EM. Snaar[1], P. Carey[2], R. Taylor[2], P. G. Morris[1]
[1]University of Nottingham, Nottingham, Nottinghamshire, UK; [2]University of Newcastle-upon-Tyne, Newcastle, UK

To understand the basic pathophysiologic regulation of muscle glycogen metabolism in type 2 diabetes, the diurnal changes in calf muscle glycogen concentration were measured using carbon-13 magnetic resonance spectroscopy before and after two mixed meals of similar composition. Results showed that fasting muscle glycogen levels were lower in diabetic subjects compared to age-matched controls (57.1±3.6 vs. 68.9±4.1 mmol/l,$p<0.05$), that the postprandial increase in response to the first meal was less (65.9±5.2 vs. 97.1±7.0 mmol/l at 240 min,$p<0.005$). The induced response to the second meal observed in controls was even more attenuated in the type 2 diabetes.

11:06 *786*. Muscle-specific Differences in the Usage of Intra-myocellular Lipids (IMCL) During Long-term Exercise Detected by ^{1}H MR Spectroscopic Imaging: A Feasibility Study.

Peter Vermathen[1], Roland Kreis[1], Michael Ith[1], Monica Zehnder[1], Chris Boesch[1]
[1]University & Inselspital Berne, Berne, Switzerland

Concentrations of intramyocellular lipids (IMCL) in different muscles of the lower leg were measured pre- and post-exercise using ^{1}H MR spectroscopic imaging (MRSI). On average an IMCL reduction of 30% after exercise was detected in all muscles. In 67% (38/57) pair-wise comparisons of muscles before and after exercise/replenishment revealed significant reductions. IMCL reduction in m.tibialis anterior measured by MRSI was similar to that obtained by single voxel spectroscopy (SVS) measured in the same session. The results demonstrate the feasibility of MRSI measurements to detect possible differences in IMCL usage between muscles.

11:18 *787*. Biphasic Parameters of Muscle Metabolism Detected with ^{31}P-MRS are Correlated with Changes in Plasma Lactate during Progressive Exercise

Graydon H. Raymer[1], Greg D. Marsh[1], John M. Kowalchuk[1], Terry Thompson[2]
[1]The University of Western Ontario, London, Ontario, Canada; [2]Lawson Health Research Institute, London, Ontario, Canada

Subjects (N=6) performed two ramped, isotonic wrist flexion protocols to fatigue (~0.11 W/min). On the first trial, 31P-MRS data were collected continuously throughout exercise to measure intracellular pH and log[Pi/PCr]. In the second trial, blood sampled from a deep forearm vein was analyzed for plasma lactate concentrations [La-]pl. Exercise caused a biphasic change in all these parameters, with a threshold evident at ~55% peak power output (1.17 ± 0.26, 1.21 ± 0.30, and 1.17 ± 0.19 W for pH, log[Pi/PCr] and [La-]pl). These measures were all highly correlated (r = 0.97, 0.98, 0.96, $P < 0.05$).

11:30 *788*. ^{13}C MRS to Monitor Creatine Uptake and Clearance and for the Direct Detection of the Phosphocreatine to Creatine Ratio in Human Skeletal Muscle.

Marinette van der Graaf[1], Dennis Klomp[1], Mark Rijpkema[1], Monique Vlak[1], Jack van Asten[1], George Padberg[1], Arend Heerschap[1]
[1]University Medical Center Nijmegen, Nijmegen, Netherlands

Oral creatine intake is common practice in sports and medicine, but difficult to evaluate in vivo. To monitor the dynamic uptake and clearance of creatine in human skeletal muscle we introduce a new approach using 13C MRS and a 5 day supplementation regime with 13C-4 labelled creatine. The 13C creatine signals in the gastrocnemius muscle increased by a factor of 2, to a stable level in this period, while total creatine (as assessed by 31P MRS) increased about 5%. The ratio Cr/TCr was 0.28. Only after more than 3 months the 13C signals had returned to control levels.

11:42 *789*. Structure-Function Correlation of the Human Soleus Muscle

Shantanu Sinha[1], Taija Finni[1], John A. Hodgson[1], Reggie V. Edgerton[1]
[1]University of California, Los Angeles, California, USA

Given the structural complexity of different muscle compartments, it is difficult to explain the functional aspects of the unit as a whole in terms of a simple model comprised of parallel muscle fiber in series with connective tissue. Using high resolution MRI and 3D volume rendering to elucidate the anatomy, and velocity encoded, PC imaging, gated to isometric contractions, to map the kinematics, we correlate structure with the functional heterogeneity of the human multipennate soleus muscle in vivo and address the question, how are short muscle fibers organized in large muscles in order to function as one unit.

11:54 *790*. Fully Automated Field-Of-View Tracking of the Moving Knee using an Active Marker and Radial Fluoroscopic MR Sequences

Carsten Liess[1], Tobias Schaeffter[2], Christoph Leussler[2], Joachim Brossmann[1], Martin Heller[1], Claus-Christian Glueer[1]
[1]CAU Kiel, Kiel, Germany; [2]Philips Research Laboratories - Hamburg, Hamburg, Germany

Anterior knee pain is a common symptom frequently encountered in young active patients with patellofemoral malalignment, which may cause chondromalacia of the patella. Although MRI is superior to conventional axial radiography for the detection of this condition, it is generally accepted that the diagnosis should be based on dynamic MRI scans. Here we present a radial fluoroscopic MR method with an integrated tracking sequence for the detection of an active marker; the method allows fully automated field-of-view (FOV) tracking of the moving knee.

12:06 *791*. Human Imaging of Phosphorus in Cortical and Trabecular Bone Using Ultrashort TE Pulse Sequences

Matthew D. Robson[1], Peter D. Gatehouse[2], Taigang He[3], David N. Firmin[2], Stefan Neubauer[1], Graeme M. Bydder[3]
[1]Oxford University Centre for Clinical Magnetic Resonance Research, Oxford, UK; [2]Imperial College of Science, Technology & Medicine, London, UK; [3]Imperial College, Hammersmith Hospital Campus, London, UK

In this work we present the first images of the 31P content of human bone obtained in-vivo. Phosphorus in bone has a very short T2 (here measured at 176µs), consequently it has been necessary to image with an ultra-short TE (80µs). The radio frequency excitation is performed using a half pulse and k-space sampling is radial. Images have been acquired of human bone with a true in-plane resolution of 2.9mmx2.9mm yielding a high SNR for cortical bone. There is significant clinical interest in bone metabolism and access to phosphorus imaging may provide a new method for demonstrating bone disease.

12:18 ***792***. **Combined Proton and ^{31}P Imaging of Solid Components of Bone**

Yaotang Wu[1], Jerome L. Ackerman[2], David A. Chesler[2], Lila Graham[1], Yan Wang[1], Melvin J. Glimcher[1]
[1]Children's Hospital, Boston, Massachusetts, USA; [2]Massachusetts General Hospital, Boston, Massachusetts, USA

One of the most important characteristics differentiating osteoporosis (subnormal volumetric bone mass) from osteomalacia (reduced bone minerl mass per unit bone substance volume) is degree of mineralization. Such information is currently available only by biopsy of bone. In addition to its invasive nature, biopsy is a very sparse spatial sampling of the bone, and may yield results which are unrepresentative of the skeleton as a whole. This study demonstrates acquisition of paired identically scaled 1H and 31P solid state MR images (yielding mineral and matrix density respectively) that may be used to compute degree of mineralization.

Neurological MR

Room 715 A/B 10:30 - 12:30 Chairs: Roger J. Ordidge and Tarek Yousry

10:30 ***793***. **Improved MR-Intracranial Pressure (MR-ICP) Measurement using a new Data Acquisition Technique**

Hasan Abbas Dhoondia[1], Noam Alperin[1]
[1]University of Illinois at Chicago, Chicago, Illinois, USA

Intracranial pressure (ICP) can be measured non-invasively from velocity encoded cine phase contrast (PC) MRI of the CSF and blood flow [1]. The MR PC technique uses a single velocity encoding (VENC) value hence two separate scans are employed to measure the slow CSF and the fast blood flow. When a change in heart rate occurs between the two scans, the time correspondence between the blood and the CSF flows is lost leading to measurement errors.A new MRI data acquisition scheme for simultaneous measurement of slow and fast velocities has been developed to improve the robustness of the ICP measurements.

10:42 ***794***. **High Resolution Imaging of the Human Brain at 4.7 Tesla using Fast Spin Echoes**

Roger John Ordidge[1], Enrico De Vita[1], Stephen Roberts[2], Harold Parkes[1], Robert Turner[1], Paul Kinchesh[1], Karin Shmueli[1], David Thomas[1]
[1]University College London, London, England, UK; [2]Pulseteq Ltd, Guildford, Surrey, UK

MRI systems utilizing high field magnets (3 T and above) have been commonplace for a decade1. However, conventional wisdom has suggested that the production of high-resolution images of the entire brain with even contrast behaviour may be confounded by the dielectric resonance effect2. In this abstract we present images obtained using the Fast Spin Echo (FSE) method (3) at 4.7 T that display excellent contrast and resolution.

10:54 ***795***. **Application of High-Resolution Susceptibility-Weighted BOLD Angiography at 1.5 T: Clinical Experience**

Jürgen R. Reichenbach[1], Clemens Fitzek[1], Hans Joachim Mentzel[1], Werner A. Kaiser[1]
[1]Friedrich-Schiller University, Jena, Germany

We report the application of high-resolution, susceptibility-weighted BOLD angiography in patients with different brain lesions, such as venous malformations or cavernoma, and patients with primary brain tumors or brain metastases. The technique basically uses the susceptibility difference between veins and parenchyma to image small veins, but it is also sensitive to susceptibility differences arising from the presence of small clots or microhemorrhages. Detailed vascular and local susceptibility-related information is obtained in clinical applications, which is often not as clearly evident or even not at all visible on more conventional MR images. The technique is promising and holds clinical significance.

11:06 ***796***. **Cranial Nerve Conspicuity in 3D High-Resolution Imaging of the Internal Auditory Canal at 3T**

Heidi A. Ward[1], Matthew A. Bernstein[2], Armen Kocharian[2], Robert J. Witte[2], John I. Lane[2], Jason A. Polzin[1]
[1]GE Medical Systems, ASL-Central, Waukesha, Wisconsin, USA; [2]Mayo Clinic, Rochester, Minnesota, USA

High-resolution MR imaging of the internal auditory canal (IAC) provides beneficial information for the clinical management of sensorineural hearing loss patients. The contrast to noise (CNR) ratios and ability to resolve cranial nerves from CSF within the IAC were compared for three different sub-five minute, high-resolution 3D protocols at 3T acquired with a hybrid phased-array coil. 3D Phase-Cycled FIESTA with a 6cm FOV provides approximately the same CNR as a 12cm FOV 3D Fast Spin Echo sequence, while also providing improved nerve definition. However, sensitivity to motion may limit its clinical utility to compliant patients.

11:18 *797*. On-Line Automatic Slice Positioning and Between-Scan Correction for Brain MR Protocols

Andre van der Kouwe[1], Sebastien Gicquel[2], Gen-Nan Chen[2], Franz Schmitt[3], Martin Harder[4], David Salat[1], A. Gregory Sorensen[1], Bruce Fischl[1], Anders Dale[1]
[1]MGH/MIT/HMS, Charlestown, Massachusetts, USA; [2]CorTechs Laboratories Inc., Charlestown, Massachusetts, USA; [3]Siemens Medical Solutions, MGH NMR Center, Charlestown, Massachusetts, USA; [4]Siemens Medical Solutions, Erlangen, Germany

In clinical brain imaging protocols, the MR technician collects a quick localizer, and manually positions the subsequent scans using the localizer as guide. We present a system for real-time on-line automatic positioning of slices using a statistical atlas, and for correcting the positioning between scans for subsequent patient movement. Accurate alignment ensures that left/right asymmetries reflect true anatomy, that all patients' scans are aligned in a consistent manner, and that patients returning for follow-up scans are positioned in precisely the same way so that images may be compared side-by-side to accurately monitor the progression of illness.

11:30 *798*. Characterization of Healthy Human Brain Parenchyma Using Single-Quantum ^{23}Na MRI

Daniel C. Medina[1], Xin Li[1], Charles S. Springer, Jr.[1], William D. Rooney[2]
[1]Brookhaven National Laboratory, Upton, New York, USA

The investigation of edema accompanying inflammatory processes, as well as homeostasis and cellular bioenergetics, is crucial in understanding brain pathology and physiology, respectively. The purpose of this report is to reasonably account for the "NMR-invisible" ^{23}Na as well as to estimate intra- (p_i) and extra-cellular (p_o) volume fractions, which are important for the study of many brain pathologies.

11:42 *799*. MR Elastography for Studying the Biomechanics of Traumatic Brain Injury

Paul J. McCracken[1], Armando Manduca[1], Richard L. Ehman[1]
[1]Mayo Clinic and Foundation, Rochester, Minnesota, USA

The mechanisms by which head trauma causes hemorrhage, cerebral contusions and diffuse axonal injury is theorized as resulting from angular acceleration and its resulting shear motion. To better understand the underlying biomechanics of brain trauma, we have imaged a small amplitude transient shear displacements as it traversed the brain of a volunteer. This allows non-invasive tracking of the maximum displacement, and the ability to visualize the pattern of the motion and possible coup/contrecoup interactions. This may also be useful as a verification tool for injury mechanism models.

11:54 *800*. Asymmetric Spin Echo Acquisition Facilitates T_2 Window Based Brain Segmentation and Volume Measurement for Alzheimer's Disease

Zhu Li[1], Richard P. Mallozzi[1], Abdalmajeid M. Alyassin[1], Daniel J. Blezek[1], Tom W. Dixon[1]
[1]GE CRD, Niskayuna, New York, USA

A fast, accurate, unsupervised segmentation technique using a T2 window method has been developed for brain segmentation and volume measurement to track the rate of atrophy in Alzheimer's disease. The technique is based on multi-spectrum analysis and hence susceptible to cluster overlapping, resulting in misclassifications that affect brain volume measurements. An asymmetric spin echo acquisition clusters tissues according to T2 and T2*. Brain tissue (gray and white matter) and facial tissue (fat and muscle) are better separated with the asymmetric echo acquisition than with the standard dual spin echo acquisition.

12:06 *801*. Medial Temporal Lobe and Language Impairment in the Elderly

Huali Wang[1], Min Ying Su[1], Jr. Yuan Chiou[1], Orhan Nalcioglu[1]
[1]University of California-Irvine, Irvine, California, USA

Twenty-six elderly subjects, who had completed a neuropsychological battery test and MRI scanning, were identified for the retrospective analysis. Mouse-oriented method was used to manually trace the boundaries of medial temporal lobe (MTL) structures. There was a positive relationship between the normalized volume of hippocampus and performances on verbal fluency tasks, MMSE, and recent verbal memory. It was indicated that hippocampus was engaged in the verbal fluency and memory, which implies the possible role of MTL in language processing.

12:18 *802*. Serial MRI Studies of Mild Head Injury Indicate Significantly Increased Cerebral Atrophy within the First 6 Months

Barrie Condon[1], David Brennan[1], Donald M. Hadley[1], Barbara McKeen[2], J. Lindsay Wilson[2], Graham Teasdale[1], Gordon Murray[3], James Nicoll[4]
[1]Institute of Neurological Sciences, Glasgow, Lanarkshire, UK; [2]University of Stirling, Stirling, Stirlingshire, UK; [3]University of Edinburgh, Edinburgh, Lothian, UK; [4]University of Southampton, Southampton, Hampshire, UK

Recent studies show that disability is common after even apparently mild head injuries but the cause of this is unknown. Measurements of change in brain volume between one and six months after injury were made in 40 patients referred to a Neurosurgical Department. In 30 patients whose injury was initially judged to be mild, the mean decrease in brain volume was by 16.3ml which was significantly greater than the decrease in volume that could be attributed to normal ageing over this period (0.6ml, $p<0.001$) and similar in extent to the change in volume in more seriously brain injured participants.

MR Microscopy

Room 717 A/B 10:30 - 12:30 Chairs: Axel Haase and Suzanne L. Wehrli

10:30 *803*. NMR Diffraction Revisited with a Modified CRAZED Double Quantum Imaging Sequence

Chih-Liang Chin[1], Xiaoping Tang[2], Louis-S. Bouchard[2], Warren S. Warren[2], Felix W. Wehrli[1]
[1]University of Pennsylvania Medical Center, Philadelphia, Pennsylvania, USA; [2]Princeton University, Princeton, New Jersey, USA

Distant dipolar fields allow observation of intermolecular multiple quantum coherences. Recently, this phenomenon has been exploited to obtain structural information since these signals result from pairs of spins separated by the correlation distance (Dc). Here we show experimentally in a model system consisting of a 7×6 array of water-filled capillaries that capillary diameter and spacing can be retrieved by a CRAZED-type double quantum sequence. Using phase cycling, signal attributed to different coherence transfer pathways (M=0, 2, ±1) at various Dc could be isolated. For M=0, ±1, diffraction peaks occurring at Dc=(2-M) ×λ/2 could be observed, with λ being the inter-capillary spacing.

10:42 *804*. Stem Cell Implantation into Ischemic Heart: A High-Resolution Magnetic Resonance Investigation

Ekkehard Kuestermann[1], Wilhelm Roell[2], Stefan Wecker[1], Dirk Wiedermann[1], Christian Buehrle[1], Armin Welz[2], Juergen Hescheler[3], Bernd Fleischmann[3], Mathias Hoehn[1]
[1]Max-Planck-Institute for Neurological Research, Koeln, Germany; [2]University of Bonn, Bonn, Germany; [3]University of Cologne, Koeln, Germany

Embryonic ventricular cardiomyocytes were labeled with USPIOs by lipofection prior to implantation into mouse hearts immediately after cryolesioning of the left ventricle. Two weeks later, animals were perfused and high-resolution MR images of the heart in-situ were acquired. By comparing T2* and proton-density weighted MR images it was possible to detect the successful engraftment of implanted cells into lesioned tissue. Interpretation of MR images was validated by iron staining of heart tissue specimen.

10:54 *805*. Single Cell Detection with FIESTA: Effect of Iron Loading and Distribution

Chris Heyn[1], Chris V. Bowen[1], Brian K. Rutt[1], Paula J. Gareau[1]
[1]Robarts Research Institute, London, Ontario, Canada

Detection of single SPIO-labeled cells is possible using the SSFP sequence FIESTA (Fast Imaging Employing Steady State Acquisition). Little is known, however, about the effects of Fe mass and distribution on contrast. Utilizing a methodology for MR imaging and optical verification of single or multiple cells, we investigated the effect of Fe mass and distribution on susceptibility-induced contrast with FIESTA. We determined the lower limit of Fe detection to be between 24.5fmol and 54fmol for a 100x100x200µm voxel. CNR increases approximately linearly with increasing Fe/voxel, however, Fe mass/cell appears to also be important in determining contrast with FIESTA.

11:06 *806*. Imaging of Magnetic Susceptibility of Iron Loaded Single Cells using 3D Spiral Magnetic Resonance Microscopy

Atsushi M. Takahashi[1], Andrew Coristine[1], Chris Heyn[1], Brian K. Rutt[1]
[1]Robarts Research Institute, London, Ontario, Canada

Ultra high-resolution MR images of macrophages loaded with ten picograms of iron per cell, suspended in gelatin were acquired using a 3D "stack of spirals" sequence. A high performance gradient insert set and a small solenoidal RF coil were installed in a clinical 1.5 Tesla scanner and to achieve 39um x 39um x 200um resolution. Frequency maps, calculated from phase difference images, were used to visualize the susceptibility perturbations surrounding the iron-loaded cells.

11:18 *807*. Magnetic Resonance Microscopy of the Human Cardiac Conduction System at 17.6 Tesla

Cornelius Faber[1], Wolf Schweitzer[2], Walter Bär[2], Axel Haase[1]
[1]University of Würzburg, Würzburg, Germany; [2]Institute for Legal Medicine, Zürich, Switzerland

Magnetic resonance microscopy at 17.6 Tesla was performed on formalin fixed tissue samples from the human heart comprising the cardiac conduction system. Three dimensional datasets with isotropic resolutions of 70 µm were recorded in six hours scan time. Comparison of the images with histological serial sections showed that diagnostic findings can also be deduced from the MR data in a much shorter time. A three dimensional reconstruction of the cardiac conduction system is presented.

11:30 *808*. The Relaxation Effects of Gadolinium Concentration at 1.5 T and 7.0 T in Fixed Mice

Brian J. Nieman[1], X. J. Chen[1], Yu-Qing Zhou[1], Lori M. Davidson[1], John G. Sled[1], R. M. Henkelman[1]
[1]University of Toronto, Toronto, Ontario, Canada

With the advent of higher field strengths--3 and 7 T for humans and 7 to 11 T for animals--we need to investigate the efficiency of gadolinium to ensure effective administration for various imaging protocols. It is the purpose of this abstract to determine and compare the effects produced by a large range of gadolinium concentrations on T1 and T2 relaxation at both 1.5 T and 7.0 T in phantoms and fixed whole mice. We find a gadolinium concentration enabling fast T2-weighted 3D images at 7.0 T. We believe these results will also have relevance to in vivo mice studies.

11:42 *809*. High-Resolution 3D Diffusion Tensor Measurements of Japanese Quail Embryos

Melanie Martin[1], Seth W. Ruffins[1], Rusty Lansford[1], J. Michael Tyszka[1], Russell E. Jacobs[1]
[1]Caltech, Pasadena, California, USA

Diffusion tensor measurements made from high-resolution (100-250 µm isotropic) 3D ultra-fast low-angle rapid acquisition and relaxation enhancement (UFLARE) images are compared and contrasted to T2-weighted UFLARE images of *in vivo* and *ex vivo* Japanese quail embryos. The diffusion images exhibit more contrast between the central nervous system (CNS) and the rest of the body. Structures within the CNS, eyes, and many organs are more easily recognized with DTI than with T2 imaging because of their anisotropy. Such images can be used in a 3D interactive atlas of quail development to follow the normal and irregular development of the quail embryo.

11:54 *810*. Effect of Acute ATP Depletion on the Intracellular Water ADC of Xenopus Oocyte

Lin Zhao[1], Jonathan V. Sehy[1], Junqian Xu[1], Joseph J.H. Ackerman[1], Jeffrey J. Neil[1]
[1]Washington University in St. Louis, Saint Louis, Missouri, USA

It has been suggested that the rapid decrease of the apparent diffusion coefficient (ADC) of brain water in the face of injury is associated with ATP depletion. The purpose of this study was to evaluate the effect of rapid ATP depletion on the intracellular water ADC of Xenopus oocyte. ^{31}P spectra and diffusion-weighted images were collected to quantify intracellular ATP levels and water ADC. We show that, despite the acute depletion of ATP, there was no associated change in intracellular water ADC.

12:06 *811*. Micro MR Imaging of Live Normal Lamprey Cord using Magnetization Transfer Contrast

Andra Mirela Popescu[1], Hidemasa Uematsu[1], Guixin Zhang[1], Alexander W. Wright[1], Suzanne L. Wehrli[2], Masaya Takahashi[3], Felix W. Wehrli[1], Michael Selzer[1], David B. Hackney[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA; [3]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

Magnetization transfer (MT) has the potential to provide information on tissue composition. This study aims to characterize the MT effects in live lamprey spinal cord by NMR microscopy at 12 microm resolution. The observed MT ratios (highest in regions with high density of small-diameter axons and lowest in regions with sparse population of giant axons) correlate with our hypothesis that cell membrane constituents may be responsible for the variation in MT.

12:18 *812*. Pilot Study of Dermal and Subcutaneous Fat Structures by MRI in Individuals that Differ in Gender, BMI, and Cellulite Grading.

Fakhereh Mirrashed[1], Jonathan C. Sharp[1], Vicky Krause[1], Jeffrey M. Morgan[2], Boguslaw Tomanek[1]
[1]National Research Council Canada, Winnipeg, Manitoba, Canada; [2]The Procter & Gamble Company, Cincinnati, Ohio, USA

A pilot study was performed to evaluate MR micro-imaging as a tool for the investigation of cellulite. We show in-vivo micro-MRI is able to detect the effects of cellulite and demonstrate gender differences. We found tissue parameters correlated with cellulite and how MRI can differentiate skin tissues of differing cellulite grades. The diffuse pattern of extrusion of underlying adipose tissue into dermis was clearly imaged and quantified. This parameter and the percentile of adipose versus connective tissue in a given volume of hypodermis were correlated with cellulite grade.

POSTER SESSIONS

Hall D Saturday 14:00 – 16:00, Sunday – Tuesday 13:30 – 15:30

Young Investigator Awards Finalists

Hall D

Poster 34 will also be presented in the oral session **Cancer: MR Imaging of Model Systems** on Saturday, 12 July, at 11:00 in Room 714A/B.

Su ***34***. Young Investigator Awards Finalist: **Magnetic Resonance Image Guided Proteomics of Human Glioblastoma multiforme**

Susan Hobbs[1], Gongyi Shi[1], Ronald Homer[1], Griff Harsh[1], Scott Atlas[1], Mark Bednarski[1]
[1]Stanford University, Stanford, California, USA

The purpose of the study was to investigate the correlation between gadolinium contrast enhancement patterns on T1-weighted magnetic resonance (MR) images and spatial changes in protein expression profiles in human glioblastoma multiforme (GBM). We show that there are protein profile differences that correlate to imaging parameters, in this case contrast enhancement. Imaging can then be used as a non-invasive technique to evaluate the heterogeneity of solid tumors prior to microarray analysis for identification of tumor markers.

Poster 149 will also be presented in the oral session **Flow Quantitation** on Saturday, 12 July, at 16:30 in Room 714A/B.

Su ***149***. Young Investigator Awards Finalist: **Correction of the Inflow Effect on Fast GRE MR Sequence for Perfusion Imaging**

Marko Ivancevic[1], Ivan Zimine[1], Xavier Montet[1], Jean-Noel Hyacinthe[1], François Lazeyras[1], David Foxall[2], Jean-Paul Vallée[1]
[1]Geneva University Hospital, Geneva, Switzerland; [2]Philips Medical Systems, Cleveland, Ohio, USA

The purpose of this study was to assess the inflow effect on signal intensity for fast GRE sequences in MR first pass tissue perfusion quantification with contrast media. An in-vitro experiment with a flow apparatus was performed to determine signal intensity vs. Gd-DTPA concentration for various velocities. Therefrom a flow-sensitive calibration method was developed, and validated on bolus injections both in-vitro and in patients. We show that calibration methods based on static phantoms are not appropriate for accurate signal calibration in flow-affected images. Our flow-corrected calibration method improves the accuracy and robustness of the arterial input function determination.

Poster 221 will also be presented in the oral session **New Contrast Agents** on Sunday, 13 July, at 10:30 in Room 701B.

M ***221***. Young Investigator Awards Finalist: **Modulation of the Pharmacokinetics of Macromolecular Contrast Material by Avidin Chase: Magnetic Resonance Imaging, Fluorescence Microscopy and Histological Tracking of Triple Labeled Albumin**

Hagit Dafni[1], Assaf Gilead[1], Nava Nevo[1], Raya Eilam[1], Michal Neeman[1]
[1]The Weizmann Institute of Science, Rehovot, Israel

The goal of this work was to develop a method for experimentally controlling the clearance of macromolecular contrast materials. Intravenous administration of avidin resulted in elimination of albumin labeled with biotin, fluorescein and GdDTPA (but not of non-biotinylated fluorescent albumin) from the circulation, as observed by MRI and confirmed by fluorescence microscopy and histology. Contrast material that extravasated from leaky blood vessels in a VEGF over-expressing tumor, was not cleared by avidin and showed continued interstitial convection. Thus, avidin chase can provide an effective tool for experimental control over the rate of clearance of intravascular biotinylated contrast materials.

Poster 292 will also be presented in the oral session **Artifact Reduction in Rapid Imaging** on Sunday, 13 July, at 16:00 in Room 718A.

M **292**. Young Investigator Awards Finalist: **Dixon Techniques in Spiral Trajectories with Off-Resonance Correction: A New Approach for Fat Signal Suppression without Spatial - Spectral RF Pulses**

Hisamoto Moriguchi[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]University Hospitals of Cleveland / Case Western Reserve University, Cleveland, Ohio, USA

One of the main disadvantages of spiral imaging is blurring artifacts due to off-resonance effects. Spatial-spectral (SPSP) pulses are commonly used to suppress fat signals to avoid their blurring artifacts. However, SPSP pulses are usually long relative to spiral readouts and thus increase acquisition time. Furthermore, these pulses may produce non-uniform fat signal suppression or unwanted water signal suppression in the presence of B0 inhomogeneity. Dixon techniques have been developed as methods of unequivocal water-fat signal decomposition in rectilinear sampling schemes. In this study, Dixon techniques are extended to spiral data acquisition for unambiguous water-fat decomposition with off-resonance blurring correction.

Poster 293 will also be presented in the oral session **Artifact Reduction in Rapid Imaging** on Sunday, 13 July, at 16:20 in Room 718A.

Sa **293**. Young Investigator Awards Finalist: **Flow Effects in Balanced Steady State Free Precession Imaging**

Michael Markl[1], Marcus Alley[1], Chris Elkins[1], Norbert Pelc[1]
[1]Stanford University, Stanford, California, USA

An analysis of the effect of flow on 2D fully balanced Steady State Free Precession (SSFP) imaging is presented. Transient and steady-state SSFP signal intensities in presence of steady and pulsatile flow were simulated using a matrix formalism based on the Bloch equations. For accurate modeling of SSFP it is crucial to include properties such as imperfect slice profiles and, more importantly, 'out-of-slice' signal contributions. Simulations and experiments show that there can be considerable flow related changes in SSFP signal intensity resulting from frequency-dependent contributions from flowing spins that have already left the slice but still influence the SSFP signal.

Poster 403 will also be presented in the oral session **Pulmonary MR: Perfusion, Embolism, and Lung Masses** on Monday, 14 July, at 10:30 in Room 716A/B.

Sa **403**. Young Investigator Awards Finalist: **Quantitative Assessment of Regional Pulmonary Perfusion in the Entire Lung using 3D Ultra-fast Dynamic Contrast-enhanced Magnetic Resonance Imaging: Preliminary Clinical Experience in 22 Subjects**

Yoshiharu Ohno[1], Hiroto Hatabu[2], Kenya Murase[3], Takanori Higashino[1], Hideaki Kawamitsu[4], Hirokazu Watanabe[1], Daisuke Takenaka[5], Masahiko Fujii[4], Kazuro Sugimura[1]
[1]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [2]Beth Israel Deconess Medical Center, Boston, Massachusetts, USA; [3]Osaka University, Suita, Osaka, Japan; [4]Kobe University Hospital, Kobe, Hyogo, Japan; [5]Kobe Ekisaikai Hospital, Kobe, Hyogo, Japan

The purpose of the present study is to assess the regional differences in quantitative pulmonary perfusion parameters, i.e., mean transit time (MTT) and pulmonary blood flow (PBF) on a pixel by pixel basis in the entire lung on normal volunteers and pulmonary hypertension (PH) patients from 3D ultra-fast dynamic CE-MR data. Regional PBF and MTT showed significant differences in the gravitational directions ($p<0.05$). RBF and MTT maps demonstrated significant differences between normal volunteers and PH patients ($p<0.05$). In conclusion, 3D ultra-fast dynamic CE-MR imaging was feasible to assess the regional quantitative pulmonary perfusion parameters in normal volunteer and PH patients

Contrast Agents

Hall D Saturday 14:00 - 16:00

813. **Imaging Water Proton Exchange Rate with Proton-Decoupled Oxygen-17 2D-CSI: A Potential pH Mapping Technique**

Peter E. Thelwall[1]
[1]McKnight Brain Institute at the University of Florida, Gainesville, Florida, USA

Water proton exchange rate is affected by the pH-sensitive acid- and base-catalysed proton exchange reactions. Proton exchange rate in oxygen-17 enriched water can be determined from ^{1}H or ^{17}O T_2 relaxometry, thus the water molecules themselves report sample pH. We used ^{17}O 2D-CSI to quantitate ^{1}H-^{17}O scalar coupling in water phantoms, imaging change in ^{17}O T_2^* on proton decoupling. Phantom studies showed ΔR_2^* predicted sample pH in agreement with theory. Preliminary in vivo brain ΔR_2^* measurements from 1.5% $H_2^{17}O$ enriched mouse suggested that catalysis of proton exchange by reactions other than acid and base catalysis may hinder in vivo applications.

814. Sensitive CEST Agents Based on Nucleic Acid Imino Proton Exchange

Karim Snoussi[1], Jeff W.M. Bulte[1], Maurice Guéron[2], Peter C.M. van Zijl[1]
[1]Johns Hopkins University; F.M. Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA; [2]École Polytechnique, Palaiseau, Ile de France, France

The exchange properties of the imino protons of poly(rU) allow use of this compound as a chemical-exchange saturation transfer (CEST) contrast agent. A proton exchange rate of over 5000s-1 per imino proton allowed the detection of a few micromolar of polymer (2000 uridine units; 644 kD) with a 50% change in the water signal. When poly(rU) was complexed to a dendrimer, PTE was reduced only by a factor of two. With a stoichiometry of approximately one RNA per 10 dendrimers, this complex was positively charged, and may thus provide a model for a gene delivery system with good CEST visibility.

815. Paramagnetic CEST Agents: Fitting of Experimental Data to Theory

Donald Woessner[1], Matthew Merritt[1], Shanrong Zhang[2], Alison Weiner[1], Dean Sherry[1]
[1]University of Texas Southwestern Medical Center, Dallas, Texas, USA; [2]University of Texas at Dallas, Dallas, Texas, USA

Chemical exchange saturation transfer (CEST) is a complex physical phenomena that depends upon the chemical exchange rate, the relaxation characteristics of the exchanging sites, and the B_1 field strength. The intensity of any remaining water signal after prolonged saturation at the exchanging site may be approximated by using various models but is best described by the complete Bloch equations that include chemical exchange.

816. T_2-Selective MRI Contrast-Reagents: Revisiting the Inner-Sphere Curie-Spin Relaxation Mechanism of Dysprosium (III) Chelates

Daniel C. Medina[1], Charles S. Springer, Jr.[1]
[1]Brookhaven National Laboratory, Upton, New York, USA

The inner-sphere (IS) relaxivities of Dy(III)-based CRs increase quadratically with B_0, because of Curie-Spin contributions to relaxation. This study reports the maximum attainable transverse (r_{2IS}) and longitudinal (r_{1IS}) IS relaxivities, as well as the T_2-selectivity, for Dy-CRs, while also investigating the effects of the mean CR water lifetime, t_m, on ^1H_2O relaxation. Dy-CRs display very high T_2-selectivity and strong temperature dependence; thus, they could be used to restrict catalysis of ^1H_2O relaxation to the transverse plane and/or to measure small tissue temperature variations.

817. Synthesis, Thermodynamic Stability and Relaxometric Characterization of a Novel Bioactivated Gd(III) Complex with TTDASQ-protamine

Yun-Ming Wang[1], Tsan-Hwang Cheng[1], Jie-Shiung Jeng[1], Gin-Chung Liu[1], Reu-Sheng Sheu[1]
[1]Kaohsiung Medical University, Kaohsiung, Taiwan

The derivatives of TTDA (3,6,10-tri(carboxymethyl)-3,6,10-triazadodecanedioic acid), TTDASQ (Fig. 1) and $(TTDASQ)_5$-pro_{19} (Fig. 2) were synthesized. In order to realize the thermodynamic stability of $(TTDASQ)_5$-pro_{19}, TTDASQ was used to instead of $(TTDASQ)_5$-pro_{19}. The stability constant of $[Gd(TTDASQ)]^-$ was determined by potentiometric methods. Water proton spin-lattice relaxation rate for $[Gd(TTDASQ)_5$-$pro_{19}]$ at 25.0 °C and 20 MHz is 18.2 mM^{-1} s^{-1}. The water residence lifetime (τ_m) for $[Gd(TTDASQ)(H2O)]^-$ (28 ± 2 ns) is significantly lower than that of $[Gd(DTPA)(H2O)]^{2-}$ (303 ± 35 ns). Heparin affinity assay showed that $[Gd(TTDASQ)_5$-$pro_{19}]$ is a bioactiated contrast agent for MRI.

818. Citrate-coated Superparamagnetic Iron Oxide Particles as a New MR Contrast Medium: Results of a Clinical Phase I Trial

Matthias Taupitz[1], Jörg Schnorr[1], Susanne Wagner[2], Marc Dewey[1], Herbert Pilgrimm[2], Bernd Hamm[1]
[1]Charité, Berlin, Germany; [2]Ferropharm GmbH, Teltow, Brandenburg, Germany

A new iron oxide MRI blood-pool contrast medium with citrate-coating (VSOP-C184) was investigated for its tolerance and effectiveness. VSOP-C184 (diameter: 8.6 nm; R1 and R2: 20.1 and 37.1 l/(mmol*s)) was administered intravenously at 15, 45, and 75 µmol Fe/kg in 5 healthy volunteers each. Possibly substance-related adverse events that showed complete resolution without medication occurred in 2 subjects of the 75 µmol group. Otherwise, bolus injection of VSOP-C184 was well tolerated. At the intended clinical dose of 45 µmol Fe/kg, plasma T1 is < 100 ms over a period of 68±12 min, and minimum plasma T1 is 50±6 ms.

819. Kinetics of Perfluorocarbon Emulsions with Different 'Droplet' Sizes in Rodent Tumors

Adrian Muresan[1], Jonathan River[1], Xiaobing Fan[1], Carmen Popescu[2], Marta Zamora[1], Rita Culp[1], Greg Karczmar[1]
[1]University of Chicago, Chicago, Illinois, USA; [2]University of Illinois, Chicago, Illinois, USA

Perfluorocarbon emulsions can be imaged by fluorine-19 MRI and can be used as blood pool contrast agents; they also label macrophages. Here we image PFC 'droplets' (PFCD'S) of two different sizes at moderate resolution and evaluate the kinetics of uptake and washout. PFCD's with diameters of 290 nanometers have the kinetics of a blood pool agent during the first 4 hrs after injection, while the kinetics of smaller PFCD's suggest they are leaving the vasculature in tumors due to high capillary permeability and/or absorption by macrophages.

820. Characterization of Biophysical and Metabolic Properties of Cells Labeled with Superparamagnetic Iron Oxide Nanoparticles (Feridex®) and Transfection Agent (Poly-L-lysine) for Cellular MR Imaging

Ali Syed Arbab[1], Linsey Bashaw[1], Bradley Miller[1], E Kay Jordan[1], Bobbi Lewis[1], Heather Kalish[1], Joseph Frank[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Feridex® combined with poly-l-lysine (PLL) was incubated with mammalian cells. Intracellular iron contents, long-term cell viability, apoptosis, formation of reactive oxygen species (ROS), and disappearance of iron particles from the cells were investigated. Cell viability, apoptotic rate and ROS production were not significantly different from the corresponding control cells. Intracellular iron particles disappeared by 5-8 division of rapidly growing cells but remained > 7 weeks in growth inhibited cells. Magnetic labeling of mammalian cells is safe and may provide the ability to perform cellular MRI to monitor the migration of cells in vivo following transplantation or intravenous administration.

821. Development of a New Targeted Contrast Agent for Thrombosis Enhancement in Plaque Detection

Xiaoming Bi[1], Shaoling Huang[1], Robert MacDonald[1], David D. McPherson[1], Ashwin Nagaraj[1], Debiao Li[1]
[1]Northwestern University, Chicago, Illinois, USA

A new gadolinium encapsulated liposome was developed for targeted thrombosis enhancement using MRI. These liposomes form double layer membranes to maximize signal enhancement by entrapping Gd chelates both in inner and outer membranes. Initial MR phantom experiments demonstrated its specific binding ability to avidin. The average signal enhancement was 22.1% in targeted region. This Gd entrapped paramagnetic liposomal targeting agent has the potential to detect the presence of thrombosis in vulnerable plaques.

822. Novel MRI Contrast Agent for Thrombus Detection

Yoko Kawata[1], Qingjun Han[1], Heribert Schmitt-Willich[2], Kenji Yasugi[1], Takashi Tsuji[1], Natsuko Tsuda[1], Takashi Yokawa[1], Hanns-Joachim Weinmann[2]
[1]Nihon Schering K.K., Osaka, Japan; [2]Schering AG, Berlin, Germany

A macrocyclic gadolinium chelate linked to the small peptide Gly-Pro-Arg-Pro-Pro was investigated as a thrombus imaging MR contrast agent. This peptide should bind to a specific region of fibrin/fibrinogen. The human fibrinogen binding of the gadolinium chelate was ca. 70% while the albumin binding was ca. 10%. The concentration of the gadolinium chelate in the thrombus was seven times higher than in blood 3 hours after intravenous injection in photochemically induced thrombosis rat model. The influence on the blood coagulation (bleeding time) was negligible.

823. Dynamic Contrast-Enhanced MRI of Tumor Angiogenesis with Different Size Generations of Gd-DTPA Terminated Dendrimers.

Quido G. de Lussanet[1], Sander Langereis[2], Regina G. H. Beets-Tan[1], Marcel H. P. van Genderen[2], Arjan W. Griffioen[1], Jos M. A. van Engelshoven[1], E. (Bert) W. Meijer[2], Walter H. Backes[1]
[1]Maastricht University Hospital, Maastricht, Limburg, Netherlands; [2]Technical University Eindhoven, Eindhoven, Brabant, Netherlands

Purpose: To assess whether different size generations of Gd-DTPA terminated poly(propylene imine) dendrimers can be used for mapping tumor angiogenesis with dynamic contrast-enhanced MRI (DC MRI). **Methods:** Tumor bearing mice were imaged with generations 0, 1, 3, and 5 dendritic contrast agents (dose 0.03 mmol Gd/kg) to calculate tumor microvessel permeability (K^{PS}). **Results:** The use of lower generations dendritic contrast agents resulted in higher K^{PS} values than the use of higher generations contrast agents. **Conclusion:** Different size generations of Gd-DTPA terminated (polypropylene imine) dendrimers agents may be useful for DC MRI of tumor angiogenesis..

824. Assessment of Tumor Enhancement using Mn-metalloporphyrin in Mice: MR Imaging and Histopathologic Correlation

Hatsuko Nasu[1], Yasuo Takehara[1], Satoshi Isogai[1], Nami Kodaira[1], Hiroyasu Takeda[1], Tsuneo Saga[2], Susumu Nakajima[3], Isao Sakata[4], Harumi Sakahara[1]
[1]Hamamatsu University School of Medicine, Hamamatsu, Shizuoka, Japan; [2]Kyoto University Graduate School of Medicine, Kyoto, Japan; [3]Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Hokkaido, Japan; [4]Photochemical Co.Ltd., Okayama, Japan

The signal enhancement characteristics of viable and necrotic portions of tumors were compared after administration of a metalloporphyrin derivative, HOP-9P. Ten C3H mice bearing a tumor were examined using T1-weighted spin echo magnetic resonance images before contrast injection, and five minutes, one hour, and 24 hours after intravenous administration of 0.1 mmol/kg of HOP-9P. Following the imaging schedule, the mice were sacrificed, and sectioned in the same axial planes as the MR images. HOP-9P enhanced both viable and necrotic portion of the tumor, but the degree of enhancement in the necrotic portion of the tumor was more variable among tumors.

825. The Results from Pre-Phase 2 Clinical Trial with a Novel Trimeric Gadlinium MRI Contrast Agent-NMS60.

Yasutaka Kawamura[1], Hirohiko Kimura[1], Yoshio Koshimoto[1], Harumi Ito[1], Shigemi Seri[2]
[1]Fukui Medical University, Matsuoka, Fukui, Japan; [2]Nihon Medi-physics, Tokyo, Japan

Purpose: A novel trimeric gadolinium MRI contrast agent, NMS60, had been under the pre-Phase 2 clinical trial. In this study, we present the preliminary results of the clinical efficacy of this unique tri-gadolinium MRI contrast agent for the liver and the brain neoplasm. Materials & Methods: NMS60 was provided by Nihon Medi-Physics and its safety was confirmed through Phase 1 clinical trial in Japan. The pre-Phase 2 clinical trial had been approved both by Japanese Government and by the Ethical Committee of our institution. Ten patients with lesions in the liver and four patients with brain tumors participated the study.

826. Advanced Tumor Enhancement Using A New Class of MRI Contrast Agent NMS60 Having Medium Molecular Size - Comparison of its Permeability Feature with Low Molecular Size Gd-DTPA -

Yuji Hashiguchi[1], Akira Nakatani[1], Kenichi Morishita[1], Yoshihiro Yamamichi[1], Shigemi Seri[2], Hirokatsu Yoshimura[1], Miki Kurami[1]
[1]Nihon Medi-Physics Co. Ltd. Research Center, Sodegaura, Chiba, Japan; [2]Nihon Medi-Physics Co. Ltd. R&D Division, Chiyoda, Tokyo, Japan

The permeability feature at advanced tumor enhancement of a new class of Gd based contrast agent (NMS60) is investigated. It is shown that NMS60 has lower permeability to normal tissue, but keeps its permeability against tumor from in vitro and in vivo study. Higher tumor enhancement than existing ECF agent is explained by this exceptional feature of tissue distribution not only by its high relaxibility effect.

827. MRI of Liver Tumors: Comparison of the Iron-Oxide-Based Blood Pool Contrast Medium VSOP-C184 with the Liver-Specific SPIO Resovist and the Low-Molecular-Weight Substance Multihance in an Animal Model

Joerg Schnorr[1], Susanne Wagner[1], Ronny Korn[1], Bernd Hamm[1], Herbert Pilgrimm[2], Matthias Taupitz[1]
[1]Charité, Berlin, Germany; [2]Ferropharm GmbH, Teltow, Brandenburg, Germany

A new citrate-coated, iron-oxide-based blood pool contrast medium (very small superparamagnetic iron oxide particles, VSOP-C184) was investigated in rats to determine its potential for MRI of liver tumors. In these experiments VSOP-C184 was compared with a low-molecular-weight Gd-based agent (Multihance) in T1-weighted dynamic MRI and with a conventional SPIO (Resovist) using T2*- and T2-weighted sequences. In dynamic T1-weighted MRI, VSOP-C184 (45 and 60 µmol Fe/kg) has the same liver-tumor CNR as Multihance (100 µmol Gd/kg). On delayed T2*- and T2-weighted sequences, VSOP-C184 (15 µmol Fe/kg) has the same effect as Resovist (15 µmol Fe/kg).

828. Magnetic Labeled T Cells *In Vivo* Tracking using MRI

Olivier Beuf[1], Marc Janier[2], Caroline Asport[3], Charles Thivolet[3], Claire Billotey[2]
[1]Université Claude Bernard Lyon1 - CPE, Villeurbanne, France; [2]Animage - CREATIS UMR 5515, Lyon, France; [3]INSERM U449, Faculté Laennec, Lyon, France

A new class of Monocrystalline Iron Oxide Nanoparticles (MION) allowing in vitro cell labeling was investigated to assess in vivo labeled cells tracking in a model of diabetic mouse (NOD). Labeled and unlabeled T cells were intravenously injected and MRI analysis was performed with a dedicated small animal 7T MRI system.

829. A Model of Lysosomal Metabolism of Dextran Coated Superparamagnetic Iron Oxide (SPIO) Nanoparticles: Implications for Cellular Magnetic Resonance Imaging

Lindsey Bashaw[1], Heather Kalish[1], Bobbi Lewis[1], Joseph Frank[1], Ali Syed Arbab[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

We created an in-vitro mechanism for the metabolism of the iron oxide nanoparticles comprising Feridex, an FDA-approved contrast agent for use in magnetic resonance imaging of the liver. We found that the iron oxide nanoparticles were digested into free iron in a sodium citrate buffer solution at pH 4.5, which mimics the environment of the mammalian reticuloendothilial cells. Using spectroscopy, relaxometry and magenetic resonance analyses, we determined that solubilization of the nanoparticles into free iron occurs most rapidly between the 6 hour and 96 hour time points.

830. *In Vitro* MR Imaging of Cells Labeled with Magnetic Nanoparticles

Jürgen R. Reichenbach[1], Ingrid Hilger[1], Beate Danz[1], Martin Roskos[1], Peter Weber[1], Werner A. Kaiser[1]
[1]Friedrich-Schiller University, Jena, Germany

Cell samples labeled with iron oxide nanoparticles were investigated with MRI at 1.5 T. Multi-echo spin-echo and multi-echo gradient echo se-quences were used to determine relaxation rate constants 1/T2 and 1/T2*, respectively. A linear dependence of both constants on total iron content was observed with R2* sensitivity (0.2726 s-1 nmol-1) roughly 15 times greater than R2 (0.0118 s-1 nmol-1). High resolution 3D gradient echo scan showed increasing signal loss with increasing iron concentration of labeled cells.

831. Detection of Angiogenic Epitopes at Picomolar Concentrations with $\alpha_v\beta_3$-Integrin Targeted Ultra-Paramagnetic Nanoparticles in Human Cancer Cells *in vitro*

Anne M. Morawski[1], Patrick M. Winter[1], Shelton D. Caruthers[2], Ralph W. Fuhrhop[1], Kathy Crowder[1], Thomas D. Harris[3], Gregory M. Lanza[1], Samuel A. Wickline[1]
[1]Washington University in St. Louis, St. Louis, Missouri, USA; [2]CMRL and Philips Medical Systems, St. Louis, Missouri, USA; [3]Bristol-Myers Squibb Medical Imaging, Bellerica, Massachusetts, USA

The development of MRI contrast agents specifically targeted to molecular markers of disease processes such as angiogenesis would allow sensitve and accurate detection of these diseases in their early stages. We have developed an $\alpha_v\beta_3$-integrin targeted liquid perfluorocarbon nanoparticle with a high paramagentic payload for use in the identification of angiogenic epitopes. Mathematical modelling of signal intensities has indicated that picomolar concentrations of bound nanoparticles provide adequate contrast for specific detection of the targeted tissue. Experiments with phantoms and human cancer cells *in vitro* have agreed with these predictions.

832. Immuno-Imaging: Cell-Selective In Vivo NMR Microscopy in Experimental Animals

Istvan Pirko[1], Aaron J. Johnson[1], Moses Rodriguez[1], Slobodan I. Macura[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Visualizing and localizing immune cells is a common method to study the immune system. Conventional immunohistochemistry methods are accurate, reproducible, and universally accepted but require tissue samples. Due to its noninvasiveness magnetic resonance imaging (MRI) could be a method of choice to image immune cells. To achieve this, specific immune cells need to be labeled with paramagnetic materials, usually by conjugating lanthanoid complexes to specific antibodies. This frequently results in loss of antigen specificity. Our laboratory has implemented and extensively tested a simpler approach to label virtually any cells, or antigens of interest by using commercially available antibody-conjugated USPIO particles..

833. Pharmacokinetics, Biodistribution and Efficacy of EP-1873: A Gd-based Fibrin Specific Thrombus MR Agent

Andrea J. Wiethoff[1], John A. Barrett[1], JuFeng Wang[1], Peter Caravan[1], Shrikumar Nair[1], Michael A. Melisi[1], Torian L. Williams[1], Lindsay A. Drzwecki[1], Charles R. Chesna[1], Cheryl R. Costello[1], Matthew T. Greenfield[1], Thomas J. McMurry[1], Randall B. Lauffer[1], E Kent Yucel[2], Robert M. Weisskoff[1], Alan P. Carpenter[1], Phil B. Graham[1]
[1]Epix Medical, Inc., Cambridge, Massachusetts, USA; [2]Brigham and Women's Hospital, Boston, Massachusetts, USA

EP-1873 is a fibrin-specific MRI contrast agent comprised of a constrained six amino acid cyclic peptide core and four Gd-DTPA chelates. The agent binds intact fibrin selectively without binding to circulating fibrinogen. To determine the potential utility of this prototype compound, efficacy studies were conducted in rabbits. These studies included imaging studies as well as quantitative uptake experiments with radiolabeled compound. Pharmacokinetic and toxicology studies were performed in rats, rabbits and mice. In vitro cell toxicology studies were also conducted to assess renal safety.

MR Spectroscopy of Cells, Body Fluids, and Others

Hall D Sunday 13:30 - 15:30

834. Characterization of Choline Compounds in Cerebral Tumors Using Multinuclear High Resolution MR Studies

Tariq Shah[1], Rama Jayasundar[1], Virender Paul Singh[1], Chitra Sarkar[1]
[1]All India Institute of Medical Sciences, New Delhi, India

The aim of this study is to analyze the choline metabolites in brain tumors using high resolution 1H and 31P Magnetic Resonance Spectroscopy on perchloric acid extracts of surgically excised brain tumors. The study has shown that the concentration as well as % contribution of free choline and phosphocholine were significantly higher in benign and malignant tumors, respectively ($p < 0.03$).

835. Apoptosis Induced by Gamma Irradiation in Breast Tumor Cells and in Multicellular Spheroids Detected by ^{1}H MRS

Antonella Rosi[1], Sveva Grande[1], Anna Maria Luciani[1], Laura Guidoni[1], Vladimir Mlynarik[2], Vincenza Viti[1]
[1]Istituto Superiore di Sanità, Roma, Italy; [2]University of Vienna, Vienna, Austria

The effects of gamma irradiation on mobile lipid (ML) signals from MCF-7 cells and spheroids have been examined by means of high resolution and localized 1H MRS. Intensities of ML signals in the rim of spheroids are larger in irradiated with respect to controls and follow the same pattern of the corresponding signals in cell suspensions, showing a gradual increase with time after irradiation. Irradiation of MCF-7 cells induces cell death by apoptosis. The high intensity signals from ML and polyunsaturated chains observed in irradiated samples are related to this effect.

836. Reduced Invasion of Human Breast Cancer Cells after Anti-inflammatory Treatment.

Ellen Ackerstaff[1], Dmitri Artemov[1], Zaver M. Bhujwalla[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Similar to wounds, the physiological microenvironment in most solid tumors is characterized by hypoxia and extracellular acidosis. This microenvironment can contribute to the upregulation of inflammatory pathways, which will influence cell motility, invasion, vascularization and metastasis. Here, we have evaluated the effect of the anti-inflammatory agent indomethacin on invasion and metabolism of an invasive human breast cancer cell line, MDA-MB-435, using our MR compatible Metabolic Boyden Chamber. Indomethacin decreased the invasion of MDA-MB-435 cells and changed the profile of phospholipid precursors toward a less malignant one. Additionally, the culture and perfusion conditions of MDA-MB-435 cells influenced their invasiveness and metabolism.

837. Potential Role of Glucose, Glutamine and Energy Metabolism in Oxidative Stress and Apoptosis of Thymoma Cells

Norbert W. Lutz[1], Margaret E. Tome[1], Margaret M. Briehl[1]
[1]University of Arizona, Tucson, Arizona, USA

The role of glucose, glutamine and energy metabolism in steroid-induced oxidative stress and apoptosis in thymoma cells was investigated. 1H and 31P NMR spectroscopy was employed to measure relevant metabolite concentrations in extracts of steroid-sensitive and steroid-resistant WEHI7.2 variants at various time points after the onset of dexamethasone treatment. Initial ATP increase followed by a major subsequent decrease of ATP and glycolytic-metabolite levels appeared to be characteristic of apoptosis induction in steroid-sensitive cells. In contrast, early aspartate and hexose/triose phosphate accumulation accompanied by moderately decreasing ATP levels may partly reflect resistance to oxidative stress and apoptosis in steroid-resistant cells.

838. ^{13}C NMR Detected Glutamate-4 Labeling Rates Correlate with Oxygen Consumption Rates in Cultured Murine Adenocarcinomas

Anthony Mancuso[1], Suzanne Wehrli[2], Nancy Jean Beardsely[1], Jerry D. Glickson[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA

Rates of labeling in glutamate from [1-13C] glucose or [1,6-13C2] glucose were determined for a cultured murine adenocarcinoma. They were compared to rates of oxygen consumption determined simultaneously with in-line polarographic probes. The results indicate that the rate of labeling in glutamate-4 was approximately linearly related to the rate of oxygen consumption. With doubly labeled glucose, a nearly 3-fold increase in glutamate-4 labeling was observed relative to singly labeled glucose. Thus, the flux from glucose-6 to glutamate-4, through the pentose phosphate pathway, was likely very significant.

839. Proton NMR Analysis of Human Prostate Tissue with Slow Rate High Resolution Magic Angle Spinning: (A+B-|A-B|)

Leo Ling Cheng[1], Andrea G. Zepeda[1], Chin-Lee Wu[1], R. Gilberto Gonzalez[1], Anthony Bielecki[2], David Cory[2]
[1]MGH/Harvard Med School, Boston, Massachusetts, USA; [2]MIT, Cambridge, Massachusetts, USA

Applying high resolution magic angle spinning (HRMAS) NMR spectroscopy to investigate cellular metabolism of diseases has encouraged exploration of slow spinning methodologies to better preserve tissue pathology structures against HRMAS centrifuging damages. Spinning sidebands (SSB) resulting from slow spinning must be eliminated to prevent complications to metabolite spectra. A novel scheme employing two spectra (A, B) of different slow spinning rates is evaluated with human prostate tissue. By editing these spectra according to the formula A+B-|A-B|, SSB free spectra can be obtained for metabolite quantification, resulting in spectra that are comparable to those measured with high rate spinning.

840. ^{1}H NMR Spectroscopy of Extracts from HEPA-1 Wild Type and Cells Deficient in HIF-1b Incubated under Hypoxic and Normoxic Conditions

Helen Troy[1], Yuen L. Chung[1], Marion Stubbs[1], Debbie L. Baines[1], John R. Griffiths[1]
[1]St George's Hospital Medical School, London, UK

This study looked at the effects of hypoxia on metabolites in a HIF-1b deficient line compared to wild type cells and compared them to a previous study in which the cells were grown as solid tumours in vivo. Lactate and glycine were lower in c4 HIF-1b-deficient cells under normoxic and hypoxic conditions. Glycine levels were not affected by hypoxia, suggesting that this is an intrinsic difference between the WT and deficient c4 phenotypes. This suggests that some effects of HIF-1 are intrinsic to the metabolic phenotype whilst others are hypoxia-induced.

841. Effect of Aminooxyacetate on Pancreatic β-Cell Glutamate, Glutamine and Aspartate Levels, Insulin Release and Mitochondrial Oxidative Phosphorylation

Nicolai Doliba[1], Wei Qin[1], Changhong Li[2], Carol Buettger[1], Marko Vatamaniuk[1], Heather Collins[1], Suzanne Wehrli[2], Franz Matschinsky[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA

A physiological mixture of 20 amino acids stimulates respiration and insulin release from β–HC9 cells in the presence of 0.1 mM IBMX as effectively as high glucose alone. Glucose added to amino acids elevated glutamine and glutamate and decreased aspartate levels. Aminooxyacetate (AOA), an inhibitor of transaminases, prevented the rise of glutamine and minimized the changes of glutamate and aspartate. Addition of AOA to mitochondria oxidizing glutamine abolished the stimulation of respiration by ADP. Thus, the levels of glutamine, glutamate and aspartate emerge as sensitive metabolic indicators of the stimulus-secretion coupling in β–cells.

842. A ^{13}C NMR Spectroscopy Study of the Effect of Acetate on Glycogen Synthesis in perfused Rat Liver

Niki Bergans[1], Tom Dresselaers[1], Paul Van Hecke[1], Florent Vanstapel[1]
[1]KUL, Leuven, Belgium

To assess the influence of acetate on glycogen synthesis, we followed glycogen synthesis from 1-^{13}C-enriched glucose in perfused livers of fed rats. We compared perfusion experiments with or without addition of 2 mM acetate. The glycogen signal was monitored using ^{1}H-decoupled ^{13}C NMR spectroscopy and net glycogen synthesis rates were calculated. Without acetate, the signal intensity of 1-^{13}C glycogen increased at a linear rate. Addition of acetate caused the signal intensity of 1-^{13}C glycogen to level off towards the end of the perfusion. Acetate markedly suppresses net incorporation of glucose into glycogen (direct synthesis).

843. Application of Bayesian Spectral Decomposition for Identification of Toxin-Induced NMR Spectral Patterns from Biofluids

Radka Stoyanova[1], Andrew W. Nicholls[2], Jeremy K. Nicholson[3], John C. Lindon[3], Truman R. Brown[4]
[1]Fox Chase Cancer Center, Philadelphia, Pennsylvania, USA; [2]Metabometrix Ltd., London, UK; [3]Imperial College of Science, Technology and Medicine, London, UK; [4]Columbia University, New York, New York, USA

The complexity of 1H-NMR spetrum of urine makes it difficult to follow the biochemical changes caused by xenobiotic compounds. We have applied Bayesian Spectral Decomposition to spectra from rat urine following administration of different doses of a known liver toxin, hydrazine. The technique assumes each spectrum is a mixture of two spectral shapes, related to urine of untreared and dosed rats. Both the spectral shapes and their magnitudes are simultaneously determined. The 'aberrant' spectral pattern contained peaks of metabolites, asociated directly with the hydrazine effects. The magnitudes of the patterns are related to the hydrazine dose and time-related events.

844. Quantitative ^{1}H NMR Spectroscopy of Blood Plasma Metabolites

Robin A. de Graaf[1], Kevin L. Behar[1]
[1]Yale University, New Haven, Connecticut, USA

The absolute quantification of blood plasma metabolites is complicated by the presence of broad resonances originating from serum macromolecules and lipoproteins. A method for spectral simplification of proton NMR spectra of blood plasma is presented. Serum macromolecules and metabolites are completely separated by utilizing the large difference in translational diffusion coefficients with diffusion-sensitized proton NMR spectroscopy. The results are compared with those obtained with ultrafiltration, a traditional method for separating macromolecules and metabolites, and demonstrate an excellent correlation between the two methods. The general nature of diffusion-sensitized NMR spectroscopy allows application on a wide range of biological fluids.

845. ^{1}H NMR Determination of Liposomal Encapsulation Efficiency

Xian Man Zhang[1], Anant B. Patel[1], Robin A. de Graaf[1], Kevin L. Behar[1]
[1]Yale University School of Medicine, New Haven, Connecticut, USA

The liposome is a useful model system to study effects of cellular and subcellular compartmentation on NMR parameters of metabolites measured in vivo. A simple 1H NMR method was developed to determine the encapsulated and unencapsulated metabolite markers in liposomes under chemically defined conditions without the need to physically separate the internal and external components. The method relies on the use of the pH-sensitive chemical shift of a marker metabolite while maintaining a stable pH difference between internal and external environments. Comparison of the encapsulation efficiencies determined for various sized liposomes with a chemical shift reagent gave remarkable similar results.

846. Codrug Effects on Lithium in an Animal Model by ^{7}Li MR.

Katie Luterbach[1], Emily Pierson[1], Elzbieta Rzepka[1], Subbaraya Ramaprasad[1]
[1]University of Nebraska Medical Center, Omaha, Nebraska, USA

Lithium is widely used in the treatment of manic-depressive disorders and mania. A significant fraction of patients (30%) who fail to respond to lithium treatment often respond quickly when supplemented with a co-drug (1-3). The resulting interaction and the codrug effect on Li are not fully understood. In this study, a mammalian model is used to elucidate the nature of these drug interactions and provide a better understanding of how lithium functions in the treatment of manic-depressive illness.

847. ^{31}P NMR Studies of Perfused Muscle Cells during Prolonged Ischemia

Krzysztof Pawel Wroblewski[1], Simon Spalthoff[2], Un-Jin Zimmerman[1], Joseph Wiliam Sanger[1], Robert Elder Forster[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Medizinische Hochschule Hannover, Hannover, Germany

Inhibition of carbonic anhydrase (CA) retards the ability of muscle cells to control intracellular pH. We demonstrated that pH drop during prolonged ischemia is exponential, and calculated asymptotic values of pH (pHmin) can serve as an indicator of the ability of cells to control intracellular pH. Observed pHmin in control experiments was 0.25 and 0.30 pH unit higher in H-2Kb-tsA58 cells and myotubes respectively, than in acetazolamide (AZ) inhibited ones. The results prove significant contribution of CA catalyzed hydration/dehydration of CO_2 to pH regulation making muscle cells resistant to prolonged nutrient and oxygen deprivation.

848. Metabolic Adaptations in Young and Old Subjects to Short-Term Training

Russell S. Richardson[1], Melissa Camargo[1], Charles F. Brown[1], Luke J. Haseler[1]
[1]U.C. San Diego, La Jolla, California, USA

The metabolic adaptations associated with short-term training were assessed by 31P MRS in both young and older subjects. Initial phosphocreatine (PCr) recovery was longer in the older group, was unaffected by the training, and both groups improved maximal work rate while PCr was spared for a given submaximal work rate. These data imply diminished metabolic capacity in the older subjects, but that muscle plasticity in response to short-term exercise training is not lost with age.

849. Minimal Errors in Measuring Creatine Kinase Flux When Exchange between ATP

Ronald Ouwerkerk[1], Paul A. Bottomley[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

The Creatine Kinase (CK) flux is often determined with saturation transfer experiments based on a two site chemical exchange model. Numerical analysis for spin evolution in the presence of three site chemical exchange during RF pulses was used to evaluate errors caused by exchange to a third site (Pi). The model used includes effects of imperfections in the saturation pulse. Numerical simulations were performed for measurements at 1.5T on rested and depleted skeletal muscle. The calculated relative errors were mostly below 10% over a very broad range of exchange rates to the third site, metabolic state, or field strength.

850. Slice-Selective Coherence Transfer Using Symmetric, Linear Phase Pulses. Applications to GABA Editing

Jun Shen[1], Zhengguang Chen[1]
[1]NIMH, Bethesda, Maryland, USA

Symmetric, linear phase, selective RF pulses were analyzed theoretically for performing slice-selective coherence transfer. It was shown using numerical simulations of product operators that, when a prefocusing gradient of the same area as that of the refocusing gradient is added, these pulses become slice-selective universal rotator pulses, therefore, capable of performing slice-selective coherence transfer. As an example, a slice-selective universal rotator pulse based on a seven-lobe hamming-filtered sinc pulse was applied to in vivo single-shot, simultaneous spectral editing and spatial localization of neurotransmitter GABA in the human brain.

851. BOOZE: A Water Suppression Method

Mari A. Smith[1], Joe Gillen[1], Peter B. Barker[1], Xavier Golay[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Since the presence of metabolites in 1H magnetic resonance spectroscopy is obscured by any residual H2O signal, they can be more readily recorded if the unwanted signal is suppressed. Ideally, a water suppression waveform should exhibit a sharp transition between its stopband where magnetization is suppressed and its passband where magnetization remains unaffected so that any peaks of interest nearby will not also be suppressed. We present a novel waveform incorporated into the CHESS1 scheme to achieve water suppression, which demonstrates a transition band of less than 1 ppm.

852. GAVA – A Graphical Pulse Sequence Simulation, Display and Storage Environment

Zakaria Aygula[1], Brian J. Soher[1], Karl Young[2], Andrew A. Maudsley[1]
[1]University of Miami, Miami, Florida, USA; [2]Stanford Linear Accellerator Center, Menlo Park, California, USA

Spectral simulation is an effective and efficient means for optimizing data acquisition sequences and for facilitating spectral analysis. GAMMA is a powerful C++ library, which can be used to describe and simulate NMR experiments. In this study we report the development of a graphical tool using IDL, GAMMA and MySQL, which can run predefined or user defined pulse sequence simulations, display results in a variety of forms and store the results for later use.

ESR and Sodium

Hall D Monday 13:30 - 15:30

853. Constant Time Spectral Spatial Imaging: CTSSI

Ken-ichiro Matsumoto[1], Joost A. B. Lohman[2], Chandrika Baby[1], James Mitchell[1], Sankaran Subramanian[1], Cherukuri Murali Krishna[1]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]Bruker UK Limited, Coventry, UK

Constant Time Spectral Spatial Imaging (CTSSI) modality has been developed for CW EPR imaging. CW data collection carried out in Cartesian raster is inverse Fourier transformed to simulate time-doamin constant time imaging data. The processing of the data with limited range of gradients deals in a transparent way with the well known problem of the missing angle projections in Spectral-Spatial Projection-Reconstruction. The results from CTSSI are compared with the conventional Spectral-Spatial method.

854. An Eddy-Current Immune Experimental Setup for X-Band Pulsed EPR under High Field Gradient Pulses

Claudio Jose Magon[1], Rogerio Ferreira Xavier[1], Alberto Tannus[1], Antonio Jose Costa-Filho[1], Jose Fernando Lima[1], Mateus Jose Martins[1], Edson Luis Gea Vidoto[1], Noam Kaplan[2]
[1]Universidade de Sao Paulo, Sao Carlos, SP, Brazil; [2]Hebrew University of Jerusalem, Jerusalem, Israel

EPR imaging at X-band microwave frequencies (~10GHz) have found implementation difficulties due to undesirable eddy currents induced in the microwave cavity and electrically conductive surroundings. This report describes a dedicated experimental approach, in which eddy currents are unimportant. Experiments were performed with a 1D organic conductor crystal, (FA)2PF6 (FA: fluoranthene). 1D and 2D spatial images of the crystal will be shown. Work is in progress to demonstrate the utility of the presented methodology to obtain X-band 3D spatial maps of the conduction electrons, with resolution of 10 mm for a field of view of 2 mm.

855. Measurements of Clinically Significant Doses of Ionizing Radiation Using Non-Invasive *In Vivo* EPR Spectroscopy of Teeth *In Situ*

Akinori Iwasaki[1], Tadeusz M. Walczak[1], David A. Schauer[2], Piotr M. Starewicz[3], William F.B. Punchard[3], Harold M. Swartz[1]
[1]Dartmouth Medical School, Hanover, New Hampshire, USA; [2]Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA; [3]Resonance Research, Inc., Billerica, Massachusetts, USA

The increased potential for radiological incidents resulting in clinically significant doses (i.e. above 50 Gy) has created an urgent need for field deployable dosimetry systems. The measurement system needs to be accurate to about 25 cGy and rely on changes that occur within the potentially exposed individual. About 40 years ago it was shown that the unpaired electrons induced in bones and teeth by ionizing radiation provide such a potential dosimeter, but that approach required removal of the teeth or bones for the assay (1). The development of in vivo EPR now makes it feasible to make such measurements.

856. NO-Dependent Modulations of the Tumor Oxygenation and Nitric Oxide Production: Correlation with Tumor Radiation Sensitivity

Benedicte F. Jordan[1], Nelson Beghein[1], Pierre Sonveaux[1], Olivier Feron[1], Vincent Gregoire[1], Bernard Gallez[1]
[1]Université Catholique de Louvain, Brussels, Belgium

Oxygen deficiency in tumors reduces the efficacy of non-surgical treatment modalities such as conventional radiotherapy and chemotherapy. We tested the effects of pharmacological and physiological NO-mediated modulations on tumor bearing mice on the tumor oxygenation and nitric oxide production. These three treatments consisted in 1) i.p. injection of a NO donor (isosorbide dinitrate, 0.2 mg/kg); 2) i.v. insulin infusion (16 mU/kg/min, 25 min) and 3) electrical stimulation of the host tissue (5 Hz, 0.2 ms pulses, 15 min).

857. Mapping of the T_2^* of ^{23}Na on a 4T Whole-Body Machine using SPRITE

Joackim Kaffanke[1], Sandro Romanzetti[1], Meghan Halse[2], James Rioux[2], Bruce Balcom[2], Nadim Jon Shah[1]
[1]Research Centre Jülich GmbH, Jülich, Germany; [2]University of New Brunswick, Fredericton, New Brunswick, Canada

The implementation on a whole-body 4T scanner of the SPRITE sequence for the imaging of ^{23}Na distributions is reported. Further, through the acquisition of multiple data points following each rf excitation, and subsequent reordering thereof, reconstructed T_2^* maps of ^{23}Na are demonstrated. The T_2^* maps were reconstructed through a pixel-by-pixel fit to 81 data points on the signal decay curve; the large number of acquired data points make a bi-exponential fit of in vivo data readily feasible.

858. Evaluation of Intracellular Sodium Imaging as a Tool for Assessment of Myocardial Viability

Maurits A. Jansen[1], Cees J.A. Van Echteld[1]
[1]CardioNMR Laboratory/Heart Lung Center, Utrecht, Netherlands

Due to the rapid changes of intracellular sodium during ischemia and reperfusion of viable myocardium, ^{23}Na-MRI appears to be an ideal diagnostic modality for early detection of myocardial ischemia and viability. The very early rise in intracellular sodium during ischemia makes it a very sensitive indicator of ischemia. Reperfusion of viable myocardium causes an immediate decrease in intracellular sodium, making intracellular sodium also a very sensitive indicator of myocardial viability. So far, data on cardiac ^{23}Na-MRI are extremely limited and are only concerned with imaging of total sodium. For proper interpretation, imaging of both intra- and extracellular sodium is essential.

859. Intracellular Sodium Imaging after Coronary Artery Ligation in Rats

Maurits A. Jansen[1], Marcel G.J. Nederhoff[2], Cees J.A. Van Echteld[1]
[1]CardioNMR Laboratory/Heart Lung Center, Utrecht, Netherlands; [2]Interuniversity Cardiology Institute of the Netherlands, Utrecht, Netherlands

Due to the rapid changes of $[Na^+]_i$ during ischemia and reperfusion of viable myocardium, ^{23}Na-MRI appears to be an ideal diagnostic modality for early detection of myocardial ischemia and viability. Following acute ischemia and reperfusion, increased total sodium MR image intensity was shown to be associated with non-viable tissue1. We developed a ^{23}Na-MR chemical shift imaging (CSI)-technique for imaging of intra- and extracellular sodium, employing the shift reagent $Tm(DOTP)^{5-}$. The aim of this study is to test the value of intracellular sodium imaging in a rat model of myocardial infarction (MI).

860. **Indication of ^{23}Na Quadrupolar Splitting in the Human Calf *In-Vivo* using ^{23}Na NMR Imaging**

Sonia Nielles-Vallespin[1], Michael Bock[1], Achim Bankamp[1], Renate Jerecic[2], Rainer Umathum[1], Lothar Rudi Schad[1]
[1]Deutsches Krebsforschunszentrum, Heidelberg, Germany; [2]Siemens Medical Systems, Erlangen, Germany

In this work the signal intensity of a 2D ^{23}Na FLASH sequence has been analysed as a function of RF pulse amplitude. The RF amplitude to achieve a 90º pulse in a sample with ^{23}Na quadrupolar splitting is half that of a sample without this effect. The results of both phantom and *in-vivo* experiments indicate the presence of quadrupolar splitting in the human calf muscle.

861. **Effects of Post-Ischemic Myocardial NHE Blockade on $[Na^+]_i$ and pH_i; a ^{23}Na and ^{31}P MRS Study**

Michiel Ten Hove[1], Cees J. A. Van Echteld[2]
[1]Interuniversity Cardiology Institute of the Netherlands, Utrecht, Netherlands; [2]Heart Lung Center Utrecht, University Medical Center, Utrecht, Netherlands

Introduction - Ischemic blockade of the Na^+/H^+ exchanger (NHE) has been found to be cardioprotective in many studies. However, reports on the efficacy of specific NHE blockers when administrated only during reperfusion are inconsistent. Differences in the severity of ischemia and in drug delivery may explain these inconsistencies. Little is known about the primary goal of post-ischemic NHE blockade, i.e. reduction of Na^+_i overload. Methods - Isolated rat hearts were subjected to either 25 minutes of zero flow ischemia or 60 minutes of low flow (0.2 ml/min.) ischemia. Hearts were reperfused with or without the selective NHE blocker cariporide added

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
ESR, Oxygenation, and Sodium

Room 714 A/B Tuesday 13:30 - 15:30 Chairs: Harold M. Swartz and Cees J.A. van Echteld

13:30 **862.** **Time-Domain Single Point Spectral/Spatial EPR Imaging of Tumor Hypoxia**

Sankaran Subramanian[1], Ken-ichiro Matsumoto[1], Chandrika Baby[1], Nallathamby Devasahayam[1], John Cook[1], James Mitchell[1], Cherukuri Murali Krishna[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Using Single Point or Constant Time pure phase encoding modality (SPI or CTI), time-domain spectral/spatial EPR imaging has been carried out on phantoms and tumor-bearing mice in vivo at 300 MHz . Triarylmethyl (TAM) derivatives have been employed as in vivo spin probes. Employing pure phase-encoding gradients in two or three dimensions we are able to generate good quality pO2 maps from tumors and normal tissue with sub mm resolution. The high spatial and temporal resolution of this technique make this a useful modality in small animal imaging research, such as transgenic and knockout mice.

13:40 **863.** **Measurements by EPR and BOLD of the Effectiveness of an Allosteric Hemoglobin Effector, RSR13, to Repetitively Enhance Tumor Oxygenation**

H. Hou[1], N. Khan[1], J. A. O'Hara[1], O. Y. Grinberg[1], J. F. Dunn[1], M. A. Abajian[1], E. Demidenko[1], R. P. Steffen[2], H. M. Swartz[1]
[1]Dartmouth Medical School, Hanover, New Hampshire, USA; [2]Allos Therapeutics, Inc., Westminster, Colorado, USA

Using in vivo EPR oximetry and BOLD imaging, the time course of the effect of RSR13, on tumor pO2 was measured. RSR13, (2-(4-(2-[(3,5-dimethylphenyl) amino]-2-oxoethyl]phenoxy]-2-methylpropanoic acid) has been shown to enhance tissue oxygenation by decreasing the affinity of hemoglobin for oxygen thus promoting release of oxygen from erythrocytes to tissue. The results show that daily RSR13 treatment significantly and repetitively enhanced oxygenation of the tumor (RIF-1 in the mouse) in a range that would effectively increase the cytotoxicity of ionizing radiation to the tumor. The results also illustrate the potential power of EPR and BOLD to provide data on tumor oxygenation.

13:50 **864.** **Proton Electron Double Resonance Imaging of the *In Vivo* Distribution and Clearance of Nitroxide Radicals in Mice**

Haihong Li[1], Guanglong He[1], Yuanmu Deng[1], Periannan Kuppusamy[1], David J. Lurie[2], Jay L. Zweier[1]
[1]Ohio State University Heart & Lung Research Institute, Columbus, Ohio, USA; [2]University of Aberdeen, Aberdeen, Scotland, UK

Proton electron double resonance imaging (PEDRI) is a powerful technique that enables detection and mapping of free radicals. By measuring the distribution, clearance and metabolism of nitroxide spin probes the reduction and redox status of a biological object can be established. With a lab-developed 20.1mT PEDRI system, the RF power and spin probe concentration dependence of the NMR signal enhancement factor was evaluated. In vivo distribution, clearance and metabolism of PCA in mice were measured with a maximum enhancement of -7 observed in the kidneys. The uptake and clearance of nitroxides was monitored in the different organs of the mice.

14:00 *865*. The Regulation of Brain Tissue Oxygenation (PtO_2)--An *In Vivo* EPR Study

Jeff F. Dunn[1], Jennifer Merlis[1], Michelle Abajian[1], Stalina A. Grinberg[1], Eugene Demidenko[1], H. G. Hou[1], Oleg Y. Grinberg[1]
[1]Dartmouth Medical School, Hanover, New Hampshire, USA

We do not fully understand the regulatory mechanisms in brain with respect to O2, and so we have begun studies on awake animals to measure the capacity to regulate PtO2 during acute and chronic hypoxia. We measured PtO2 in awake, restrained animals during exposure to 21% and 10% O2, before during and after acclimation to ?atm (equivalent to breathing 10% O2). The hypothesis was that the brain responds to chronic exposure in such a way as to restore brain pO2 to normal pre-hypoxic levels, even when the animal is breathing a low oxygen mixture.

14:10 *866*. Intermolecular Multiple Quantum Coherences (iMQC) in Brain: A Dramatic Change in Signal with Hyperoxia

Daniel P. Bulte[1], Louis S. Bouchard[2], Warren S. Warren[2], Michael D. Noseworthy[1]
[1]The Hospital for Sick Children, Toronto, Ontario, Canada; [2]Princeton University, Princeton, New Jersey, USA

Intermolecular multiple quantum coherences (iMQC) have been used to probe tissue structure on scales beyond those accessible by conventional imaging. Combining this technique with hyperoxia (breathing 100% O2), to increase contrast and highlight tissue microvasculature oxygenation, yields a new method of potentially evaluating tissue function and pathology. Using a GE 1.5T CV/i MRI, intermolecular double quantum coherence (iDQC) imaging of a single axial slice through the brain lateral ventricles was performed. Hyperoxia showed a marked reproducible change in image signal (~40% in gray matter), and is more sensitive to signal changes attempted by T1 or T2 mapping.

14:20 *867*. Effects of Increasing Oxidative Metabolism on Stored Pulmonary Allograft Function

Matthias Peltz[1], Timothy Thomas Hamilton[1], Tian-Teng He[1], Glenn Adams IV[1], Robert Yun-Nian Chao[1], Michael Erik Jessen[1], Dan Marshall Meyer[1]
[1]University of Texas Southwestern Medical Center at Dallas, Dallas, Texas, USA

Lungs stored for transplantation continue to utilize oxygen after procurement. It is unknown whether ongoing oxidative metabolism is beneficial or deleterious. We modified a preservation solution by adding U-^{13}C-glucose (5 mM) or increasing concentrations of 3-^{13}C-pyruvate (4 to 64 mM) to alter oxidative metabolism. After storage, glutamate ^{13}C enrichment was maximal in lungs stored in a solution containing 32mM pyruvate. Subsequently, lung function was compared between lungs stored under low (5 mM glucose) and high metabolic conditions (32mM pyruvate). No functional differences were observed between these groups. Increasing oxidative metabolism during storage does not appear to harm reperfusion function.

14:30 *868*. Study of ^{17}O NMR Sensitivity and Relaxation Times of Cerebral Water in Human at 7 Tesla

Xiao-Hong Zhu[1], Xiaoliang Zhang[1], Wei Chen[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

The cerebral metabolic rate of oxygen (CMRO2) is an important physiological parameter for studying brain function and diseases. We demonstrated previously the possibility of using high-field 17O MR approach for mapping metabolic H217O and imaging CMRO2 in rat brain. Recently, we have studied 17O relaxation times of the natural abundance H217O in human brain (T1=5.46±0.09ms, T2=4.32±0.24ms and T2*=2.40±0.07ms), and sensitivity of 3D 17O MRS image at 7 Tesla. Our results indicate that the excellent sensitivity of 17O MRS image obtained at ultra-high field will be feasible for achieving 3D imaging of CMRO2 in the human brain.

14:40 *869*. Quantifying Sodium Content in Human Heart with Short-echo, Adiabatic, Twisted Projection ^{23}Na MRI

Ronald Ouwerkerk[1], Robert G. Weiss[1], Paul A. Bottomley[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Sodium (^{23}Na) image intensity is elevated in cancer, stroke, and myocardial infarction. Whether this is due to an increased total sodium concentration (TSC), or due to altered relaxation times is confounded by the very short ^{23}Na T2 components. To remove this ambiguity, we combine fully-relaxed, ultra-short TE, ^{23}Na TPI, with adiabatic excitation and an external concentration reference to allow quantitation using surface coils with inhomogeneous RF fields. We noninvasively quantify, for the first time, myocardial TSC in 7 normal volunteers. TSC was 38±4, 41±10, and 78±17 μMol/g tissue, respectively, in Left Ventricular (LV) wall, septum and blood.

14:50 *870*. *In Vivo* 3D Single/Triple Quantum Sodium MRI of Human Breast

Erica L. Authier[1], Eric Reid[1], Fernando Boada[1]
[1]UPMC Health System, Pittsburgh, Pennsylvania, USA

We demonstrate the feasibility of performing triple quantum filtered sodium MRI in the breast of female normal human volunteers at 3.0T using a 17cm diameter distributed capacitance transmit/receive surface coil. Our results indicate that 3D images of adequate signal-to-noise ratio and spatial resolution (>1cc) can be acquired in acceptable imaging times (<16mins).

15:00 *871*. A Theoretical Model for B_0 Inhomogeneity Effects in Triple Quantum Sodium MRI

Costin Tanase[1], Fernando Emilio Boada[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

We introduce and demonstrate the use of a superspace Relaxation Matrix formalism for the study of spin 3/2 relaxation in the presence of quadrupolar fluctuations and B0 inhomogeneities. The formalism allows for the automatic generation of the relaxation matrix as well as the Multiple Quantum Filtered (MQF) signal. Using this formalism we have derived the analytic expressions for the triple quantum (TQ) and double quantum magic angle sodium signals in the presence of B0 inhomogeneities. Predictions from the model agree well with experimentally measured results.

15:10 *872*. Quantitative Imaging of ^{23}Na using Spiral SPRITE on a 4T Whole-Body Machine

Meghan Halse[1], Sandro Romanzetti[2], Joackim Kaffanke[2], James Rioux[1], Nadim Jon Shah[2], Bruce Balcom[1]
[1]University of New Brunswick, Fredericton, New Brunswick, Canada; [2]Research Centre Jülich GmbH, Jülich, Germany

The spiral SPRITE sequence has been implemented on a whole-body 4T scanner for imaging of ^{23}Na. A significant reduction in acquisition time, achieved by virtue of the spiral trajectory through k-space, is reported. Further, reconstructed T_2^* maps of ^{23}Na are demonstrated where the large number of acquired data points make bi-exponential fitting readily feasible.

15:20 *873*. *In-Vivo* Sodium Signal Changes during Acute Cerebral Ischemia in Rabbits Measured by ^{23}Na MRI

Robert Bartha[1], Ting-Yim Lee[1], Mathew J. Hogan[2], Sarah Hughes[1], Enzo Barberi[1], Nagalingam Rajakumar[3], Ravi S. Menon[1]
[1]Robarts Research Institute, London, Ontario, Canada; [2]University of Ottawa, Ottawa, Ontario, Canada; [3]University of Western Ontario, London, Ontario, Canada

The non-invasive identification of the duration of cerebral ischemia is of paramount clinical importance when the duration of ischemia cannot be determined from the time of symptom onset. The purpose of this study was to determine whether the accumulation of total 23Na measured non-invasively by MRI is correlated with the duration of acute focal ischemia in a rabbit model. 23Na signal decreased initially in infarcted tissue, then increased linearly until four hours after the start of ischemia. Increased 23Na signal intensity is likely due to the accumulation of 23Na in infarcted tissue from the collateral circulation.

MR Microscopy

Hall D Saturday 14:00 - 16:00

***874*. MRI in Biomedical Materials Science: Non-Invasive Imaging of Controlled Release Pharmaceutical Formulations**

David George Reid[1], Keith J. Brooks[1], Albert L. Busza[1], Peter D. Reid[1], Gino Martini[2], Tracey A. Naylor[2], Helen A. Willey[2], Laurence Robinson[2], Chi Li[2], Vin Re[2], David A. Valentini[3], Peter J. Coles[3]
[1]GlaxoSmithKline, Welwyn, UK; [2]GlaxoSmithKline, Harlow, Essex, UK; [3]GlaxoSmithKline, Mississauga, Ontario, Canada

MRI is finding increasing application in biomedical materials science. Its ability to detect water ingress into tablets and other controlled drug release devices lends it to the study of pharmaceutical formulations [1-5]. Drug release kinetics are a function of numerous factors, many of which are amenable to non-invasive study by MRI: rate and uniformity of solvent ingress, swelling or erosion of the tablet matrix, phase changes such as solid to gel transitions, and diffusibility of included solvent. We illustrate instances where MRI has contributed to understanding physical processes underlying formulation behaviour.

***875*. Forensic MR Microscopy: Analysis of Blunt Force Trauma in Skin and Subcutaneous Fat Tissue**

Michael J. Thali[1], Kimberlee Potter[2], Richard Dirnhofer[1]
[1]University Bern, Berne, Switzerland; [2]Armed Forces Institute of Pathology, Rockville, Maryland, USA

This is the first application of magnetic resonance microscopy (MRM) to the documentation and analysis of soft tissue skin injuries due to blunt force trauma, which are of medico-legal importance. The advantage of using MRM for wound documentation is that the analysis was not compromised by damage introduced during histologic processing, and it was not limited to studies of the superficial layers of the skin but also included the subcutaneous tissues.

***876*. *In-Vitro* High Resolution MR Imaging of Lymph Node at 1.5T: Technique and Preliminary Observations**

Dow-Mu Koh[1], David Collins[2], Gina Brown[3], Martin Leach[2], Janet Husband[1]
[1]Royal Marsden Hospital & Institute of Cancer Research, Sutton, UK; [2]Institute of Cancer Research, Sutton, UK; [3]Royal Marsden Hospital, Sutton, UK

The ability to detect nodal metastasis using MR imaging in combination with ultra-small iron oxide particles (USPIO) is influenced by the distribution and magnetic susceptibility effects produced by these particles within nodes. We describe our results of in-vitro high-resolution MR imaging at 1.5T, which enabled us to observe USPIO distribution in a human lymph node. On high-resolution imaging, nodal uptake of USPIO uptake was seen predominantly within the medulla. High regional concentration of USPIO resulted in local magnetic field distortion, which was recognised as areas with strong susceptibility artifacts.

877. Comparison of High-resolution MRI and Optical Microscopy in Quantitation of Trabecular Architecture in the Rat Femur

Tim A.J. Hopper[1], Roger Meder[1], Jim M. Pope[1]
[1]Queensland University of Technology, Brisbane, Queensland, Australia

Recently, magnetic resonance micro-imaging (mMRI) has been applied to the study of trabecular bone structure in the diagnosis of osteoporosis [1-5]. In vitro studies using clinical MR scanners have shown the potential of mMRI to predict the biomechanical strength of bone [2], and in vivo studies have demonstrated the ability to discriminate between patients with and without osteoporotic fractures [3-5]. MRI also has the potential to quantify both trabecular bone density and architecture. The aim of this project was to compare quantitative measures of rat femur bone morphology obtained from MRI with those obtained by conventional optical microscopy.

878. Measuring the Refractive Index Distribution of the Eye Lens by MRI

Catherine Jones[1], Jim Pope[1]
[1]Queensland University of Technology, Brisbane, Queensland, Australia

A novel MRI technique has been developed to directly and non invasively measure refractive index distribution of the eye lens which could fill gaps in our knowedge about age induced changes in the lens. The mechanism behind this technique is that both refractive index and relaxation rates in the lens depend on local protein concentration. However the technique had not yet been verified since accurate optical measurements of lens power were not obtained. In this study focal length of isolated pig lenses was measured optically and using the MRI technique to investigate its feasibility.

879. Characterization of Tissue-Engineered Middle Phalanx by Magnetic Resonance Microscopy

Kimberlee Potter[1], Paul Anderson[2], Noritaka Isogai[3], William Landis[4]
[1]Armed Forces Institute of Pathology Annex, Rockville, Maryland, USA; [2]Queen Mary College, University of London, London, UK; [3]Kinki University School of Medicine, Osaka, Japan; [4]Northeastern Ohio Universities College of Medicine, Rootstown, Ohio, USA

This work describes the application of magnetic resonance microscopy (MRM) for assessing the spatial and temporal development of tissue elements in tissue-engineered implants without destructive sectioning or the introduction of histologic stains or fluorescent dyes. Three-dimensional X-ray microtomography (XMT) images were used to validate the underlying relations between mineral density and water proton relaxation times and to develop surrogate measures for mineral densities generated in the mineralizing system investigated. The advantage of the MRM technique is that it can yield information about the implant in vivo as well as the biological response of the body to the implanted material.

880. Mapping Retinal Hemorrhages with Magnetic Resonance Microscopy

William Oliver[1], Kimberlee Potter[1], Ian McLean[2], David Fowler[3], Jamie Downs[4]
[1]Armed Forces Institute of Pathology Annex, Rockville, Maryland, USA; [2]Armed Forces Institute of Pathology, Washington, DC, USA; [3]Office of the Chief Medical Examiner, State of Maryland, Baltimore, Maryland, USA; [4]Regional Medical Examiner, Savannah, Georgia, USA

Diagnosis of Shaken Baby/Shaken Impact Syndrome (SBS) has traditionally emphasized the importance of retinal hemorrhage, but this has been recently challenged. Other studies have found qualitative changes between retinal hemorrhage due to SBS and those due to other causes. MRM may provide a means of quantifying and mapping retinal hemorrhage to provide an objective evaluation of retinal hemorrhage in questioned cases. In this study, five pairs of eyes of suspected and confirmed child abuse cases were evaluated using MRM. The distribution correlated with histologic evaluation, though higher resolution will be necessary for adequate mapping.

881. MR Microscopy of Myocardial Outflow Configuration in Normal Chick Embryo Hearts and Hearts after Cardiac Neural Crest Ablation

Xiaowei Zhang[1], T. Mesud Yelbuz[1], Gary P. Cofer[1], Margaret L. Kirby[1], G. Allan Johnson[1]
[1]Duke University, Durham, North Carolina, USA

Studies to describe myocardial outflow configuration have been performed with various imaging techniques. Magnetic resonance microscopy (MRM) could provide new insight to assess and understand normal and abnormal cardiac development in established embryonic models. We performed 3D MRM with a dual contrast technique that combines perfusion with immersion fixation, to improve cardiac structural study of chick embryos. The results demonstrate the useful application of this method to compare myocardial outflow configuration in normal chick embryo hearts with the hearts after cardiac neural crest ablation (CNCA).

882. MRI Study of Root Hair Dynamics and Micro Scale Water Uptake Patterns

Uri Shani[1], Yacov Itzchak[2], Eran Segal[1], Tammar Kushnir[2]
[1]Hebrew University, Rehovot, Israel; [2]The Chaim Sheba Medical Center, Tel Hashomer, Israel

MRI images provide means for noninvasive monitoring and quantification of spatial and temporal changes of the soil water during water uptake by plant roots. In addition, root morphology and function can be studied in vivo. In this study, the spatial water content distribution, surrounding roots of cucumber seedlings grown in a sandy soil, was evaluated under various transpiration periods. The depletion patterns of water serve as the basis for an attempt to understand and quantify the mechanism and dynamics of water uptake.

Novel Diffusion Applications

Hall D Sunday 13:30 - 15:30

883. ^{23}Na NMR Spectroscopy and Diffusion Weighted MRI Studies on Sea-Ice at Different Temperatures. The Influence of Environmental Effects on Ice Growth

Christian Bock[1], Hajo Eicken[2], Rolf M. Wittig[1]
[1]Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven, Germany; [2]University of Alaska Fairbanks, Fairbanks, Alaska, USA

Knowledge of the physico-chemical properties of sea-ice with its inclusions of liquid brine is essential for our understanding of the role of polar ice covers in climate change. Spin-Echo, Diffusion-weighted MRI and 23Na-NMR were conducted on sea-ice sampled in Arctic Alaska to study the thermal evolution of brine inclusions over a temperature range from –30 to –3 C. An in-plane resolution of 100 micrometers allowed us to investigate the increase in pore size, changes of diffusion constants as well as the different precipitation points of hydrohalite and mirabilite with temperature. The results are in good agreement with theoretical predictions.

884. *In Vivo* Measurement of ADC Change Due to Administration of Contrast Agents

Lisa Marie Fleming[1], Lisa J. Wilmes[1], Savannah C. Partridge[1], Donghui Wang[1], Maria Pallavicini[1], Roland G. Henry[1], Nola M. Hylton[1]
[1]University of California San Francisco, San Francisco, California, USA

Diffusion-weighted single-shot fast spin echo (DW-SSFSE) was used to investigate the effect of contrast agents on the apparent diffusion coefficient (ADC) in human breast cancer BT474 xenografts. The clinically available contrast agent, Gd-DTPA (Magnevist; Nihon Schering), demonstrated significant increases in tumor ADC after administration at a dosage of 0.1 and 0.2 mmol/kg, with a trend toward greater change at the higher dose. ADC values were significantly reduced in tumor after administration of Albumin GdDTPA30 and GdDTPA-BMA encapsulating liposomes. Contrast agents appear to alter the in vivo ADC measurement after their administration.

885. Dependence of T_1 and T_2 on High Field Strengths in Doped Agarose Gels; Facilitating Selection of Composition for Specific T_1/T_2 at Relevant Field.

Lowri Cochlin[1], Andrew Blamire[1], Peter Styles[1]
[1]University of Oxford, Oxford, UK

Paramagnetic doped gel phantoms are widely used for evaluating MR procedures. Although copious data on relaxation properties for such gels exists at low-field (<100MHz) this is not the case at high-field. Gel compositions of 0.1 to 6%w/v agarose with 0.001 to 6mMol dm-3NiCl2, were measured with inversion-recovery and spin-echo sequences at 85 to 500MHz. Relaxation rates are largely independent of each other: T1 principally [NiCl2] dependent, T2 [agarose] dependent. Plots of T1. T2 and composition are similar at each field, whereas T1 and T2 versus field illustrate mechanistic change between 300 and 400MHz, preventing simple extrapolation from low-field data.

886. Biexponential Attenuation of Water Diffusion in Leukemic Cells

Masato Sano[1], Masaki Sekino[1], Mari Ogiue-Ikeda[1], Shoogo Ueno[1]
[1]Graduate School of Medicine, University of Tokyo, Bunkyo-ku, Tokyo, Japan

We measured the fractions of fast and slow diffusion components for TCC-S cells using diffusion MRI, and compared with the fractions of volume obtained from the diameter and the intensity of cells (intracellular space:0.486±0.053, extracelluar space:0.514±0.042). The signal decay of TCC-S using high b factor was approximated to a biexponential form and two components were obtained. The fractions of fast and slow diffusion components were 0.596±0.042 and 0.416±0.042, respectively. The difference between the fractions of diffusion components and volume is attributed to the exchange of water molecules between two compartments.

887. Contributions of Collagen Matrix to Restricted Water Diffusion in Post-infarct Rat Heart

Junjie Chen[1], Sheng-Kwei Song[1], Wei Liu[1], Mike Scott[1], Liz Lacy[1], Stacy Allen[1], Samuel A. Wickline[1], Xin Yu[1]
[1]Washington University in Saint Louis, Saint Louis, Missouri, USA

The purpose of this study is to delineate the impact of remodeled collagen matrix of post-infarct myocardium on water diffusivity and diffusion anisotropy. A rat heart was digested with NaOH 4 weeks after infarction. Diffusion tensor MR images were acquired after all the non-fibrous components were digested. Infarct area showed decreased water diffusion and increased diffusion anisotropy compared to non-infarct region, primarily due to increased collagen deposition. This study suggested that highly concentrated collagen fiber in infarct myocardium restricted water diffusion and contributed to water diffusion anisotropy.

Economics and Training

Hall D Monday 13:30 - 15:30

888. Is Sedation Necessary for Paediatric MRI?

Nisha Jain[1], Andrew James Watt[1]
[1]The Royal Hospital for Sick Children, Glasgow, UK

Oral and IV sedation is widely used in paediatric MRI with a wide range of protocols and agents described in the literature. The reported failure rates of sedation are in the order of 5-10% and complications such as hypoxaemia in the range of 1-2%. With the advent of ultra fast and 'silent' MRI scanning techniques there may be less need for routine sedation. This study reviews our experience of providing a paediatric MRI service with a policy of no routine oral or IV sedation.

889. Development of a Comprehensive MRI Training Programme: European Medical Imaging Technology Training (EMIT)

R. Wirestam[1], A. Simmons[1], F. Milano[1], F. Ståhlberg[1], M. Almqvist[1], C. Deane[1], J. Y. Giraud[1], B. A. Jönsson[1], I. L. Lamm[1], C. Lewis[1], A. Noel[1], C. Roberts[1], P. Smith[1], S. E. Strand[1], S. Tabakov[1]
[1]EMIT Project Consortium, King's College London - GKTSM, London, UK

The present project aims to produce a comprehensive MRI training programme for medical physicists, to be introduced in hospitals as work-linked training. The programme, of approximately 80 days duration, includes curricula, timetables, training tasks, training materials (electronic and Internet-based) and a large image database. The training consists of approximately 50 tasks with emphasis on practical and experimental MRI physics activities, but also with the opportunity to learn from simulation tools, realistic image sets and documents. The programme is also expected to be relevant to other disciplines.

Image Processing and Analysis

Hall D Tuesday 13:30 - 15:30

890. An Assessment of Perfusion Reserve using Acetazolamide-BOLD Technique using EPI Compared to 99mTc - HMPAO SPECT in Cerebrovascular Disease: Preliminary Report

In Chan Song[1], Kee Hyun Chang[1], Chang Wan Oh[1], Keon Ha Kim[1], Moon Hee Han[1]
[1]Seoul National University Hospital, Seoul, Republic of Korea

We developed a new method called the acetazolamide - BOLD MRI technique for perfusion reserve based on acetozolamide challenge and BOLD effect using EPI technique. Perfusion reserves were assessed by the signal change in acetazolamide BOLD images by the integral of the signal intensity-time curve on a pixel-by-pixel basis and compared with those of acetazoleamide SPECT in the peri-operative evaluation of cerebrovascular disease. Acetazolamide-BOLD MRI is similar to or better than acetazoleamide SPECT in demonstrating cerebral perfusion reserve. Acetazolamide-BOLD MRI may be useful in perioperative evaluation of perfusion reserve in patients with cerebrovascular disease.

891. Brain Iron Analysis of High Field MR Images for Alzheimer's Disease

Abdalmajeid Musa Alyassin[1], John F. Schenck[1], Zhu Li[1], David C. Alsop[2], Earl A. Zimmerman[3]
[1]GE Global Research Center, Niskayuna, New York, USA; [2]BI Deaconess Medical Center, Boston, Massachusetts, USA; [3]Albany Medical Center, Albany, New York, USA

Analysis of brain T2 values has been conducted on high-field (3T) MR images for Alzheimer's disease subjects as well as cognitively healthy controls. Twelve subjects were scanned with high field MR using a dual spin echo pulse sequence. The analysis of global brain iron indicated the T2 values for specific brain regions were shorter for AD subjects than for normal volunteers. In addition, the regional brain analysis indicated that the spin echo sequence is effective in capturing the drop in the apparent T2 values.

892. A Simple Algorithm for Curvilinear Reformatting of 3D MRI Data.

Janaka P. Wansapura[1], Otis L. Williams[1], Jimmy M. Williams[1], George Mandybur[1]
[1]University of Mississippi, Jackson, Mississippi, USA

A simple algorithm for curvilinear multiplanar reformatting (CMPR) of 3D MR imaging data is presented. The contour of the cortical surface was delineated interactively on several user-selected slices of the 3D data set. The contour data is then used to form a surface grid to which the 3D MRI data is mapped. Curved surfaces at different depth levels are generated automatically. The method written in MATLAB, was used to visualize the position of subdural strip electrodes on epilepsy patients (n=3), who were undergoing invasive electroencephalography.

893. 3D Visualization of Pathological Forms from MRI Data Obtained with Simultaneous Water and fat Signals Suppression

Yuri A. Pirogov[1], Leonid V. Gubskii[2], Nikolai V. Anisimov[1]
[1]Moscow State University, Moscow, Russian Federation; [2]Russian State Medical University, Moscow, Russian Federation

For enhancement of visualization and 3D-reconstruction of intracranial pathological forms, it is suggested to use MR images obtained with simultaneous water and fat signals suppression. In this case one can more distinctly reveal pathological forms that are hidden under powerful signals of fat and water. To realize simultaneous suppression of water and fat signals, we use sequence "inversion-recovery" supplemented by second inversion pulse. Herewith the graphical data processing and construction of 3D-images are simplified, as tissue contrast picture is maximally refined. The method is illustrated by 3D images in the cases of intracranial tumors and subdural hematomas.

894. Reproducibility of Parametric T_2 versus Relaxation-weighted Signal Intensity in Longitudinal Studies of Human Brain Tumors

AJ Frew[1], PM Thompson[1], PB Tseng[1], TF Cloughesy[1], AW Toga[1], JR Alger[1]
[1]University of California Los Angeles Los Angeles, California, USA

The effectiveness of automated T2 (transverse relaxation time) calculation and automated image registration was evaluated with 11 longitudinally acquired 1.5-Tesla magnetic resonance imaging studies of a brain cancer patient. Co-registered T1-weighted, double-echo PD and T2 weighted volume images for each time point were compared to parametric T2 images calculated from double echo scans using automated image registration. The investigation demonstrated that the parametric T2 values have significantly lower study-to-study variances (less than 2%) than the directly acquired signal intensity values (6.4% to 19%), suggesting that parametric imaging is advantageous for detecting subtle changes in longitudinal studies.

895. Histogram Analysis of the Bound Proton Fraction and other Parameters obtained from Quantitative Magnetisation Transfer Imaging of Multiple Sclerosis Patients

Daniel Tozer[1], Gerard R. Davies[1], Anita Ramani[1], David H. Miller[1], Paul S. Tofts[1]
[1]University College London, London, UK

Maps of the parameters produced from a quantitative analysis of magnetisation transfer are used to produce whole brain histograms from Multiple Sclerosis patients and controls. Five parameters are investigated, including the bound proton fraction, f, and the transverse relaxation time of these protons, T2B, A simple analysis of these histograms is performed using parameters such as peak height and location. It is shown that the group histograms of f have significantly different 25th and 75th centile points and that f/RA(1-f) has different peak locations for the two groups. Other parameters show borderline differences for some histogram parameters.

896. State Space Estimation of the Input Stimulus Function Using the Kalman Filter

Doug B. Ward[1], Yousef Mazaheri[2]
[1]Medical Collge of Wisconsin, Milwaukee, Wisconsin, USA; [2]University of California, San Diego, California, USA

The fMRI signal in response to stimuli is temporally blurred and distorted due to the slow response of the hemodynamic response function. Knowledge of the hemodynamic response function, obtained during the same experiment, or as a result of a separate experiment, can be employed to obtain an estimate of the input stimulus function. Reconstruction of the input stimulus function provides insight into actual brain activity during task activation without temporal blurring, and may be considered as a first step toward estimation of the true neuronal input function.

897. Removal of Histogram Spikes Originating from Quantisation Noise in Images

Daniel Tozer[1], Paul S. Tofts[1]
[1]University College London, London, UK

Histogram spikes occur as a result of quantization noise in images used to generate parameter maps such as MTR or T1. A simple method is presented for the removal of these spikes, which occur at predictable values, when the result of the division is equal to a simple fraction e.g. 1/2, 1/3, or 1/4. The addition of uniformly distributed noise to the integer image data removes these spikes without degrading the histogram. T1 and MTR histograms from images with and without this correction are shown, clearly showing that the spikes are removed by this procedure.

898. Reduction of Triangles in Discretized Marching Cubes for 3D Rendering of Brain MR Images

Yeji Han[1], Min Jeong Kwon[1], HyunWook Park[1]
[1]Korea Institude of Science and Technology, Daejeon, Republic of Korea

Surface rendering is a useful method in 3D visualization of brain MR images. Especially when the segmented result of MR images is given in advance, discretized marching cubes (DiscMC) algorithm can be easily utilized. However, the complexity of cerebral surface increases the number of triangles produced by DiscMC and thus, the computation time becomes an impediment to real-time 3D rendering. In order to speed up the 3D rendering, we propose a modified DiscMC table to reduce the number of triangles DiscMC. The proposed method reduces the number of triangles by 30% without loss in brain MR image quality.

899. Task Dependent Effects of Single-Trial Averaging on the Spatial Extent Detected in fMRI

Shin Yi Fang[1], Ju Chuan Huang[1], Fan Chi Su[1], Ho Ling Liu[1]
[1]Chang Gung Memorial Hospital and Chang Gung University, Kueishan, Taoyuan, Taiwan

We compared the effects of single-trial averaging on the spatial extent of event-related fMRI activation induced by a visual and a language task. The exponential relation between number of trials and spatial extent, but the ascending rate was different between these two experiments. For the language task, the spatial extents required less averaged-trials to reach the plateau level than the visual task (71.70 vs. 135.64 and 34.88 vs. 116.23 trials to reach 68% of asymptotic values in two subjects respectively). Therefore the appropriate number of trials for fMRI experiments might depend on the tasks involved or the anticipated activated area.

Image Processing: Segmentation

Hall D Saturday 14:00 - 16:00

900. Volumetry of the Human Brain: A Novel Segmentation Algorithm Combining Structural Quantitative MRI with Voxel Connectivity

Erin Lee McKinstry[1], Hernan Jara[1]
[1]Boston University/BUSM/BME, Boston, Massachusetts, USA

This paper describes a novel, semi-automated, segmentation technique based on quantitative MRI properties and spatial connectivity. By utilizing a specialized MRI pulse sequence, and two physics-based algorithms, we are able to calculate T1, T2, and proton density quantitative data in large contiguous volumes at the voxel level. This information allows for accurate, reproducible segmentation and volumetry of tissue types in the brain. The technique is applied to several data sets acquired under different conditions. Consistent volumetric results are encouraging for the future development of a fully automated segmentation tool.

901. Towards an Automatic Lesion Segmentation Method on FSE Images Using an Ensemble of Neural Networks

Andreas Hadjiprocopis[1], Paul Tofts[1]
[1]University College London, London, UK

There is a well recognised need for a robust, accurate and reproducible automatic method for identifying multiple sclerosis lesions on PD and T_2-weighted images. We present a method for automatic lesion segmentation of FSE images (PD&T_2) based on an ensemble of feed-forward neural networks (FFNN). The input layer of the ensemble is trained with different portions of hand-segmented lesion and non-lesion data. The final output of the ensemble is determined by a gate FFNN trained to weigh the response of the input layer to previously unseen data.

902. Nonlinear Multi-Resolution Symmetric Registration in Automated Segmention of Sub- and Allocortical Structures in MRI

Andrew Janke[1], Robert Renwick[2], Marc Budge[3], Jens Pruessner[2], D Louis Collins[2]
[1]Centre for Magnetic Resonance, Brisbane, Queensland, Australia; [2]Montreal Neurological Institute, Montreal, Quebec, Canada; [3]University of Oxford and Radcliffe Infirmary, Oxford, UK

Model based segmentation relies upon a pre-existing notion of the chosen structure on an average model, various techniques allow these labels to then be transformed onto individual patients anatomy. An inherent problem with this approach is that of the asymmetry in the cortex. Here an approach that annuls this effect without compromising the automatic segmentation performance is presented. In this methodology, images are iteratively matched non-linearly to an evolving model of average structure. At each iteration, images are matched to the model in both their original and mirrored orientation. An evolving model is then built from this result.

903. A Multi-Agent Framework for MRI Brain Scans Segmentation

Nathalie Richard[1], Michel Dojat[1], Catherine Garbay[2]
[1]INSERM U438, Grenoble, France; [2]CNRS TIMC, Grenoble, France

We are interested in the segmentation of MRI Brain scans. Image segmentation is intrinsically a distributed process in term of goals to be reached, of zones in the image to be processed and of treatments to be achieved. Face to the general complexity of images (i.e. variability of anatomical structures and acquisition artifacts such as noise, intensity non-homogeneities or partial volume effect) the focalizations are continuously reconsidered during the evolution of the segmentation process. We advocate situated and cooperative agents as a framework to manage the various information processing steps required in this context.

904. Segmentation of Brain MR Image Using Template Matching and Hierarchical Fuzzy C-means Algorithm

Min Jeong Kwon[1], Yeji Han[1], Il Hong Shin[1], HyunWook Park[1]
[1]Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea

In brain magnetic resonance (MR) images, segmentation and 3D visualization of brain are useful to diagnose abnormalities. The fuzzy c-means algorithm (FCM) has been widely used for segmentation of brain MR images. However, FCM does not yield sufficient results under RF nonuniformity. We propose a segmentation method composed of template matching to extract the cerebrum and a hierarchical FCM to segment the cerebrum into white matter, gray matter, and cerebrospinal fluid without any parameter setting and heavy computation. The proposed method shows good segmentation results from T1-weighted image under RF nonuniformity.

905. Segmentation of Brain Tissues by using DAEM

Ricardo Jose Ferrari[1], Xingchang Wei[1], Yunyan Zhang[1], J Ross Mitchell[1]
[1]Seaman Family MR Research Centre, Calgary, Alberta, Canada

The Expectation-Maximization (EM) algorithm has been incorporated and is fundamental in several automatic tissue segmentation techniques. However, in the initial stages of the algorithm the parameter unreliability may drive the technique to a local maximum. Here we report on the first use of Deterministic Annealing Expectation-Maximization (DAEM) and the Minimum Descriptor Length (MDL) principle for automatic segmentation of brain tissues in MRI. The EM and DAEM algorithms were compared by using a multispectral MRI dataset from a patient with MS. The DAEM shown better tissue differentiation and higher accuracy in lesion quantification (79.69%) compared to the EM algorithm (63.54%).

906. Automated Segmentation of Cerebral Ventricular Compartments

Ying Wu[1], Kilian M. Pohl[2], Simon K. Warfield[1], Charles R. G. Guttmann[1]
[1]Brigham & Women's Hospital, Boston, Massachusetts, USA; [2]Massachusetts Institute of Technology, Boston, Massachusetts, USA

Fully automated segmentation of cerebral ventricle chambers, which is designed to discriminate the lateral, third and fourth ventricles, as well as the aqueduct is presented and validated. A novel topology-restricted intensity-based algorithm was extended by incorporating a ventricle probability model for ventricle segmentation, and validated on 124 coronal SPGR sections of a healthy volunteer's brain. 3D-rendering of the segmented ventricles showed good qualitative delineation of ventricular compartments. Comparison with a radiologist's manual delineation showed excellent agreement. We expect this method to be useful in clinical studies involving ventricular morphometry and for improving the segmentation of white matter lesions.

907. Segmentation of T_2-weighted MRI Using an Ensemble of Neural Network and Clustering Experts

Andreas Hadjiprocopis[1], Waqar Rashid[1], Paul Tofts[1]
[1]University College London, London, UK

We present a method for segmenting T_2-weighted EPI diffusion (b=0) images into three compartments, namely WM, GM and CSF, using a hybrid ensemble of experts. One type of these experts (CLX) employs iterative, non-deterministic clustering based on soft K-means, expectation-maximisation and simulated annealing while the other employs feed-forward neural networks (NNX) and neural network entities (NNEX). NNX and NNEX experts are combined using yet another neural network – the gate. The final outcome is determined by an output function – e.g. winner-takes-all, simple or weighted averaging, voting etc. – which considers the outputs of the gate and the CLX experts.

908. Improved Brain Image Segmentation by Multiscale Analysis and Deformable Template Matching

Anirban Roy[1], Jim Xiuquan Ji[1], Lei Yuan[1], Zhi Pei Liang[1]
[1]University of Illinois at Urbana-Champaign, Urbana, Illinois, USA

We present in this paper an improved brain image segmentation method based on a hybrid technique that integrates multiscale analysis and template deformation. We propose a new likelihood function and a new confidence measure, which can be used to classify the regions obtained by multiscale analysis into anatomical structures under the guidance of template deformation results with enhanced accuracy. The algorithm has been tested on several MR image data sets, yielding a fairly accurate match with manually segmented results.

909. Automated Segmentation of Brain Structure from MRI

Ladan Amini[1,2], Hamid Soltanian-Zadeh[1,2,3], Caro Lucas[1,2]
[1]University of Tehran, Tehran, Iran; [2]Institute for Studies in Theoretical Physics and Mathematics, Tehran, Iran; [3]Henry Ford Health System, Detroit, Michigan, USA

We developed a new method for segmentation of specific brain structures from MRI. The method is based on a dynamic contour model, which deforms under external and internal forces. The desired image features are utilized to define external force. A new algorithm integrating thresholding, fuzzy clustering, edge filters, and morphological operations overcomes limitations of low contrast tissues and unclear edges. A new method automatically generates the initial contour for the model, to delineate dependency of results on the operator. Application of the methods to thalamus illustrates its steps and similarity of the results to manual segmentation by a radiologist.

910. Novel Initialization Technique for Expectation-Maximization Based Image Segmentation: Quantification and Validation

Sulaiman Sheriff[1], *David Lefkowitz*[2], *Steven Roys*[2], *Tulay Adali*[1], *Rao Gullapalli*[2]
[1]University of Maryland Baltimore County, Baltimore, Maryland, USA; [2]University of Maryland Medical Center, Baltimore, Maryland, USA

Segmentation of brain MR images involves estimation of the various tissue quantities and defining contiguous regions of interest. We present a new method of effective segmentation of brain MR images and also introduce an efficient and intuitive framework for comparison of the performance of various segmentation algorithms. Any segmentation algorithm, which is applied to MR brain images, can be quantified within this framework and the performance of the algorithm measured efficiently against the performance of another. We compare our segmentation algorithm against two others using this framework and discuss the relative merits and demerits of each algorithm.

911. SIN: Segmentation by Inversion Nulling

Glyn Johnson[1], *Henry Rusinek*[1]
[1]New York University School of Medicine, New York, New York, USA

Image segmentation is generally based on the different MRI signal intensities generated by different tissues. However, variations in signal intensity due to RF non-uniformity complicate segmentation. Furthermore, current methods are only semi-automatic. It is necessary to manually place regions of interest within typical tissue areas. Here we present a method of segmentation based on inversion nulling of selected tissue types. The method is fully automatic and robust with respect to RF non-uniformity.

912. MR Brain Volumetric Using Unsupervised Segmentation T_2 Window Technique

Abdalmajeid Musa Alyassin[1], *Richard Mallozzi*[1], *Zhu Li*[1], *Daniel Blezek*[1]
[1]GE Global Research Center, Niskayuna, New York, USA

A fully automatic segmentation technique of whole brain structures was developed in order to track the progression of dementia in Alzheimer's disease patients. The technique utilizes a standard dual spin echo MRI pulse sequence and is based on multi-spectral analysis technique. The percent brain parenchyma was used as a measure of the whole brain volume. A standard deviation of less than 0.3% was achieved on seven repeated scans of the same subject. The technique runs under a minute on a dual 550 MHz Pentium-III PC.

Image Processing: Registration

Hall D Sunday 13:30 - 15:30

913. Within-Group Non-Linear Registration Improves VBM Analysis

Simon Duchesne[1], *Neda Bernasconi*[1], *A. Janke*[1], *Andrea Bernasconi*[1], *D. Louis Collins*[1]
[1]Montreal Neurological Institute, Montreal, Quebec, Canada

VBM relies heavily on an accurate registration process before comparing different volumes at a voxel level. Typically, linear registration is used to conform all brains to the same shape, orientation and size. We have used non-linear registration of subjects to the average of their respective grouping to reduce normal, anatomical inter-subject variability and at the same time increase differences between groups. Results demonstrate (A) an increase in statistically significant voxels and (B) that a smaller smoothing kernel can be used to achieve the same statistical significance with improved spatial localization.

914. Intermodality Registration via Interactive Graphics Coupled with AIR Intramodality Registration

James Q. Zhang[1], *John M. Sullivan*[1], *Praveen P. Kulkarni*[1], *Mathew E. Brevard*[2], *Udo A. Benz*[1], *Hongliang L. Yu*[1]
[1]Worcester Polytechnic Institute, Worcester, Massachusetts, USA; [2]University of Massachusetts Medical School, Worcester, Massachusetts, USA

An intuitive graphical user interface records every step of the user-directed registration process yielding a single 4x4 cumulative affine transformation matrix. The interactive GUI provides a seamless interface to the automated registration program AIR. This coupled registration strategy resolves several constraint situations. It addresses the lack of topological relationships for intensity-driven registration programs. The coupled system accelerates convergence within AIR by allowing interactive adjustments of registration parameters and view results on the fly. This system has produced highly reliable results for registration of MR rat brain images to 3D atlases fully segmented with more than 1000 sub-volume regions.

915. A Semi-Automatic Brain MR Image Registration Using 2-Level Template Matching

Yeji Han[1], *HyunWook Park*[1]
[1]Korea Institude of Science and Technology, Daejeon, Republic of Korea

A semi-automatic process of determining 10 necessary points is presented, which is required to register brain MR images based on Talairach atlas. Generally, 10 points are AC, PC, AP, PP, SP, IP, LP, RP and two points for midline. The suggested method reduces user input to 5 points, and finds the necessary points for registration in a more stable manner by finding AC and PC using 2-level shape matching of the corpus callosum in an edge-enhanced image. Remaining points are found using the intensity information of cutview.

916. Verification of Multimodal Image Registration using CT/MR/SPECT Brain Phantom

Tae-Suk Suh[1], Hosang Jin[1], Juyoung Song[1], Rahyeoung Juh[1], Sookyo Chung[1], Boyoung Choe[1], Hyongkoo Lee[1]
[1]The Catholic University of Korea, Seoul, Republic of Korea

Image registration technique of CT-MR and CT-SPECT images using chamfer matching was studied. In addition, a method of accuracy evaluation of the image registration using a home-made brain phantom was developed. The brain phantom was specially designed to obtain imaging dataset of CT, MR, and SPECT. Accuracy of image fusion was assessed by the comparison between the center points of the section of N-shaped bars in an external frame and inserted targets of the phantom. 3D rms (root-mean-square) translation deviations of CT-MR and CT-SPECT registration were found to be 1.98±0.63mm and 3.69±1.07mm, respectively.

917. Global Optimization of Mutual Information: Retrospective Registration of Rodent Brain MRI

Ponnada A. Narayana[1], Renjie He[1]
[1]University of Texas Medical School at Houston, Houston, Texas, USA

A fully automatic technique for retrospective alignment of rodent MR brain images is described. It relies on global optimization of mutual information (MI), using a multi-resolution paradigm for improved efficiency. Conventional optimization techniques often fail because of distortions and local minima introduced in the MI function by the properties and manipulations of images. In these studies we have combined differential evolution (DE), a stochastic method which is efficient in large search space, with dividing rectangle (DIRECT), a deterministic technique, for increased efficiency and guaranteed optimization. Registration results on MR images of rodent brains indicate subvoxel precision.

918. A Monte Carlo Technique for Co-Registration of 3D MRA images

K. Craig Goodrich[1], Dennis L. Parker[1]
[1]University of Utah, Salt Lake City, Utah, USA

In order to determine reproducibility of MR Angiography acquisition and segmentation, MRA images must be co-registered. MR Angiograms were interpolated, segmented and a landmark visible in all data sets was used as the center of rotation. Random angles within a user-defined range are generated and used to rotate the image. A binary (1=vessel, 0=not vessel) multiplication of the 3D volumes is summed and used as the figure of merit. The process is repeated with a diminishing range of random angles until the stop criterion is met. The algorithm obtains excellent registration of 3D segmented angiograms in a reasonable time.

919. Image-Based Methods and Orbital Navigator Echoes for Prospective Registration

Egbert Gedat[1], Jürgen Braun[1], Ingolf Sack[1], Johannes Bernarding[1]
[1]University Hospital Benjamin Franklin, Berlin, Germany

Monitoring cerebral diseases such as stroke or brain tumors with MRI requires high-precision comparison of initial and follow-up images. Prospective registration and adaptation of slice gradients and FOV prior to the examination avoid interpolation artifacts. Image- and k-space-based methods to obtain the 3D transformation matrix were implemented and compared. Inter-exam translation and rotation were determined with cross-correlation of pre- and post images. This time-consuming image-based registration can be obviated by using orbital navigator echoes in different orientations. Phantom measurements showed that the orbital navigator echo method is as accurate and much faster than image based prospective registration.

Image Processing: Atlases, Templates, and Volumetry

Hall D Monday 13:30 - 15:30

920. A Dynamic MRI Brain Atlas

Derek L. Hill[1], Jo V. Hajnal[2], Daniel Rueckert[2], Thomas Hartkens[1], Steve M. Smith[3], Kate McLeish[1]
[1]King's College London, London, UK; [2]Imperial College, London, UK; [3]University of Oxford, Oxford, UK

We describe a dynamic brain atlas that uses the capabilities of computational grids to customize a brain atlas on the fly to a study subject. The atlas can be generated from a sub-set of 180 reference brains closest in age and gender to the study subject. The dynamic atlas can be used to assist in interpretation of volume MR images of the brain for clinical or research purposes.

921. Reproducibilities of Cerebral Atrophy Measured from Various MRI Pulse Sequences

Mark Andrew Horsfield[1], Mara Rocca[2], Paolo Rossi[2], Massimo Filippi[2], Marco Rovaris[2], Rohit Bakshi[3]
[1]University of Leicester, Leicester, UK; [2]Ospedale S. Raffaele, Milano, Italy; [3]Jacobs Neurological Institute, Buffalo, New York, USA

Cerebral atrophy from MRI brain scans is an important outcome measure in clinical trials for several neurological diseases, such as Alzheimer's and multiple sclerosis. The measurement of atrophy can be time consuming when the technique is applied to studies involving many patients, and it is important to assess the reproducibility of the data collection and image analysis methods. This study examines the scan-rescan reproducibility achievable using different T1-weighted pulse sequences with fully-automated, and semi-automated methods of analysis.

922. Measuring Brain Volume in Patients with Multiple Sclerosis: A Comparison of Three Common Approaches

Zografos Caramanos[1], Douglas L. Arnold[1], D. Louis Collins[1]
[1]Montreal Neurological Institute, Montreal, Quebec, Canada

We compared three common approaches to calculating brain volume in MS: Collins' BICCR, Fisher's BPF and Losseff's ventricular/brain ratio and found that all three were highly intercorrelated - both in patients with RR and SP MS (*r*'s = 0.92 to 0.99). The addition of T1 data to the T2/PD data used in calculating these measures did not improve correlations with either EDSS or age. Surprisingly, the Losseff measure, which is much simpler to calculate than either the BICCR or the BPF, correlated as well - or better - with EDSS than these two more computationally-expensive measures of brain volume.

923. Local Volume Changes of the Corpus Callosum from 3D MR Images of Wildtype and Knockout Mouse Brains

Ghassan Hamarneh[1], Josette Chen[1], Nir Lifshitz[1], Jeff Henderson[2], Mark Henkelman[1]
[1]Hospital for Sick Children, Toronto, Ontario, Canada; [2]University of Toronto, Toronto, Ontario, Canada

We characterize 3D local volume changes of the corpus callosum from MR images of wildtype and neuro-transgenic fixed mouse brains. We demonstrate how the measurement technique could be used for detecting morphological phenotypes for mutant mouse screening.

Image Processing: New Techniques

Hall D Tuesday 13:30 - 15:30

924. Micro-MRI Derived Bone Structure: Effect of Serial Registration on Longitudinal Analysis

James C. Gee[1], Zhiyong Xie[1], Bryon R. Gomberg[1], Alexander C. Wright[1], Punam K. Saha[1], Felix W. Wehrli[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Recent advances in µ-MRI technology now allow imaging at resolutions suitable for detailed structural analysis in patients. For effective treatment monitoring, methods are needed to reliably match the analysis volume of the baseline to that of the follow-up studies. Here we examine a rigid and non-rigid registration method in repeat exams performed 1 month and 12 months after the baseline scan as part of a clinical study aimed at evaluating the effect of hormone replacement therapy on trabecular architecture.

925. Evaluation of a Semi-Automatic Segmentation of Cartilage Based on k-Means

Julio Carballido-Gamio[1], Timothy C. Dunn[1], Grace E. Lau[2], Suchandrima Banerjee[1], Sharmila Majumdar[1]
[1]University of California San Francisco, San Francisco, California, USA; [2]University of California Berkeley, Berkeley, California, USA

Cartilage segmentation based on magnetic resonance images (MRI) is a necessary but often time-consuming process in order to determine morphologic parameters for assessment of osteoarthritis (OA) of the knee. A semi-automatic segmentation process was developed and shown to reduce the number of points placed by 35% on average compared to manual segmentation. The paired (n = 268) volume and thickness values for the two techniques were found to have good agreement (r = 0.932 and r = 0.851, respectively), however there were a significant increases in both with the semi-automatic technique of 35% ($p<0.001$, both).

926. 3-Dimensional Rigid Body Registration of Normal and Arthritic Rat Joints

Nadeem Saeed[1], Keith J. Brooks[1], Howard Dennison[1], Alan White[1], K Kumar Changani[1]
[1]GlaxoSmithKline, Welwyn, Hertfordshire, UK

Rheumatoid arthritis (RA) results in inflammation of the joints. High resolution 3-dimensional MR images of rat hind legs ex-vivo were acquired to visualize the joints so that comparisons could be made between diseased and normal joints. A key requirement for such analysis is that the joints in the two groups (diseased and normal) should be in identical positions. 3-dimensional rigid body image registration employing segmentation of tendons and bone was employed to register images from the diseased and normal rat joints.

927. Magnitude Image C-SPAMM Reconstruction (MICSR) and HARP Analysis of Tongue Motion

Moriel NessAiver[1], Vijay Parthasarathy[2], Jerry L. Prince[2], Maureen Stone[3]
[1]University of Maryland Medical School, Baltimore, Maryland, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA; [3]University of Maryland Dental School, Baltimore, Maryland, USA

CSPAMM tagged cine images of the tongue are obtained during the repeated annunciation of short syllables. The use of Magnitude Image CSPAMM Reconstruction (MICSR), which produces tags which persist for more than 1000 msec, eliminates the need to process complex data and facilitates both the use of surface coil correction algorithms and harmonic phase (HARP) processing to compute motion and strain in two-dimensions. These improved processing methods allow us to measure tongue deformations in speech more easily, with more accuracy and using longer speech samples.

928. Comparisons of Rotation Algorithms for MR K-space and Image Data

Yunhong Shu[1], Wen-tung Wang[1], Matt A. Bernstein[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Rotation of a portion of k-space is required for some motion correction methods and other applications. The sharply-peaked nature of k-space data makes the problem challenging, in addition to being computationally intensive. Three rotation algorithms are investigated here: 1) bicubic 2) 3-pass shear, and 3) chirp-z. Rotations were performed on both MR k-space and image data. Qualitative comparison and quantitative metrics indicate that method 2) and 3) provide superior image quality than method 1), at the cost of more computation time. Rotation using chirp-z transformation offers the best trade off between image quality and computation time.

929. Registration of MR Data in the *k*-Space Domain using Projections

W. Scott Hoge[1], Carl Fredrik Westin[1]
[1]Brigham and Women's Hospital and Harvard Medical School, Boston, Massachusetts, USA

We present a method for the registration of two similar images via subspace projections in the Fourier domain. Two images that are similar up to a translation in the spatial domain exhibit a linear phase difference in their Fourier domain representation. We review a method based on this *Fourier shift theorem* that gives estimates of translational shifts between two images with subpixel resolution, and extend the concept to enable identification of image rotations.

930. Partial Volume Tissue Segmentation using Local Grey-Level Slope Information

David C. Williamson[1], Neil A. Thacker[1], Stephen R. Williams[1]
[1]University of Manchester, Manchester, UK

Partial volumes in MR images can lead to misclassification of pixels and substantial errors in volumetric estimation. Often ad hoc Bayesian priors, based on assumed structure of an image, are used to resolve ambiguities in classification. However such methods may results in a model-driven segmentation, rather than one driven by the data. In this work the distribution of grey levels and the grey-level slope is modelled. A Bayesian tissue classifier is constructed from the model, requiring no assumptions about image structure. Segmentation of images of the human leg and the human brain demonstrate how this method removes commonly occurring artefacts.

931. A New Image Similarity Measure for an Improved Small-Scale Accuracy of Nonrigid Image Registration

Oskar Skrinjar[1], Yi-Yu Chou[1]
[1]Georgia Institute of Technology, Atlanta, Georgia, USA

Normalized mutual information (NMI) outperforms other image similarity measures (ISMs) in the case of rigid image registration (IR). However, it completely neglects information in the point neighborhood (PN). While the underlying (rigid) spatial transformation compensates for this problem in the case of rigid IR, it turns out that the PN information is critical for nonrigid IR. We propose a new ISM that incorporates PN information and show that it performs better than mean square difference (MSD) and NMI in the case of nonrigid IR. Such an ISM allows for an improvement of the small-scale accuracy of nonrigid IR algorithms.

932. Resampling Original Components Included MR Images Using Independent Component Analysis

Moyoko Saito[1], Toshiharu Nakai[1], Naoyuki Takei[2], Shumei Murakami[3], Shigeru Muraki[4]
[1]National Institute of Advanced Industrial Science and Technology, Ikeda, Osaka, Japan; [2]Institute of Biomedical Research and Innovation, Kobe, Hyogo, Japan; [3]Osaka University Graduate School of Dentistry, Suita, Osaka, Japan; [4]National Institute of Advanced Industrial Science and Technology, Tsukuba, Ibaragi, Japan

A phantom study was designed in order to demonstrate the property of independent component analysis (ICA) to resample the components of different T1 and T2 relaxation times included in MR images. Twenty-three combinations consisted of four MR images, which were selected from seven original MR images, were applied to the ICA. By choosing the appropriate TE and TR, the signals from the four original components included in the phantom were separated into the IC images with the resample rate over 70 %. ICA may be a tool to enhance tissue contrasts in MR images based on the relaxation times.

933. MRI Database Development and Visualization for Translational Science Studies

Udo A. Benz[1], John M. Sullivan[1], Miao Lu[1], Marcelo Febo[2], Craig F. Ferris[3]
[1]Worcester Polytechnic Institute, Worcester, Massachusetts, USA; [2]University of Puerto Rico Medical School, San Juan, Puerto Rico; [3]University of Massachusetts Medical School, Worcester, Massachusetts, USA

The science of high field MRI is growing exponentially and the amount of data collected is large. 1GB per study is not uncommon. We have developed routines that extract parameters from manufacturer-encoded files and store this information in a MySQL database with XML retrieval procedures. Graphical display tools facilitate the queries and subsequent analyses such as segmentation and registration. The Internet2 consortium is used for high bandwidth communication that allows real time collaborations amongst geographically distant research sites. Training and interactive research sessions between the two Internet2 universities viewed the same graphical tools and displays simultaneously.

934. De-Noising of MR Images by Complex GCV Wavelet Algorithm

Uri Nevo[1], Israel Tvito[1], Gadi Goelman[2], Solange Akselrod[1]
[1]Tel Aviv University, Tel-Aviv, Israel; [2]Hadassah Hebrew University Hospital, Ein Karem, Jerusalem, Israel

A de-noising scheme is presented here whereby the complex components of the image are decomposed by Wavelet transform and de-noised by General Cross Validation (GCV) threshold, prior to the reconstruction of the magnitude image. We show that this de-noising scheme improves the SNR in both simulated and experimentally acquired images, and allows significantly more reliable analysis of the images. The Complex-GCV denoising scheme minimally affects the image sharpness, and is superior to other commonly used Wavelet de-noising schemes.

935. 3D-Reconstruction of Bone Structures From Multi-Spectral MRI Data Sets

Christian Dullin[1], Thomas Körbs[1], Peter Adam[2], Paul Seidel[2], Alexander Petrovitch[2], Werner A. Kaiser[2], Jürgen R. Reichenbach[2]
[1]3di GmbH, Jena, Thuringia, Germany; [2]Friedrich-Schiller University, Jena, Germany

An image reconstruction algorithm was developed and tested to extract and visualize bone structures of the human head in-vivo from T1-weighted and proton-density-(PD)-weighted 3D-MRI data sets, which were acquired with an isotropic voxel resolution of 1 x 1 x 1 mm3. Image data were transformed to a two-dimensional feature space whose parameters were estimated with an expectation-maximation (EM) algorithm. A mean geometric deviation of less than 1 mm in all directions was obtained between the reconstructed skull from MRI data and the corresponding reconstruction from CT data of a patient.

936. Variable Contrast and Brightness for Extended FOV MRI

Stephen J. Riederer[1], Chengying N. Wu[1], Roger C. Grimm[1], David C. Kruger[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Recently a number of methods have been developed to image an extended field of view; e.g. > 100 cm, using either multiple-station or continuous table motion techniques. Because of the variation in signal over the extended image, it may be difficult to select display brightness and contrast settings well suited to the entire FOV. The topic of this poster is the development of a technique in which brightness and contrast may vary continuously across the image. This provides an image which optimally portrays targeted structures but without discontinuities in brightness. The method is demonstrated using peripheral runoff MRA studies

937. Building Optimal Statistical Deformable Model with Manifold Embedding

Paramate Horkaew[1], Robert D. Merrifield[1], GuangZhong Yang[1]
[1]Imperial College, London, UK

We describe the creation of an optimal statistical deformable model from a set of surfaces whose topology is homeomorphic to a compact 2D manifold with boundary. The optimal parameterization of each shape is recursively refined by using hierarchical PBMs and B-spline representation of the surfaces. A criterion based on MDL was used to define the global correspondence. The strength of the proposed method is demonstrated by deriving a concise statistical model of the LV, which has principal modes of variation that correspond to intrinsic cardiac motions. The extension of the technique to shapes with complex topology is also discussed.

938. An Optimised Gel Dosimeter for Verification of Absolute Radiation Dose using MRI

Gary Paul Liney[1], Andrew Beavis[2], Alan Heathcote[1], Alan Jenner[1], Lindsay Turnbull[1]
[1]University of Hull, Hull, East Riding, UK; [2]Hull & East Yorks Hospitals, Hull, East Riding, UK

This work demonstrates the efficacy of MRI in providing absolute dose verification for Radiotherapy planning. A new type of gel dosimeter is used to provide a calibration of R_2 versus dose. The gel has a number of advantages over previous materials in terms of production, reproducibility and an extended dose range. The calibration technique is used to verify dose measurements in a separate vessel in three dimensions, to within 2% of delivered intent. This technique will be invaluable in the acceptance testing of Intensity Modulated Radiotherapy, which permits advanced conformal treatment and therefore requires rigorous quality control.

939. Quantification of Fluid using Calibrated Magentic Resonance Hydrometry

Johannes T. Heverhagen[1], Dominik Boehm[2], Klaus J. Klose[3]
[1]The Ohio State University, Columbus, Ohio, USA; [2]MeVis, Bremen, Germany; [3]Philipps University, Marburg, Hessen, Germany

Quantification of fluid in vivo is a desirable goal in diagnostic imaging. Purpose of our study was to show the feasibility to quantify steady volumes of fluid with heavily T2-weighted imaging. In a phantom study, we used calibration phantoms with known volumes to determine volumes of measurement phantoms. The results demonstrated a linear correlation between MRI signal and amount of fluid in phantoms and confirmed the possibility of easy and fast volume measurement. In conclusion, our study proposes a tool for non-invasive, fast and accurate measurement of fluid volumes. In vivo studies have to be conducted to verify the data.

940. Wavelet Packet Denoising of Complex Phase Difference MRA Images

John W. Grinstead[1], Shantanu Sinha[1]
[1]University of California Los Angeles, Los Angeles, California, USA

Phase subtracted (velocity encoded) images can suffer from low SNR when imaging small vessels. Wavelet packet filtering allows noise removal with less loss of resolution and detail than many methods such as Fourier analysis. Filtering of the complex data allows one to simultaneously improve the magnitude and phase images, and also allows one to assume a Gaussian noise distribution in each of the quadrature images that are filtered. A simplified wavelet packet denoising algorithm was tested on phantom and in-vivo cerebral phase-contrast flow data and was seen to provide noticeable improvements.

941. Spiral Steady State Free Precession Imaging with the Diminishing Variance Algorithm for High Resolution Coronary Artery Imaging

Robert W. Schaffer[1], Brian A. Hargreaves[1], Craig H. Meyer[2], Krishna S. Nayak[1], Bob S. Hu[3], Dwight G. Nishimura[1]
[1]Stanford University, Stanford, California, USA; [2]University of Virginia, Charlottesville, Virginia, USA; [3]Palo Alto Medical Foundation, Palo Alto, California, USA

A breath-held, cardiac-gated, fat-suppressed, steady state free precession (SSFP) sequence with short spiral readouts can produce high-resolution images of the coronary arteries; however, the resolution and SNR are limited by breath-hold length. The diminishing variance algorithm (DVA) reduces motion artifacts while maintaining SNR and allowing free breathing. It monitors heart position using navigators and iteratively improves a base image by re-acquiring motion-afflicted data. By combining a cardiac-gated, fat-suppressed, spiral SSFP sequence with navigated imaging using DVA we have the ability to produce sub-millimeter resolution coronary artery images in free-breathing subjects with good contrast and high SNR.

942. *Ex-Vivo* Rabbit Aortae Wall and Plaque Segmentation Using Texture Analysis, Region Growing and Thresholding

Nadeem Saeed[1], Andrew P. Blackaby[1], Paul D. Hockings[1], G Martin Benson[2], David G. Reid[1]
[1]GlaxoSmithKline, Welwyn, Hertfordshire, UK; [2]GlaxoSmithKline, Stevenage, Hertfordshire, UK

Atherosclerotic plaque deposition occurs along the aortic wall in WHHL rabbits. 3D MRI of rabbit aortae ex-vivo is useful for quantifying the build-up of plaque in this model. Manual segmentation of the aorta wall from the plaque is laborious, monotonous and prone to operator errors. A semi-automated method that employs texture analysis, region growing and thresholding has been developed to segment the aortic wall and plaque. Segmentation of five samples has resulted in good correlation (r=0.966) between the manual and the semi-automated methods. Paired t-test showed that the difference between the methods was not significant (p=0.2895).

943. Estimation of Noise Pixel Intensity for MRI Blood Flow Images

Arsalan Sepehri[1]
[1]University of Nottingham, Nottingham, UK

In the preceding work I introduced a new technique to estimate the noise pixel intensity for the MR blood flow images using Fourier Velocity Encoding Technique. The images, which have been used, are acquired on a MR system and were located on the femoral artery. I used a mathematical model to measure the noise. Knowing more about the noise will help to introduce a proper filtering in turn to help to diagnosis of arterial disease.

944. Measuring Clot Volumes using a Watershed Segmentation Algorithm.

Anne L. Martel[1], Gota S. Delay[1], Lucy R. Daniels[1], Paul S. Morgan[1], Alan R. Moody[1]
[1]University Hospital, Nottingham, UK

Recent thrombus within atherosclerotic plaque appears as a region of high intensity on T1 weighted fat suppressed images. Estimating clot volume is difficult as the signal intensity in both the plaque and the tissue background is heterogeneous. We have used a 3D segmentation technique based on the watershed method. In order to overcome the problem of over-segmentation, markers have been placed on the images marking the inside and outside of the thrombus. Interpolation is used to refine the segmentation. The user interface is quick and simple to use and reproducibility of the technique is acceptable.

945. An Automated Segmentation Method for Assessing Myocardial Infarct Size Using K-Means Algorithm

Priti Madhav[1], Vu Mai[2], Ming Zhang[3], Qun Chen[2]
[1]Northwestern University, Evanston, Illinois, USA; [2]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [3]MD OnLine, Lexington, Massachusetts, USA

The objective of the work is to develop an automated method for volumetric measurement of myocardial infarct volume. Segmented maps of the left ventricle with infarcted tissue were automatically constructed using k-means algorithm. This map can be used to assess the size of the infracted myocardium and diagnose the extent of myocardial injury in patients.

946. Visualizing 3D Difference Images in Comparative MR-Mammography

Michael Andrew Wirth[1], Alexei Stapinski[1]
[1]University of Guelph, Guelph, Ontario, Canada

Three-dimensional MR imaging of the breast allows for visualization of structures within the breast, their size, shape, and relationships with neighboring structures. The process of comparing contrast-enhanced MR images of the breast to delineate differences is often limited by difficulties in 3D visualization. To provide a clearer understanding of the 3D nature of a breast MR it is possible to use 3D rendering techniques such as iso-surface and volume rendering. This paper illustrates methods of blending visualization techniques to provide for improved comprehension of 3D difference images.

947. An algorithm for Extracting the Skin Surface in MR Breast Images

Michael Andrew Wirth[1], Rui Wang[1], Alexei Stapinski[1]
[1]University of Guelph, Guelph, Ontario, Canada

Segmentation of 2D MR breast images is usually composed of detecting (i) the breast/air boundary (skin edge) and (ii) the chest wall boundary. The individual 2D contours representing the skin edge can then be integrated to form a 3D representation of the skin surface. Extraction of the breast region through identification of the breast contour marks the outer margin of the breast, making it possible to exclude the non-breast region from the search for abnormalities. This paper outlines a simple algorithm to extract the skin surface from MR breast images.

Data Processing and Pulse Sequences

Hall D Saturday 14:00 - 16:00

948. Magnetic Resonance Artery Vein Segmentation

Harvey E. Cline[1], Siegwalt Ludke[1]
[1]GE Global Research Center, Niskayuna, New York, USA

Blood pool agents provide more time for the higher resolution three-dimensional acquisition; however, they contrast both arteries and venous structures. The bubble wave algorithm provides automatic segmentation for separating of arteries from veins in peripheral vascular disease to better assess the blood vessel morphology in magnetic resonance angiograms.

949. On the Resolution of HARP-MRI

Vijay Parthasarathy[1], Jerry Ladd Prince[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Harmonic phase MRI is used to measure myocardial motion and strain from tagged MR images. Since HARP uses a band-pass filter to extract the spectral peaks, it is natural to believe that HARP strain resolution is equal to the intrinsic Fourier resolution defined by the filter. We show here using a theoretical model and a computer simulation that the strain resolution is actually better than the intrinsic resolution.

950. A New HARP-based Method for Fast Tracking of 3D Cardiac Motion

Li Pan[1], Joao A.C. Lima[1], Nael F. Osman[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

We present a fast and semiautomatic method for tracking 3D cardiac motion from short- and long-axis tagged MRI images. The technique is based on the harmonic phase (HARP) method and extends it to track 3D motion. The phase time-invariance property of material points is used for motion tracking. The total time required for tracking 3D cardiac motion is ~10 minutes. Further analysis of Lagrangian strain and twist angle demonstrates that during systole, the lateral left ventricle wall shows a greater strain than the septum and the short-axis slices show a gradually changing twist pattern.

951. Simple Segmentation of Cardiac MR

Rado Andriantsimiavona[1], Derek L. Hill[1], Lewis D. Griffin[1], Reza Razavi[1]
[1]King's College London, London, UK

In the current work, an approach for cardiac segmentation is described that not only allows blood segmentation (as a mean to define cardiac chambers - left and right ventricles - and vessels) but also integrates user’s input - his interpretation of where the boundaries are - in a simple and user friendly way.

952. The Preprocessing Effect using k-Means Clustering and Merging Algorithms in Cardiac Left Ventricle Segmentation

Ik Hwan Cho[1], Jung Su Oh[2], Kyong Sik Om[3], In Chan Song[4], Kee Hyun Chang[4], Dong Seok Jeong[1]
[1]Inha University, Incheon, Republic of Korea; [2]Seoul National University, Seoul, Republic of Korea; [3]Medical Research Center,, Seoul, Republic of Korea; [4]Seoul National University Hospital, Seoul, Republic of Korea

In MR cardiac left-ventricle (LV) segmentation using snake model, the preprocessing method to remove artifacts is necessary since the contour may converge into undesirable one because of artifacts inside of LV. Therefore we propose the new preprocessing method using k-means clustering and merging algorithms and evaluate its effect as comparing the segmentation results before and after using images preprocessed by our proposed method in the GVF (Gradient Vector Flow) snake model. With the proposed preprocessing method, artifacts inside of LV disappeared and then contour can converge into correct one, and the performance of the GVF snake model can be improved.

953. Denoising of the Dynamic Sequence of Images for Cardiac Perfusion Studies

Dmitri Y. Riabkov[1], Edward V.R. Di Bella[1], Albert J. Sinusas[2]
[1]University of Utah, Salt Lake City, Utah, USA; [2]Yale University, New Haven, Connecticut, USA

Estimation of the kinetic parameters of the myocardial tissue in cardiac perfusion studies requires rapid dynamic image sequences with high SNR to follow the contrast bolus. Principal component analysis (PCA) was applied to dynamic sequences and a significant noise reduction was achieved. Since the accuracy of PCA denoising increases with the number of images per unit time, it somewhat compensates for the higher noise intrinsic to rapid imaging. Model parameter estimates obtained without use of an arterial input function were improved by processing with PCA.

Exploitation of RF Techniques for MRI

Hall D Sunday 13:30 - 15:30

954. Strip-MAMBA: Combined Step Field and Gradient 2D Planar Encoding

Martyn Paley[1], Kuan Lee[1], Jim Wild[1], Stan Fichele[1], Elspeth Whitby[1], Iain Wilkinson[1], Edwin van Beek[1], Paul Griffiths[1]
[1]University of Sheffield, Sheffield, Yorkshire, UK

A new method of collecting ultra-fast 2D images, known as strip-MAMBA, has been demonstrated experimentally. The images have conventional resolution in the frequency encode direction but orthogonal in-plane resolution dependent on the number of coils in a B0 step field array, which encodes through a priori knowledge of the coil location. A single unidirectional readout gradient is used to encode one dimension whilst the second in-plane dimension is encoded without conventional switched phase encoding in a single shot. The method has been tested on phantoms yielding very rapid 2D image frame rates.

955. Magnetization Dynamics in the SSFP or FSE Sequences Made Simpler, Somewhat.

Patrick Le Roux[1]
[1]GE Medical Systems, Buc, France

A better understanding of the SSFP sequence is brought about by considering the transformation undergone by the magnetization from one center of the TR interval to the center of the next interval rather than from pulse to pulse as is usually done. Then the SSFP and FSE (or RARE or CPMG) sequences can be seen in the same framework. The rotation , stabilization by dispersion, the relaxation processes, and active stabilization can now be characterized in a simple manner for both sequences.

956. Improved Slice Profile and Reduced Fast Spin Echo Spacing with Variable-Rate Selective Excitation

Reed F. Busse[1], Belinda SY Li[2], Xiaojuan Li[3]
[1]GE Medical Systems, Menlo Park, California, USA; [2]GE Medical Systems, Evanston, Illinois, USA; [3]University of California, San Francisco, California, USA

The Variable-Rate Selective Excitation (VERSE) technique is shown to improve image quality by reducing fast spin echo spacing and improving slice profile. An algorithm was developed to use VERSE waveform reshaping to minimize echo spacing given specific prescription parameters and system constraints and was implemented for an SSFSE sequence to create shorter RF pulses with higher time bandwidth products. Phantom and volunteer experiments demonstrate reduced cross-talk, and increased resolution.

957. Fast T_2-Weighted MRI at 4 Tesla Using a TRAPS Sequence

Thomas Ernst[1], Kai Zhong[1], Dardo Tomasi[1], Juergen Hennig[2]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]Uniklinik Freiburg, Freiburg, Germany

Conventional RARE sequences require relatively high radio-frequency (RF) power deposition, which limits their utility at high magnetic fields (4T or higher). We have implemented a modified RARE-type sequence (named "transition between pseudo-steady states", or TRAPS) that affords a 3 to 5-fold reduction in RF power compared to a conventional RARE sequence with 180 refocusing pulses. The new sequence makes it possible for the first time to acquire high-quality T2-weighted images at high magnetic fields (4 T and possibly higher) in as little as 2-3 minutes.

958. Clinical 3T SAR Reduction Using VERSE Pulses

Yuval Zur[1], James Hugg[1], Avram Montag[1], Daniel Outmezguine[1], Reed Busse[2]
[1]GE Medical Systems, Haifa, Israel; [2]GE Medical Systems, Menlo Park, California, USA

Over the past several years, 3T scanners have become increasingly used for routine clinical scanning. In order to achieve the same slice coverage as in routine scanning at 1.5 T, while staying within the SAR regulatory limits, it is necessary to modify the standard 1.5T imaging protocols. We have reduced the transmitted power in the spin echo and fast spin echo pulse sequences by replacing the standard excitation and refocusing pulses with VariablE Rate Selective Excitation (VERSE) pulses.

959. Starter Sequence For Steady State Pree Precession Imaging

David L. Foxall[1]
[1]Philips Medical Systems (Cleveland) Inc., Cleveland, Ohio, USA

This paper presents preconditioning sequences for balanced steady state free precession imaging that can either excite or store Z magnetization, allowing imaging to be started or stopped at will. These sequences suppress start up oscillations uniformly across the SSFP spectral response, and can be phase cycled to eliminate static banding via signal averaging.

960. Adiabatic Inner Volume Selection (IVS) Method for High Resolution 3D MRI

Olli Gröhn[1], Joseph Poduslo[2], Clifford Jack[2], Joseph Lin[1], Michael Garwood[1]
[1]Center for Magnetic Resonance Research, Minneapolis, Minnesota, USA; [2]Mayo Clinic, Rochester, Minnesota, USA

A novel inner volume selection (IVS) method using single hyperbolic secant (HS)-pulses for slab selection for 3D imaging is introduced. The feasibility of the method for high-resolution 3D imaging is demonstrated by imaging amyloid-β plaques in transgenic mouse brain, *ex vivo*. The quadratic phase-roll caused by single HS refocusing pulses spreads the signal energy in the time-domain, which normally prevents use of single-HS pulses for refocusing. However, in 3D-imaging the phase variation over each imaging voxel was found to be insignificant, and a 17% improvement in signal-to-noise ratio resulted because receiver gain could be increased to reduce digitization noise.

961. Slice-Selective Spin-Echo Formation Using Hyperbolic Secant RF Pulses

Karin Shmueli[1], David L. Thomas[1], Roger J. Ordidge[1]
[1]University College London, London, UK

Hyperbolic Secant (HS) pulses are used for both excitation and refocusing with pulse parameters chosen such that the quadratic phase distributions compensate each other. Measured quadratic phase coefficients agreed with simulated values. A sharper slice profile was produced compared to that from a conventional spin-echo sequence using Sinc pulses. The true adiabaticity of the refocusing pulse may lead to better B1 insensitivity than so far achieved with frequency modulated (linear frequency sweep) pulses without any phase dispersion across the selected slice.

962. Directional Selective k-Space Acquisition ("DISKA") A Technique for Selectively Imaging Targeted Segments or Branches of a Contrast Enhanced Vessel

Dawei Gui[1], Nikolaos V. Tsekos[1], Robert J. Gropler[1]
[1]Washington University, Saint Louis, Missouri, USA

The aim of this work is to exploit the correlation between the geometry of a vessel (curvature, thickness, spatial orientation) and its k-space to selectively image portions of the vessel with high temporal and spatial resolution for potential use in guiding vascular interventions with MRI. Computer simulations and phantom studies demonstrate that with this approach a user-selected portion or branch of a vessel, that is oriented along a specific spatial direction, can be imaged by collecting a portion of the k-space. The lumen and sharpness of the targeted vessel remain virtually the same for full and partial k-space acquisition.

963. Incremental Contrast-Enhanced Quadruple Inversion Recovery MRI for Characterizing Temporal Patterns of Enhancement in Carotid Atherosclerosis

William Sean Kerwin[1], Vasily Yarnykh[1], Baocheng Chu[1], Marina Ferguson[1], Thomas S. Hatsukami[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

This study investigates the feasibility of monitoring incremental changes in contrast enhancement by repeated imaging over periods up to 30 minutes, with a black-blood preparation. The motivation is to characterize atherosclerotic plaque composition by temporal enhancement behavior. The method, called incremental contrast-enhanced quadruple inversion recovery (INCQIR), features very high spatial resolution, suppression of flowing blood at a wide range of contrast agent concentrations, and motion compensation via the KFRS algorithm.

964. Calibration Techniques for a PERiodic and Linear (PERL) Spatial Encoding Field

Samuel Patz[1], Mirko I. Hrovat[2]
[1]Brigham & Women's Hospital, Boston, Massachusetts, USA; [2]Mirtech, Inc., Brockton, Massachusetts, USA

Experimental images have recently been obtained using a novel spatial encoding field that is PERiodic in x and Linear in y (PERL). The PERL pulse sequence uses the PERL field as well as two standard linear gradients, readout and slice selection. To implement PERL and to successfully reconstruct images, both the amplitude of the PERL field and its spatial offset in x relative to the standard linear gradients are needed. Here, we describe two imaging calibration methods that allow the determination of these parameters.

965. Extended Multiple Periodicity Tagging Sequence

Vasiliki N. Ikonomidou[1], George D. Sergiadis[1]
[1]Aristotle University of Thessaloniki, Thessaloniki, Greece

Magnetic resonance tagging is a technique for non-invasively examining tissue motion in-vivo. Recently, new methods, based on selective excitation techniques, have been proposed that are capable of producing tagging grids with arbitrary spacing. This aims at producing a varying density grid, better suited to the characteristics of the expected motion. Grids of varying density can also be produced using the superposition of localized DANTE tagging sequences of different periodicity. In this paper, we will demonstrate that the flexibility of the above combination can be further enhanced by introducing a phase shift between the individual pulses of the DANTE sequence.

966. Independent Dual-Band Spectral-Spatial Pulses

John M. Pauly[1], Charles H. Cunningham[1], Bruce L. Daniel[1]
[1]Stanford University, Stanford, California, USA

A new method of designing dual-band spectral-spatial pulses is described that allows the two bands to be designed independently, and to have their own constant frequency offsets and linear shims.

967. A New Approach for the Design of Composite Pulses Based on the Extended Phase Graph (EPG)-Algorithm

Juergen Hennig[1]
[1]University Hospital, Freiburg, Germany

The paper presents a novel approach for the calculation of composite pulses using the extended phase graph (EPG)- algorithm. This is based on the insight, that the dephasing states F1, F1*, Z1, F2, F2*, Z2…., correspond to the Fourier transform of Mx(w), My(w) and My(w). Fourier transformation of a desired profile thus leads to the corresponding phases states, which can be reached by an appropriate sequence of RF-pulses. The use of the EPG-algorithm for periodic bandwidth-selective pulses is demonstrated. Applications for superstimulated echo sequences demonstrate the feasibility of producing stimulated echoes without the 50%-penalty in signal-to-noise of conventional sequences.

Rapid Imaging: Spin-Echo Methods

Hall D Monday 13:30 - 15:30

968. Strategies for Inner Volume 3D Fast Spin Echo MRI

Dimitris Mitsouras[1], Robert V. Mulkern[2], Lawrence P. Panych[3], Lei Zhao[3], Alan Edelman[1], Gary P. Zientara[3], Frank J. Rybicki[3]
[1]MIT Laboratory for Computer Science, Cambridge, Massachusetts, USA; [2]Children's Hospital, Boston, Massachusetts, USA; [3]Brigham and Women's Hospital, Boston, Massachusetts, USA

This project combines spatially selective excitations with an ultra-fast spin echo (FSE) acquisition technique to produce inner volume 3D FSE MR images at high resolution with minimal aliasing artifact. Two methods of spin selection are explored: first, 2D selective spin excitation along a spiral trajectory, and second, dual 1D selective pulses along orthogonal dimensions. In the former approach, reversed spiral trajectories allow for very short echo spacing. In the latter, variability in echo spacing must be introduced while care is taken to avoid stimulated echoes.

969. Simultaneous Echo Refocusing EPI (SER-EPI) using Spin Echoes

Matthias Guenther[1], Koichi Oshio[1], David Feinberg[1]
[1]Advanced MRI Technologies, Sebastopol, California, USA

Recently, the Simultaneous Echo Refocusing (SER) technique has been introduced for gradient-echo EPI sequences (SER-EPI). In this work we explain, how to extend the SER-EPI sequence for time-efficient simultaneous acquisition of multiple spin echoes. An additional phase-encode gradient pulse is introduced, which only affects the magnetization of the first of two slices, allowing to acquire the spin echo signal of both slices in the center of their k-space. This new sequence is used for diffusion-weighted imaging with only a single diffusion preparation for two slices. The Spin-Echo SER-EPI sequence provides time-efficient acquisition of multiple spin-echoes with a single echo train.

970. Ultra-Long Echo Trains for Rapid 3D T_2-Weighted Turbo-Spin-Echo Imaging

John P. Mugler, III[1], James R. Brookeman[1]
[1]University of Virginia, Charlottesville, Virginia, USA

Substantially longer echo trains for turbo/fast spin-echo imaging are advantageous for decreasing acquisition time or increasing spatial resolution. We investigated whether the previously described approach of tissue-specific prescribed signal evolutions could be optimized to provide considerably longer echo trains while maintaining contrast suitable for T2W brain imaging. Theoretical results predicted that this goal was achievable for an echo-train duration of up to 1000 ms, which is 50% longer than previously demonstrated and approximately four times longer than typically used for 2D TSE/FSE imaging. This prediction was experimentally confirmed for 3D T2-weighted TSE imaging using a 250-echo, 900-ms echo train.

971. k-Space Trajectory and Flip-Angle Effects in Hyperecho Imaging

Huairen Zeng[1], *R. Todd Constable*[1]
[1]Yale University, New Haven, Connecticut, USA

As field strength increases many pulse sequences are constrained by RF power deposition. Imaging approaches such as fast spin echo imaging can produce excellent images, but are power intensive. Reduced flip angle methods such as the hyperecho sequence represent a promising alternative. There are many free parameters in hyperecho imaging that influence SAR and image quality. This work examines a range of RF flip angle combinations, in terms of the impact on SAR, SNR, PSF, and T1- T2- weighting. The trade-offs between the many free parameters are described and comparisons are made to FSE and conventional spin echo imaging.

972. Assessing Spatial Resolution of Turbo Spin Echo Sequences *In Vivo.*

Sarah Wayte[1]
[1]University Hospitals of Coventry & Warwickshire, Coventry, UK

A (11) binomial tagging sequence demonstrated *in vivo* the reduction in percentage modulation, and hence spatial resolution, in the phase encoding direction with increasing echo train length of turbo spin echo (TSE) sequences. However, resolution in the frequency encoding direction was independent of echo train length. Using a HASTE sequence modulation in the frequency direction was visible across all tissue types but only across cerebrospinal fluid(long T2)in the phases encoding direction. This technique could be used to aid parameter selection of TSE and HASTE sequences *in vivo*, by matching resolution to the desired contrast and scan speed.

973. TIDE (Transition Into Driven Equilibrium)-Sequences for Brain Imaging with Improved Signal and Contrast.Behaviour

Juergen Hennig[1], *Klaus Scheffler*[1]
[1]University Hospital, Freiburg, Germany

The TIDE-sequence is based on a steady state free precession (SSFP) experiment, where variable flip angles are used to bring the spin system in and out of the signal steady state. The purpose of this paper is to demonstrate new implementations of TIDE for 2D- and 3D-applications, where the high S/N and the possibility to start data acquisition without delay are used to create images with contrast so far unattainable with SSFP-sequences. Especially MP-TIDE which is based on similar principles as MR-RAGE is demonstrated to produce images with very high gray-white matter contrast.

974. FASCINATE: Development of New Pulse Sequence for Simultaneous Acquisition of T_2 Weighted and Fluid Attenuated Imaging

Kazuhiro Takeo[1], *Akihiro Ishikawa*[1], *Masato Okazaki*[1], *Satoru Kohno*[1], *Koji Shimizu*[1]
[1]Shimadzu Corporation, Kyoto, Japan

A new pulse sequence that enables simultaneous acquisition of T2 weighted and fluid attenuated imaging was developed. We refer to this sequence as FASCINATE (Fluid Attenuated Scan Combined with Interleaved Non-ATtEnuation). In this new technique, the inversion pulse of conventional fast FLAIR is replaced with a fast SE acquisition that has additional 180(y)-90(x) pulse train. By using an appropriate scan parameters the first part of the sequence provides T2 weighted image and the second part provides fluid attenuated image. FASCINATE can greatly reduce the scan time to obtain both T2 weighted and fluid attenuated images.

Rapid Imaging: New Developments in Gradient-Echo Sequences

Hall D Tuesday 13:30 - 15:30

975. New Compact TrueFisp Startup Sequence for Optimizing the Transient Osciallation Behavior into Steady-State

Michael Gerhard Kaul[1], *Alexander Stork*[1], *Christian R. Habermann*[1], *Florian Weiss*[1], *Gerhard Adam*[1]
[1]University Hospital Hamburg-Eppendorf, Hamburg, Germany

Despite of the improvement in gradient performance which made TrueFisp (Balanced-FFE, refocused SSFP) applicable this steady-state sequence suffers of the poor transient behavior provoking artifacts or a long scan time by using dummy cycles. The aim was therefore to optimize the transient behavior by developing a compact preparation sequence based on the concept of magnitude-scaling and direction-selection. Simulations for sequence design purposes were performed. For experimental measurements the new preparation pulse sequence was implemented in the clinical Philips scan software. The oscillating behavior of simulated and experimental data was frequency analyzed and the effectiveness of the new sequence was shown.

976. General Framework for the SNR Analysis of Multiple-Acquisition SSFP

Neal Kepler Bangerter[1], Brian Andrew Hargreaves[1], Dwight George Nishimura[1]
[1]Stanford University, Stanford, California, USA

Refocused steady-state free precession (SSFP) is limited by high sensitivity to local field variation, particularly at high field strengths. Several methods have been proposed to reduce banding artifact by combining multiple phase-cycled SSFP acquisitions. In this work we present a general procedure for predicting the SNR of any multiple-acquisition combination method, and propose a sum-of-squares combination method that delivers both robust banding artifact reduction and high SNR.

977. The Sensitivity of TrueFISP to Mesoscopic Field Inhomogeneities

Sascha Köhler[1], Jens Maier[1], Karl-Heinz Hiller[1], Axel Haase[1], Peter M. Jakob[1]
[1]Physikalisches Institut, Wuerzburg, Germany

The purpose of the present study is to investigate the sensitivity of TrueFISP to mesoscopic field inhomogeneities and to analyse the effect of intravoxel dephasing in TrueFISP sequences compared to conventional gradient echo experiments. Numerical simulations on different off-resonance distributions were performed and compared to MR imaging experiments at 11.75T. In conclusion, TrueFISP shows a similar sensitivity to intravoxel dephasing than gradient echo experiments. In certain circumstances, TrueFISP is even more sensitive to intravoxel dephasing than gradient echo experiments.

978. Startup Method for Magnetization-Prepared SSFP Cine Imaging

J.J.M. Zwanenburg[1], J.P.A. Kuijer[1], J.T. Marcus[1], R.M. Heethaar[1]
[1]VU University Medical Center, Amsterdam, Noord-Holland, Netherlands

A startup method is presented to combine steady state free precession (SSFP) cine imaging with tissue tagging. The method consists of linearly increasing startup flip angles (LISA), together with interleaved segmented k-space ordering, and was compared with the standard $\alpha/2$ startup method. Unlike the $\alpha/2$ method, LISA was not prone to artifacts from spins that are far off-resonance due to chemical shift or field inhomogeneities. With LISA-SSFP, ghost artifacts from the interruption of the steady state were negligible, even in the first cine image obtained immediately after the application of the tissue tagging.

979. Steady-State Preparation for Improved Efficiency in Breath-Held Multi-Slice 2D FIESTA Imaging of the Heart

Glenn S. Slavin[1], Dan W. Rettmann[1]
[1]GE Medical Systems, Baltimore, Maryland, USA

To address the issue of slice misregistration in multiple-breathhold functional (cine) cardiac imaging, single-breathhold methods have recently been described. However, they are all subject to long breathholds and low spatial and/or temporal resolution. Two-dimensional methods are more robust than 3D for breathhold cine imaging of the beating heart, but they require the time consuming effort of setting each slice to steady state individually. The 2D technique proposed here provides a more rapid approach to steady state for successively acquired slices, thereby making breathhold multislice 2D imaging more efficient for functional cardiac imaging.

980. SNR Behavior of SSFP: Dependence on TR, Bandwidth & Gradient Performance Optimization

Daniel A. Herzka[1], Scott B. Reeder[2], Elliot R. McVeigh[3]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; [2]Stanford University Medical Center, Stanford, California, USA; [3]National Institutes of Health, Bethesda, Maryland, USA

The SNR behavior of SSFP was studied with respect to TR and receiver BW. Optimum imaging flip angle and the maximum signal are shown to be independent of TR and BW. Therefore, SNR is independent of TR and BW for a constant scan time and depends only on T1, T2, voxel size, and pulse sequence efficiency. Maximum gradient amplitude and slew rate are critical to optimize SNR. Simulations show current gradient performance is well matched: no appreciable gain in efficiency or SNR is possible within current peripheral stimulation limits or without the development of gradient hardware concepts for reduced stimulation.

981. SSFP Fat Water Separation by Fourier Transfer Phase Cycling and the Single Quadrature Dixon Method

Mitsuharu Miyoshi[1], Susumu Kosugi[1], Aki Yamazaki[1], Kenji Asano[1]
[1]GE Yokogawa Medical Systems, Hino, Tokyo, Japan

Steady-state free-precession(SSFP) provides strong signal, high contrast images in a short scanning time. However, its demerits are banding artifact and strong fat signal. Fourier Transfer Phase Cycling(FTPC) can separate GRE and Steady State Spin Echo(SSSE) terms from the SSFP signal and magnitude sum of them has less banding artifact. Single Quadrature Dixon(SQD) method can separate fat and water signal of the GRE and SSSE terms. By applying SQD in each terms of FTPC, fat is separated from SSFP water signal without banding artifact.

982. Real-Time Fat Supressed SSFP

Juan M. Santos[1], Brian A. Hargreaves[1], Krishna S. Nayak[1], John M. Pauly[1]
[1]Stanford University, Stanford, California, USA

Refocused SSFP is useful for real-time imaging due to its high SNR and good tissue contrast. In many applications such as coronary artery imaging, fat suppression is required to diminish artifacts and to obtain better tissue contrast. However traditional fat suppression methods are incompatible with real-time SSFP. This study considers fat suppression methods for real-time SSFP. Magnetization preparation is proposed as an effective fat suppression method.

983. Efficient yet Simple Stabilization of Refocused SSFP.

Patrick Le Roux[1], Belinda S.Y. Li[2], Graeme McKinnon[2], Jason Polzin[2]
[1]GEMS, Buc, France; [2]GEMS, Milwaukee, Wisconsin, USA

Signal stabilization schemes in refocused SSFP have evolved from a very simple one to rather elaborate ones using a sequence of variable pulse angles. Another approach uses a simple linear 'ramp up' of the nutation angle. Its justification by a simple linear system approach was somewhat questionable. By a change of reference frame one is able to more thoroughly justify this solution. It is then a matter of classical signal processing technique to design a more selective preparation giving much lower amplitude artifacts .

984. Transient State TrueFISP

Teng-Yi Huang[1], Chao-Ying Wang[1], Tzu-Chao Chuang[1], Hsiao-Wen Chung[1], Cheng-Yu Chen[2]
[1]National Taiwan University, Taipei, Taiwan; [2]Tri-Service General Hospital, Taipei, Taiwan

Recently, TrueFISP sequences draw much attention due to great benefits of cardiac and body imaging. However, TrueFISP does not gain popularity for brain imaging owing to the relative lower T1/T2 contrast between gray and white matter. In our study, we used recently reported transient-state phenomenon of TrueFISP combined with driven equilibrium magnetization preparation to peform fast T2-weighted imaging which provides image contrast similar to conventional Turbo-Spin-Echo. This acquisition scheme could be further applied to achieve other image contrast.

985. B_1 Insensitive FLASH Imaging

Danli Wang[1], Keith Arron Heberlein[1], Stephen Michael LaConte[1], Xiaoping Hu[1]
[1]Emory University/Georgia Tech., Atlanta, Georgia, USA

At high magnetic fields, RF inhomogeneity becomes substantial and unavoidable at high magnetic fields due to its dependence on the sample. It leads to intensity/contrast nonuniformities, which cause difficulties in image interpretation and segmentation. In this paper, we report an interesting observation that the FLASH sequence can be insensitive to RF inhomogeneity when the same coil is used for both transmission and reception and a proper flip angle is used.

986. Frequency Selective Balanced SSFP Imaging with Randomised TR

Jochen Leupold[1], Juergen Hennig[1], Klaus Scheffler[2]
[1]University of Freiburg, Freiburg, Germany; [2]University Hospital Basel, Basel, Switzerland

The balanced SSFP signal amplitude shows strong dependency on off-resonance frequencies (banding artifact). Several methods have been proposed to broaden the stopband for fat/water selection. However, a suppression is not possible for the whole range of off-resonance frequencies. Here we present a method that accomplishes the frequency selection by randomizing TR for each sequence repetition step and acquiring several acquisitions. It offers selectivity only to the on-resonance signal and suppresses off-resonance frequencies. The method is useful for applications which require averaging, such as low gamma nuclei CSI due to low SNR.

Rapid Imaging: EPI Methods

Hall D Saturday 14:00 - 16:00

987. Doubling EPI Resolution with Two k-Space Lines per Gradient Reversal

Andrew Nicholas Priest[1], Roger John Ordidge[2]
[1]UCL Hospitals NHS Trust, London, UK; [2]University College London, London, UK

The echo-planar imaging (EPI) readout length is limited by short T2 and T2* decay times, especially at high field. Within this time limit, the resolution achievable is restricted by gradient coil performance, particularly in the phase-encode direction, since the readout gradient must normally be reversed once for every k-space line acquired. However, two k-space lines may be acquired for each gradient reversal, using two signal coherences with the same contrast behaviour. Combining two such readouts within a modified stimulated echo sequence, EPI resolution can be doubled in the phase-encode direction without increased demands on the gradient amplitude or slew rate.

988. High Resolution, Multi Slab, Multi Slice, Single Shot Echo Planar Imaging

Pierre-Francois Van de Moortele[1], Essa Yacoub[1], Michael Garwood[2], Kamil Ugurbil[1]
[1]University of Minnesota Medical School, Minneapolis, Minnesota, USA

High resolution EPI data typically require either segmentation, or a reduced field of view. However, inter-segment signal fluctuations are difficult to correct, and field of view reduction is not convenient to study large brain areas. Here we introduce a versatile, modified EPI sequence, allowing to acquire high resolution data without segmentation. The principle relies on dividing the imaged slice into small stripes, sequentially sampled as individual images in a single shot.

989. Multislice T_1 Measurements in a Single Shot using LL-EPI

Benito de Celis[1], Penny A. Gowland[1]
[1]Nottingham University, Nottingham, UK

A Look-Locker EPI sequence has been used to make accurate, multislice T_1 measurements from a single recovery. The T_1 of three slices were measured in 3 seconds. A good agreement has been found between single slice IR-EPI measurements and the multislice Look-Locker-EPI measurements in phantoms containing solutions of Gd-DTPA.

990. Dual-Contrast Echo Planar Imaging with Keyhole for Dynamic Contrast-Enhanced Applications

Nadim Jon Shah[1], Maxim Zaitsev[2]
[1]Research Centre Jülich, Jülich, Germany; [2]Research Centre Jülich, Jülich (now at University Hospital, Freiburg), Germany

A new dual-contrast method for perfusion mapping applications, based on EPI combined with keyhole, half-Fourier and data sharing techniques, has been implemented on a clinical scanner. The method enables acquisition of two types of images predominantly T1- and T2*-weighted, both characterised with the same distortions and artefacts, with high spatial and temporal resolution. The feasibility of bolus tracking and contrast agent accumulation is demonstrated.

991. Spiral Echo-Planar Trajectories for 3D Non-Fourier Encoded MRI

Dimitris Mitsouras[1], Lawrence P. Panych[2], Alan Edelman[1], Gary P. Zientara[2]
[1]MIT Laboratory for Computer Science, Cambridge, Massachusetts, USA; [2]Brigham and Women's Hospital, Boston, Massachusetts, USA

Spatially selective excitations can increase the acquisition efficiency of MRI by encoding the signal prior to acquisition using encoding bases other than the Fourier basis. However, spatially selective excitations require relatively long RF pulses which may limit their usefulness. Spiral trajectories through k-space can be used to minimize excitation time for 3D MRI by optimizing the k-space trajectory. Spiral trajectory use during excitation (of 2D encoding functions) or in acquisition (of 2D responses) allows us to maintain image quality in 3D MRI, while achieving speedups through software-based adaptive encoding methods.

Rapid Imaging: Moving Table and Complex Acquisition

Hall D Sunday 13:30 - 15:30

992. Adaption of HASTE for Continuous Moving Table Acquisition

Matthias Weigel[1], Hans-Peter Fautz[1], Nadir Ghanem[1], Oliver Speck[1], Juergen Hennig[1]
[1]University Clinics Freiburg, Freiburg, Germany

An axial whole body technique with continous table movement supplying clinical T2-contrast or STIR-weighted images is presented. The acquisition is based on a single shot HASTE sequence. The established protocol is motion-insensitive and allows free breathing of the patient during the measurement. The protocol yields five independent sets of axial images for a gapless homogenous coverage of the whole human body. RF power deposition into the patient’s body was drastically reduced by introduction of the hyperecho mechanism into a conventional HASTE using TRAPS.

993. Implementation Issues Associated with Continuously Moving Table Methods for Peripheral Contrast-Enhanced MRA

Mohammad Sabati[1], Raymond W. Lau[1], Nirupama Nagarajappa[1], Michal Louis Lauzon[2], Richard Frayne[1]
[1]University of Calgary, Calgary, Alberta, Canada; [2]Seaman Family MR Research Centre, Calgary, Alberta, Canada

The major challenge to existing and contemplated peripheral MR angiography techniques is the large vascular territory (greater than 100 cm) that needs to be covered at moderate-to-high spatial resolution in, ideally, a single examination. Recently, large field-of-view (LFOV) peripheral contrast-enhanced MRA with continuously moving table has been proposed. The LFOV is built up as a local FOV_x is translated down the legs. In implementing moving table methods on an MR scanner, significant engineering issues arise. This work focuses on the engineering challenges and their solutions discovered in implementing LFOV MRA on a clinical MR scanner.

994. Steady State Effects in Continuously Moving Table Axial Imaging

Ajit Shankaranarayanan[1], Brian Hargreaves[2], Jean Brittain[1]
[1]GE Medical Systems, Menlo Park, California, USA; [2]Stanford University, Palo Alto, California, USA

An analysis of the steady state effects in continuously moving table axial imaging is presented. Simulation results and MR experiments show that the spins rapidly achieve steady state due to a natural "catalysation" effect.

995. MRI Combo Acquisitions Using Variable Acquisition Parameters and K-Space Data Sharing

Ralf Mekle[1], Ed X. Wu[1]
[1]Columbia University, New York, New York, USA

Further results on the combo acquisition approach to reduce clinical MRI scan time and improve data utilization are reported. The approach combines the acquisition of images of different contrasts into a single scan, using variable acquisition parameters and k-space data sharing. In this work, optimization of acquisition protocols was improved by minimizing three quantitative criteria. The general applicability of optimized combo acquisitions was tested by acquiring multi-slice images and images with pathology and examining the point spread function for a wide range of relaxation times..

996. Flow Measurements in the Xylem of Populus tremula x. P. alba: First Results

Ute Ariane Ludwig[1], Andreas Peucke[2], Heinz Rennenberg[2], Jürgen Hennig[1]
[1]University Hospital Freiburg, Freiburg, Germany; [2]University Freiburg, Freiburg, Germany

The flow velocity in plants is usually measured with heat tracer methods, which are in part invasive. Flow weighted MR imaging represents a non-invasive alternative to determine flow velocities. Our aim was (a) to measure the flow velocity in the xylem of older poplar plants with a 2T whole body MR scanner and (b) to combine this technique for comparison with the conventional heat tracer methods. For both methods we found flow velocities, which increase during illumination by approx. 22% compared to darkness. Therefore the MR experiments can be used for calibration of conventional heat tracer measurements.

997. Magnetic Resonance Electrical Impedance Tomography: Theory and Phantom Experiments

Soo Yeol Lee[1], Suk Hoon Oh[1], Byung Il Lee[1], Eung Je Woo[1], Min Hyoung Cho[1]
[1]Kyung Hee University, Yongin, Kyungki, Republic of Korea

Magnetic Resonance Electrical Impedance Tomography (MREIT) is a new imaging modality combining MRI and Electrical Impedance Tomography (EIT). In MREIT, we try to obtain electrical resistivity images utilizing the information of the magnetic flux density inside a subject that is produced by injecting electrical currents into the subject. We present the theory of MREIT with a novel image reconstruction algorithm called J-substitution algorithm and some experimental results obtained from a saline phantom.

998. MRI Measurement of Magnetic Susceptibility Using Volumetric Breath-Hold Gradient Echo Technique: A Phantom Study

Zili Chu[1], Raja Muthupillai[2], Zhiyue J. Wang[1]
[1]Texas Children's Hospital, Baylor College of Medicine, Houston, Texas, USA; [2]Texas Children's Hospital, Baylor College of Medicine, Philips Medical Systems, Houston, Texas, USA

MRI techniques that can measure magnetic susceptibility of the liver reliably in vivo would have important clinical applications for quantitative assessment of iron overload. From the vessel orientation dependence of the frequency offset of blood in the hepatic veins, the susceptibility difference between the liver tissue and venous blood can be obtained. A 3D gradient echo fast imaging technique was tested using a phantom. It was found that the susceptibility of the solution obtained from the measurement agrees with the expected value and that the result is not sensitive to flow induced phase shifts.

Rapid Imaging: Optimizing Trajectories and Encoding

Hall D Monday 13:30 - 15:30

999. Single-Shot MR Imaging Using Trapezoidal-Gradient Based Lissajous Trajectories

Hanhua Feng[1], Hong Gu[1], Wang Zhan[1], Su Xu[2], David A. Silbersweig[1], Emily Stern[1], Yihong Yang[1]
[1]Weill Medical College of Cornell University, New York, New York, USA; [2]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

A novel single-shot trapezoidal-gradient based Lissajous trajectory is proposed here to image the human brain. A feature of this trajectory is that its sampling points are located on a nonequidistant rectangular grid, which permits the usage of 1-D optimal algorithms to increase the robustness and speed in image reconstruction. Another advantage of the trajectory is that two images with different effective echo time can be obtained within a single excitation, which might be used for fast T2* mapping. Baseline images were acquired, and functional activation experiments were performed on human brain to demonstrate the feasibility of the new sequence.

1000. Optimizing Data Acquisition and Image Reconstruction for Generalized Series Dynamic Imaging

Jim Xiuquan Ji[1], Jingfei Ma[2], David C. Munson, Jr[1], Zhi Pei Liang[1]
[1]University of Illinois at Urbana-Champaign, Urbana, Illinois, USA; [2]University of Texas MD Anderson Cancer Center, Houston, Texas, USA

We present a new data acquisition and image reconstruction scheme for use with generalized series imaging. This scheme covers k-space in rotating stripes so that dynamic features can be reconstructed with high spatiotemporal resolution. Experimental results from a MRA study are presented to demonstrate the effectiveness of the proposed method.

1001. Minimum-Time Multi-Dimensional Gradient Waveform Design using Convex Optimization

Brian A. Hargreaves[1], Dwight G. Nishimura[1], Steven M. Conolly[1]
[1]Stanford University, Stanford, California, USA

Rapid sequences demand very efficient use of gradient strength and slew-rate. We present a general method of designing multi-dimensional, minimum-time waveforms, particularly preparatory and rewinder gradients, using standard optimization techniques. This method is easily adapted to design gradients subject to constraints on endpoints, gradient moments, amplitude and slew rate , and is fast enough to design most gradient waveforms during scan prescriptions. We have applied these techniques to design general oblique gradients as well as freely-rotatable rewinder gradients for spiral imaging.

1002. Rapid Three-Dimensional Imaging with a Variable Density Hourglass Trajectory

Daniel Ross Thedens[1]
[1]University of Iowa, Iowa City, Iowa, USA

Radial imaging acquisitions that purposely undersample parts of k-space have been applied to projection reconstruction and spiral imaging to considerably reduce imaging time at the expense of modest aliasing artifact. In this work, variable density sampling is applied to a three-dimensional "hourglass" trajectory to rapidly acquire fully isotropic 3D volumes. Initial studies demonstrate the feasibility of this technique to reduce imaging time by 33% or more while still producing high-quality images.

1003. Fast and Exact Solution for Spiral Trajectory Generation

Tun-Wei Hsu[1], Jan-Ray Liao[2], Chung-Ming Chen[1], Jyh-Horng Chen[1]
[1]National Taiwan University, Taipei, Taiwan; [2]National Chung Hsing University, Taipei, Taiwan

Generating an optimal spiral trajectory within hardware limits in real-time is a critical issue in the deployment of spiral MRI. Previously, real-time spiral trajectory generation was usually done using approximate solutions from differential equations. Therefore, the generated trajectory didn't match the Archimedean spiral trajectory exactly. We propose a real-time spiral trajectory design algorithm which can find a trajectory exactly matches to the Archimedean spiral. This algorithm used second-order solution to find a point on the Archimedean spiral that satisfies the gradient and slew-rate constraints. We show that the algorithm can find the solutions without iteration in 97% of the points

1004. Imaging Relaxation and Frequency Directly from a Single-Shot Signal

Donald Twieg[1]
[1]University of Alabama at Birmingham, Birmingham, Alabama, USA

A technique is described which is capable of single-shot imaging of local magnetization M0, frequency, and net relaxation rate R2*, is inherently free of off-resonance geometric errors, is more robust against susceptibility gradients than established methods, and may be more accurate in its R2* estimates. A disadvantage of the method is that reconstruction processing time is long at this early stage of development.

1005. Time-resolved Imaging with Radial Scanning

Ralf Lethmate[1], Hélène Ratiney[1], Yannick Crémillieux[1], Dirk van Ormondt[2], Danielle Graveron-Demilly[1]
[1]Université Claude Bernard Lyon I, CPE, Villeurbanne, France; [2]Delft University of Technology, Delft, Netherlands

Dynamic MRI is a challenging topic that opens a vast field in medical diagnosis such as contrast-enhanced MR angiography, hyperpolarized gas imaging, interventional imaging, etc. Dynamic (time-resolved) image sequences are ideally acquired with temporal and spatial resolution which are matched to the phenomenon of interest. Means for improving temporal resolution while maintaining spatial resolution are desirable. The present work investigates the ability of PA-Keyhole and the sliding window techniques to restore dynamic contrast changes when using radial scanning. An application of PA-Keyhole to in vivo ventilation of rat lungs using hyperpolarized helium is demonstrated.

1006. Initial Experimental Results from a PERiodic and Linear (PERL) Spatial Encoding Field

Samuel Patz[1], Mirko I. Hrovat[2], Seth Berger[1]
[1]Brigham & Women's Hospital, Boston, Massachusetts, USA; [2]Mirtech, Inc., Brockton, Massachusetts, USA

Initial experimental images are presented that were obtained with a novel periodic and linear spatial encoding field that encodes two dimensions simultaneously. Details of the encoding field coil and the hardware used to drive it are described. In addition, the basic pulse sequence and data collection scheme are discussed including the application of a novel phase encoding scheme where the spatial phase of the spatially periodic coil is varied.

1007. Exploiting Information Redundancy using an Undersampled Projection Acquisition Technique

Jose Luis Albornoz[1], Ignacio Contreras[1], Matias Rosenblitt[1], Pablo Irarrazaval[1]
[1]Pontificia Universidad Católica de Chile, Santiago, Chile

The acquisition of 3D data sets in MRI can be time demanding. In this work we explored the possibility of acquiring 3D data using Helical Undersampled Projections. This method was developed as a fast imaging technique for scanning tree logs taking advantage of their cylindrical symmetry. Our hypothesis was that it can be applied to certain parts of the body. We were able to acquire better images and reduce the scan time by a factor of 3.5 with respect to MS-2DFT, which confirmed our hypothesis.

1008. Genetic Design of Variable-Density Spiral Trajectories to Minimize Off-Resonance and Flow Effects

Brian M. Dale[1], Jonathan S. Lewin[2], Jeffrey L. Duerk[1]
[1]Case Western Reserve University/University Hospitals of Cleveland, Cleveland, Ohio, USA; [2]University Hospitals of Cleveland, Cleveland, Ohio, USA

Spiral trajectories have recently been an active area of research. They are known to have good flow properties but often suffer from off-resonance blurring. To alleviate this problem, k-space trajectory design can be formulated as a multi-objective optimization in order to reduce the off-resonance blurring while retaining the beneficial flow properties. A suitable multi-objective genetic algorithm is used here to find the set of center-out trajectories which are Pareto-optimal with respect to flow-artifact and off-resonance blurring. All Pareto-optimal trajectories have 6 interleaves and many have an unconventional, low-density spiral through the middle range of k-space frequencies.

1009. Improvements in the Single-Shot Burst Imaging Method

Simon John Doran[1], Marc Bourgeois[2], Martin Oswald Leach[2]
[1]University of Surrey, Guildford, Surrey, UK; [2]Cancer Research UK Clinical Magnetic Resonance Research Group, Sutton, Surrey, UK

The ultra-rapid imaging technique Burst was introduced in 1988. Although it had a number of highly attractive features for single-shot acquisitions, it has been seen as a low signal-to-noise ratio (SNR) method and few significant results have been presented since 1997. Here, we show images obtained using a technically much improved version of the sequence with higher spatial resolution and better SNR. We discuss briefly the causes of remaining image artifacts.

1010. BURST Imaging with Reduced Peak Power Requirement using Chirp Pulses

Benjamin Wilton[1], Paul M. Glover[1]
[1]Nottingham University, Nottingham, Nottinghamshire, UK

A modified BURST imaging technique with greatly reduced peak power requirements has been implemented. By using frequency modulation the pulse duration can be increased while maintaining the bandwidth of the response. The resulting image displays a quadratic phase roll in the readout direction with no reduction in magnitude. Results are presented of simulations and of experiments, where a sixteen-fold reduction in peak power was achieved. There is a theoretical maximum possible N-fold reduction in peak power, where N is the number of pixels in the readout direction.

1011. Investigating UNFOLD with Factors Greater Than 2

Calvin Lew[1], Frandics Chan[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA

UNFOLD can produce an increase in temporal resolution of almost a factor of 2 if half the FOV is known to be less dynamic than the other half. We explore the extension of UNFOLD to a factor n greater than 2, assuming that the principal signal dynamics were in the central 1/n of the FOV. We show here that UNFOLD with n=3 or n=4 follows the high temporal dynamics better than standard UNFOLD at lower temporal resolution but introduce aliasing when the aliased signal dynamics are too great. A scheme for reducing the ringing artifact for n>2 is introduced.

1012. (Almost) Free Lunch: Single-Shot STEAM MRI with GRAPPA

Jürgen Finsterbusch[1], Martin A. Koch[1]
[1]University Hospital Hamburg-Eppendorf, Hamburg, Germany

In single-shot STEAM MRI the read-out flip angle, and thus the signal-to-noise ratio (SNR), is limited by the field-of-view and resolution in phase-encoding direction. Parallel imaging techniques (PAT) allow to reduce the field-of-view and therefore to increase the flip angle of single-shot STEAM. As a consequence parallel imaging techniques like GRAPPA can be used to speed up single-shot STEAM measurements without sacrificing the SNR. This is in contrast to the combination of PAT with most other sequences.

Rapid Imaging: K-Space Artifacts and Corrections

Hall D Tuesday 13:30 - 15:30

1013. A Modified Projection Reconstruction Trajectory for Reduction of Undersampling Artifacts

Wen-Tung Wang[1], Roger C. Grimm[1], Stephen J. Riederer[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Recently projection reconstruction (PR) has received renewed interest in MR imaging. Due to its various advantages, undersampled PR has been applied to MR angiography and myocardial wall tagging. In this poster, we propose a modified trajectory for undersampled PR. As compared to typical PR trajectory, the modification samples more mid-frequency but fewer high-frequency k-space components. The trajectory was studied by extracting a portion of typical PR data of a knee. The feasibility study suggests that the modified PR trajectory may maintain spatial resolution and decrease undersampling artifacts, making it promising in resolution and time demanding applications.

1014. A Method to Determine the Interleaves That Can Be Omitted in Sparse Spiral Sampling

Bart Desplanques[1], Rik Van de Walle[1], Ignace Lemahieu[1]
[1]Ghent University, Ghent, Belgium

Many k-space trajectories that are used in practice are multi-shot trajectories (radial trajectories, interleaved spirals,…). In the interest of saving scan time, interleaves can be omitted (sparse trajectories). The choice of the interleaves that should be omitted is not always obvious. The existing performance figures that try to determine to what extent that images reconstructed from sparse trajectories correspond with the full trajectory images can be misleading. In this work we present an improved performance figure that takes into account the reconstruction properties that may result in undersampling artifacts. More specifically, we demonstrate the usefulness in sparse spiral sampling.

1015. Block Regional Off-Resonance Correction (BRORC): A Fast and Effective Deblurring Method For Spiral Imaging

Hisamoto Moriguchi[1], Brian M. Dale[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]University Hospitals of Cleveland / Case Western Reserve University, Cleveland, Ohio, USA

One primary disadvantage of spiral imaging is blurring artifact due to off-resonance effects. The conventional frequency segmented off-resonance correction method is computationally intense due to the required number of Fast Fourier Transforms. Here, a new fast off-resonance correction method 'Block regional off-resonance correction (BRORC)' is presented. In this method, FFTs are performed on matrices smaller than the full image matrix. Additional computational reductions can be expected if only specific regions of the image require deblurring since the off-resonance correction algorithm proceeds block-by-block through the reconstructed image. This new off-resonance correction method offers significant speed advantages over existing methods.

1016. Dynamic Contrast Agent Bolus Tracking Using a 3D T_1 Weighted Sequence: The Need for Sufficient kz Apodization

Michael Gillard[1], Jason Polzin[2], Ting-Yim Lee[1], Brian Rutt[1]
[1]Robarts Research Institute, London, Ontario, Canada; [2]GE Medical Systems, Waukesha, Wisconsin, USA

Use of dynamic 3D pulse sequences for absolute measurement of perfusion would have potential advantages of coverage, SNR and quantitative accuracy. This paper studies the consequences of Gibb's ringing in the axial direction resulting from insufficient apodization in the kz direction. This leads to reduced cerebral blood flow and volume values obtained through deconvolution analysis. Raw k-space data sets were acquired during a contrast bolus acquisition and apodized in the kz direction using various filter structures. With sufficient k-space filtering, the Gibb's artifact was reduced and MR derived CBF and CBV deviated from CT by less than 10%.

1017. Artifact Reduction and SNR Comparison of Multiple-Acquisition SSFP Techniques

Neal Kepler Bangerter[1], Dwight George Nishimura[1]
[1]Stanford University, Stanford, California, USA

Fully refocused SSFP sequences yield high signal in short scan times, but are limited by sensitivity to local field variations. Multiple SSFP acquisitions can be combined to reduce the banding artifact resulting from local field variations. The optimal choice of combination technique can be difficult to determine for a given application. In this work, we analyze the performance of several techniques for a range of tissues and tip angles, and show that the sum-of-squares technique is an attractive option in many cases where high SNR and low residual banding is desired.

1018. Calculating T_2 and B_1 from Decay Curves Collected with non-180° Refocusing Pulses

Craig Jones[1], Qing-San Xiang[1], Kenneth P. Whittall[1], Alexander L Mackay[1]
[1]University of British Columbia, Vancouver, British Columbia, Canada

A new method is introduced to fit T_2 decay curves collected using trains of refocusing pulses less than 180 . The method can handle either mono-exponential T_2 or multi-exponential T_2 distributions. T_2 and proton density ρ were calculated from phantoms using trains of refocusing pulses at 90 ,110 ,...,180 . Calculated parameters (T_2 and ρ) were within 10% of those from an optimized pulse sequence. Initial in vivo results with multi-exponential T_2 were similar to those in the literature. This method accounts for B_1 inhomogeneity and allows refocusing pulses significantly less than 180 thereby reducing power deposition.

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
Artifact Correction

Room 718A Monday 13:30 - 15:30 Chairs: Matt Bernstein and Jeffrey L. Duerk

13:30 *1019*. A Method for MR Eddy Current Characterization and Compensation

Marcus T. Alley[1], Angel R. Pineda[1], Roland Bammer[1], Michael Markl[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA

A generalized approach to the characterization and correction of eddy currents in magnetic resonance is presented. An impulse-response formalism is used to model the 4D phase evolution resulting from the eddy currents produced by test gradients along a single physical axis. A 3D phase contrast study of a static phantom was used to demonstrate the non-linear spatial variation of the eddy current effects. The fitted model parameters were then used to significantly reduce these residual phase errors. This approach provides a correction method for effects that are not possible to eliminate using gradient pre-emphasis filters.

13:40 *1020*. Evaluation of a Fourier Based Method for Calculating Susceptibility Induced Magnetic Field Perturbations

Jose Pedro Marques[1], Richard Bowtell[1]
[1]Magnetic Resonance Centre, Nottingham, Nottinghamshire, UK

Inhomogeneous B0 fields generate distortion in MR images, particularly those produced using EPI, and are responsible for T_2^* effects. It is therefore important to be able to quantify field inhomogeneities. We present a novel method for rapidly calculating frequency shifts due to spatially varying magnetic susceptibility, based on the approach used to calculate long-range dipolar field effects. The method relies on a simple expression that relates the 3D-Fourier transforms of the magnetization and the field. It has been used to evaluate field inhomogeneity in the head due to varying tissue susceptibility and the effect of lung movement in respiration

13:50 *1021*. Distortion-Free EPI with Half the Effective Readout Time using TRAIL

Andrew Nicholas Priest[1], Enrico DeVita[2], David L. Thomas[2], Roger John Ordidge[2]
[1]UCL Hospitals NHS Trust, London, UK; [2]University College London, London, UK

At high fields, magnetic susceptibility differences cause distortion and blurring in echo-planar imaging (EPI), related to the long readout. Distortion correction techniques relying on reference data acquired at a separate time point may suffer reduced efficiency on subject motion. TRAIL (Two Reduced Acquisitions InterLeaved) is a new technique that can halve acquisition times, interleaving two half-resolution images taken in rapid succession. It is shown here that TRAIL can be applied to halve effective EPI readout times. Additionally, any distortion may be removed using the phase difference between two TRAIL EPI images with different echo times, acquired in a single shot.

14:00 *1022*. T_2*-Weighted Measurements at High Fields Without Susceptibility Artifacts

Scott D. Kennedy[1], Zhong Chen[2], Patrick Connelly[1], Jianhui Zhong[1]
[1]University of Rochester, Rochester, New York, USA; [2]Xiamen University, Xiamen, People's Republic of China

Measurements of blood flow and oxygenation using gradient-echo images are complicated at high field strengths because of susceptibility artifacts caused by air-tissue or bone-tissue interfaces. Images from thick slices are particularly problematic. We demonstrate here that a modified CRAZED pulse sequence allows local T2*-weighted imaging with thick slices or large voxels without the need for sub-voxel encoding or selective excitation.

14:10 *1023*. Distortions in Diffusion Tensor Imaging (DTI): Putting it all together.

Jesper L.R. Andersson[1], Stefan Skare[1]
[1]Karolinska Institute, Stockholm, Sweden

Diffusion tensor maps suffer from geometric and intensity distortions caused by eddy current and susceptibility-induced field inhomogeneities. In addition, inevitable subject movements cause inconsistencies within the set of diffusion weighted images. We present a forward model for the imaging process that simultaneously consider all images (non-weighted and diffusion weighted) and all sources of distortion (eddy currents, susceptibility and movement). Based on this we derive an estimation model that allow us to simultaneously solve for parameters characterising these effects, thereby allowing for their correction.

14:20 *1024*. Removing Phase Artifacts from fMRI Data using the Stockwell Transform

Bradley Gordon Goodyear[1], Hongmei Zhu[1], Robert A. Brown[1], J Ross Mitchell[1]
[1]University of Calgary, Calgary, Alberta, Canada

Phase fluctuations can lead to image artifacts in BOLD-contrast MR images, reducing BOLD sensitivity. The Stockwell transform (ST), which determines frequency content at each time point in a time-varying signal, may be used to remove phase distortions. The time series of phase for each point in a 1D phase profile was subjected to the ST, and frequency components contributing to artifact were removed by replacing the magnitude of the artifact frequency with its median magnitude. This technique improves fMRI data quality by significantly reducing image ghosts. Artifacts can be removed while preserving frequency at all other time points.

14:30 *1025*. Absolute Correction of B_0 Fluctuations in Echo-Planar Imaging

Stefan Thesen[1], Gunnar Krüger[1], Edgar Müller[1]
[1]Siemens Medical Solutions, Erlangen, Germany

Rapid dynamic imaging methods in magnetic resonance imaging are sensitive to resonance offsets and fluctuations in the main magnetic field B0. In echo-planar imaging (EPI), constant and dynamic off-resonances produce image shifts most notably along the phase-encoding direction. Here, we propose a method to correct for the respective artifacts by computing the off-resonance frequency from phase differences between two k-space echos of the phase correction scan in EPI sequences. The method has been shown to consistently remove corresponding image shifts in functional and diffusion MRI. Thereby spatial object displacements are also minimized and allow a more accurate overlay onto anatomy.

14:40 *1026*. Reducing Motion-Related Artefacts Caused by 2D Phase Correction in Time Course EPI of the Human Brain at 4.7T

David L. Thomas[1], Enrico De Vita[1], Andrew N. Priest[1], Robert Turner[1], Roger J. Ordidge[1]
[1]University College London, London, UK

Elimination of the Nyquist ghost artefact in echo planar images is particularly problematic at high field. In this work, we examine the use of 2D phase correction for Nyquist ghost correction of an EPI time series, and suggest an alternative acquisition scheme which allows the calculation of 2D phase maps continuously throughout the acquisition. This method is shown to greatly reduce the deterioration of image quality seen when a single reference scan is acquired at the beginning of the EPI acquisition. We attribute this improvement to the reduced effect of subject movement during the time course.

14:50 *1027*. Generalized Modeling of Gradient Field Non-Linearities and Reconstruction of Phase Contrast MRI Measurements

Michael Markl[1], Roland Bammer[1], Marcus T. Alley[1], Mike E. Moseley[1], Gary H. Glover[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA

A generalized model to characterize gradient field nonlinearities and their effect on velocity encoding in phase contrast (PC) MRI is presented. The true gradient field demonstrates not only deviations from the nominal gradient strength but also from the original gradient direction and thus affects the value of encoded velocities but also velocity encoding direction. The true magnitude and direction of the underlying velocities can be recovered from the phase difference images by a generalized phase contrast velocity reconstruction which requires the measurement of full three directional velocity information.

15:00 *1028*. Correction of Respiration Induced Resonance Offsets by Simple Coil Arrangements

S Leach[1], P A. Gowland[1], R W. Bowtell[1], P Glover[1]
[1]University of Nottingham, Nottingham, Notts., UK

Respiration induced resonance offsets have been observed and their magnitude found to be linearly correlated with chest expansion. Two methods of correcting these offsets have been tested. A significant reduction in the observed offset for maximum inspiration and expiration has been achieved using a simple coil arrangement. A real time correction of RIRO by application of time varying equal and opposite fields is proposed.

15:10 *1029*. Progress on the RINGLET Motion Correction Method for 3D Elliptical Centric Acquisitions

Yunhong Shu[1], Andrew M. Elliott[1], Matt A. Bernstein[1]
[1]Mayo Clinic and Foundation, Rochester, Minnesota, USA

We describe recent development of the RINGLET (rings linked by Euclidean transformation) rigid-body motion correction algorithm for 3D image sets acquired with the elliptical centric (EC) view order. The characteristics of the EC acquisition enable the tracking of patient motion without dedicated navigator echoes when external markers are used (i.e., EC can be self-navigating). Motion in the plane of the two phase encoded directions is modeled with Euclidean group for rotation and translation. Retrospective compensation is applied to correct corrupted portions of k-space. This method is shown to improve motion-corrupted 3D image sets both qualitatively and quantitatively.

15:20 *1030*. Fast Motion Tracking of a Rigid Body Using MRI

Andreu F. Costa[1], Yi-Fen Yen[2], Daniel Petrie[1], Maria Drangova[3]
[1]The University of Western Ontario, London, Ontario, Canada; [2]Lawson Health Research Institute, London, Ontario, Canada; [3]Robarts Research Institute, London, Ontario, Canada

Previously, a spherical navigator echo (SNAV) technique has been shown to measure 3D rotations and translations of a rigid body. Although accurate, the algorithm used to find the rotations is too slow for real-time motion correction. We present an improved technique to analyze SNAV data that reduces 3D rotations to 2D, planar rotations by determining the axis of rotation (AOR) between two SNAVs. The orientation of and rotation about the AOR are used to initialize and constrain a fast 2D minimization search in the latitude-longitude plane. Results of this technique are presented for spherical navigator data at different k-space radii.

MRI System-Based Artifacts and Corrections

Hall D Saturday 14:00 - 16:00

1031. fMRI Gradient Noise Removal from EEG Data using Principal Component Analysis

Michiro Negishi[1], Silvina Holovits[1], Robert Todd Constable[1]
[1]Yale University, School of Medicine, New Haven, Connecticut, USA

Simultaneous EEG-fMRI recording has been used for localizing generators of EEG waveforms including epileptiforms. It remains a challenge to remove fMRI artifacts from EEG data without distorting the signals of interest. This work presents a method of MR gradient artifact removal based on statistically optimal subtraction of principal components extracted from contaminated signals. Using simulated epileptic spikes and simulated alpha waves superimposed on a real data contaminated with the gradient noise, it is shown that the proposed method results in better correlation between signals of interest and the recovered signals, compared to an adaptive average waveform removal method.

1032. Quantitative Investigation of Bias in Phased Array Combination

Mark Bydder[1], Martina Callaghan[2], Andi Williams[2], David Larkman[2], Jo Hajnal[2]
[1]University of Western Australia, Crawley, Western Australia, Australia; [2]Hammersmith Hospital, Imperial College, London, UK

Phased array coil images are typically combined into a single image using the square root of the sum of squares (SOS). However this method always produces a positive bias in the final image that can affect quantitative measurements. The effect of bias has been investigated in determining T1 and T2 and shown to cause errors that depend on the SNR and on the choice of data points sampled. To minimise errors, the SUPER method and a suitable acquisition strategy are adopted.

1033. A Way To Apply The real-SUPER Technique To Partially Parallel Imaging

Mark Bydder[1]
[1]University of Western Australia, Crawley, Western Australia, Australia

Combining the data from phased array coils using the sum of squares (SOS) leads to bias in the combined image. Bias may be avoided using real-Summation Using Profiles Estimated from Ratios (rSUPER), which requires the phase of the low-resolution images used for coil sensitivity information to be the same as the full-resolution images. Since the former are derived from the latter this is often the case. When applying the technique to partially parallel imaging (PPI), however, the phase requirement seriously limits the choice of sequence used for acquiring coil sensitivity information. A way around this limitation is presented.

1034. Anomalous Bo Field from a PERiodic and Linear (PERL) Spatial Encoding Coil

Mirko I. Hrovat[1], Samuel Patz[2]
[1]Mirtech, Inc., Brockton, Massachusetts, USA; [2]Brigham & Women's Hospital, Boston, Massachusetts, USA

Experimental images have recently been obtained using a novel spatial encoding field that is PERiodic in x and Linear in y (PERL). Any misalignment of the PERL coil seems to produce a small Bo field that produces an anomalous phase shift in the acquired data. Because two PERL coils are utilized in order to vary the spatial phase of the periodic component of the field, the anomalous phase shift varies with the spatial phase. In this work, we describe the attributes of the anomalous phase shift and describe how to correct for it.

1035. Correction of High Order Eddy Current Induced Distortion in Diffusion EPI

Yuji Shen[1], Serena Counsell[1], David J. Larkman[1], Mary Rutherford[1], Olga Kapellou[1], Joanna Allsop[1], Anthony David Edwards[1], Joseph V. Hajnal[1]
[1]Imperial College, London, UK

Diffusion weighted imaging with EPI is sensitive to eddy current induced distortions that vary with magnitude and direction of sensitisation. These result in errors in maps of apparent diffusion coefficient. Previous correction methods required extra images to determine errors without contributing to the final image data or only correct zero and first order errors. We have developed a method that corrects higher order errors and requires only pairs of images with reversed diffusion gradients. This allows error correction and signal averaging with no redundant data. The method has been tested by simulation, on phantoms and on brain examinations.

1036. Effects of Gradient Distortion on Low Frequency Current Density Imaging

Tim P. DeMonte[1], Richard S. Yoon[1], Dawn B. Jorgenson[2], Michael L.G. Joy[1]
[1]University of Toronto, Toronto, Ontario, Canada; [2]Philips Medical Systems, Seattle, Washington, USA

Low frequency current density imaging (LF-CDI) is a technique that uses MRI to measure volume current density (CD) distributions in tissue. 3D LF-CDI requires registration of three phase image sets corresponding to three orthogonal orientations of a subject. Proper registration is not possible in the presence of non-spherically symmetric distortion as in MRI. Mis-registration causes CD artifacts such as spurious CD values and CD curls. One source of distortion is nonlinear gradient fields. This can be measured and corrected using an appropriate phantom and data processing as is done here for an LF-CDI data set.

1037. Self Correcting Transform for Non-linear Magnetic Field Gradients in MRI

David George Kruger[1], Jason A. Polzin[2]
[1]Mayo Clinic, Rochester, Minnesota, USA; [2]GE Medical Systems, Milwaukee, Wisconsin, USA

There has been considerable recent interest in continuously moving table imaging. These imaging modalities acquire data in a restricted smaller FOV at any one time and sum the data together to form an extended FOV. However, when the moving FOV is extended beyond the length of gradient linearity significant blurring will result. In this poster a method is detailed in which the gradient non-linearities are self-corrected within the reconstruction engine itself rather than by Fourier transform and later image warping.

1038. A New Method for the Reduction of Spectral Ghost Artifacts in High Resolution Echo-Planar Spectroscopic Imaging

Weiliang Du[1], Yiping P. Du[2], Xiaobing Fan[1], Marta A. Zamora[1], Gregory S. Karczmar[1]
[1]University of Chicago, Chicago, Illinois, USA; [2]University of Colorado Health Sciences Center, Denver, Colorado, USA

Inconsistency between odd and even echoes causes image ghosts in echo-planar imaging. This inconsistency is also likely to exist in echo-planar spectroscopic imaging (EPSI), where a series of echoes are used to produce a proton spectrum in each image voxel. In our implementations of EPSI at high spectral and spatial resolutions, the water spectra suffer from the ghost artifacts, impeding accurate spectral quantitation. A post-processing method is proposed to correct for the relative shifts and the zero-order phase errors between odd and even echoes. This method significantly reduces the spectral ghost artifacts in the EPSI data.

1039. Auto Correction for Echo-Planar Nyquist Ghost Artifacts Without Reference Scan

Yan Zhang[1], Hee Kwon Song[1], Felix W. Wehrli[1]
[1]University of Pennsylvania Medical Center, Philadelphia, Pennsylvania, USA

A new algorithm obviating the need for a reference scan was designed and implemented to correct for the Nyquist artifact in EPI. It is based on a search scheme whereby the pixels pertaining to overlapping regions were identified and subsequently removed before searching for the phase difference between even and odd echoes. The algorithm is shown to be reliable and robust.

1040. Artifacts Caused by Transient Effects in Multi-Shot EPI

Calvin Lew[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA

Some MRI sequences such as perfusion imaging collect data when the magnetization is not in the steady state, causing the signal to vary during acquisition. GRASS EPI sequences exhibit ghosting artifacts in the phase-encoded direction due to the effect of these transients in k-space. We examined these effects using simulations and experiments in sequences with centric phase-encoding order. The artifacts depend on the flip angle, TR, and T1/T2. Furthermore, at high flip angles, the ghost pattern has modulation bands. Phantom experiments verified that, especially at high flip angles, significant artifacts could be observed.

1041. Iterative Nyquist Ghost Correction for Single and Multi-shot EPI using an Entropy Measure

Stuart Clare[1]
[1]University of Oxford, Oxford, UK

An iterative method for reducing the Nyquist ghost in EPI, based on an entropy cost function measure is evaluated. The method works well for both single shot and multi-shot EPI, but would be particularly useful in the multi-shot case where no other method currently exists that does not require either a reference scan, navigators, or user intervention.

1042. Automated Online EPI Distortion Correction for fMRI Applications

Maxim Zaitsev[1], Juergen Hennig[1], Oliver Speck[1]
[1]University Hospital, Freiburg, Germany

Geometric distortions are a well-recognised problem in echo-planar imaging (EPI), the technique most commonly used for functional imaging. This limits the accuracy of the registration between the reconstructed functional maps and high-resolution anatomical images, thus complicating the results interpretation. Increased availability of high-field imagers, where distortions are more pronounced, and high-performance gradient systems, which afford EPI with higher spatial resolution, requires the development of robust operator-independent correction techniques. Presented here is a simple and efficient fully-automated distortion correction protocol, which is based on the point-spread function mapping technique. Application of the distortion correction to a functional experiment is demonstrated.

1043. A Simulation Study on the Characteristics of Full and Partial Fourier EPI Imaging in the Presence of Susceptibility Gradients

Hong Gu[1], Hanhua Feng[1], Wang Zhan[1], Su Xu[2], David A. Silbersweig[1], Emily Stern[1], Yihong Yang[1]
[1]Weill Medical College of Cornell University, New York, New York, USA; [2]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

The artifacts induced by susceptibility gradients (SG) at various levels in gradient recalled EPI images were demonstrated and the characteristics of partial Fourier imaging in the presence of SGs were investigated using simulation. It is shown that the degree of geometric distortion increases with the magnitude of SGs, and significant signal loss occurs when the SG reaches a certain level. In addition, the directionality of the SGs along the phase-encoding direction has distinct asymmetric effects on the EPI images, whereas the effects of the SG along the readout direction is approximately symmetric.

1044. Simultaneous Acquisition of Gradient-Echo and Asymmetric Spin-Echo for Single-Shot Z-Shim

Keith Arron Heberlein[1], Kyle A. Salem[2], Xiaoping Hu[1]
[1]Emory University/Georgia Tech., Atlanta, Georgia, USA; [2]Siemens Medical Solutions USA, Inc., Atlanta, Georgia, USA

This paper describes a sequence that acquires a z-shimmed image and an image without z-shim in a single shot. The z-shimmed image is formed from the FID following the excitation pulse and that without z-shim is formed from an asymmetric spin echo EPI image. The sequence is timed such that both images have identical T2´ weighting. T2 decay between the images is minimized by a partial Fourier acquisition. Results show that the technique is robust for reducing signal lost due to susceptibility artifacts.

1045. Improved Detection of Bilateral Visual Activity in Ventrolateral Temporal Cortex at 7 Tesla Using a Z-Shim Technique

Cheryl A. Olman[1], Gregor Adriany[1], Kamil Ugurbil[1], Pierre-Francois Van de Moortele[1]
[1]Univeristy of Minnesota, Minneapolis, Minnesota, USA

We describe successful application of the z-shim technique in measuring cortical activity in the ventrolateral temporal lobe at 7 Tesla. Because fMRI data acquisition is inherently sensitive to T_2*, the enhanced effects of susceptibility artifacts due to air-tissue interfaces increase the difficulty of high field fMRI for large field of view or whole brain imaging. We acquired functional series in whole-brain slices showing bilateral activation in higher visual areas. The z-shim technique increased the number of significant voxels by 25% over uncompensated gradient echo EPI, and the BOLD fMRI contrast to noise ratio increased 50% in this region.

1046. High Accuracy Automated Template Based Correction of Brain MRI Intensity Distortion

Colin Studholme[1], Valerie Cardenas[1], Enmin Song[1], Andrew Maudsley[2], Michael Weiner[1]
[1]UCSF, San Francisco, California, USA; [2]University of Miami School of Medicine, Miami, Florida, USA

A novel template based automated MRI bias field correction scheme is described. Bias fields are estimated by deforming brain MRI data to a reference intensity template, and evaluating the ratio of the MRI values in the template and distorted scan after coarse spatial filtering of the data. Global RMS intensity error and coefficient of variation in manually segmented white matter in 9 test scans verify consistent reduction in residual intensity variation, with improved performance over the N3 method with default parameters.

1047. Combined Registration and Activation Detection for fMRI: Solving Both Problems Simultaneously

Jeff Orchard[1], Chen Greif[2], Gene H. Golub[3], Bruce Bjornson[4], M. Stella Atkins[1]
[1]Simon Fraser University, Burnaby, British Columbia, Canada; [2]University of British Columbia, Vancouver, British Columbia, Canada; [3]Stanford University, Stanford, California, USA; [4]British Columbia's Children's Hospital, Vancouver, British Columbia, Canada

The large blood oxygenation level dependent (BOLD) signal present in high-field (3T or higher) fMRI datasets can influence the accuracy of least-squares registration algorithms. In a new model, the registration and activation least-squares problems are combined into a single least-squares problem. A method to simultaneously solve for both patient motion and brain activation is proposed. A drastic reduction in stimulus-correlated registration errors is demonstrated on simulated fMRI datasets.

1048. Comparison between B_0 Experimental Mapping Techniques and Numerical Simulations at 8 T

Trong-Kha Truong[1], Roger A. Dashner[1], Donald W. Chakeres[1], Petra Schmalbrock[1]
[1]The Ohio State University, Columbus, Ohio, USA

Assessment of susceptibility artifact correction methods, particularly needed at ultra-high field strength, requires knowledge of the static magnetic field B0. Two experimental methods for B0 mapping were implemented on an 8 T MRI system: a 2D multislice echo-time encoding technique and a 3D double-echo gradient echo (GE) method. B0 maps of a phantom and a human brain were acquired with both methods and compared to numerical simulations, showing excellent agreement. The GE method is faster, but may be limited by signal loss and excessive phase aliasing near air/tissue interfaces, even at the shortest TE and ΔTE currently achievable.

1049. Mutual Information-Based Correction of B_0 Inhomogeneity, Susceptibility- and Chemical-Shift Artefacts

Stefan A. Reinsberg[1], Liz Moore[1], Simon J. Doran[1], Odysseus Benekos[1], Martin O. Leach[1]
[1]Royal Marsden NHS Trust and Institute of Cancer Research, Sutton, UK

A more accurate delineation of disease is required to fully exploit recent advances in external beam radiotherapy. MRI provides superior soft tissue contrast to computer tomography (CT) but suffers from inherent geometrical inaccuracies unsuitable for radiotherapy treatment planning. Main field (B0) inhomogeneity (system- and patient-based) distortions can be corrected by combining two images that differ only in the polarity of read gradients employed. This approach is not used clinically because the quality of the corrected images can become severely degraded. We present the first robust and tested tool for the correction of images for the effects of B0 inhomogeneities.

1050. Cross-Modality Registration: Validation and Application in Magnetisation Transfer Imaging

Mark Symms[1], Philip Boulby[1], Gareth Barker[2]
[1]Institute of Neurology, London, UK; [2]Institute of Psychiatry, London, UK

A technique to validate cross-modality registration tecniques is described. Serial scans are used from an interleaved MTR measurement sequence that acquires intrinsically registered images with proton density and Magnetisation Transfer weighting. The registration parameters from the serial registration of proton density weighted images are used as a "gold standard" for the serial cross-modality registration, which is performed between the first proton density weighted image and the second magnetisation transfer weighted image. It is then shown that a modified Automated Image Registration technique is capable of performing such cross-modality registrations with a high degree of accuracy.

1051. Spoiled Gradient Echo (SPGR) Ghost Artifact in Endoluminal MRI

Andrew CH Yung[1], Ergin Atalar[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Ghost replicas of endoluminal MR coil outlines have been observed in spoiled gradient echo (SPGR) sequences. The artifact is not caused by motion, and originates from oscillations in the incompletely RF-spoiled transverse magnetization that remains after each excitation. Changing the value of the linear RF phase increment (i.e., the seed value) affects the positions of the ghosts, while the TR, flip angle, and relaxation times affect only their amplitude. Computer simulations correctly predicted the locations of the ghosts observed in experiments, for a variety of seed values.

1052. An Analytic Study on the Tubular Stent Model

Cecil Chern-Chyi Yen[1], Henry Zhu[1], Yi Wang[1]
[1]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA

The quasistatic magnetic field equation is solved analytically for the tube geometry as a simplified stent model to predict RF shielding effects. Experimental results agree with theoretical calculation. The quasistatic magnetic field equation may be solved numerically for realistic stent geometry to predict stent artifacts.

1053. Signal Correction for Narrow-Bandwidth Coils

Mirko I. Hrovat[1], F William Hersman[2], Samuel Patz[3], Ross W. Mair[4], Ron L. Walsworth[4]
[1]Mirtech, Inc., Brockton, Massachusetts, USA; [2]University of New Hampshire, Durham, New Hampshire, USA; [3]Brigham & Women's Hospital, Boston, Massachusetts, USA; [4]Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, USA

Narrow-bandwidth coils (transmit and/or receive) provide unique problems for MRI. Effects are manifested as coil ring down, distorted signal lineshape, and poor slice profiles. If the coil response (L/R) is measured, it is then possible to design excitation waveforms and to correct NMR signals to compensate for the coil bandwidth.

Motion Artifact Correction

Hall D Sunday 13:30 - 15:30

1054. MR Motion Correction of 3D Affine Deformations

Guy Shechter[1], Elliot R. McVeigh[2]
[1]Johns Hopkins School of Medicine, Baltimore, Maryland, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

MRI motion correction is used to improve image quality while reducing total scan time. The Fourier nature of MRI is used to describe a technique for compensating for 3D affine transformations (translation + rotation + dilation + shear) of an object during the imaging process. We present the mathematical basis for this correction strategy and results of a simulated MR acquisition.

1055. A Comprehensive Approach for Correcting Motion and Distortion in Diffusion Weighted MRI

Gustavo K. Rohde[1], Alan S. Barnett[1], Peter J. Basser[1], Stefano Marenco[1], Carlo Pierpaoli[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

We present a method for removing artifacts related to patient motion and eddy-current induced image distortions in DW-MRI. The images are corrected for motion and distortion simultaneously using a well-established registration technique. Subject motion is modeled using a 3D rigid body transformation while image distortion is modeled using a general solution for eddy-current induced fields inside the magnet. The DW-MRI dataset can at the same time be rigidly aligned to a standard template. Thus our robust post-processing method can be used to simultaneously remove motion and distortion related artifacts as well as to position the dataset in a standardized orientation.

1056. Fast Helical-Spiral Spherical Navigator Echoes for 3-D Motion Detection and Inter-Scan Alignment

E. Brian Welch[1], Armando Manduca[1], Roger C. Grimm[1], Heidi A. Ward[2], Clifford R. Jack, Jr.[1]
[1]Mayo Clinic & Foundation, Rochester, Minnesota, USA; [2]ASL Central, GE Medical Systems, Milwaukee, Wisconsin, USA

We have employed a rapid (< 1/4 sec) spherical navigator echo (SNAV) to prospectively modify image acquisitions in serial MRI examinations. Detected motions using the faster helical-spiral SNAV and a computer-controlled phantom are now of comparable accuracy to previous results using a slower SNAV comprised of many circular trajectories. The faster SNAV also performs well in a pre-scan registration application for aligning image volumes acquired on different scanners at different times. Correlations of base and SNAV-aligned image volumes were comparable to or exceeded results achieved using a retrospective image registration algorithm.

1057. Motion Correction Using Two Interleaved Scans with Different View Orders

E. Brian Welch[1], Armando Manduca[1]
[1]Mayo Clinic & Foundation, Rochester, Minnesota, USA

It is possible to correct for in-plane interview translations in the frequency encode (FE) direction using repeated, interleaved 2DFT acquisitions where each data set has a unique acquisition order. The second data set's altered view order causes its corruption to be nearly linearly independent from corruption in the first data set. The translation time record may be found by solving the appropriate large system of linear equations. The technique was successfully applied to scans of a resolution phantom on a cyclically moving table.

1058. Automatic Retrospective Translational Motion Correction in Image Space

Armando Manduca[1], Lee M. Kiessel[1], David S. Lake[1], Richard L. Ehman[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Automatic retrospective motion correction algorithms based on iterative optimization of an image quality measure have been demonstrated in a variety of MRI acquisitions. These algorithms are computationally intensive and may require several minutes per image or more. One computational bottleneck is the need for an inverse FFT at each iteration to reconstruct and evaluate the image. We describe a method for performing the iterative search primarily in image space, greatly reducing the number of FFTs required. This can significantly increase the computational speed, particularly when the evaluation is performed only on a sub-region of the image.

1059. Use of Fiducial Markers for Motion Corrected MRI

Hendrik Zimmermann[1], Sven Zuehlsdorff[1], Reiner Umathum[1], Steffen Volz[1], Wolfhard Semmler[1], Michael Bock[1]
[1]Deutsches Krebsforschungszentrum, Heidelberg, Germany

A small inductively coupled coil was used as a fiducial marker to monitor the respiratory motion of the chest wall. Motion corrected T1-weighted spin-echo images were reconstructed using the position information of the marker coil which was obtained with a projection technique followed by peak detection. Therefore, projection gradients with z-dephasing for background suppression were incorporated into a spin-echo sequence. From up to ten complete data sets motion-corrected images at different breathing excursions were calculated.

1060. New Strategy for Simultaneous Suppression of Intra- and Inter-Slice Motion

Haitham M. Ahmed[1], Refaat E. Gabr[1], Keith Heberlein[2], Xiaoping Hu[2], Yasser M. Kadah[1]
[1]Cairo University, Giza, Egypt; [2]Emory Universty, Atlanta, Georgia, USA

We introduce a new method to simultaneously address the problems of intra- and inter-slice in-plane motion estimation. The new method works for sequences in which the k-space is collected as small number of bands. Instead of repeating the acquisition in the same format for the extra acquisitions when NEX>1, we present a new strategy to achieve the same NEX via overlapped acquisition. The overlapping area between consecutive acquisitions is used to estimate both translation and rotation parameters, which are subsequently used to perform correct reconstruction.

Motion and Artifact Correction Using Parallel Imaging

Hall D Tuesday 13:30 - 15:30

1061. PINs: Parallel Imaging Navigators

Mark Bydder[1]
[1]University of Western Australia, Crawley, Western Australia, Australia

SMASH Navigators compare a line of k-space predicted using SMASH with the actual measured line in order to navigate for motion artefacts. Although SMASH and its more general variants are conceptually helpful, they do not necessarily make best use of all the acquired data. In this abstract, an exact representation of the coil sensitivities is expressed in the full sensitivity matrix form of generalised parallel imaging. The matrix equations are solved by singular value decomposition (SVD) and navigator comparisons made using several lines of k-space.

1062. Optimising Artifact Removal in PPI Corrected GRASE Imaging.

David J. Larkman[1]*, Martina F. Callaghan*[1]*, Joseph V. Hajnal*[1]
[1]Imperial College, London, UK

Partially Parallel Imaging can be used to separate coherent ghosts in MR images. This allows flexibility in sequence structure and more complete correction of such artefacts. We have applied it to the Gradient and Spin echo sequence (GRASE) to deal with artefacts associated with mixing spin and gradient echoes. Such artefacts may be localised to particular regions with other regions being artefact free. We have developed a method to automatically vary the degree of ghost separation, so that only those regions of the image contaminated by ghosts are processed. This has a signal to noise ratio advantage over global correction.

1063. Generalised Motion Correction in Parallel Imaging

David Atkinson[1]*, Philipp G. Batchelor*[1]*, David J. Larkman*[2]*, Derek LG Hill*[1]*, Joseph V. Hajnal*[2]
[1]King's College London, London, UK; [2]Imperial College, London, UK

The extra information provided by multiple coils is used in this work to determine and correct for patient motion. The unknown phase errors caused by motion are included in an equation linking all the measured data to the coil profiles and underlying object. An optimisation scheme is used to determine these motion-induced phases. The motion-corrupted data is corrected and results demonstrated on volunteer images. There is no requirement to fit coil profiles to spatial harmonics.

Image Reconstruction

Hall D Saturday 14:00 - 16:00

1064. Partial Fourier Reconstruction for Spiral Imaging

Hisamoto Moriguchi[1]*, Jonathan S. Lewin*[1]*, Jeffrey L. Duerk*[1]
[1]University Hospitals of Cleveland / Case Western Reserve University, Cleveland, Ohio, USA

Partial Fourier reconstruction techniques have been investigated to reduce scan time in rectilinear sampling schemes in MRI. This abstract is, to our knowledge, the first proposed partial Fourier reconstruction technique for spiral MR sampling schemes. This technique employs variable density spiral (VDS) trajectories so that the Nyquist criterion is satisfied in the central region of k-space; the outer regions of k-space are undersampled. The projections onto convex sets (POCS) method is used in the reconstruction. The newly proposed partial Fourier spiral reconstruction (PFSR) technique permits reduced scan time when compared with the conventional spiral imaging.

1065. Iterative Partial K-Space Spiral Reconstruction Method

Bernd Aldefeld[1]*, Peter Börnert*[1]
[1]Philips Research Laboratories, Hamburg, Germany

Partial k-space spiral imaging still encounters unsolved problems relating to the correction of the image artefacts induced by the destruction of the Hermitian symmetry of the MR signal even under moderate phase errors. A new approach to partial k-space MRI is proposed, which is based on an iteration process alternating between image reconstruction and MRI simulation. The simulation data are used to successively improve the estimated k-space data that have not been acquired. Phase errors caused by spatially varying off-resonance, concomitant fields and other sources are accommodated in the procedure.

1066. A New Approach for Optimal Reconstruction Using Rescaled Matrices from Non-uniformly Sampled K-space Data

Hisamoto Moriguchi[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]University Hospitals of Cleveland / Case Western Reserve University, Cleveland, Ohio, USA

K-space gridding is commonly performed following non-uniform K-space MRI data acquisition. A drawback of conventional gridding algorithm is that the image quality depends on the density compensation function (DCF) used in the pre-compensation step. We present a new simple reconstruction algorithm that does not need density compensation. Instead, iterative procedures are performed on a rescaled matrix larger than the original-sized grid; the resulting reconstructed images are of quite high quality. The proposed algorithm provides a new approach for optimal image reconstruction; it represents an alternative to the previously proposed URS/BURS algorithms but with equal or better image quality.

1067. Reconstruction of the Magnetic Resonance Images Using Wigner Distribution.

Peter Novak[1], Amir M. Abduljalil[2], Vera Novak[3]
[1]Boston University, Boston, Massachusetts, USA; [2]Ohio State University, Columbus, Ohio, USA; [3]Harvard Medical School, Boston, Massachusetts, USA

Wigner distribution (WD) modified by smoothing has been employed for reconstruction of the Fourier encoded magnetic resonance images. MRI data were acquired using 8 Tesla whole body MRI system with routine 2D gradient echo encoding. Frequency variant of 2D WD was used. Results showed that WD applied on the oversampled k-space and using long smoothing windows reconstructs images without any phase distortion and gives higher signal to noise ratio than Fourier transform. It is concluded Wigner distribution can be used as a framework for design of advanced methods of magnetic resonance data processing.

1068. Phase-Sensitive Inversion Recovery Imaging using a Markov Random Field Model

Jim Xiuquan Ji[1], Lei Ying[1], Jingfei Ma[2], David C. Munson, Jr[1], Zhi Pei Liang[1]
[1]University of Illinois at Urbana-Champaign, Urbana, Illinois, USA; [2]University of Texas MD Anderson Cancer Center, Houston, Texas, USA

This paper addresses the image reconstruction problem for phase sensitive inversion recovery imaging. A new algorithm is proposed, which is based on a Markov Random Field model of the phase variations. An important advantage of the proposed method over other existing methods is that it does not require phase unwrapping or image filtering. The method is found to be robust and efficient for in-vivo brain imaging.

1069. Multipoint Dixon Imaging using Sensitivity Encoding

Jingfei Ma[1], James A. Bankson[1], Roger Jason Stafford[1]
[1]The University of Texas M. D. Anderson Cancer Center, Houston, Texas, USA

An imaging technique combining the robustness of multi-point Dixon (MPD) for fat-water separation with the reduced scan time of sensitivity encoded (SENSE) imaging was investigated in phantom and in vivo. The MPD and SENSE techniques were complementary with regard to SNR and acquisition time. The combination of the two techniques therefore provides fat-suppressed imaging that is insensitive to field inhomogeneities and offers image SNR and acquisition times that are comparable to chemical saturation techniques using similar acquisition parameters.

1070. A Post-processing Method for Obtaining Accurate T_2 Estimates from a Single Radial Fast-Spin Echo K-space Data Set

Maria I. Altbach[1], Ali Bilgin[1], Zhiqiang Li[1], Eric W. Clarkson[1], Arthur F. Gmitro[1]
[1]University of Arizona, Tucson, Arizona, USA

A simple post-processing method to generate high-resolution T2 maps from a single radial fast-spin echo (RAD-FSE) k-space data set is presented. The method presented here is superior to an existing method, because it reduces significantly the T2 bias in smaller objects.

1071. Faster Volumetric Imaging Using Hexagonal Sampling with Circular Support

Jiachen Zhuo[1], Fernando E. Boada[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

We demonstrate the use of a hexagonal sampling with circular support as a means to reduce the scan time in high resolution three dimensional MRI. Our results in experimental phantoms and human volunteers demonstrate that up to a 32% reduction in data acquisition time can be achieved with no loss of spatial resolution and only a slight decrease in the signal-to-noise ratio (~10%).

1072. Real-Time Diagnostic Cardiac Imaging with a Fast Multi-Coil Multi-Processor Reconstruction System

Ajit Shankaranarayanan[1], Andres Carrillo[1], Bob Hu[2], Graham Wright[3], John Pauly[4], Juan Santos[4], Jean Brittain[1]
[1]GE Medical Systems, Menlo Park, California, USA; [2]Palo Alto Medical Foundation, Palo Alto, California, USA; [3]University of Toronto, Toronto, Ontario, Canada; [4]Stanford University, Palo Alto, California, USA

A fast multi-coil multi-processor image reconstruction system for real time diagnostic cardiac imaging is described. Results, showing the efficiency of this reconstruction system, from volunteer experiments with different cardiac coils is also presented.

1073. Application of Variable FOV to Continuously Moving Table MRI

Houchun Harry Hu[1], Ananth Jayaseelan Madhuranthakam[1], David G. Kruger[1], Stephen J. Riederer[1], James F. Glockner[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

An approach is presented in which variable field of view (FOVy) in the Y phase encoding (R/L) direction is applied to the continuously moving table method for extended FOV MRI. Using variable FOVy allows both small and large objects present in the extended FOV to be imaged with FOVy dependent on their size. The spatial registration of data afforded by the continuously moving table method with variable FOVy does not allow for straightforward reconstruction due to data mixture from different FOVy at several frequency encoded locations. Interpolation methods are applied to reregister the data, leading to proper image reconstruction.

1074. Superresolution from Coplanar Image Sequences in MRI

Benoit Desjardins[1], Thomas L. Chenevert[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

Although successfully applied to satellite mapping and video surveillance and based on formal mathematical results, superresolution has recently been a very controversial topic in MRI and it has not been clear whether this set of techniques could indeed be applied to improve in-plane resolution from sequences of MR images. In this paper, we introduce both a scanning and a reconstruction method that successfully uses superresolution to improve resolution on sequences of coplanar images. Besides the improvement in resolution, the method also takes advantage of the chemical shift artifact to decouple water and fat signals.

MR Elastography: Techniques and Applications

Hall D Sunday 13:30 - 15:30

1075. Piezoelectric Bending Elements for Use as Motion Actuators in MR Elastography

Phillip Rossman[1], Kevin Glaser[1], Joel Felmlee[1], Richard Ehman[1]
[1]Mayo Foundation, Rochester, Minnesota, USA

Magnetic Resonance Elastography (MRE) is a phase contrast method that utilizes propagating acoustic waves to determine elastic properties of tissues. A mechanical actuator coupled to the tissue provides cyclic motion synchronized to the imaging sequence. We have designed a system for generating such motion in the MR environment incorporating readily available piezoelectric bending elements. Our initial measurements of both phantom and in vivo system performance are presented and the results are promising.

1076. Strain Encoded (SENC) Imaging with Multi-tuning: A Fast Technique for MR Elastography

Ahmed S. Fahmy[1], Nael F. Osman[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Non-invasively quantifying tissue elasticity (Elastography) can be achieved indirectly by measuring the strain of tissues under compression. Current MR Elastography techniques require many acquisitions to obtain images at different imaging parameters. In this work, strain maps are generated in a fraction of a second using fast implementation of Strain Encoded (SENC) MRI. Rapid acquisition is achieved using an EPI pulse sequence. The imaging parameters are also changed during acquisition; thus, repetition of the compression is not necessary. Preliminary results from a gel phantom confirmed the ability to reconstruct strain maps using only one compression.

1077. Encoding Harmonic Motion in MR Elastography Using the Imaging Gradients

John B. Weaver[1], Xiaochuan Qin[2], Marvin Doyley[1], Elijah van Houten[2], Francis Kennedy[2], Keith Paulsen[2]
[1]DHMC, Lebanon, New Hampshire, USA; [2]Dartmouth College, Hanover, New Hampshire, USA

Measurement of motion resulting from some mechanical excitation is essential to MR elastography. Current methods encode the motion with separate, phase cycled, bipolar gradient waveforms added between the RF excitation and the echo readout increasing the TE and the imaging time. We are using the frequency encoding gradient to encode the motion instead of using a separate motion encoding gradient. The TE is reduced from 14 ms to 3.6 ms increasing the SNR and reducing the imaging time. However, larger motion is required and small artifacts are introduced into the image at discontinuities caused by simultaneous motion and position encoding.

1078. Comparison of Two Simple MR Elastography Reconstruction Algorithms

Uwe Hamhaber[1], Uwe Klose[1]
[1]University of Tuebingen, Tuebingen, Germany

In MR elastography (MRE) it is possible to visualize snapshots of the propagation of a mechanical wave through soft tissue on MR phase images by motion sensitive MR imaging sequences. There are different approaches to reconstruct elastograms from these snapshots. We implemented two such algorithms. One is based on solving the equation of motion and the other determines the local wavelength of the mechanical wave. The aim of this work was to compare these two different reconstruction algorithms by applying them on our measured MRE data with continuous and pulsed mechanical excitation.

1079. Improved Characterization of Sol/Gel Phase Transitions in Agarose Gel with Combined Magnetic Resonance Elastography and Diffusion Weighted Imaging

Egbert Gedat[1], Jürgen Braun[1], Johannes Bernarding[1], Gerd Buntkowsky[2], Ingolf Sack[1]
[1]University Hospital Benjamin Franklin, Berlin, Germany; [2]Free University of Berlin, Berlin, Germany

Dynamic Magnetic Resonance Elastography enables the monitoring of the sol/gel transition in agarose. By heuristically varying the local shear stiffness, the solidification process could be numerically reconstructed. In a new approach, diffusion weighted imaging (DWI) was applied for a spatially resolved monitoring of the cooling process. To use the data without further assumptions for the reconstruction, the temperature dependence of the apparent diffusion coefficient (ADC) of water and gel was determined.

1080. The Maximum Likelihood Estimator of Stiffness for MR Elastography and its Approximation as an Adaptive Filter

Travis E. Oliphant[1]
[1]Brigham Young University, Provo, Utah, USA

MR Elastography (MRE) uses displacement measurements of vibrating tissue to reconstruct its mechanical properties for use in pathology detection and diagnosis and treatment monitoring. Under assumptions of isotropicity, incompressibility, and local homogeneity the Helmholtz equation models the relationship between shear modulus and displacement at a given frequency. Using Green's function analysis of the Helmholtz equation, the general Maximum Likelihood (ML) estimator for MRE reconstruction in isotropic soft tissues is presented. It is shown that a single iteration of a Newton-Raphson procedure for finding the ML estimate is a kind of adaptive ratio-of-filter method analogous to other reconstruction methods currently used.

1081. Magnetic Resonance Elastography of Bone Marrow – Preliminary Results of Phantom Studies

Juergen Braun[1], Georg Duda[2], Devakara Epari[2], Ingolf Sack[1]
[1]University Hospital Benjamin Franklin, Berlin, Germany; [2]Charité Campus Virchow-Klinikum, Berlin, Germany

Dynamic magnetic resonance elastography (MRE) enables the determination of spatially resolved biomechanical properties. The propagation speed of the enforced mechanical waves is related to tissue stiffness. The observed wave patterns are closely related to the geometry and biomechanics of the object. In this regard, the applicability of MRE to bone marrow for future application in bone healing was evaluated using a bone phantom. Different coexisting wave propagation patterns, separated by a small transition zone, were observed. The analysis of the wave propagation enabled the determination of elasticity parameters.

1082. Shear Modulus Measurements Obtained by MR Elastography: Validation with Mechanical Testing

Yuan Le[1], Jennifer L. Kugel[1], Richard L. Ehman[1]
[1]Mayo Foundation, Rochester, Minnesota, USA

Magnetic Resonance Elastography (MRE) is a technique for measuring the mechanical properties of tissue or tissue-like materials. While the MRE technique has been previously validated with static mechanical testing, this work compares the technique with dynamic mechanical analysis (DMA) testing. The results of these two tests show good correlation, with some systematic differences that are likely due to the non-linear characteristics of the material.

1083. Broad-Spectrum Beam Magnetic Resonance Elastography

Anthony J. Romano[1], Phillip J. Rossman[2], Roger C. Grimm[2], Joseph A. Bucaro[1], Richard L. Ehman[2]
[1]Naval Research Laboratory, Washington, DC, USA; [2]Mayo Clinic and Foundation, Rochester, Minnesota, USA

The measurement method termed Magnetic Resonance Elastography (MRE) permits a direct measurement of elastic displacements within media that are subject to forced vibration. Standard MRE methods, however, allow for sensitization to only a single frequency of vibration and must be phase locked to the mechanical stimulus. In this paper, we present a novel adaptation of standard MRE methods which permits an extremely rapid measurement of elastic displacements along a beam of interrogation due to broad-spectrum vibration. Temporal and spatial Fourier transforms are then performed on the displacement information to form dispersion images for elastic modulus, attenuation, and anisotropic characterization.

1084. 2D Approximation of 3D Wave Propagation in MR Elastography of the Brain

Scott A. Kruse[1], Richard L. Ehman[1]
[1]Mayo Clinic & Foundation, Rochester, Minnesota, USA

Previous brain Magnetic Resonance Elastography (MRE) was performed using a 2-dimensional MR acquisition. However, given the complex geometry of the brain, 2D imaging may not accurately represent the actual wave propagation. MRE was performed with a healthy volunteer, using a modified 3-dimensional gradient-echo phase contrast sequence. From this data the 3D motion vector was constructed. By viewing the coronal plane of the 3D slab the amount of through-plane motion was measured. These results indicate that the 2D images give an accurate record of wave motion. The SNR advantage of 3D imaging can be maintained with multi-NEX 2D scans.

Relaxometry and Contrast

Hall D Monday 13:30 - 15:30

1085. T_1 Map with Exponentially-Weighted *S*lice-*O*rder *RoT*ation (*SORT*)

H. MIchael Gach[1], *Costin Tanase*[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

T_1 maps are used with continuous arterial spin labeled (CASL) MRI to calculate perfusion. A rapid T_1 mapping technique using multislice echo-planar imaging (EPI) with *S*lice-*O*rder *RoT*ation (*SORT*) yields high SNR and dynamic range for a large number of slices, and enables T_{1S} (T_1 with RF saturation) measurements. We have optimized the technique with an exponentially-weighted sampling distribution. A theoretical comparison with linear and quadratic sampling distributions indicates that the exponential *SORT* technique can give modest improvements for both inversion and saturation recovery.

1086. Parameter Optimisation of TAPIR Method for Fast T_1 Mapping

Maxim Zaitsev[1], *Sven Steinhoff*[2], *Nadim Jon Shah*[2]
[1]Research Centre Jülich, Jülich (now at University Hospital, Freiburg), Germany; [2]Research Centre Jülich, Jülich, Germany

The error-propagation analysis of the accuracy of the T_1 values for TAPIR fast T_1 mapping has been performed, enabling derivation of recipes for the optimal selection of measurement parameters such as flip angle, preparation delay and number of points. The approach can mostly be transferred to other Look-Locker based techniques.

1087. Age and Sex: Effects on Brain Properties Assessed by ^1H_2O T_1 Histograms

William D. Rooney[1], *Xin Li*[1], *Frank W. Telang*[1], *Charles S. Springer, Jr.*[1], *Patricia K. Coyle*[2], *Elisabeth Caparelli*[1], *Thomas Ernst*[1], *Linda Chang*[1]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]State University of New York, Stony Brook, New York, USA

Cerebral ^1H_2O T_1 maps were collected from 29 healthy adult controls (17 M, 12 F) at 4 T. T_1 histograms were constructed and analyzed to determine the global white matter (WM) T_1 range, and normalized volume fractions of WM, gray matter (GM) and CSF tissue water. Significant sex differences in WM T_1 (F > M), and volume fractions of WM (M > F) and GM (F > M) were found. With age, the men showed significantly increased WM T_1 values, decreased GM volumes, and increased CSF. In contrast, women were much more immutable with age.

1088. Multiple Excitation Single Slice (MESS) Sequence for Contrast Optimisation in 3D Structural Imaging of the Brain

Donald W. McRobbie[1], *Rebecca A. Quest*[1], *Louise Teo*[2]
[1]Hammersmith Hospitals NHS Trust & Imperial College, London, UK; [2]Hammersmith Hospitals NHS Trust, London, UK

A 3D MP-RAGE T1-weighted structural MR sequence with an inversion prepulse has been modified to produce a series of 2D images at one slice location but with different effective inversion times. We call this sequence Multi-Excitation Single-Slice (MESS). MESS enables the in-vivo optimisation of structural MRI for tissue segmentation and relaxometry. Initial results show some differences with the theoretical brain signal models found in the literature and that the standard clinical implementation of this sequence is sub-optimal for structural neuro-imaging.

1089. Accurate T_1 Measurements at 8 Tesla Despite Radiofrequency Inhomogeneity

Chad A. Mitchell[1], *Trong-Kha Truong*[1], *Tamer S. Ibrahim*[1], *Petra Schmalbrock*[1]
[1]Ohio State University, Columbus, Ohio, USA

While many methods have been defined for measuring T1 relaxation rates, most rely on RF homogeneity, which cannot be guaranteed in ultra high field systems. In this work, we compare Inversion Recovery Spin Echo (IR-SE), Saturation Recovery Spin Echo (SR-SE), and Inversion Recovery RARE (IR-RARE) techniques. IR-SE appears to be the most stable against ultra high field RF inhomogeneity. Results are obtained for the relaxivity of Gd-DTPA and for T1 in gray matter, white matter, and cerebrospinal fluid.

1090. Relaxivity of Gd-DTPA in Solution with Different Macromolecular Content at Different Field Strengths from 0.7 to 8.0 Tesla

Chad Mitchell[1], *Chastity DS Whitaker*[1], *Hendrik von Tengg-Kobligk*[1], *Michael Knopp*[1], *Donald W. Chakeres*[1], *Petra Schmalbrock*[1]
[1]The Ohio State University, Columbus, Ohio, USA

Relaxivity for paramagnetic MR contrast agents has to be known for quantitative studies of contrast agent uptake in tissue. Relaxivity changes with field strength and in the presence of macromolecules. We measured relaxivity for Gd-DTPA in water, bovine serum albumin (BSA), and skim milk. T1 relaxivity increases with solid concentration by weight and decreases with field strength, thus making Gd-DTPA a less efficient agent for ultra-high field MRI. T2 times are unchanged or slightly increase with increasing Gd-DTPA concentration in BSA and milk.

1091. *In Vivo* Predictions of Cellular Density Map Quality for Iron-Oxide Loaded Cells

Chris V. Bowen[1], Paula J. Foster-Gareau[1], Chris Heyn[1], Brian K. Rutt[1]
[1]The John P. Robarts Research Institute, London, Ontario, Canada

The in vivo requirements for producing quantitative cellular density maps with R2' (R2' = R2* - R2) for iron-oxide labeled cells is presented. This is accomplished by separately characterizing two sources of R2' variance: intrinsic electronic noise (from finite image SNR) and background R2' for a tissue of interest. Background R2' was measured in two distinct tissue types (rat tumor and brain), while electronic noise predictions were confirmed with phantoms. Predictions indicate that an optimum tissue iron-oxide concentration exists for a given acquisition and tissue type, and cellular density maps having an SNR of 8-12 are possible.

1092. Detection of Mesoscopic Paramagnetic Particles and Clusters by using Local Signal Conservation in a Dephasing Background Gradient

Jan Henry Seppenwoolde[1], Max A. Viergever[1], Chris J.G. Bakker[1]
[1]University Medical Center, Utrecht, Netherlands

In this study, a gradient echo sequence with an unbalanced slice-selection gradient is used to detect mesoscopic paramagnetic particles and clusters. Because this sequence is used, susceptibility artifacts are selectively identified with positive contrast, while background signal is suppressed. The applicability of the modified GE sequence is demonstrated in vitro and in vivo for respectively mesoscopic susceptibility artifacts and paramagnetic loaded microspheres. The results show an easy, reliable and selective identification of the mesoscopic susceptibility artifacts and clusters of microspheres in a straightforward way.

1093. Quantitation of T_2-Effects in TSE-Sequences with Low Refocusing Flip Angles

Juergen Hennig[1], Matthias Weigel[1]
[1]University Hospital, Freiburg, Germany

The paper presents a theoretical approach to quantify the T1- and T2-contributions in CPMG-sequences with low refocusing flip angles. Even for modest reductions in the refocusing flip angle the stimulated echo contributions will become significant leading to a reduced T2-contrast at a given echo time. A corrected TEcorr can be calculated, which leads to images with identical contrast compared to a fully refocused TSE-experiment. This prolongation of TE allows the use of longer echotrains and is especially beneficial for sequences like hyperecho-TSE and TRAPS, which refocus all magnetization at the time of the zero phase encoding step.

1094. Optimised Clinical T_2 Relaxometry with a Standard CPMG Sequence

Gaby S. Pell[1], Anthony B. Waites[1], Regula S. Briellmann[1], David P. Lewis[2], Graeme D. Jackson[1]
[1]Brain Research Institute, Heidelberg, Victoria, Australia; [2]Nathan Kline Institute, Orangeburg, New York, USA

The quantitative accuracy and precision of the standard CPMG sequence for T2 relaxometry is compromised by deviations of the flip angles of the refocusing pulses from their ideal 180º values. It is demonstrated in this study that these effects can be obviated to a significant extent by widening the refocusing pulses with a corresponding modification to the interleaving scheme. This relatively simple change to the imaging sequence is shown to have significant benefits on the accuracy and reproducibility of phantom and clinical T2 measurements.

1095. Reliability of Multi-Echo T_2 Relaxation, T_1 Relaxation and Magnetization Transfer in Brain in Controls

Irene Vavasour[1], Campbell Clark[1], David Li[1], Alex MacKay[1]
[1]University of British Columbia, Vancouver, British Columbia, Canada

The reliability of five MR parameters (water content, myelin water content, magnetization transfer, T2 relaxation and T1 relaxation) was investigated using three reliability models. The absolute model, where measurements are identical and constant for all people, best explained MTR. The relative model, where measurements are constant within a person but vary over a population, described myelin water content and T1. The pattern model, where profiles of parameter over 5 white matter regions are constant for all people, was fit well except for water content. Water content and T2 showed a mixture of different models.

1096. Optimization of Multiple Spin-Echo Sequences for Quantitative R_2 Mapping in 3D

Yves De Deene[1]
[1]Ghent University Hospital, Flanders, Belgium

In this study, optimal sequence parameters are proposed to obtain a series of quantitative R2 maps (R2 = 1/T2) by use of existing imaging sequences such as single spin-echo and multiple spin-echo sequences. The concept of R2 resolution is introduced. It is shown that in multiple spin-echo sequences it is the number of spin-echoes that should be optimized in order to obtain the highest R2 resolution within the shortest measurement time possible for a subject that is characterized by a defined range of R2 values.

1097. Rapid, Quantitative T_2 Measurements at 3T

Juimiin Hong[1], Jeff A. Stainsby[1], Eric Han[2], Jean Brittain[2], Graham A. Wright[1]
[1]Sunnybrook & Women's College Health Sciences Centre, Toronto, Ontario, Canada; [2]GE Medical Systems, Menlo Park, California, USA

For higher field scanners, techniques to measure T2 need to be modified to account for the increased magnetic field non-uniformity and heat deposition. Localized B1 tuning over a small region may help minimize the error caused by the non-uniform field, and using a magnetization-prepared measurement sequence can reduce the amount of heat deposition. Our results suggest using local tuning and rectangular pulses when measuring a large volume will yield accurate T2 measurements. In contrast using global tuning and composite pulses will suffice when measuring small volumes.

1098. Accuracy of 8T T_2 Measurements: Evaluation of Errors due to RF Inhomogeneity

Chastity Diane Shaffer Whitaker[1], Trong-Kha Truong[1], Tamer S. Ibrahim[1], Petra Schmalbrock[1]
[1]The Ohio State University, Columbus, Ohio, USA

T2 relaxation times need to be accurately known to optimize image contrast for ultra-high field imaging (>7T), and for the assessment of relaxation mechanisms. Measurement methods, however, are complicated by severe RF inhomogeneity (excitation and reception fields) inherent with ultra-high field imaging. In this work we evaluated the flip angle dependency of T2 measurements with a standard multi-echo spin echo sequence and found that T2 measurements are accurate as long as regional flip angles do not deviate by more than approx. ±20° from a nominal 90° flip angle.

1099. The Transverse-Relaxation Spectrum of Optic Nerve

Isidro Bonilla[1], Keith Wachowicz[1], Richard E. Snyder[1]
[1]University of Alberta, Edmonton, Alberta, Canada

Three T2-relaxation components have been identified in rat optic nerve in vitro. Effects of the buffer solution were removed by adding FeCl3, to which nerve perineurium is impermeable. The relationship between the components and micro-anatomical water compartments of the nerve were tested by adding MnCl2, perineurium being permeable to Mn2+. This rapidly reduced the sizes of both the intermediate- and long-lived T2 components of the nerve, in contrast to only the intermediate of rat sciatic nerve. We conclude that rat sciatic and optic nerve exhibit similar three-component T2 spectra, but may not share a similar component-compartment relationship

1100. Relaxometry using Transient Steady-State Free Precession Imaging

Brian A. Hargreaves[1], Dwight G. Nishimura[1]
[1]Stanford University, Stanford, California, USA

Separation of tissue components by T2 measurements is usually performed using multi-echo (CPMG) spin-echo or repeated single-echo sequences, followed by a multi-exponential fit in a voxel or region of interest. The minimum echo spacing limits the ability to measure short-T2 components reliably. A new sequence that images during the transient period of an SSFP sequence can be used to obtain data with a slower exponential decay from short-T2 components as well as two to three times the temporal sampling density. Results show that this technique can separate the short-T2 component associated with myelin water in white matter.

1101. Optimized T_2 Selective Myelin Imaging

Logi Vidarsson[1], Kelvin O. Lim[2], John M. Pauly[1]
[1]Stanford University, Stanford, California, USA; [2]University of Minnesota, Minneapolis, Minnesota, USA

Until recently myelin maps have been computationally difficult to generate. We developed a new T2 selective imaging method which was tested by generating a myelin map of the upper brain of a normal volunteer. The myelin map is generated by linearly combining only 3 images at different echo times. The weights and echo times are optimized to filter low T2's, while keeping noise to a minimum. This method has shown great promise generating high resolution, low noise myelin maps, while requiring relatively small computation time.

1102. Determination of Confidence Regions of Model Parameters in Mono- and Biexponential Fitting of Relaxation Curves

Zenon Starcuk Jr.[1], Jana Starcukova[1]
[1]Academy of Sciences of the Czech Republic, Brno, Czech Republic

Various MRI and MRS data sets acquired by relaxation-sensitive measurements were analyzed with the aim to assess relaxation parameters. Considerable sensitivity of these parameters to the setup of the algorithm used to minimize the quadratic error of mono- or biexponential models was often found. Bad conditioning was identified as the principal cause, rather than the minimizing algorithm or noise alone. Interpretation of model parameters should take the inherent uncertainty into account. Simulated and real data were used to study the shape and extent of the confidence regions including those model parameter sets that are consistent with the data measured.

1103. Dipolar Contribution to Water Proton Signal Decay in Human Brain. Determination of the NOE at 4T.

Shalom Michaeli[1], Olli Grohn[1], Heidi Makela[1], Kamil Ugurbil[1], Michael Garwood[1]
[1]University of Minnesota School of Medicine, Minneapolis, Minnesota, USA

Fully adiabatic pulse sequences, based on Carr-Purcell (CP) type CP-LASER technique were employed to investigate the direct through-space dipolar coupling interactions leading to cross-relaxations, with their manifestation to the nuclear Overhauser effect (NOE) in human visual cortex V1. The apparent $T_2^{\dagger}$ measurements were alternated using: (i) 360^o-LASER pulse sequence, when 360^o pulses substituted part of the 180^o refocusing pulses in the CP train; (ii) Frequency Selective (FS) pre-inversion by Gaussian pulses prior to excitation in CP-LASER. In addition to dynamic dephasing, the contribution of the NOE and/or ROE (NOE in the rotating frame) to the transverse relaxation constants was demonstrated.

1104. Verification of an IMRT-Delivered Dose Distribution by Means of MR Polymergel Dosimetry Using a Modified Turbo-Spin-Echo Sequence

Achim Bankamp[1], Lothar R. Schad[1]
[1]Deutsches Krebsforschungszentrum, Heidelberg, Germany

For quality assurance in modern radiotherapy the complex dose distributions have to be verified three-dimensional. This can be performed with certain polymergel dosimeters which are evaluated by measuring the spin-spin-relaxationrate. In this study a polymer gel was irradiated using the IMRT technique. The resulting dose distribution was measured with an optimized TSE-sequence. The comparison of the obtained relative dose distribution with the calculated treatment plan indicates good agreement for the lines of isodosis >50% of the maximum dose. However, the results crucially depend on the calibration of the gel.

1105. Fast High-Resolution Imaging and Histogram Analysis of Cross-Relaxation Parameters in the Entire Brain

Vasily L. Yarnykh[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

A time-efficient technique is proposed for 3D imaging of cross-relaxation rate constant and content of bound spins in the entire brain. The technique uses four magnetization transfer (MT)-weighted images with variable offset frequency and maps of T1 and proton density. Reconstruction algorithm fits a matrix model of pulsed steady-state magnetization to voxel intensities assuming that the saturation rate for bound spins is independent of tissue type and described by superLorentzian line shape. Properties of parametric maps and whole-brain histograms are discussed. It was found that maps of bound pool fraction generate specific contrast, which highlights fiber tracts in white matter.

1106. A Thermodynamic Approach to Magnetization Transfer Processes Between Water and the Exchangeable Hydrogens of Biomolecules

Marina Benito[1], Alejandra Sierra[1], Paloma Ballesteros[2], Sebastián Cerdán[1]
[1]Consejo Superior de Investigaciones Científicas, Madrid, Spain; [2]UNiversidad Nacional Educacion a Distancia, Madrid, Spain

We report on the thermodynamics of reversible, pH dependent magnetization transfer in model solutions. Z-spectra and rate constants for the transfer of magnetization between the exchangeable hydrogens of L-glutathion and water was measured at three different pH´s (4.0, 6.5, 9.0) in the temperature interval 295-330 ºK. MT processes between water molecules presented more negative values of ΔG than MT transfers between exchangeable hydrogens of biomolecules and water, suggesting that the former are preferred energetically. MT activation energies were smaller than the activation energy for water diffusion, indicating that MT processes are limited by water diffusion.

1107. Field Dependence of the Bright Fat Effect in Fast Spin Echo Imaging: Theory and Experiment

Robert V. Mulkern[1], Alan B. Packard[1], Giulio Gambarota[2]
[1]Children's Hospital, Boston, Massachusetts, USA; [2]UMCN, Nijmegen, Netherlands

If J-coupling is primarily responsible for the bright fat effect in fast spin echo (FSE) imaging (1-3), then predictions regarding its field strength behavior, largely unexplored to date, may be tested as the ratios of relevant chemical shifts to J coupling constants vary. Namely, for clinically low (0.2 T) and high (3.0 T) fields, the bright fat effect is expected to vanish while at intermediate fields around 1.5 T a pronounced bright fat effect is predicted. These predictions are tested and verified in corn oil and 2,3-dibromothiophene (DBT) samples.

1108. Numerical Simulations of the DQC Signal in Inhomogeneous Solutions

Jose Pedro Marques[1], Richard Bowtell[1]
[1]Magnetic Resonance Centre, Nottingham, Nottinghamshire, UK

In this work a numerical method has been used to simulate the evolution of the signal arising from a Double Quantum CRAZED (DQC) sequence applied to a magnetically inhomogeneous sample. The aim was to better understand the sensitivity of the DQC sequence to the BOLD effect. The results indicate that: BOLD contrast is maximised when a 180^o refocusing pulse is employed, with an evolution time of T_2 and a dephasing time of $nT_2^*/(n-1)$ where $n= T_2/T_2^*$; the contrast doesn't depend strongly on the modulation length; the DQC produces a larger percentage, but smaller absolute, signal change, than a GE sequence.

1109. Effects of Residual SQCs on Signal Contrast in iMQC Studies

Geoffrey D. Charles-Edwards[1], Geoffrey S. Payne[1], Martin O. Leach[1], Angelo Bifone[2]
[1]Institute of Cancer Research & The Royal Marsden Hospital NHS Trust, Sutton, Surrey, UK; [2]Glaxo SmithKline Research Centre, Verona, Italy

The observations of signal dips corresponding to specific correlation distances in multiple-spin echo (MSE) experiments have frequently been cited as evidence of a specific sensitivity afforded by intermolecular multiple-quantum coherences (iMQCs) to sample structure. We have investigated the origin of these dips in MSE studies closely matching previously reported experimental conditions. We show here that these dips arise when residual single quantum coherences (SQCs) are present in the detected signal, and that these dips disappear when phase cycling to suppress SQCs is implemented.

1110. Magnetic Resonance Imaging of the Distant Dipolar Field in Structured Samples Using Intermolecular Multiple-Quantum Coherences of Various Orders

Louis Bouchard[1], Xiaoping Tang[1], Chih-Liang Chin[2], Felix W. Wehrli[2], Warren S. Warren[1]
[1]Princeton University, Princeton, New Jersey, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Intermolecular multiple-quantum coherences (iMQC) have been proposed as a novel contrast mechanism for clinical MRI. Its reliance on the distant dipolar field offers a user-tunable distance scale over which tissue structure can be probed. The potential for functional MRI, tumor detection and measurements of trabecular bone architecture have drawn considerable attention. We demonstrate that an 8-step phase cycle can be used to simultaneously extract images corresponding to several quantum coherence pathways, each potentially containing a wealth of information to help characterize the microstructure.

1111. A Novel Mechanism for MRI Contrast Enhancement based on Control of Spin Chaos

Susie Yi Huang[1], Yung Ya Lin[1]
[1]University of California Los Angeles, Los Angeles, California, USA

Two readily observed effects in solution magnetic resonance – radiation damping and the dipolar field – combine to generate spatiotemporal chaos in routine experiments. The extreme sensitivity of chaotic spin dynamics to experimental conditions during the initial evolution period provides a novel mechanism to achieve enhancement of intrinsic spatial contrast and temporal resolution in MRI. We propose a new pulse sequence based on the control of spin chaos that provides a gain in contrast of 10~50 fold in theory by exploiting the rapid divergence of nonlinear spin trajectories. Numerical experiments are used to demonstrate its applicability in MRI.

1112. Intermolecular Multiple-Quantum Coherence Imaging of Murine Tumors Depends on Choice of Dipolar Correlation Distance

Louis Bouchard[1], Harish Poptani[2], Rahim R. Rizi[2], Jerry D. Glickson[2], Warren S. Warren[1]
[1]Princeton University, Princeton, New Jersey, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Image contrast based on intermolecular multiple-quantum coherences (iMQCs) is predicted to be useful for enhanced tumor detection. We compare images of mouse RIF-1 tumors acquired with iMQC and conventional T2-weighted sequences and conclude that the tumor to normal tissue contrast is larger for iMQC in some regions of the tumor. We also observe a strong dependence of tumor to normal tissue contrast with the choice of correlation distance.

1113. Structural Characterization of Trabecular Bone Using Bulk NMR Measurements of Intermolecular Multiple-Quantum Coherences

Louis Bouchard[1], Chih-Liang Chin[2], Xiaoping Tang[1], Warren S. Warren[1], Felix W. Wehrli[2]
[1]Princeton University, Princeton, New Jersey, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Magnetic resonance imaging based on intermolecular multiple-quantum coherences (iMQC) is an emerging new technique with potentially useful applications to materials science and in vivo studies. It has been proposed that its sensitivity to long-range dipolar interactions be used to characterize the mean pore size distribution of porous materials such as bone. Previous published structural studies using multiple spin echoes (MSE) may be limited by problems with coherence pathway selection.

1114. Orientation Dependence of Intermolecular Double Quantum Coherence (iDQC) Signal on Tendon

Bahadir Ozus[1], Stephen J. Dodd[1], Lada Krasnosselskaia[1], Geoffrey D. Clarke[1], Gary D. Fullerton[1]
[1]University of Texas Health Science Center at San Antonio, San Antonio, Texas, USA

Recently, intermolecular double quantum coherence (iDQC) sequences have been investigated to probe sample heterogeneity over a specific length scale defined by the correlation distance. We investigated the orientation dependence of the signal level obtained from iDQC experiments on tendon. The orientation dependent behavior of the iDQC signal is similar in character to the single quantum coherence (SQC) signal variation but depicts sharper peaks and greater dynamic range.

1115. FID Orientational Spectroscopy of Water on Bovine Tendon

Gary D. Fullerton[1], *Lada Krassnoselskaia*[1], *Elena Nes*[1], *Stephen J. Dodd*[1], *Ivan L. Cameron*[1]
[1]UTHSCSA, San Antonio, Texas, USA

This study of water proton FID amplitude as a function of tendon orientation in the main magnetic field applies the concepts of selective excitation of protons in a gradient magnetic field to develop a new method of orientational spectroscopy that allows measurement of the orientational distribution of protein surfaces. The resolution of the spectroscopic measurement depends on the main magnetic field which induces the diamagnetic orientational variation in the local magnetic field (equivalent to the gradient strength in imaging) and the bandwidth of the excitation pulse (determined by excitation pulse length).

1116. Applications of T_2 Orientational Spectroscopy of Water on Bovine Tendon

Lada Krassnoselskaia[1], *Gary D. Fullerton*[1], *Elena Nes*[1], *Stephen J. Dodd*[2], *Ivan L. Cameron*[3]
[1]UTHSCSA, San Antonio, Texas, USA

This report of spin-echo behavior for water on tendon demonstrates that two factors determine echo amplitudes as a function of orientation; (1) proton dipole-dipole variation as a function of orientation and (2) variation of diamagnetic susceptibility with orientation. The large orientational change in local magnetic field caused by superdiamagnetism allows application of echo amplitude to quantify surface water orientation. This indirectly measures protein orientation as shown for collagen by these measurements. We refer to this new measurement method as orientational spectroscopy.

1117. T_2 Relaxation of Fibrin Gels with Oriented and Random Fiber Structures

Michihiro Takeuchi[1], *Masaki Sekino*[1], *Kikuo Yamaguchi*[1], *Norio Iriguchi*[2], *Shoogo Ueno*[1]
[1]Graduate School of Medicine,University of Tokyo, Bunkyo-ku, Tokyo, Japan; [2]University of Kumamoto, Kurokami, Kumamoto, Japan

In this study, we measured T2 relaxation times of water molecules in fibrin gels with different fibrin fiber structures. The fibrin with magnetically oriented fibrin fiber structure exhibited only one relaxation time T2=0.35 s, whereas, the fibrin gel with randomly oriented fibrin fiber structure had at least two exponential components. The long component, T2=0.35 s, was the same order as the T2 of the fibrin gel polymerized in the magnetic field. The short component was T2=0.07 s. This difference is attributed to a change in the magnetic dipole-dipole interactions between water molecules and fibrin fibers.

1118. Determination of Optimal Angles for Variable Nutation T_1 and T_2 Measurement

Sean CL Deoni[1], *Brian K. Rutt*[1], *Terry M. Peters*[1]
[1]Robarts Research Institute, London, Ontario, Canada

We introduce a new method for determined the set of angles that maximize the precision of T1 and T2 estimates derived from spoiled gradient echo and fully refocused steady-state free precession images. Additionally, we introduce a least squares weighting function that increases the accuracy and precision of the T1 and T2 estimates. Here we describe the angle determination and weighting methods and demonstrate their utility through phantom results.

1119. Quantitative $T_{1\rho}$ Imaging of Human Occipital Lobe at 4 T

Olli Gröhn[1], *Heidi Mäkelä*[1], *Risto Kauppinen*[2], *Michael Garwood*[1]
[1]Center for Magnetic Resonance Research, Minneapolis, Minnesota, USA; [2]School of Biological Sciences, Manchester, UK

Recent studies show that $T_{1\rho}$ relaxation can uniquely characterize several experimental disease models, but clinical feasibility of the technique has been limited by its high RF energy deposition. Here we show that $T_{1\rho}$ imaging using a spin-lock field of 0.2 G can be performed within SAR guidelines in human head at 4T, using sensitive RF coils and a rapid imaging pulse sequence. The obtained $T_{1\rho}$ was compared with T_2 measurements with different inter-pulse delay τ_{CP} between refocusing pulses. Both in gray and white matter, $T_2(\text{long-}\tau_{CP}) < T_2(\text{short-}\tau_{CP}) < T_{1\rho}$ showing differential sensitivities to dipolar interaction and/or other relaxation processes.

1120. MRI Measurement of Magnetic Field Correlation in a Cell Suspension

Jens Hesselberg Jensen[1], *Glyn Johnson*[1], *Ramesh Chandra*[1], *Joseph A. Helpern*[1]
[1]New York University School of Medicine, New York, USA

A method for determining the magnetic field correlation (MFC) in biological tissues by means of MRI has been recently proposed. Here phantom results are given for suspensions of yeast cells, with Gd-DTPA as a contrast agent. The theoretically predicted quadratic dependence of the MFC on the contrast agent concentration is confirmed. The expected decrease of the MFC with increasing sampling time, due to water diffusion, is also observed. The MFC is a quantitative measure of microscopic magnetic field inhomogeneities that provides information beyond that contained in standard NMR relaxation times.

1121. Assessment of the Efficacy of Electrical Impedance Imaging Using MRI

M. Hamamura[1], *L. T. Muftuler*[1], *O. Birgul*[1], *O. Nalcioglu*[1]
[1]University of California, Irvine, California, USA

In this study, we carried out a set of experiments to measure electrical impedance changes in phantoms prepared to assess the spatial resolution and contrast resolution of an MRI based impedance imaging method. A special reconstruction method is proposed which utilizes only one component of the magnetic field. Initial results show that the method can resolve impedance perturbations of several mm in size. It has also been shown that impedance ratios of 4:1 can be resolved clearly.

Spectroscopic Localization and Imaging

Hall D Tuesday 13:30 - 15:30

1122. Fast SSFP Based Proton Spectroscopic Imaging with EPI Readout

Matthias Althaus[1], Wolfgang Dreher[1], Christian Geppert[1], Dieter Leibfritz[1]
[1]Universität Bremen, Bremen, Germany

A pulse sequence based on spectroscopic steady state free precession (SSFP) methods in combination with EPI principles is proposed. The already short minimum total measurement time of a SSFP spectroscopic imaging (SI) sequence can be further reduced, if the signal is sampled in presence of an oscillating read-gradient. The high 3D spatial and temporal resolution of this technique compared to standard SI measurements will allow to follow up the time course of transient or progressing metabolic changes.

1123. Fast Proton Spectroscopic Imaging Using Steady-State Free Precession Methods

Wolfgang Dreher[1], Christian Geppert[1], Matthias Althaus[1], Dieter Leibfritz[1]
[1]Universität Bremen, Bremen, Germany

New pulse sequences for fast proton spectroscopic imaging (SI) are proposed based on SSFP imaging methods. Using slice or chemical shift selective RF pulses either the FID-like signal S1, the echo-like signal S2, or S1 and S2 are acquired without readout gradients. 2D or 3D localization is achieved by phase encoding gradients. The sequences were implemented at 4.7T and applied to the rat brain in vivo. Uncoupled and J-coupled signals of various metabolites were detected. SSFP based SI is of interest for fast proton SI at high B0 because of the short minimum total measurement time and the high SNR.

1124. Optimized Composite Pulses for Steady State Free Precession Proton Spectroscopic Imaging

Christian Geppert[1], Wolfgang Dreher[1], Matthias Althaus[1], Dieter Leibfritz[1]
[1]Universität Bremen, Bremen, Germany

The optimization of a steady state free precession proton spectroscopic imaging sequence which uses only the echo-like signal S2 and composite pulses for RF excitation and refocusing is described. The use of chemical shift selective composite pulses allows a short TR because of the inherent water and lipid suppression. Based on the flip angle dependence of the SSFP signal it is shown that both the shape and the nominal flip angle can be optimized to allow the simultaneous detection of signals within a wide chemical shift range. The sequence is applied to phantom and in vivo experiments.

1125. Fast Correlation Peak Imaging Using Spectroscopic RARE and Circularly Reduced Chemical Shift Encoding

Dirk Mayer[1], Wolfgang Dreher[2], Dieter Leibfritz[2], Daniel M. Spielman[1]
[1]Stanford University, Stanford, California, USA; [2]Universität Bremen, Bremen, Germany

A fast correlation peak imaging sequence combining spectroscopic RARE and circularly reduced chemical shift encoding was implemented on a 4.7 T MR scanner. Effective homonuclear decoupling was performed in both frequency dimensions and the evolution times t_{c1} = 100 ms and and t_{c2} = 50 ms were optimized for the spin systems of *myo*-inositol and taurine. The sequence was tested on a spherical phantom containing a solution of *myo*-inositol. In experiments on the healthy rat brain *in vivo* cross peak signals from *myo*-inositol and taurine could be separated.

1126. High Resolution Spiral PRESS at 3T

Dong Hyun Kim[1], Napapon Sailasuta[2], Ralph Hurd[2], Elfar Adalsteinsson[1], Daniel M. Spielman[1]
[1]Stanford University, Stanford, California, USA; [2]GE Medical Systems, Fremont, California, USA

The immediate advantage of CSI at 3T is the benefit of increased SNR, which can potentially lead to several new applications. We optimized a PRESS sequence for high resolution CSI applications. Spiral based readout gradients were used to offer efficient k-space sampling which enables realistic scan times compared to normal phase encoded acquisitions. Spectral-spatial refocusing RF pulses were used for improved spectral selectivity and spatial selectivity was improved by preceding the excitation with VSS pulses. Data were also acquired with a surface coil for increased SNR.

1127. Four Dimensional (2D Spectral / 2D Spatial) Up-Down Spiral Spectroscopic Imaging in the Rat Brain

Bassem Hiba[1], Anne Ziegler[1]
[1]Unité mixte INSERM-UJF U438 - RMN Bioclinique, LRC CEA, Grenoble, France

As 2D-CSI is very time consuming, in-vivo spectroscopy is generally achieved in a non-localized or single -voxel mode. In this study, we demonstrate the possibility to perform 2D spectral / 2D spatial up-down spiral spectroscopic imaging (SSI) with a spatial resolution of 27µl in rat brain at 7T. 4D spiral spectroscopic images of (20,20,16,256) points in the (x,y,F1,F2) directions were acquired in 43 min. Signal-to-Noise Ratio and Point Spread Function were computed to assess the quality of the spectroscopic images.

1128. Fast 2D Spectroscopic Imaging Using Rosette Trajectories

Claudiu Valerian Schirda[1], *Douglas C. Noll*[2], *Fernando Emilio Boada*[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [2]University of Michigan, Ann Arbor, Michigan, USA

We demonstrate the use of 2D rosette trajectories for 2D spectroscopic imaging. Our simulation studies and experimental results demonstrate that 2D rosette trajectories can be used for the development of efficient chemical shift imaging schemes in two dimensions

1129. Minimum Norm Reconstruction for Parallel Spectroscopic Imaging

Javier Sánchez[1], *Jeffrey Tsao*[2], *Ulrike Dydak*[2], *Manuel Desco*[1], *Peter Boesiger*[2], *Klaas Paul Pruessmann*[2]
[1]Hospital General Gregorio Marañón, Madrid, Spain; [2]ETH and University of Zurich, Zurich, Switzerland

Minimum norm reconstruction is proposed as a means of enhancing the spatial response function (SRF) in parallel spectroscopic imaging (SI). By directly optimizing the shape of the SRF, the new method accounts for coil sensitivity variation within SI voxels. In this fashion, it mitigates the signal contamination and sidelobe aliasing that previous techniques are susceptible to at low resolution. Although the computational burden is higher, minimum norm reconstruction is shown to be feasible using iterative algorithms. Significant benefits in terms of SRF shape and artifact suppression are demonstrated in sample reconstructions from simulated data.

1130. Water-Fat Imaging with Partially-Opposed-Phase (POP) Acquisition: An Asymmetric Dixon Method

Qing San Xiang[1]
[1]University of British Columbia, Vancouver, British Columbia, Canada

A new water-fat imaging method is introduced which acquires 2 images, one in-phase, the other partially-opposed-phase. Two possible solutions are used to form and select 2 test phasors in a neighborhood of each pixel, leading to first-pass water-fat maps, along with a weighting map. An iterative weighted complex dilation yields a consistent water and fat solution. Finally, water and fat maps with good SNR are obtained as linear least square solution after a field error correction. In vivo data have demonstrated the clinical utility of this method.

1131. Voxel Selection at High Field Using Frequency Offset Corrected Inversion (FOCI) Pulses

Paul Kinchesh[1], *Harry G. Parkes*[1], *Roger J. Ordidge*[1]
[1]UCL, London, UK

It is demonstrated that PRESS voxel selection is significantly improved by employing FOCI pulses. In particular, at high field, the use of high bandwidth FOCI pulses greatly reduces the spatial displacement error in voxel selection of metabolite resonances with characteristically different frequencies. Phantom data using 2 ms FOCI pulses with a bandwidth of 20 kHz on a whole body 4.7 T system is presented.

1132. SESAME: An Interleaved Multislice Chemical Shift Imaging Method with Spatial Presaturation and Selective Excitation

Rachel Katz-Brull[1], *Napapon Sailasuta*[2], *Thomas Raidy*[2], *Robert E. Lenkinski*[1]
[1]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA; [2]GE Medical Systems, Waukesha, Wisconsin, USA

Among the Chemical Shift Imaging (CSI) sequences, the classical CSI experiment (Brown, 1982) and Spin Echo CSI offer the best sensitivity. However, the common implementation of these sequences for proton magnetic resonance spectroscopy in vivo (PRESS-CSI and STEAM-CSI) does not allow for interleaved multislice acquisition. The purpose of this work was to develop a CSI sequence that allows for interleaved multislice acquisition without compromising the sensitivity of the experiment. The method was tested in a phantom and then optimized and used to obtain spectroscopic images from the brain of a normal volunteer.

1133. Phased-Array Multi-Slice Proton MR Spectroscopic Imaging at 3 Tesla

Peter B. Barker[1], *Joseph Gillen*[1], *Peter CM van Zijl*[1], *Xavier Golay*[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Signal-to-noise ratios (SNR) and resolution are limiting factors in the application of proton MR spectroscopic imaging (MRSI) to the human brain. It is expected that these factors will be enhanced by the use of high magnet fields and sensitive, phased-array receiver coil systems. This abstract reports the development and initial results of phased-array proton MRSI on a 3 Tesla system.

1134. Method for "On-Demand" Generation of RF Saturation Pulses

Charles H. Cunningham[1], *Graham A. Wright*[2], *Daniel B. Vigneron*[3], *John M. Pauly*[1]
[1]Stanford University, Stanford, California, USA; [2]Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada; [3]University of California San Francisco, San Francisco, California, USA

A new method is presented for designing RF pulses for spatial saturation. The method is derived from a technique developed for Hadamard encoding and is well-suited to "on-demand" pulse generation. The method was demonstrated with the design of a saturation pulse suitable for application in MR spectroscopic imaging of the prostate. The performance of the pulse (5 ms, 0.017 mT peak) was tested with a Bloch simulation. Measurements on the resulting profile showed a selectivity of 23, 1% ripple and 12.63 kHz bandwidth.

1135. Correction for RF Inhomogeneity for Improved Spatial Saturation

Charles H. Cunningham[1], Graham A. Wright[2], Daniel B. Vigneron[3], John M. Pauly[1]
[1]Stanford University, Stanford, California, USA; [2]Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada; [3]University of California San Francisco, San Francisco, California, USA

For applications in which spatial saturation is crucial for suppression of unwanted signal, such as MR spectroscopic imaging, inhomogeneity in the RF field is problematic. We have investigated the feasibility of using an "on-demand" design of an RF saturation pulse which is compensated for the inhomogeneity in the RF field. Using a Bloch simulation with a quadratic RF inhomogeneity implemented, the effect of the inhomogeneity was shown. Using a pulse designed with compensation for the inhomogeneity, a six-fold improvement in saturation was demonstrated.

1136. High Spatial Resolution Acquisition Improves Spectral Quality for 3D MR Spectroscopic Imaging of the Brain

Andreas Ebel[1], Andrew A. Maudsley[1]
[1]University of Miami School of Medicine, Miami, Florida, USA

Improved spectral quality of MR Spectroscopic Imaging of brain in regions affected by moderate B0 inhomogeneity is presented. This technique used higher resolution acquisition, followed by correction for local B0 shifts and filtering to match the spatial resolution to that of conventional MRSI. Significant improvement of spectral quality was obtained in regions of moderate B0 inhomogeneities, enabling measurement over a larger brain volume. The improved spectral quality was sufficient to offset the SNR loss, such that automated spectral analysis was not significantly affected.

1137. Similarity Maps at Different Coordinate Systems: New Approach to Present Multi-Voxel Proton 3D MRS Data

Gadi Goelman[1], Oded Gonen[2]
[1]Hadassah Hebrew University Hospital, Jerusalem, Israel; [2]NYU, New York, New York, USA

New 2D or 3D multivoxel MRS post-processing method is introduced. It presents metabolite similarity to a predefined reference. The MRS data of each voxel is viewed as a 3D vector in a virtual Cartesian coordinate system of NAA, Cr and Cho. The simplest similarity maps are the projections difference of this vector with a reference one. To allow complex relations between metabolites, the data is presented in spherical coordinate system. For demonstration, MRS discrimination between gray and white matter, is shown. The method identify areas of abnormality, 'similar' to a given fingerprint metabolite levels known to present pathological condition

1138. Interleave Measurements of Multinuclear Spectra from the Same Localized Area at 4.7 Tesla Wholebody MRI System

Fumiyuki Mitsumori[1], Nobuhiro Takaya[1]
[1]National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan

We developed a method for an interleave measurements of ^{1}H and ^{31}P spectra from the same localized area without increasing the measurement time at 4.7 Tesla wholebody MRI system. A quadrature ^{31}P surface coil was integrated with a ^{1}H TEM coil for head. We combined STEAM for ^{1}H and ISIS for ^{31}P into one sequence, in which ^{1}H and ^{31}P were transmitted and received in the separate channels. Accumulation of 128 transients exhibited excellent localized spectra on both nuclei from the occipital lobe of the human brain. The method can be extended up to three nuclei measurements.

1139. Glx Detection in the Human Brain on a 1.5T Clinical Scanner with a QD Volume Coil by using a 3D Localized Selective Double Quantum Filter Sequence

Hidehiro Watanabe[1], Masaaki Umeda[1], Kazuya Okamoto[1], Satoshi Sugiura[1]
[1]Toshiba Corporation Medical Systems Research & Development Center, Otawara, Tochigi, Japan

Glx detection in the human brain is demonstrated on a 1.5T clinical scanner with a QD volume coil by using a 3D localized selective double quantum filter sequence. This sequence utilizes J_{HH} between Glx-2 and Glx-3. It consists of three RF pulses (90°, 180° and 180°) for 3D localization and two selective 90° pulses on Glx-3 after water suppression pulses. Glx-2 can be obtained without macromolecule contamination by using gradients for double quantum coherence selection. In human studies, Glx-2 could be detected. The signal-to-noise ratio was about 2.

1140. Simultaneous Detection of GABA and Glutamate by Selective Homonuclear Multiple-Quantum Coherence Transfer

Dikoma C. Shungu[1], Arthur G. Palmer[1], Ravi Ramasamy[1], Xiangling Mao[1]
[1]Columbia University, New York, New York, USA

In this study, the structural and magnetic property similarities between γ-aminobutyric acid (GABA) and glutamate+glutamine have been exploited to develop a selective homonuclear multiple-quantum coherence transfer pulse sequence, G-BAssale, that permits simultaneous detection of all three neurochemicals in a single scan. Spectra of a mixture of the neurochemicals, as well as those of a mouse brain tissue extract obtained with the sequence demonstrate the unique ability of this sequence to achieve simultaneous and unambiguous detection of these important neurotransmitters.

1141. Spectral-Selective Volume Localized Selective Multiple Quantum Spectroscopy

Sunitha B. Thakur[1], Qiuhong He[1]
[1]Memorial Sloan Kettering Cancer Center, New York, New York, USA

A spectral-selective volume-localization technique (VOL-SelMQC) have been developed for the detection of metabolites using selective multiple quantum coherence spectroscopy. A binomial sequence $\{1_{-x}$-τ-3_x-τ- 3_{-x}-τ-$1_x\}$ was employed for simultaneous frequency-selective excitation of lactate CH_3 resonances and volume-localization. Frequency selection is achieved by adjusting the interpulse delay equal to the inverse of twice the difference in the center frequencies of maximum and null excitation bands. The three orthogonal slice-selective gradients were applied during the last three successive pulses to localize the desired volume of interest (VOI). Single-voxel spectra and 2D CSI- were obtained from the selected VOI localized in lactate phantoms.

1142. Implementation of 3D Localized ZQ/Z-filtered COSY on a 1.5T MRI Scanner

Hyun-Kyung Chung[1], Kenneth Yue[1], Talaignair N. Venkatraman[2], Michael Albert Thomas[1]
[1]David Geffen School of Medicine at UCLA, Los Angeles, California, USA; [2]Harbor-UCLA Medical Center, Torrance, California, USA

A three-dimensionally (3D) localized ZQ/Z-filtered correlated spectroscopic (COSY) sequence was implemented on a 1.5T MRI scanner. The sequence was optimized using phantom solutions of various metabolites at physiological concentrations. The ZQ/Z-filtered COSY spectra had the crosspeaks from the J-coupled metabolites due to ZQ-filtering, and the diagonal peaks from single or magnetically equivalent protons and auto-crosspeaks from J-coupled metabolites due to Z-filtering. ZQ/Z-filtered COSY spectra of human calf muscle showed several 2D diagonal and crosspeaks due to carnosine, creatine, choline, saturated, and unsaturated fatty acid resonances.

1143. Localized Constant-Time Correlated Spectroscopy (CT-COSY) of Human Brain *In Vivo*

Hyun-Kyung Chung[1], Shida Banakar[1], Michael Albert Thomas[1]
[1]David Geffen School of Medicine at UCLA, Los Angeles, California, USA

A spatially resolved constant-time correlated spectroscopic (CT-COSY) sequence has been implemented and optimized on a whole body 1.5T MRI/MRS scanner. Dependence of 2D cross peaks on the constant-time (Tc) was investigated using phantom solutions of several metabolites. GAMMA simulated spectra were used for further optimization. Compared to the basic COSY spectra, a broadband decoupling was achieved in the second dimension of CT-COSY. Our preliminary results on the 2D CT-COSY spectra recorded in the frontal and occipital cortical regions of nine healthy volunteers are presented. The merits and demerits of CT-COSY compared to other 2D spectra are discussed.

1144. Adaptive Line Enhancement for *In-Vivo* NMR Spectroscopy

Joseph C. McGowan[1], Richard G.S. Spencer[2]
[1]USA Naval Academy, Annapolis, Maryland, USA; [2]National Institute on Aging, Baltimore, Maryland, USA

Adaptive noise cancellation may be achieved by design of a digital filter to transform an incoming signal into the desired output through the use of a previously defined reference function for the noise. In applications such as NMR spectroscopy, where the noise may not be precisely characterized a priori, a related approach known as adaptive line enhancement (ALE) may be employed. Adaptive line enhancement is based upon comparison of an incoming signal with a delayed version of itself, relying upon the assumption that the autocorrelation coefficients of the noise decay much more rapidly than those of the signal.

Spectroscopic Quantitation

Hall D Saturday 14:00 - 16:00

1145. 3T Brain Spectroscopy: Repeatability and Inter-subject Variability

Ralph E. Hurd[1], Napapon Sailasuta[1], Radhika Srinivansan[2], Daniel B. Vigneron[2], Sarah Nelson[2]
[1]GE Medical Systems, Menlo Park, California, USA; [2]University of California, San Francisco, California, USA

This study compares repeatability and inter-subject variation of metabolite values, and of T2 relaxation measurments, at 1.5T and 3T. A group of 10 normal volunteers participated in the protocol, which included TE 35 and TE-averaged PRESS prescriptions, one "gray" mid-parietal location, and one "white" parietal location. Acquisitions were closely matched, and both homogeneity and physiological noise were included in the comparison. Inter-subject variation of T2eff may account for the observed metabolite level variations. Mean T2eff values are consistent with the observed 80-85% increase in SNR.

1146. A Fast Method for Image Segmentation: Application to Quantitative Proton MRSI at 3 Tesla

Alena Horska[1], Michael A. Jacobs[1], Vince D. Calhoun[2], Atilla Arslanoglu[1], Peter B. Barker[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]Yale University, Hartford, Connecticut, USA

A rapid data acquisition and analysis procedure is described for image segmentation, designed to be used in conjunction with quantitative proton MRSI. The method is based on collection of several fast spin echo images, each with different contrast, from which a linear filter ("Eigenimage" filter) can calculate the percentage of each tissue type within the voxel. The method was applied to evaluate tissue composition in brain slices corresponding to localizer images for proton "turbo" MRSI at 3T. Comparison with "conventional" segmented images obtained with high resolution 3D MPRAGE revealed that the EI filter technique is a fast and reliable method.

1147. Quantitative Proton Short Echo-Time LASER Spectroscopy of Normal Human White Matter and Hippocampus at 4 Tesla Incorporating Macromolecule Subtraction

Mohamed NE Kassem[1], Robert Bartha[1]
[1]Robarts Research Institute, London, Ontario, Canada

For in-vivo short echo-time 1H MR spectroscopy, the acquisition and subtraction of a separately acquired macromolecule spectrum to simplify quantification is sensitive to subject motion and increases noise in the resultant spectrum. An interleaved (full/macromolecule) acquisition approach was tested to reduce sensitivity to subject motion. Fitting the macromolecule spectrum with the Hankel Lanczos Singular Value Decomposition prior to subtraction was also tested to decrease noise in the resultant spectrum. Absolute metabolite level quantification accuracy and precision were compared in LASER localized 4.0 Tesla 1H spectra from parietal lobe white matter and posterior hippocampus in 21 subjects.

1148. Feasibility of Highly Resolved *In Vivo* ^{1}H NMR Spectroscopy of the Mouse Brain at 9.4 Tesla

Ivan Tkac[1], Pierre Gilles Henry[1], Peter Andersen[1], Christopher Dirk Keene[1], Walter C. Low[1], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

In vivo ^{1}H NMR spectra were measured from 6 - 10 µl volumes positioned in mouse hippocampus, striatum, and cerebral cortex using ultra-short echo-time STEAM (TE = 2 ms). High spectral resolution was achieved using the FASTMAP automatic shimming method and an extremely powerful shimming system, particularly the custom-designed 2nd order shim coil. Sixteen brain metabolites were reliably quantified using LCModel, which revealed significant regional differences for several brain metabolites. The data presented demonstrate that regionally specific neurochemical information from the mouse brain is achievable *in vivo*, which can be very useful for non-invasive monitoring of transgenic mice models.

1149. Lipid Signal Suppression and Lactate Doublet Quantification in ^{1}H MR Spectroscopy using a New Post-Processing Bi-Exponential Decay Filter

Hacene Serrai[1], Lotfi Senhadji[2], Gouyu Wang[1], Serge Akoka[3], Patrick Stroman[1]
[1]IBD-NRC, Winnipeg, Manitoba, Canada; [2]LTSI-INSERM, Rennes, France; [3]UFR Sc. & Tech, Nantes, France

A new bi-exponential decay filter based on Continuous Wavelet Transform (CWT) method is used to isolate and quantify the lactate methyl doublet from overlapping lipid peak(s) in 1H MRS. Application of the new filter to simulated and real MRS data collected from human blood plasma and brain tumors demonstrate that using the same algorithm the new filter provides better lactate quantification than the previous single exponential decay filter with less computation time. The CWT allows full recovery of lactate, whereas the MQ methods detect 50% of the signal intensity, and it's less sensitive to motion artifacts than difference spectroscopy.

1150. Short Echo 2D Spectroscopic Imaging of Human Brain at High Field

Baolian Yang[1], Wen Jang Chu[1], Fei Du[1], Thian C. Ng[1]
[1]University of Alabama at Birmingham, Birmingham, Alabama, USA

A short echo 2D spectroscopic imaging (SI) sequence was implemented by using inversion recovery delay (TIR) of 160ms and TE of 21ms at 4.1T system. Water suppression was achieved by three CHESS pulses and OVS method was used to improve lipid suppression. Metabolites signal intensity increased 30% comparing with the result using SI sequence at TIR of 260ms. Preliminary in vivo result shows high quality spectra were obtained even voxels close to the brain scalp. The spatial resolution is nominally 0.5cc and the signals from different metabolites NAA, Cho, Cr, Glu and Gln are well resolved.

1151. Chemical Shift Imaging using Spectrum Modeling

Sangwoo Lee[1], Douglas Noll[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

We propose a water/fat chemical shift imaging method based on spectrum modeling in k-space. This method successfully reconstructs water and fat images from a single scan data. We also investigated the robustness of this method to model mismatches.

1152. Metabolite Quantitation in Muscles using ^{1}H MR Spectroscopic Imaging and Validation by Single Voxel MR Spectroscopy.

Peter Vermathen[1], Roland Kreis[1], Chris Boesch[1]
[1]University & Inselspital Berne, Berne, Switzerland

A method for quantitation of intra-myocellular lipids (IMCL) in human muscle measured by MR spectroscopic imaging (MRSI) is presented. The method employs the signal from bone marrow lipids as internal reference for quantitation. IMCL concentrations in tibialis anterior (TA) obtained by this method were compared with concentrations obtained in the same session by single-voxel measurements. The results of the two methods are significantly correlated (R=0.90), demonstrating that MRSI measurements of IMCL are feasible in human muscle, providing reliable quantitative results. IMCL concentrations were significantly different between muscles, with low values in TA and three times higher values in soleus.

1153. Endorectal Coil with an Internal Reference for Quantitative MRSI

Moriel NessAiver[1], Novena Rangwala[1], Ted Rysker[2], Rao Gullapalli[1]
[1]University of Maryland Medical School, Baltimore, Maryland, USA; [2]USA Instruments, Aurora, Ohio, USA

MR prostate imaging and spectroscopy with an endorectal coil provides high sensitivity in obtaining structural and cellular function information. We have modified a rigid endorectal coil to house an internal reference standard that can be used to obtain quantitative information on biochemical markers of the prostate such as citrate, choline, and creatine. Coil location was determined from axial and sagittal images. Surface coil corrections based on the Biot-Savart equation were applied to both images and spectra. The corrected spectra correlated well with the internal reference suggesting the feasibility of this technique in clinical practice.

1154. Quantitative Mapping of Glx and Myo-Inositol in Human Brain by MR Spectroscopic Imaging at 3Tesla.

Yoshiaki Someya[1], Noriaki Hattori[1], Masahiro Umeda[2], Masaki Fukunaga[2], Noriko Inoue[1], Mieko Matsui[1], Tohru Sawada[1]
[1]BF Research Institute, Suita, Osaka, Japan; [2]Meiji University of Oriental Medicine, Hiyoshi, Kyoto, Japan

Proton MR spectroscopic imaging (MRSI) with short echo time (TE) were performed to evaluate cerebral metabolite concentrations by using a 3-Tesla MR system. The spectra were acquired from a plane above the lateral ventricle and the voxel size of the MRSI was 1 mL. The concentrations of metabolites including N-acetylaspartate, myo-inositol and glutamine+glutamate were successfully quantified and these concentrations were increased along with the increase of the gray matter fraction in the voxel with different ratios. Our results indicated the feasibility of quantitative evaluation of cerebral metabolites with short TE MRSI for the clinical investigation.

1155. In-plane Background Gradient Effects on Spectroscopic Imaging

Yan Zhang[1], Hee Kwon Song[1], Felix W. Wehrli[1]
[1]University of Pennsylvania Medical Center, Philadelphia, Pennsylvania, USA

In-plane background gradient effects on spectroscopic imaging are investigated theoretically and experimentally. A linear in-plane background gradient does not affect spectroscopic FID up to a critical time at which the signal drops abruptly. Contrary to the general perception that the through-plane gradients are most critical, in-plane background gradients can have detrimental effects on the spectral line shape.

1156. Metabolite Quantitation in the Monkey Brain by ^{1}H MRS using LCModel and MRI Automatic Segmentation

Fawzi Boumezbeur[1], Laurent Besret[2], Renaud Maroy[1], Françoise Vaufrey[1], Philippe Hantraye[1], Vincent Lebon[1], Gilles Bloch[1]
[1]CEA - SHFJ, Orsay, France; [2]CNRS URA2210 - SHFJ, Orsay, France

A method for absolute quantitation of brain metabolites is proposed. The approach relies on the combination of localized ^{1}H MRS and high resolution MRI. Relative metabolite quantitation is derived from LCModel analysis and water content in the spectroscopic voxel is calculated using an automatic MRI segmentation procedure in order to provide a reference for absolute quantitation. The method was applied to the quantitation of 6 metabolites in the striatum of macaque monkeys. Linear regression was preformed in order to derive the metabolite concentrations in pure white matter (corpus callosum) and pure striatum gray matter.

1157. GUI for Automatic Post Processing and Display of 2D-SI Data Sets with LCModel

Cheng-Wen Ko[1], Bjoern Kreher[1], Martin Buechert[1]
[1]University of Freiburg, Freiburg, Germany

LCModel is widely used for processing clinical single voxel spectroscopic data. With the newest generation of MR-scanners the handling of spectroscopic imaging (SI) measurements reaches a new level of simplicity. Therefore the interest of applying LCModel to SI data sets is increasing. Our SI_LCModel_Tool is a Matlab-based graphical user interface combining LCModel to be used to process SI data sets in a user friendly and time efficient way. A region of interest tool and an ASCII result interface allows the easy quantitative evaluation of SI metabolite maps and their export to standard statistic programs

1158. Quantitation of 3D Chemical Shift Data: Nonlinear Least-Squares Spectral Estimation Using a Water Reference and A Priori Knowledge

David B. Clayton[1], Elfar Adalsteinsson[1], Daniel M. Spielman[1]
[1]Stanford University, Stanford, California, USA

In vivo chemical shift imaging (CSI) poses a great challenge to spectral estimation. To acurrately quantitate the large number of varied spectra acquired in 3D CSI and form reliable metabolic images, a nonlinear least-squares fitting algorithm was implimented and tested in a phantom and in vivo. The method uses a basis set of nonparametric signals derived from a water signal and a priori knowledge of metabolite frequency shifts and relaxation times. Three linear and two nonlinear parameters are estimated using a simplex algorithm. The method does not introduce bias in the presence of field inhomogeneities and converges with high regularity.

1159. Time Domain Quantitation of Multi-Echo Chemical Shift Imaging Data

David C. Williamson[1], Pawel F. Tokarczuk[1], Stephen R, Williams[1]
[1]University of Manchester, Manchester, UK

The clinical utility of chemical shift imaging (CSI) to detect metabolites is hampered by lengthy acquisition times. One approach to speeding up acquisition is to use multi-echo CSI (ME-CSI). However, the decrease in scan time is usually associated with a reduction in spectral resolution. Here a method is described using time domain analysis (TDA) incorporating prior knowledge to quantify creatine and choline under conditions when they cannot be resolved in the spectrum. Data were acquired using ME-CSI for a six-tube phantom with known concentrations of acetate, creatine and choline. The results demonstrate that quantitative information can be extracted from data.

1160. Time-Domain Fitting of ^{1}H-MR Spectra of the Human Brain: A Model-Free Integration of the Macromolecular Baseline

Elisabeth Weiland[1], Stefan A. Roell[2], Gunnar Krueger[2], Dieter Leibfritz[1]
[1]University of Bremen, Bremen, Germany; [2]Siemens Medical Solutions, Erlangen, Germany

Quantification of short-TE ^{1}H-MR spectra requires accounting for strong baseline contributions, which originate from residual water, macromolecules and lipids. In this study, we present a novel time-domain estimate for broad background signals, which parameterises the baseline as a model-free signal of finite duration. Our approach can easily be integrated into time-domain linear combination model fitting, which therefore benefits from all advantages of modelling in this domain such as handling of truncation points, easy model parameterisation, and no computational burden for FFT. Quantification of simulated and short-TE in-vivo data demonstrates reliable modelling of metabolites and macromolecules.

1161. Time-Domain Quantitation with a Metabolite Basis Set

Hélène Ratiney[1], Yoeri Coenradie[2], Sophie Cavassila[1], Dirk van Ormondt[2], Danielle Graveron-Demilly[1]
[1]Université Claude Bernard Lyon I , CPE, Villeurbanne, France; [2]Delft University of Technology, Delft, Netherlands

A time-domain quantitation algorithm based on a metabolite basis set obtained by quantum mechanical simulation is proposed. This non-linear least squares algorithm fits a time domain model function, combination of (quantum-mechanically simulated) metabolite signals, to low-SNR in vivo data. The metabolite basis set was created with NMR-SCOPE which can handle various experimental protocols. The present work investigates through Monte Carlo studies the ability of the algorithm to quantify strongly overlapping spectral components in presence of (residual) water and a macromolecule spectrum. Quantitation of short echo-time 1H human brain signals at 1.5T is demonstrated as well as quantitation of 31P signals.

1162. T_2-Based Segmentation of Periventricular Volumes for Quantification of MR Spectra of Multiple Sclerosis Lesions

Gunther Helms[1], Gunther Helms[1]
[1]Karolinska Institutet, Stockholm, Sweden

Magnetization transfer was used to identify tissue signal contributing to the slowly-relaxing ‘CSF’-component by amplitude reduction and T2 prolongation in 15 periventricular MS lesions. Properties of pure CSF was derived from the assumption of zero MT and employed for T2-correction of CSF sub-volume. This was applied for improved quantification of MRS in 21 lesions. ShortestT2 (>400ms) and severe overestimation of metabolite concentrations (<2mM NAA) was observed when the voxel contained much lesion and little CSF. The average overestimation was 6% because little effect (<3%) was seen when T2 was in the 2SD range of controls.

1163. Improved Absolute Quantification of ^{1}H-MRS Metabolites in Multiple Sclerosis

Gisela E. Hagberg[1], Fabrizio Fasano[1], Ugo Nocentini[2], Umberto Sabatini[1], Carlo Caltagirone[1], Alessandro Castriota-Scanderbeg[1]
[1]Foundation Santa Lucia, Rome, Italy; [2]Tor Vergata University, Rome, Italy

Absolute quantification of 1H-MRS metabolites in multiple sclerosis with water as reference signal is cumbersome, because of the difference in brain tissue water content and relaxation behaviour between lesioned tissue and normal-appearing tissue. Here, we compare two quantification methods, one based on the signal measured by MRS and an MRI-based method. The performance of the MRI-based method was superior, since it resulted in a more precise determination of metabolite concentrations. By means of this method, significant differences (p?0.06) between lesions in patients with relapsing-remitting and secondary progressive disease type were found for N-acetyl-aspartate and choline.

1164. Observation of ^{1}H Coupled Spin Metabolite Groups at Long TE

Brian J. Soher[1], Andrew A. Maudsley[1], Jerry Matson[2]
[1]University of Miami, Miami, Florida, USA; [2]UCSF/VAMC, San Francisco, California, USA

Once excited, metabolite resonance groups from strongly coupled spins degrade rapidly with echo time and normally require a short TE observation. However, short TE spectra often include complicated baseline contributions due to macromolecule and lipid signals, which make quantification difficult. In this study, it is demonstrated that a Carr Purcell (CP) pulse train, applied at a sufficiently short repetition time, preserves the strongly coupled resonance patterns for myo-Inositol (mI) at 1.5 T. Both spectral simulations and solution spectra show significantly improved metabolite SNR at TE over 20ms for the mI multiplet at 3.5 ppm.

1165. Improved Metabolite–Baseline Discrimination in Automated ^{1}H Spectral Analysis Using a Flexible Lineshape Model

Brian J. Soher[1], Andrew A. Maudsley[1]
[1]University of Miami, Miami, Florida, USA

Analysis of *in-vivo* short TE, ^{1}H spectra is complicated by broad baseline signal contributions. The assumption that baseline signals are broader than metabolite peaks has been used in iterative methods to separate these signals. However, broad or asymmetric lineshapes can invalidate this assumption. We used Monte Carlo simulations to measure variations in calculated metabolite amplitudes due to interactions between a baseline and various metabolite lineshapes. In simulations using Gaussian lineshape model, metabolite areas were progressively overestimated (as per optimization iterations) as data lineshapes broadened or became asymmetric. Use of a spline-based, complex, time-domain decay envelope lineshape model decreased these effects.

1166. LCModel Analysis of Spectra Edited for Glutathione (GSH)

Melissa Terpstra[1], Pierre Gilles Henry[1], Rolf Gruetter[1]
[1]Center for Magnetic Resonance Research, Minneapolis, Minnesota, USA

Spectral editing for the resonance of glutathione (GSH) can result in spectral patterns with mixed peak phases that are difficult to integrate in vivo. This problem was overcome by using Linear Combination Model (LCModel) analysis of difference-edited spectra obtained at 4T in the human occipital lobe. The spectral pattern in vivo was very close to that in vitro as judged from the flat fit residual. GSH concentration was measured with increased precision (0.96 ± 0.14 mM (n=18)) compared to conventional analysis. We conclude that analysis using deconvolution methods can greatly improve the precision of concentrations quantified from edited spectra.

1167. Estimation of the Cerebral Metabolite Concentrations in Pure Gray Matter and White Matter by *In Vivo* Proton MR Spectroscopy

Noriaki Hattori[1], Kazuo Abe[1], Masahiro Umeda[2], Masaki Fukunaga[3], Noriko Inoue[3], Yoshiaki Someya[3], Mieko Matsui[3], Saburo Sakoda[1], Tohru Sawada[3]
[1]Osaka University Graduate School of Medicine, Suita, Osaka, Japan; [2]Meiji University of Oriental Medicine, Hiyoshi, Kyoto, Japan; [3]BF Research Institute, Suita, Osaka, Japan

Metabolite concentrations in pure gray matter and white matter were estimated by multiple single voxel MR spectra. The spectra were acquired from regions of interest (ROIs) located on the frontal, parietal and occipital lobes of 18 healthy subjects. The estimated concentrations of most of the metabolites were higher in the gray matter, while that of N-acetylaspartylglutamate was higher in the white matter. The concentration of choline-containing compounds was different depending on the cerebral lobes. Anatomical information of the ROI is critical for the precise investigation of *in vivo* MRS.

1168. Cerebral Metabolite Concentrations in Pure Gray and White Matter Calculated by Proton MR Spectroscopy and Image Segmentation

Uwe Seeger[1], Thomas Nägele[1], Irina Mader[1], Michael Erb[1], Thomas Ethofer[1], Uwe Klose[1]
[1]University of Tübingen, Tübingen, Germany

In proton MR spectroscopy of the human brain, it is often difficult to select voxels that contain only one tissue type, such as gray matter (GM) or white matter (WM), due to relatively large voxel sizes. In this study, metabolite concentrations in pure GM and pure WM were calculated from the values obtained from short TE spectra of voxels with mixed tissue components. The tissue composition was determined by image segmentation. Significant differences between GM and WM were found for most of the major metabolites in the parietal region and the cerebellum.

1169. *In Vivo* Comparison of Short and Ultra-Short Echo Time ^{1}H STEAM MRS at 4.0 Tesla

Jean Théberge[1], Dick J. Drost[2], Peter C. Williamson[1], Ravi S. Menon[3]
[1]University of Western Ontario, London, Ontario, Canada; [2]Lawson Health Research Institute - St.Joseph's Health Care, London, Ontario, Canada; [3]Robarts Research Institute, London, Ontario, Canada

The short and ultra-short echo STEAM sequence allows quantification of brain glutamate and glutamine. Going from a standard short echo time of 20 ms to an ultra-short echo time of 6ms reduces J-coupling related dephasing of the strongly coupled resonances of these metabolites and reduces signal losses due to T2 relaxation. An ultra-short echo STEAM sequence is technically challenging to implement. Is it worth the effort? This 4.0 Tesla study demonstrates that those predicted signal increases do occur in an in vivo situation and translate into quantification precision improvements for glutamine but not glutamate.

Interventional MR and Image-Guided Therapy

Hall D Sunday 13:30 - 15:30

1170. Intraoperative High-Field MRI Supported by Neuronavigation: First Clinical Experience

Christopher Nimsky[1], Oliver Ganslandt[1], Boris v. Keller[1], Lars Anker[1], Rudolf Fahlbusch[1]
[1]Department of Neurosurgery, Erlangen, Bavaria, Germany

A high-field MR scanner was adapted to the needs of an operating room environment. Surgery at the 5 Gauss perimeter was realized by a rotating operating table, which serves as MR tray. Furthermore, a ceiling-mounted neuronavigation system was installed in the radiofrequency-shielded operation room. Functional neuronavigation for preservation of eloquent brain areas was added by integration of functional data from fMRI and magnetoencephalography. Preliminary experience gained with the first 74 patients is summarized and compared to the experience in the application of low-field intraoperative MRI, performed in 330 patients.

1171. MR Planning, Tracking and Verification of Infusions into Brain Parenchyma

Norman B. Konyer[1], Raghu Raghavan[2], Martin Brady[2], Nancy J. Lobaugh[1], Greg J. Stanisz[1], Michael J. Bronskill[1]
[1]Sunnybrook & Women's College Health Sciences Centre, Toronto, Ontario, Canada; [2]Image Guided Neurologics, Baltimore, Maryland, USA

Quantitative T1 imaging has been used to monitor direct infusions of gadolinium (Gd) contrast agent into gel phantoms and ex-vivo brains, on a voxel-by-voxel basis. The measured infusion pattern has been compared to that modeled using specific knowledge of tissue structure and properties, such as the pore fraction and extra-cellular diffusion component, inferred from diffusion tensor imaging. Sufficient agreement has been obtained to proceed to in-vivo studies.

1172. MR Imaging of Intraprostatic Gene Therapy Vector Delivery Techniques in an *Ex Vivo* Canine Model

Roger J. Stafford[1], Noriyoshi Tanaka[1], Roger E. Price[1], Charles J. Rosser[1], M. Tanaka[1], Louis L. Pisters[1], John D. Hazle[1]
[1]The University of Texas M. D. Anderson Cancer Center, Houston, Texas, USA

This research correlates magnetic resonance (MR) image characteristics and macroscopic tissue changes to evaluate intraprostatic gene therapy delivery injection paradigms. Using different injection schemes, *ex vivo* canine prostates were injected with a Gd-DTPA/methylene blue (MB) solution under ultrasound guidance. MR imaging and macroscopic tissue changes independently assessed resulting distribution of injected material. Gd-DTPA from MR, correlated well with MB patterns observed in gross photographs. 10-core injection schemes provided best coverage of the prostate. Given previous experiments correlating MB and adenoviral transduction patterns, this encourages investigation of MR for non-invasive imaging of *in vivo* intraprostatic delivery.

1173. MRI Guidance and Planning for High-Dose-Rate Brachytherapy (HDRT) of the Prostate

Robert C. Susil[1], Kevin Camphausen[2], Ergin Atalar[1], Elliot R. McVeigh[2], Holly Ning[2], Robert W. Miller[2], C Norman Coleman[2], Cynthia Menard[2]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

A system for planning and guidance of high-dose-rate brachytherapy (HDRT) for the treatment of prostate cancer in a 1.5T MR scanner is described. Using a rectal imaging coil, perineal template, and positioning arm, several brachytherapy catheters can be placed within the prostate to be subsequently loaded with a radioactive source for localized delivery of HDRT. In a canine prostate, 8 catheters were placed and used for dosimetry planning – demonstrating coverage of the entire prostate with a therapeutic radiation dose without overdosing of the urethra. In a prostate cancer patient, preliminary results showing accurate placement of catheters are presented.

1174. A Novel Morphometric Approach to Functional MRI Diagnostics of Shoulder Instabilities

Harald Busse[1], Matthias Seiwerts[1], Thomas Kahn[1], Georg von Salis-Soglio[1], Michael Thomas[1]
[1]Leipzig University Hospital, Leipzig, Saxony, Germany

The aim was to realize a widely applicable morphometric analysis method for functional MRI studies of shoulder instabilities. This was achieved by patient examination in a vertically open MRI unit and a PC-based numerical processing of 3D surface model objects rendered from the acquired 3D MRI data. Useful coordinates to determine glenohumeral angles and changes in the position of the humerus head were introduced by computing the principal axes of the glenoid cavity and the humerus shaft. The presented method allows to quantify the degree of shoulder instabilities and is expected to significantly improve the validity of MRI diagnostics.

1175. Advanced Navigation Strategies for MRI-guided Interventions

Michael Moche[1], Harald Busse[1], Jens-Peter Schneider[1], Arno Schmitgen[2], Gero Strauss[1], Roger Scholz[1], Thomas Kahn[1]
[1]University of Leipzig, Leipzig, Saxonia, Germany; [2]FIT, Bonn, Nordrhein Westfalen, Germany

While interventional MRI (iMRI) scanners support continuous image guidance providing high soft tissue contrast during interventions, they often lack of appropriate image quality, the possibility to merge data with additional image information and fast refresh rates for delicate navigation tasks. We successfully addressed these issues by using an advanced navigation platform sharing resources with an existing iMRI design. This study will summarize our one year's experience with 48 MRI-guided non-neurosurgical interventions (9 transnasal, 10 bone and 2 soft tissue biopsies, 1 femoral and 15 breast markings, 11 liver LITTs).

1176. Endoscope-MR Probe Coil for Detection of the Tumor Invasion in Open MRI System

Yuichiro Matsuoka[1], Etsuko Kumamoto[2], Atsuya Okada[1], Akito Saito[3], Taiji Mine[3], Takao Shibasaki[3], Bilgin Keserci[4], Kagayaki Kuroda[1]
[1]Institute of Biomedical Research and Innovation, Kobe, Hyogo, Japan; [2]Kobe University, Kobe, Hyogo, Japan; [3]Olympus Optical Co. Ltd., Hachioji, Tokyo, Japan; [4]GE Yokogawa Medical Systems Ltd., Hino, Tokyo, Japan

The purpose of this study is to determine tumor invasion of internal organ minutely with endoscopy and MRI. First step for this purpose, we developed solenoid MR probe coil (12mm diameter) installed in the laparoscope. MR Image of in-vitro liver of swine was obtained in 0.5-T field. SNR for the depth of 5mm from the tissue surface was very high. The simulation to detect the location of endoscope was done. It was found that MR probe coil with endoscope could be useful for diagnosis of the tumor invasion, and the position confirmation of the endoscope could be possible.

1177. Innovative Coil Designs for Minimally Invasive Active Device Tracking Applications

Eddy Y. Wong[1], Daniel R. Elgort[1], Claudia M. Hillenbrand[2], Jonathan S. Lewin[2], Jeffrey L. Duerk[2]
[1]Case Western Reserve University, Cleveland, Ohio, USA; [2]University Hospitals of Cleveland, Cleveland, Ohio, USA

Active device tracking has emerged as a robust technique for interventional device localization and guidance. A novel tracking coil utilizing an integrated signal source while maintaining minimal dimensions is constructed for use in conjunction with active localization software. This new coil design is successfully located and tracked in both phantom and in vivo porcine imaging experiments.

1178. Real-time MR Image Guided Navigation Using Alternate Two Perpendicular Planes

Shigehiro Morikawa[1], Toshiro Inubushi[1], Yoshimasa Kurumi[1], Shigeyuki Naka[1], Koichiro Sato[1], Hasnine Akter Haque[2]
[1]Shiga University of Medical Science, Ohtsu, Shiga, Japan; [2]GE Yokogawa Medical Systems, Hino, Tokyo, Japan

We have developed an external computer control system of an open MR scanner for MR-guided interventional therapy. This system alternately and automatically switched two perpendicular image planes, both of which included the path of the needle. Such a method could be achieved only with MR imaging having multi-planar and multi-slice capabilities. This software also displayed 2 re-formatted images from high resolution 3D volume data corresponding to the 2 planes of the real-time images. Using these 4 images, accurate image navigation in the 3-dimensional space could be accomplished.

1179. Susceptibility Artifact Analysis of Nanoparticulate Thin Film Coating for Use in Intraluminal Guidewires and Leads

Patrick R. Connelly[1], Edmund Kwok[1], Robert Gray[2], Jeff Helfer[2], Xingwu Wang[3], Deborah Chung[4], Ronald Miller[3], Jianhui Zhong[1]
[1]University of Rochester, Rochester, New York, USA; [2]Biophan Technologies, Inc., Rochester, New York, USA; [3]Alfred University, Alfred, New York, USA; [4]University of Buffalo, Buffalo, New York, USA

Guidewires and leads, can be deleterious to MR acquisitions. We present a nanoparticulate coating for such devices and analysis of image distortion of coatings. Silicon wafers and aluminum rods were coated with various compositions of aluminum, iron and nitride. DGE and DSE images of coated rods in oil were acquired to analyze distortion. Network analyzer measurements of coated silicon wafers confirmed their ability to provide EM shielding. Projections of images at different echo times demonstrated a detectable difference in susceptibilities of different coatings. Analyses will assist in the optimization of coating parameters for shielding of intraluminal devices.

1180. Registration Strategies for Alignment of Cardiac MR Data with 3D Electrophysiological Maps

Zachary J. Malchano[1], Raymond C. Chan[2], Godtfred Holmvang[2], Ehud J. Schmidt[3], Andre d'Avila[2], Thomas J. Brady[2], Jeremy N. Ruskin[2], Vivek Y. Reddy[2]
[1]Massachusetts Institute of Technology, Cambridge, Massachusetts, USA; [2]Massachusetts General Hospital -- Harvard Medical School, Boston, Massachusetts, USA; [3]GE Medical Systems, Milwaukee, Wisconsin, USA

Electrophysiological (EP) intracardiac mapping procedures result in relatively sparse 3D cardiac maps. Because of its ability to provide detailed anatomical information about the normal and diseased cardiac tissue architecture, pre-operative MRI could greatly facilitate cardiac EP evaluations. To exploit preoperative imaging fully, cardiac MR data must be registered accurately with EP measurements obtained during in vivo intracardiac mapping. Since accuracy depends on the feature set used in registration, we evaluated the performance of iterated-closest-point MRI-EP alignment when the registration feature set was varied.

1181. Functional MRI Using Low-Field Interventional MR System

Bharat Biswal[1], Hooman Azmi[1], Elizabeth Van Iperen[1], Michael Schulder[1]
[1]UMDNJ, Newark, New Jersey, USA

Although structural information about the cortex is available and can be acquired during MR guided interventions, functional information is often not available. To obtain functional maps, maps are typically obtained from a high field MR system and overlaid on the structural images. As a consequence, a neurosurgeon can navigate using only a predefined set of activation maps that was previously obtained. Recent studies also suggest that the brain shift during neurosurgery can lead to substantial error. We demonstrates the feasibility of detecting task/stimulus induced signal changes in the cortex using a low-field interventional MR system.

Vascular Interventions

Hall D Monday 13:30 - 15:30

1182. Real-time MR-guided Endomyocardial Local Delivery

Gabor Mizsei[1], Roberto Corti[2], Juan Jose Bodimon[1], Frank Macaluso[1], Paul Licato[3], Zahi Adel Fayad[1], Valentin Fuster[1], Warren Sherman[1]
[1]Mount Sinai School of Medicine, New York, New York, USA; [2]University Hospital Zurich, Zurich, Switzerland; [3]GE Medical Systems, Milwaukee, Wisconsin, USA

Despite recent therapeutic advances, cardiovascular disease is still the leading cause of mortality. New therapies targeting tissue regeneration involving the delivery of genes, growth factors and stem or other cell types are being investigated. Their success depend upon the accuracy and extent of the local delivery. X-ray imaging does not allow optimal visualization of the target area and precise handling of catheter delivery devices. We have developed a method for real-time magnetic resonance (MR) guided endomyocardial delivery that may have important clinical applications.

1183. Improved Real-Time Adaptive Tracking System

Daniel Robert Elgort[1], Eddy Y. Wong[1], Claudia Hillenbrand[1], Frank S. Wacker[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]University Hospitals of Cleveland and Case Western Reserve University, Cleveland, Ohio, USA

This adaptive tracking system uses real-time tracking techniques to continually monitor a catheter tip's 3D position, orientation, and insertion speed. The device position and orientation information is used to automatically adjust the scan plane for real-time imaging. Insertion speed is used to automatically adjust pre-specified adaptive image parameters in real-time. Image resolution, FOV, Bandwidth, TE, TR, and temporal resolution are currently used as adaptive parameters; many other image parameters can also be used. This technology represents a first "hands free" interventional MRI system that automatically optimizes adaptive image parameters and reacts to changing clinical requirements in real-time.

1184. Chemical Shift Catheter Tracking for Intravascular MRI

Chris Flask[1], Daniel Elgort[1], Ken-Pin Hwang[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]Case Western Reserve University and University Hospitals of Cleveland, Cleveland, Ohio, USA

Catheter tracking and visualization is a useful tool for cardiovascular therapies (e.g., stent placement, balloon angioplasty, etc). Guidewire antennas deliver an independently received signal which can be reconstructed and overlaid onto a previously acquired roadmap image for catheter tracking and visualization. However, these antennas suffer from local heating which may result in significant tissue damage. In this study, a new tracking/profiling method based on the selective excitation of a chemically-shifted NMR signal source provides the necessary selectivity and large field of view for catheter visualization and steering without the risks of localized tissue heating.

1185. An Intra-Vascular Imaging Catheter Including Imaging, Tracking and Centering Components

Ehud J. Schmidt[1], Charles Dumoulin[2], Motoya Hayase[3], Vivek Reddy[3], Godtfred Holmvang[3], Thomas Brady[3]
[1]GE Medical Systems ASL, Boston, Massachusetts, USA; [2]GE Global Research Center, Schnectady, New York, USA; [3]Massachusetts General Hospital, Boston, Massachusetts, USA

Intra-Vascular (IV) MRI coils in the vascular system can potentially visualize fine structures in the vessel lumen and wall with a resolution of ~ 100 microns. Since the SNR of these coils is only 30-60 times that of surface coils , however, multi-minute acquisitions are required. As a result, current use of intravascular coils is limited by vessel motion and catheter motion, as well as by eccentric coil positions in the vessel. A prototype IV coil catheter that addresses these issues is presented and tested in "plaque" phantoms and animal models.

1186. A Catheter Based, Opposed Solenoid Phased Array Coil for Active Device Tracking and High Resolution Intravascular MRI

Claudia M. Hillenbrand[1], Daniel R. Elgort[1], Eddy Y. Wong[1], Frank K. Wacker[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]University Hospitals of Cleveland/Case Western Reserve University, Cleveland, Ohio, USA

A catheter-based opposed solenoid phased-array coil was designed and built to develop an endovascular catheter probe optimized for both active MR device tracking and high-resolution vessel wall imaging. The design essentially consists of two independent solenoid coils wound in opposite direction, connected to separate receive channels, and mounted on a catheter. This permits the coils to be used independently or together in tracking or imaging applications, respectively. It's dual functionality was successfully tested in phantom and porcine tracking and imaging experiments. It represents a new single device which fulfills two important functions required for future MRI guided endovascular therapy.

1187. Analysis of Intravascular MR Antenna Designs by Simulation of Sensitivity Profiles

Nicole A. A. Op den Kamp[1], Jan Henry Seppenwoolde[1], Huib J. Visser[2], Anton G. Tijhuis[2], Chris J.G. Bakker[1]
[1]University Medical Center, Utrecht, Netherlands; [2]Eindhoven University of Technology, Eindhoven, Netherlands

Intravascular MR antennas hold potential to enable tracking of guidewires and catheters through bloodvessels and to obtain high-resolution images of vessel walls. Previous research on intravascular MR antennas describes promising designs for these applications. To quantitatively compare and optimize intravascular antenna designs we developed a numerical method, based on Biot-Savart's law. This method was validated and used to calculate sensitivity patterns of models of intravascular MR antennas, in order to select and optimize promising designs for practical development and further testing.

1188. MR-Guided Renal Embolisation using Intra-Arterial CE-MRA and Active Catheter Tracking

Christian Fink[1], Peter Hallscheidt[2], Steffen Volz[1], Sven Zuehlsdorff[1], Rainer Umarthum[1], Roland Galmbacher[2], Wolfhard Semmler[1], Manfred Wiesel[2], Wolfgang Nitz[3], Michael Bock[1]
[1]DKFZ, Heidelberg, Germany; [2]University of Heidelberg, Heidelberg, Germany; [3]Siemens Medical Solutions, Erlangen, Germany

The aim of this study was to assess the feasibility of MR-guided renal embolization in a porcine model using active catheter tracking. Initial results indicate that MR-guided tumor embolizations are feasible in a conventional MR scanner. Intra-arterial CE-MRA allows a reliable control of embolization results. MR-visible guidewires and optimized active catheters are required for clinical embolizations.

1189. Realtime Interventional MR-Guided Renal Artery Embolization

Mark Wilson[1], Nicholas Fidelman[1], Oliver Weber[1], Alastair Martin[1], Maythem Saeed[1]
[1]UCSF, San Francisco, California, USA

Purpose: Interventional magnetic resonance (MR)-guided transcatheter embolization could increase precision of embolotherapy and improve visualization of target organs. Realtime MR imaging was tested as a means to monitor transcatheter delivery of a MR-visible embolic agent into canine renal arteries in vivo. Materials and Methods: Fourteen renal arteries in 7 dogs were catheterized using fluoroscopic guidance in a dual modality MRI/fluoroscopy (X/MR) unit, which combines a 1.5T short-bore magnet and a full-feature C-arm angiography laboratory in an interactive configuration. The dogs were then transferred to the MRI component where gadolinium-impregnated microspheres (Biosphere, Inc, Rockland, MA), measuring 300-500 and 500-700 microns in

1190. Passive Tracking with Positive Contrast by Local Signal Conservation in a Dephasing Background Gradient: The White-Marker Phenomenon

Jan Henry Seppenwoolde[1], Max A. Viergever[1], Chris J.G. Bakker[1]
[1]University Medical Center, Utrecht, Netherlands

This study describes a novel passive tracking technique with positive marker contrast by application of local signal conservation in a dephasing background gradient. The theory is briefly described and the concept is demonstrated in in vitro experiments under realistic flow conditions. The feasibility of in vivo application is shown by performing the 'white-marker' tracking in a living pig. All experiments show a reliable depiction of the devices with positive contrast and significant suppression of the background signal. It is concluded that the described tracking technique is feasible and has potential for use in MR guided endovascular interventions.

1191. Optimization of a Multiple Inversion Recovery Magnetization Preparation for Thick Slice Projection Imaging in Interventional MRI

Jordin D. Green[1], Reed A. Omary[1], Brian E. Schirf[1], Debiao Li[1]
[1]Northwestern University, Chicago, Illinois, USA

A magnetization-preparation scheme consisting of a saturation pulse followed by four inversion pulses was implemented for background suppression in thick-slice 2D projection angiography using trueFISP (Fast Imaging with Steady State Precession). The sequence was optimized using computer simulations and tested in phantom and in vivo studies. A trueFISP sequence with a single inversion pulse preparation was also implemented for comparison. All comparisons indicated that the multiple inversion pulse preparation is superior to a single inversion pulse preparation. This technique may have applications in interventional MR angiography.

1192. Interventional MRI using Undersampled PR and Reduced FOV

Dana C. Peters[1], Michael A. Guttman[1], Venkatesh K. Raman[1], Alexander J. Dick[1], Robert J. Lederman[1], Elliot R. McVeigh[1]
[1]National Institutes of Health, DHHS, Bethesda, Maryland, USA

We investigated active catheter tracking using real-time undersampled projection reconstruction (PR) combined with a reduced field of view (rFOV) technique for interventional MRI. Real-time rFOV processing was interactively activated during highly undersampled catheter imaging, providing improved artifact suppression with better temporal resolution than the view-sharing technique. Comparison with Cartesian (rectilinear) rFOV shows that PR is more immune to aliasing that results from rFOV imaging with a dynamic outer FOV. The doubling of temporal resolution possible with PR rFOV permits accurate monitoring of highly dynamic events, like ventricular ectopy and catheter movements.

1193. Development and Evaluation of a Reversible Embolic Stroke Model for MR Endovascular Thrombolysis

Ronda C. Ryder[1], Rob J. Sevick[2], William F. Morrish[2], John H. Wong[3], William Y. Hu[2], Mark Hudon[2], Richard Frayne[3]
[1]Seaman Family MR Centre, Calgary, Alberta, Canada; [2]Foothills Medical Centre, Calgary, Alberta, Canada; [3]University of Calgary, Calgary, Alberta, Canada

As part of our ongoing effort to develop MR-guided endovascular therapies, we are developing animal models of embolic stroke by injecting thrombus, via catheters, directly into the cranial circulation. Unlike glues and other embolic materials, our model is potentially reversible via thrombolysis. We have evaluated the technique in a series of six animals using x-ray angiography, MR imaging and colored microspheres. In particular, the use of intra-arterial (IA) contrast injections in MR perfusion-weighted imaging (PWI) has been evaluated. Here, we summarize our favorable early findings in developing and evaluating this model.

1194. MR-guided Intravascular Angiography of the Abdominal Arteries Using Automatic Image Slice Positioning

Michael Bock[1], Peter Hallscheidt[2], Christian Fink[1], Steffen Volz[1], Sven Zuehlsdorff[1], Reiner Umathum[1], Wolfgang Nitz[3], Manfred Wiesel[2], Wolfhard Semmler[1]
[1]Deutsches Krebsforschungszentrum, Heidelberg, Germany; [2]University Heidelberg, Heidelberg, Germany; [3]Siemens Medical Solutions, Erlangen, Germany

In this study a fully MR-guided catheterization of the aorta and its branches is presented. Active catheter tracking in combination with automatic imaging slice positioning is used in an animal model to visualize the catheter tip in the abdominal vasculature. Image contrast is changed interactively between 2D trueFISP for catheter manipulation and MR projection angiography (MR-DSA) for intra-arterial contrast injection. With the catheter in the target vessel, time-resolved 3D MR angiography data sets have been acquired to visualize the subsequent vasculature. Selective MRA data e.g. of superior mesenteric artery, splenic artery or renal arteries have been acquired.

1195. Automated near Real-Time Flow Velocity Measurements with Active Intravascular Catheters

Steffen Volz[1], Sven Zuehlsdorff[1], Michael Bock[1], Wolfhard Semmler[1]
[1]Deutsches Krebsforschungszentrum, Heidelberg, Germany

A method for fast intravascular flow velocity measurements during interventional procedures was developed. A projection gradient echo pulse sequence is used in combination with small active catheter coils to acquire velocity encoded signal projections at a temporal resolution of 10.4 ms. The pulse sequence can be activated by a dedicated real-time user interface for MR imaging to provide velocity measurements in nearly real-time.

1196. Development of an Intravascular MR-Imaging/RF-Heating System for Thermal Enhancement of Vascular Gene Transfer

Bensheng Qiu[1], Vaishali C. Shah[1], Xiangying Du[1], Ergin Atalar[1], Xiaoming Yang[1]
[1]Johns Hopkins University School of Medecine, Baltimore, Maryland, USA

To develop a novel intravascular MR-imaging/RF-heating system for thermal enhancement of vascular gene transfer by (1) improving an 0.014-in MR imaging guidewire (MRIG) to decrease the attenuation of both MR signal and RF-heating; (2) simulating the pattern of RF heating power deposited at the target and determining the optimum heating frequency with the MRIG; (3) implementing an RF generator and filter box to simultaneously generate MR imaging of and local RF heating at the target vessel; and (4) developing an intravascular MR thermal mapping method to monitor RF-mediated temperature increase in the target vessel wall.

1197. Multi-Coil Real-Time Interventional System

Juan M. Santos[1], Michael McConnell[1], Greig C. Scott[1], Min Su Hyon[1], John M. Pauly[1]
[1]Stanford University, Stanford, California, USA

Guiding interventional procedures requires both large- and small-FOV imaging, as well as tracking the position of one or more coils on interventional devices. Accordingly, we have developed a flexible system architecture that allows real-time acquisition and interactive display of image and position data from multiple coils

1198. Left and Right Heart Catheterization Using Real-Time MR Catheter Guidance

Simon Schalla[1], Maythem Saeed[1], Phillip Moore[1], Oliver Weber[1], Alastair Martin[1], Charles B. Higgins[1]
[1]University of California San Francisco, San Francisco, California, USA

A new method of cardiac catheter guidance with MR imaging was used in this study. Real-time MR imaging enabled to steer a prototype active tracking catheter using venous, venous-transseptal and arterial vascular access to obtain cardiac pressure curves and blood samples in pigs. Image planes were defined to steer the catheter to each region of interest. Diagnostic left and right heart catheterisation using real-time MR guidance is feasible. A combination of anatomical and functional cardiac imaging with catheter guidance might be especially important in patients with congenital heart disease.

Thermotherapy

Hall D Tuesday 13:30 - 15:30

1199. SSFP based MR Thermometry

Vaishali C. Shah[1], AbdEl-Monem El-Sharkawy[2], Xiangying Du[1], Xiaoming Yang[1], Ergin Atalar[3]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA; [3]Johns Hopkins University School of Medicine and Bilkent University(Turkey), Baltimore, Maryland, USA

We present a new method to quantify temperature changes using MR. Proton resonance frequency shift (PRF)- based phase difference imaging (PDI) is the most accurate and widely used of the various existing techniques (1) to quantify temperature changes using MR. PDI, however, is associated with various artifacts, such as dependence on heat source orientation and TE settings (2,3). Our experiments with PDI showed spatially varying phase drifts for experiments lasting longer than 15 minutes. These limitations motivated us to develop a new method to measure PRF shift using steady state free precession (SSFP).

1200. Rapid 2D MR Thermal Imaging Using Under-Sampled Projection Reconstruction

Yong Zhou[1]
[1]GE Medical Systems, Waukesha, Wisconsin, USA

We have investigated the feasibility of using 2D under-sampled projection acquisition for MR thermal imaging. The technique is base on the water proton resonance frequency (PRF) shift technique. Preliminary results have shown that under-sampling by a factor of less than 4 can yield satisfactory result with very limited artifacts. This technique allows rapid and possibly real-time monitoring of thermal dosage during hyperthermic treatment.

1201. Comparison of Radial, Respiratory Gated EPI, and Respiratory Gated SENSE-EPI Sequences for Temperature Monitoring in the Human Liver under Free Breathing

Claudia Weidensteiner[1], Bruno Quesson[2], Tobias Schaeffter[3], Noureddine Kerioui[1], Benedicte Caire-Gana[1], Chrit Moonen[1]
[1]RMSB UMR 5536 CNRS/Université Victor Segalen Bordeaux 2, Bordeaux, France; [2]Image Guided Therapy SA, Pessac, France; [3]Philips Research, Hamburg, Germany

Temperature stability of a radial acquisition scheme was compared with a respiratory gated segmented EPI sequence for temperature mapping with the PRF-method in the liver of 6 volunteers. The EPI sequence was performed with and without SENSE acceleration (3 slices in 1 expiration phase, in-plane resolution 3mm, SENSE factor 1.5). In the radial sequence, 3 slices were acquired with a similar resolution in 9 sec without gating. The standard deviation at normal body temperature was 1.4 C for EPI without SENSE, 2.0 C for SENSE-EPI, and 2.2 C for the radial sequence. The EPI method is promising for monitoring liver tumor ablation.

1202. Novel Simultaneous Multi-plane 2D Acquisition for 3D Temperature Monitoring

Yong Zhou[1]
[1]GE Medical Systems, Waukesha, Wisconsin, USA

We demonstrate the feasibility and efficacy of a novel multi-plane 2D acquisition technique for monitoring temperature changes in 3D. The technique is base on water proton resonance frequency (PRF) shift. The advantages of this technique include high acquisition efficiency and simplicity in post-processing and presentation.

1203. Phased Array PRF Shift Thermometry in Canine Prostate

Viola Rieke[1], Roland Bammer[1], Graham Sommer[1], Christopher J. Diederich[2], William H. Nau[2], Anthony Ross[2], Bruce L. Daniel[1], Kim Butts[1]
[1]Stanford University, Stanford, California, USA; [2]University of California San Francisco, San Francisco, California, USA

The proton resonance frequency (PRF) shift is frequently used for monitoring temperature changes during thermotherapy. The phased array combination of an endorectal coil and an anterior surface coil is used to image canine prostate ablation, improving the SNR and temperature uncertainty in the region of interest.

1204. Correction for Positional Errors in PRF Based MR Thermal Maps by Active Tracking

Mika Vogel[1], Mats Tived[2], Supri Janto[3], Peter Pattynama[1]
[1]Erasmus University Rotterdam, Rotterdam, Netherlands; [2]GE Medical Systems Sverige AB, Stockholm, Sweden; [3]Delft University of Technology, Delft, Netherlands

PRF MR thermometry currently fails in the presence of motion. Many clinical targets for tumor therapy however, experience intrinsic motion. Actively tracking the heat source allows for quantification of displacement and speed. In this ex vivo study, we show that one can employ tracking to correct for displacement of porcine liver (N=5) simulated free breathing motion. The resultant PRF based thermal maps show consistent thermal contours and allows improved assesment of coagulation size.

1205. An Integrated MR-Hyperthermia System for Esophagus Tumor Using Balloon-type Intra-Cavity Probe

Kagayaki Kuroda[1], Yuichiro Matsuoka[1], Daiki Harada[2], Masato Sakamoto[3], Bilgin Keserci[4]
[1]Institue of Biomedical Research and Innovation, Kobe, Hyogo, Japan; [2]School of Engineering, Kobe University, Kobe, Hyogo, Japan; [3]School of Medicine, Kyoto University, Kyoto, Japan; [4]GE Yokogawa Medical Systems Inc., Hino, Tokyo, Japan

A novel RF heating and MR probe device designed for imaging esophagus temperature change under hyperthermia was proposed. The signal to noise ratio of the integrated probe was approximately 20 in the porcine esophagus wall in vitro placed in a 0.5 T open magnet. The markedly high signal to noise ratio at the near field of the probe allowed us to visualize the temperature distribution in the wall structure using the phase mapping method with a microscopic spatial resolution of 0.23 mm.

1206. Observations on the Temperature Dependence of Apparent Proton Density in Bovine Adipose and Muscle

Jing Chen[1], Bruce L. Daniel[1], John M. Pauly[1], Kim R. Butts[1]
[1]Stanford University, Stanford, California, USA

The goal of this work is to investigate how the proton density (PD) of adipose and muscle tissue change with temperature. In vitro bovine muscle and adipose tissue were heated and imaged with a dual-echo spin echo pulse sequence. The results show a decrease in PD in the muscle tissue as temperature increases, but a very different response in adipose tissue. In adipose tissue, the PD increases initially as the temperature rises to 50 C, and then decreases as the temperature further increases. On cooling, the proton density increases linearly with temperature.

1207. Thermal Dosimetry during MRI-Guided Focused Ultrasound Surgery in Uterine Fibroids

Nathan McDannold[1], Clare MC Tempany[1], Elizabeth A. Stewart[1], Ferenc A. Jolesz[1], Kullervo Hynynen[1]
[1]Harvard Medical School/Brigham and Women's Hospital, Boston, Massachusetts, USA

Thermal tissue damage predicted by MRI-derived thermal dosimetry acquired during focused ultrasound surgery in uterine fibroids was compared to that observed in contrast-enhanced T1W images. A method to estimate the effects of thermal build-up is described. Preliminary tests in 14 fibroids indicate that the thermal dose under-predicted the treatment response observed in contrast-enhanced T1-weighted imaging on average by 43±20%, even when the effects of thermal buildup were estimated.

1208. Investigation of the Threshold for Tissue Damage in the Rabbit Brain using MRI-Derived Temperature Information

Nathan McDannold[1], Natalia Vykhodtseva[1], Heather Martin[1], Ferenc A. Jolesz[1], Kullervo Hynynen[1]
[1]Harvard Medical School/Brigham and Women's Hospital, Boston, Massachusetts, USA

MRI-derived temperature information acquired during focused ultrasound sonications was compared to the presence of histologically confirmed tissue damage in the rabbit brain. In addition, the ability of MRI to detect near-threshold tissue damage was tested. The thermal dose and peak temperature threshold for tissue damage was in the range of 12-40 equivalent min at 43 C and 48.0-50.8 C respectively.

1209. New Thermosensitive Liposomes for MR-guided Hyperthermia

Herbert M. Reinl[1], Lars H. Lindner[1], Philip Schneider[1], Michael Peller[1], Nicole Teichert[1], H Eibel[2], Rolf Issels[1], Maximilian Reiser[1]
[1]University Munich, Klinikum Grosshadern, Munich, Germany; [2]Max Planck Institute for Biophysical Chemistry, Goettingen, Germany

Newly designed long circulating liposomes are shown to be a temperature sensitive contrast agent for MRI when gadolinium chelat is trapped. At the therapeutic temperature of hyperthermia of 41 C nearly 50% of the gadolinium is set free, and can be detected by T_1 changes in a MRI-Hyperthermia hybrid-system. Our results indicate that our new system has the potentiality to improve monitoring of hyperthermia and thus the therapeutic outcome. Moreover, the liposomes may also be used for specific release of chemotherapeutics by moderate hyperthermia.

1210. Assessment of Residual Cancer by Dynamic Contrast-enhanced MRI following MR Imaging-guided Focused Ultrasound Ultrasound Surgery of Breast Tumors

Abdesslem Khiat[1], David Gianfelice[1], Mourad Amara[1], Assia Belblidia[1], Yvan Boulanger[1]
[1]Hôpital St-Luc du CHUM, Montreal, Quebec, Canada

The purpose of this study was to evaluate the usefulness of parameters from dynamic contrast-enhanced MRI (DCE-MRI) signal intensity vs time curves to determine the response to MR imaging-guided focused ultrasound surgery (MRIgFUS) in breast carcinoma and to correlate these parameters with the pathological findings in the excised tissue. A good correlation between two DCE-MRI parameters and percentage of residual tumor was found. Tumor necrosis and hemorrhage induced by MRIgFUS can be clearly distinguished from residual cancer by a quantification of DCE-MRI parameters.

1211. Prediction of Subtle Thermal Histopathological Change using a Novel Analysis of Gd-DTPA Kinetics

Hai-Ling Margaret Cheng[1], Donald B. Plewes[1]
[1]University of Toronto, Toronto, Ontario, Canada

Current assessment methods for MRI-guided focused ultrasound cannot distinguish different degrees of thermal damage, resulting in both inconsistent use of MR contrasts to assess damage and difficulty in ensuring clear margins. This study explores the ability of Gd-DTPA kinetics (GdK) to reveal biological information about tissue changes not available with current techniques. Rabbit studies were performed and careful comparisons made amongst peak temperatures, standard T2w MR, GdK, and histology. Results indicate that GdK reveals regions on histology not visible on standard MR and may be an earlier indicator of damage.

1212. MR Imaging and Gene Expression Changes in Focused Ultrasound-Treated Muscle Tissue

Walter Hundt[1], Esther Yuh[1], Dan Lee[1], Mark D. Bednarski[1]
[1]Stanford University, Stanford, California, USA

Focused ultrasound (FUS) was applied to muscle tissue in C3H/Km mice using a dual imaging/therapeutic system at continuous and pulsed wave mode. T2 and pre- and post-contrast T1 images were obtained on a 4.7 T scanner. Tissue changes after FUS treatment were clearly visible on MRI. Gene expression analysis was performed and revealed profound changes in expression levels of 24 genes in both FUS modes. Functional genomic analyses at treated muscle tissue revealed 7 potential upregulated targets for developing of molecular imaging probes. One gene product (HSP70) can also be used as a promotor for gene therapy.

1213. Interstitial Laser Thermotherapy *In Vivo* Brain Tissue: Evaluation by Magnetic Resonance Imaging and Quantitative Autoradiography

Michael Peller[1], Alexander Muacevic[1], Ronald Sroka[1], Lutz Ruprecht[2], Maximilian F. Reiser[1]
[1]University of Munich, Munich, Germany; [2]GSF-National Research Center for Enviroment and Health, Neuhergberg, Germany

The purpose of the study was to investigate MRI assisted interstitial laser thermotherapy in a clinical setting applicable to patients suffering from brain tumors. The chemical shift of the proton resonance frequency was chosen as temperature sensitive MR-parameter. As a model, the brain tissue of healthy canines was selected. The MRI-results were compared with morphological and pathophysiological examinations over three months after thermotherapy. The steep development in lesion size with a maximum size after 12 hours was clinically well tolerated by all dogs. Our in vivo CS-thermometry study showed adverse effects affecting a potential application of the CS-method to patients.

1214. MR-Guided High-Focused Ultrasound Treatment of Uterine Fibroids- Reduction in Fibroid Size and Clinical Improvement

Yael Inbar[1], Yaakov Itzchak[1], Jaron Rabinovici[1]
[1]Chaim Sheba Medical Center, Tel Hashomer, Ramat-Gan, Israel

Transcutaneous MR-guided High Focus Ultrasound (HIFUS) ablation of uterine fibroids was performed in 38 symptomatic women scheduled for hysterectomy. Accurate targeting of the ultrasound beam and assessment of heat generation were achieved by real-time MRI monitoring. The aim of the present study was to determine the safety, feasibility and clinical efficacy of this novel non-invasive alternative to hysterectomy. This outpatient procedure was well tolerated by all women, with only 4 women subsequently undergoing their scheduled hysterectomy. The treated fibroids demonstrated a statistically significant reduction in size on follow-up MRI, and the majority of women reported an improvement in their symptoms

1215. Nominal Orientation of MRI-Guided Focused Ultrasound Treatment of Uterine Leiomyomas Induces Greater Leiomyoma Necrosis

Fiona Fennessy[1], Nathan MacDannold[1], Elizabeth Stewart[1], Steven Haker[1], Kelly Zou[1], Kullervo Hynynen[1], Ferenc Jolesz[1], Clare Tempany[1]
[1]Brigham and Womens Hospital, Boston, Massachusetts, USA

Uterine leiomyomas are the most common female pelvic tumor, which may be associated with menorrhagia and infertility, or pressure related issues such as chronic pelvic pain, and urinary frequency. Treatment options include hysterectomy, myomectomy, uterine artery embolization and hormonal therapy. Non-invasive magnetic resonance imaging (MRI)-guided focused ultrasound (FUS) has the potential to become a non-invasive choice for selected patients. Using interactive target segmentation on MRI, an outlined volume can be non-invasively treated, monitored by on-line MR temperature control. The optimal orientation of the transducer beam for necrosis-induction using FUS is as yet unknown, but may impact overall leiomyoma volume reduction.

1216. MRI-Guided Microwave Surgery of Hepatocellular Carcinoma

Shigeyuki Naka[1], Yoshimasa Kurumi[1], Tomoharu Shimizu[1], Koichirou Sato[1], Tsuyoshi Yamaguchi[1], Yoshihiro Endo[1], Kazuyoshi Hanasawa[1], Tohru Tani[1], Shigehiro Morikawa[1], Toshiro Inubushi[1]
[1]Shiga University of Medical Science, Otsu, Shiga, Japan

The purpose of this study is to demonstrate that MRI-guided microwave surgery is a safe and effective treatment for hepatocellular carcinoma(HCC). From January 2000 to September 2002, 45 nodules in 40 patients with HCC were treated by MRI-guided microwave surgery. The microwave surgery for HCC underwent with a vertically oriented open MRI system (0.5 T SIGNA SP/i system : GE Medical Systems). The microwave electrode was introduced into the liver via a percutaneous puncture with real-time MR image guidance. Microwave ablations were repeated several times. The recurrence lesions at treated site appeared in 4 cases.

1217. Control System for MR-Guided Cryotherapy: Automatic Segmentation and Short-Term Future Prediction of Therapy Region Using 3D Optical Flow

Ryoichi Nakamura[1], Kemal Tuncali[1], Paul R. Moriison[1], Simon K. Warfield[1], Nobuhiko Hata[2], Ron Kikinis[1], Ferenc A. Jolesz[1], Gary P. Zientara[1]
[1]Brigham & Women's Hospital and Harvard Medical School, Boston, Massachusetts, USA; [2]Graduate School of Information Science and Technology, the University of Tokyo, Bunkyo-ku, Tokyo, Japan

During cryotherapy, it is extremely useful for the interventionalist to have available intra-operatively a 3D iceball visualization, to ensure the effectiveness and safety of the procedure. Additionally, it highly beneficial to provide the interventionalist with a best estimate of how the iceball will grow in the future, and an estimate of the extent to which the target region and the tissues around it will be ablated. In this study, we introduce a newly developed control system for cryotherapy using a novel approach for the real-time/future-predicted assessments of the treatment. The system has been validated using results from cryotherapy experiments.

1218. MR-Guided Percutaneous Cryosurgery of Breast Carcinomas : Results of the Phase I Clinical Trial

Jacques Morin[1], Amidou Sissou Traore[1], Guy Dione[1], Marcel Dumont[1], Bertrand Fouquette[1], Marie Dufour[1], Sonia Cloutier[1], Christian Moisan[1]
[1]Quebec City University Hospital, Quebec, Canada

To report the results of the first phase of our clinical trial aimed at evaluating the effectiveness of the MR-guided percutaneous cryosurgery in the treatment of breast carcinomas. The intra-procedural iceball induced effective cell killing and a complete tumor ablation was systematically achieved when the tumor was encompassed with a sufficient security margin. Combining the per-operative MR images with the post-operative scintimammographic findings enabled a prediction of 95% of the cryosurgical results revealed at histopathology. These results demonstrate that MR-guided cryosurgery of breast carcinomas is feasible, and safe, with predictable results.

Animal Models of Cancer: New Models, New Tools

Hall D Saturday 14:00 - 16:00

1219. *In Vivo* MRI for Detecting of an Orthotopic Bladder Cancer Mouse Model

Su Xu[1], Eiji Kikuchi[1], Cornelia Matei[1], Mihaela Lupu[1], Makoto Ohori[1], Silvia Menendez[1], Bernard H. Bochner[1], Jason A. Koutcher[1]
[1]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

We used in vivo MRI on a GE clinical scanner to evaluate the technique as a detecting method to quantitative measurement of early stage superficial tumors in orthotopic murine bladder tumor model. We found that superficial tumors measuring 1 mm in size were consistently identified by MRI using instillation of Gd-DTPA plus air (1:1) as contrast agents into the bladder. MRI calculated tumor area significantly correlated with the histological analysis.

1220. Phenotyping by MRI: NG2 Receptor Status Modifies Human Glioblastoma Development

Christian Brekken[1], Cecilie Brekke[2], Martha Chekenya[2], Per Øyvind Enger[2], Tina Bugge Pedersen[1], Arvid Lundervold[2], Rolf Bjerkvig[2], Olav Haraldseth[3]
[1]SINTEF, Unimed MR, Trondheim, Norway; [2]University of Bergen, Bergen, Norway; [3]Norwegian University of Science and Technology, Trondheim, Norway

MRI was used in examination of 17 nude rats 5 and 7 weeks after sub-cortical implantation of either wild type (n=9) or NG2 positive (n=8) human glioblastoma U251N spheroids. Tumor volume, microvascular status, and associated edema were estimated from MR images, in part enhanced by the contrast agents Gadomer-17 and Omniscan™. NG2 receptor over-expression accelerated tumor growth, resulting in curtailed survival (Mean=59 days) compared with rats bearing wild-type tumors (Mean=75 days). Gadomer-17 enhanced exclusive parts of the tumor tissue, compared with Omniscan™. This study demonstrates the versatility of MRI when investigating solid tumor phenotypes in vivo.

1221. Blood Volume Quantification in Murine Colon Carcinoma using USPIO Contrast Enhanced MRI

Giulio Gambarota[1], Hanneke vanLaarhoven[1], Marielle Philippens[1], Arend Heerschap[1]
[1]UMCN, Nijmegen, Netherlands

In this study, a new method based on USPIO-enhanced MRI was employed to quantitatively measure blood volume in murine colon tumors. After injection of USPIO, the decrease in the T2 values of intravascular water protons made these protons virtually MRI-invisible, thus they did not contribute to the pixel signal intensity. Density maps calculated from CPMG sequences acquired post-USPIO were subtracted from pre-USPIO density maps to yield quantitative blood volume maps. The tumor blood volume was 5.4 ± 1.8 %, which is consistent with previously reported values. This method provides a powerful non-invasive tool to measure blood volume in vivo.

1222. Towards a More Clinically Relevant Animal Model of Metastatic Liver Cancer

Joel Richard Garbow[1], Shi-rong Cai[1], Karen Gauvain[1], Howard McLeod[1]
[1]Washington University, St. Louis, Missouri, USA

A new, portal-vein injection murine model of metastatic liver cancer is described and characterized by MRI. The model closely mimics the human pathological process and the resulting tumors retain the morphological and biological characteristics of the injected human colon cancer cells. Respiratory-gated MRI is used to quantitatively monitor tumor growth and response to therapy. Doubling time for these tumors in exponential growth phase is approximately 9 days. An initial therapy study using the chemotherapeutic Irinotecan increased median survival time from 43 to 76 days. MRI demonstrated a range of response to therapy similar to that observed in humans.

1223. Differentiationof Non-Metastatic and Metastatic Rodent Prostate Cancer by Using a New Empirical Model to Fit Dynamic Contrast Enhanced MRI Data

Xiaobing Fan[1], Milica Medved[1], Jonathan N. River[1], Marta Zamora[1], Claire Corot[2], Philippe Robert[2], Philippe Bourinet[2], Martin J. Lipton[1], Gregory S. Karczmar[1]
[1]University of Chicago, Chicago, Illinois, USA; [2]Guerbet Laboratories, Roissy, France

A new empirical model was used to fit DCEMRI data. Parameters derived from the model distinguish between metastatic and non-metastatic rodent prostate tumors. Contrast agent washout rate and maximum contrast agent concentration was significantly lower in metastatic tumors than in non-metastatic tumors ($p < 0.005$ and $p < 0.01$ respectively). Effects of the tumor on blood flow in adjacent 'normal' tissue were evident.

1224. Characterization of Angiogenesis in the Carcinogen ENU Induced Benign and Malignant Mammary Tumor Model

Min-Ying Su[1], Hon Yu[1], Jun Wang[1], John P. Fruehauf[2], Phillip Carpenter[1], Orhan Nalcioglu[1]
[1]UC, Irvine, California, USA; [2]Oncotech Inc., Tustin, California, USA

Angiogenesis in carcinogen ENU-induced benign and malignant tumor models were studied with dynamic contrast enhanced MRI using two contrast agents (Gadodiamide and Gadomer-17). The tumors were then excised for immunohistochemical (IHC) staining to measure expression of angiogenic biomarkers, including mutant p53, TSP-1, VEGF, and Factor VIII microvessel density. Benign and malignant tumors had distinct contrast enhancement kinetics. Malignant tumors had a higher microvessel density than benign tumors. MRI and IHC may provide different aspects (macroscopic and microscopic) complementing each other for assessment of tumor angiogenesis.

1225. Non Invasive Mapping of Spontaneous Blood Flow/Oxygen Fluctuations in Tumors using Functional Magnetic Resonance Imaging and Their Modifications by Pharmacological Treatments.

Christine Baudelet[1], Réginald Ansiaux[1], Benoit Macq[2], Bernard Gallez[1]
[1]Université Catholique de Louvain, Brussels, Belgium; [2]Université Catholique de Louvain, Louvain-la-Neuve, Belgium

Substantial instability in microregional red cell flux is known to occur in tumors. The associated perfusion-limited hypoxia has proved to impact on response to radiotherapy and chemotherapy, but also on tumour growth and repopulation. The purpose of this present study was to use BOLD fMRI as a non-invasive technique of capable for the first time of providing extensive information on the spatial and temporal nature of spontaneous variations in blood flow and/or oxygenation within tumors.

1226. Molecular Imaging of Angiogenesis in Vx-2 Rabbit Tumors With a Novel $\alpha_v\beta_3$-Targeted Paramagnetic Nanoparticle at 1.5 T

Patrick M. Winter[1], Shelton D. Caruthers[2], Anne H. Schmieder[1], Thomas D. Harris[3], Lori K. Chinen[1], Tod A. Williams[1], Mary P. Watkins[1], John S. Allen[1], Huiying Zang[1], Samuel A. Wickline[1], Gregory M. Lanza[1]
[1]Washington University School of Medicine, St. Louis, Missouri, USA; [2]Philips Medical Systems, Best, Eindhoven, Netherlands; [3]Bristol-Myers Squibb Medical Imaging, Billerica, Massachusetts, USA

Molecular imaging is an emerging tool for the sensitive and specific detection of unique "biochemical signatures" that differentiate and characterize tissues beyond their gross anatomic features. Angiogenesis, the process in which preexisting capillaries proliferate and form new vascular networks, is associated with unique, transient cell surface markers. $\alpha_v\beta_3$-integrin, a well-recognized biomarker of angiogenesis, is expressed on activated endothelial cells, but not mature, quiescent cells (1). The objective of this study was to detect $\alpha_v\beta_3$-integrins expressed on neovasculature associated with early Vx-2 tumor growth using a novel $\alpha_v\beta_3$-targeted paramagnetic contrast agent and a clinical 1.5 T MRI scanner.

1227. Molecular Imaging of Tumor Angiogenesis in Human Melanoma Xenografts in Mice By MRI with αvβ3-Targeted Nanoparticles

Anne H. Schmieder[1], Shelton D. Caruthers[2], Patrick M. Winter[1], Thomas D. Harris[3], Lori K. Chinen[1], Todd A. Williams[1], Mary P. Watkins[1], John S. Allen[1], Huiying Zhang[1], Samuel A. Wickline[1], Gregory M. Lanza[1]
[1]Washington University Medical School, Saint Louis, Missouri, USA; [2]Philips Medical Systems, Best, Netherlands; [3]Bristol-Myers Squibb Medical Imaging, Billerica, Massachusetts, USA

MR Molecular imaging, the *in vivo* monitoring of biological processes at a biochemical scale, depends upon contrast agents specifically binding to cell biomarkers with dramatic signal amplification. One important biomarker is the αvβ3-integrin, an adhesion molecule prominently expressed by neovascular endothelial cells associated with developing tumors. By exploiting the differential expression of the αvβ3-integrin, early molecular imaging and biochemical characterization of nascent cancers may be feasible. The objective of this project was to demonstrate imaging of neovasculature associated with early melanoma *in vivo* with clinically relevant MRI field strengths (1.5T) using a novel αvβ3-integrin-targeted paramagnetic nanoparticle.

1228. MR-EIT of Malignant Tumors in Rats

Ozlem Birgul[1], L. Tugan Muftuler[1], Mark Hamamura[1], Orhan Nalcioglu[1]
[1]University of California, Irvine, California, USA

In this study, we performed MR based Electrical Impedance Tomography (MR-EIT) on a laboratory rat with a malignant lesion. Images of impedance distribution were obtained using a pulse sequence that is sensitive to perturbations in magnetic flux density that are induced by the electrical currents injected to the animal using electrodes. Unlike previous methods to acquire current density images, our reconstruction method does not require rotation of the animal in the magnet. High impedance distribution in the muscle region and low impedance distribution in the tumor were observed, that are in accord with the literature.

1229. $T_{1\rho}$ Imaging of Intra-Muscular RIF-1 Tumors at 4T

Umamaheswar Duvvuri[1], Harish Poptani[2], Barton F. Branstetter[1], Michael D. Feldman[2], Jerry D. Glickson[2], John S. Leigh[2]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Spin-lattice relaxation in the rotating frame is described by the time-constant $T_{1\rho}$, and is sensitive to slow molecular motions (1). Recently, $T_{1\rho}$ weighting has been shown to be useful in imaging a wide range of pathologies including osteoarthritis, ischemic stroke and tumor response to chemotherapy (2-4). Here, we show that $T_{1\rho}$-weighted images of intra-muscularly implanted RIF-1 tumors provide superior contrast to T_2-weighted images. Furthermore, the clinical diagnosis of muscular invasion was better facilitated by $T_{1\rho}$-weighted images than T_2-weighted images.

1230. Vessel Size Imaging in Subcutaneous Murine Tumors

Christian Ludwig[1], Simon P. Robinson[1], Franklyn A. Howe[1], John R. Griffiths[1]
[1]St. George's Hospital Medical School, Tooting, London, UK

A quantitative description of microvessel distributions in tumors will be a useful tool for monitoring the response to anti-vascular drugs as well as improving our understanding the variability of the BOLD MRI response to vasoactive challenges such as carbogen. The recently introduced vessel size imaging method [1] allows one to obtain information on vessel size and blood volume. Based on a previous study in GH3 tumors [2] we present here a refined methodology using a pixelwise analysis including measurements of the apparent diffusion coefficient.

1231. Breakdown of the Fast Exchange Limit in DCE Perfusion Imaging

Rong Zhou[1], Stephen Pickup[1], Thomas E. Yankeelov[2], Charles S. Springer Jr.[2], Jerry D. Glickson[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Brookhaven National Laboratory, Stony Brook, New York, USA

The effects of different assumptions about equilibrium transcytolemmal water exchange on the analysis of tumor perfusion data were investigated. Dynamic contrast enhanced (DCE) MR images from 5 mice were evaluated using the BOLERO model with the fast exchange limit (FXL) and fast exchange regime (FXR) constraints. This analysis yielded parametric maps of transfer constant and the extravascular extracellular volume fraction. These images demonstrate that heterogeneity of the perfusion parameters exist within individual tumors as well as between animals. It is shown that the FXR model is needed in order to accurately describe perfusion in the tumor rim.

1232. Intra- and Extra-Vascular Water Exchange In MRI Contrast Agent Uptake

Yue Cao[1], Steve Brown[2], Joseph Fenstermacher[2], James R. Ewing[2]
[1]Michigan State University, East Lansing, Michigan, USA; [2]Henry Ford Health Systems, Detroit, Michigan, USA

Intra- and extra-vascular (IV-EV) water exchange is typically 250 [ml/(100g)-min] in normal cerebral tissue. The water exchange couples IV-EV magnetization of proton spins, resulting in measured R1 (R1eff) in tissue different from the native R1o. The initial R1eff increase in tissue after a bolus injection of a MRI contrast agent (MCA) could be, in large part, due to IV-EV water exchange. Thus, fitting the initial uptake curve may lead to an overestimation of the MCA transfer constant. An alternative MRI approach that combines IV-EV water exchange and Patlak's tracer kinetics is present here.

1233. Simultaneous Measurement of Arterial Input Function and Tumor Perfusion in Mice

Rong Zhou[1], Stephen Pickup[1], Thomas E. Yankeelov[2], Charles S. Springer Jr.[2], Jerry D. Glickson[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Brookhaven National Laboratory, Stony Brook, New York, USA

A non-invasive method for simultaneously determining the arterial input function (AIF) and tumor GdDTPA uptake in mice is demonstrated. The placement of the tumor is such that both the tumor and heart can be visualized in the same FOV. The time dependent longitudinal relaxation rates (R1) of blood and tumor were extracted from images that were acquired following the first pass of a GdDTPA bolus. The R1 data were fitted by BOLERO (Bolus Enhanced Relaxation Overview) model, which combines the Kety equation with the Bloch two-site-exchange rate law to yield tumor perfusion parameters.

1234. Parametric Imaging of Transcapillary Transfer Rates During Progression of Metastatic Human Breast Tumors

Hadassa Degani[1], Noa Sela[1], Raanan Margalit[1], Maya Dadiani[1]
[1]The Weizmann Institute of Science, Rehovot, Israel

A quantitative assessment of tumor vascularity and perfusion characteristics is essential for understanding tumor physiology and delivery of drugs. We applied dynamic contrast-enhanced MRI to measure perfusion parameters of GdDTPA in a metastatic human breast cancer animal model that demonstrated impaired drainage. Data Analysis yielded parametric images of the transfer rate constants into the interstitium (influx) and back to the plasma (efflux), as well as the ratio between these parameters (efflux/influx). During tumor progression, both transfer constants decreased, indicating a reduction in the permeability-limited perfusion, whereas the efflux to influx ratio increased, suggesting an elevation in the interstitial fluid pressure.

1235. Spatial Resolution Effects on Permeability-Surface Area Estimation

Michael Aref[1], Xiuquan Ji[1], Josh D. Handbury[1], Keith Bailey[1], Zhi-Pei Liang[1], Erik C. Wiener[1]
[1]University of Illinois at Urbana-Champaign, Urbana, Illinois, USA

This project attempts to use the optimal parameters for histopathological determination of tumor type and grade and translate them for use with dynamic contrast enhanced (DCE) MRI. We test the hypothesis that poor spatial resolution used in clinical DCE MRI results in partial volume effects that yield inaccurate physiological parameters, which results in erroneous diagnostic information. Preliminary data shows that correlation between tumor PS and tumor type and grade done at clinical imager resolutions are diagnostically inaccurate. PS estimated from higher resolution DCE MRI obtained by direct imaging or reduced encoding techniques may provide more diagnostically relevant information.

1236. Coregistration and Comparison of OMR and BOLD MR Images

S J. English[1], Y Zhang[1], M J. McAuliffe[1], S Subramanian[1], K Reijnders[2], J A. Cook[1], A L. Sowers[1], J B. Mitchell[1], A Russo[1], M C. Krishna[1]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]University Hospital Groningen, Groningen, Netherlands

Tumor bearing mice were sequentially scanned with Overhauser enhanced MRI (OMRI) and BOLD MRI, two techniques which are sensitive to tissue oxygenation, in an attempt to co-register the two images. Markers containing image contrast agents were attached to each mouse in order to select comparable sections of tissue with each imaging technique and to improve the accuracy of image fusion. OMR and BOLD MR images of the tumors were co-registered using different fitting routines, and the correlation between the two images is presented.

1237. Improved MR Detectability of GdDTPA-BMA Encapsulating Anti-HER2 Immunoliposomes and Determination of Contribution of Antibody Targeting to Change in Tumor MR Signal Intensity

L J. Wilmes[1], L M. Fleming[1], J E. Gibbs[1], D B. Kirpotin[2], D Wang[1], M G. Pallivicini[1], J M. Park[1], N M. Hylton[1]
[1]University of California San Francisco, San Francisco, California, USA; [2]California Pacific Medical Research Institute, San Francisco, California, USA

The goals of this work were to modify anti-HER2 immunoliposome composition to achieve greater increase in MR tumor signal intensity (SI) and evaluate the contribution of anti-HER2 targeting to increase in tumor signal intensity. A greater increase in tumor SI was observed with the new liposomal phospholipid composition compared to previous formulations, however a decrease in liposome diameter did not affect tumor SI significantly. Addition of targeting resulted in an increase in tumor SI compared with non-targeted liposomes.

Antiangiogenic and Antivascular Therapy

Hall D Saturday 14:00 - 16:00

1238. Assessment of Anti-Angiogenic and Anti-Vascular Therapeutics using Magnetic Resonance Imaging: Recommendations for Appropriate Methodology for Clinical Trials.

M O. Leach[1], K M. Brindle[1], J L. Evelhoch[1], J R. Griffiths[1], M Horsman[1], A Jackson[1], G Jayson[1], I R. Judson[1], M V. Knopp[1], R J. Maxwell[1], D McIntyre[1], A Padhani[1], P Price[1], R Rathbone[1], G Rustin[1], P Tofts[1], G M. Tozer[1], W Vennart[1], J C. Waterton[1], S R. Williams[1], P Workman[1]
[1]Pharmacodynamic/Pharmacokinetic Technologies Advisory Committee (PTAC), Drug Development Office, Cancer Research UK, London, UK

Dynamic contrast enhanced MRI (DCE-MRI) is becoming widely used in trials of new anti-angiogenic and anti-vascular therapies. In view of the variation in approach, and the need to encourage robust approaches, recommendations have been developed to aid in the design of the imaging components of such trials, which it is hoped will aid investigators, pharmaceutical companies and regulators in implementing and evaluating MRI techniques.

1239. Dynamic Contrast-Enhanced MRI at 1.5 T with Gd-DTPA Measures Angiostatic Effects in Tumors after Treatment with Anginex

Quido G. de Lussanet[1], Regina G. H. Beets-Tan[1], Walter H. Backes[1], Daisy W. J. van der Schaft[1], Jos M. A. van Engelshoven[1], Kevin H. Mayo[2], Arjan W. Griffioen[1]
[1]Maastricht University Hospital, Maastricht, Limburg, Netherlands; [2]University of Minnesota, Minneapolis, Minnesota, USA

Purpose: To investigate effects of the novel anti-angiogenic agent anginex with dynamic contrast-enhanced MRI (DC MRI). **Methods:** Tumor bearing mice were treated with anginex, TNP-470 or saline. Tumor growth curves and microvessel density (MVD) were recorded. DC MRI was performed at 1.5T with Gd-DTPA injection to obtain microvessel permeability (K^{PS}) in the tumor. **Results:** Reductions in tumor growth (60%), MVD (50%) and tumor rim K^{PS} (60%) values were observed in anginex treated mice compared to saline controls. K^{PS} correlated with MVD (r=0.54, p=0.04). **Conclusion:** DC MRI with Gd-DTPA accurately measures angiogenesis inhibition with anginex.

1240. Effects of the Anti-Vascular Agent, Combretastatin-A4-Phosphate, on ^{1}H MRI Relaxation Times in Colon Tumour Xenografts

Ross J. Maxwell[1], Katharine J. Lankester[1]
[1]Gray Cancer Institute, Northwood, Middlesex, UK

The effects of combretastatin-A4-phosphate (CA4P) on 1H relaxation times at 4.7T were studied in SW1222 colon carcinoma xenografts in nude mice. CA4P (30, 100 or 200mg/kg) or saline were administered i.p. either 4 or 24 hours before MR examination. Significant increases in T1, T2 and T2* were observed 24 hours after 100 and 200mg/kg CA4P. These were consistent with an increase in necrosis and reduction in vascular volume but not with anticipated haemorrhage and reduced oxygenation.

1241. Protamine Induced Tumor Vessel Coagulation: Measurements by Dynamic Contrast Enhanced MRI

Hon Yu[1], Min-Ying Su[1], Jun Wang[1], Michael Samoszuk[1], Orhan Nalcioglu[1]
[1]University of California, Irvine, California, USA

We report here the preliminary results of our on-going study of protamine treatment as an anti-vascular therapeutic agent by using dynamic contrast enhanced MRI. The enhancement kinetics measured before and after protamine treatment on black and nude mice bearing B-16 melanoma were compared to assess thrombosis in the tumor as induced by protamine which could function as a procoagulant by neutralizing tumor's anticoagulant ability. Protamine-dosage and host-animal dependent changes in the enhancement kinetics were observed after the protamine treatment. Among the two contrast agents, Gd-DTPA-BMA and Gadomer-17, used, Gadomer-17 was more sensitive in detecting the protamine-induced effect.

1242. Implications of Anti-Angiogenic Treatment with ZD6474, a Potent And Selective VEGFR Tyrosine Kinase Inhibitor, for Tumor MRI Behaviour in a Mice Model of Brain Metastasis.

William Leenders[1], Benno Kuesters[1], Kiek Verrijp[1], Cathy Maass[1], Dirk Ruiter[1], Robert de Waal[1], Arend Heerschap[1]
[1]University Medical Centre St Radboud, Nijmegen, Netherlands

The human melanoma cell line Mel57 grows in mouse brain by vascular co-option without induction of neo-angiogenesis. When these brain tumors express VEGF-A, a highly angiogenic phenotype develops, characterized by tortuous, highly dilated and leaky vessels. These vascular changes are visible in contrast-enhanced (CE) MRI experiments (extravasation of [Gd]-DTPA). Here we examined the effects of ZD6474, a potent VEGFR tyrosine kinase inhibitor, in this model. Treatment of angiogenic tumors with this compound led to tumor invisibility because these changed their growth characteristics to a co-opting phenotype.

1243. Contrast Enhanced MRI Assessment of Efficacy of a VEGFR TK Inhibitor, AG-013763, in a Breast Cancer Mouse Model

L J. Wilmes[1], L M. Fleming[1], J E. Gibbs[1], M G. Pallavicini[1], D Wang[1], R C. Brasch[1], K- L. Li[1], R G. Henry[1], D R. Shalinsky[2], D D. Hu-Lowe[2], T M. McShane[3], J W. Park[1], N M. Hylton[1]
[1]University of California San Francisco, San Francisco, California, USA; [2]Pfizer Global Research and Development, La Jolla, California, USA; [3]Pfizer Global Research and Development, Groton, Connecticut, USA

Dynamic contrast enhanced (DCE) MR imaging with small and large molecular weight contrast agents was used to evaluate treatment effects of a VEGF-receptor tyrosine kinase inhibitor AG-013736, in human breast cancer xenografts. Tumors in treated mice showed inhibition of growth compared to control mice. A significant decrease in transfer constant (Ktrans) was measured on DCE-MRI using the large molecular weight contrast agent Albumin-GdDTPA30, at 7 days. DCE-MRI studies using the clinically approved agent GdDTPA in a smaller cohort of mice demonstrated a similar treatment effect in the signal enhancement ratio (SER), a permeability-related parameter used in clinical breast MRI studies.

1244. Decline in the Apparent Diffusion Coefficient (ADC): A Possible Early Response Marker for Pd-bacteriopheophoebide (TOOKAD®) based Photodynamic Therapy (PDT) of Human Adenocarcinoma Xenografts

Vicki Plaks[1], Natalia Koudinova[1], Uri Nevo[1], Avigdor Schertz[1], Michal Neeman[1], Yoram Salomon[1]
[1]Weizmann Institute of Science, Rehovot, Israel

The goal of this study was to use diffusion MRI to assess the early progression of photodamage induced by TOOKAD based photodynamic therapy (PDT) of s.c. human prostatic adenocarcinoma xenografts in mice. TOOKAD is presently under clinical trials with human prostatic cancer in collaboration with STEBA BIOTECH (France). A significant decrease in tumor ADC was observed 7h after treatment with a subsequent increase up to 48h concomitant with the development of tumor necrosis. The ADC changes induced can provide the basis for use of diffusion changes as an early tumor response marker for TOOKAD based PDT in the clinical setting.

1245. Diffusion MRI Detects Early Therapeutic Changes Within Brain Tumors

Daniel E. Hall[1], Dennis Pietronigro[2], Julie Carter[2], Bradford A. Moffat[1], Surabhi Sharma[1], Alnawaz Rehemtulla[1], Thomas L. Chenevert[1], Brian D. Ross[1]
[1]University of Michigan, Ann Arbor, Michigan, USA; [2]Direct Therapeutics Inc., Katonah, New York, USA

Following MRI guided intratumoral injection of DTI-015 (Direct Therapeutics Inc. solvent facilitated perfusion of carmustine, presently in clinical trials) into orthotopic 9L gliomas, anatomic and diffusion weighted MR images were obtained over time. Solvent based perfusion allows the carmustine to quickly saturate the aqueous and lipid components to the tumor boundary. MR images revealed significant increases in mean tumor diffusion values following DTI-015 treatment. Moreover, tumor diffusion changes were observed within 24 hours revealing that diffusion MRI could detect early therapeutic effects. These results demonstrate the feasibility of using diffusion MRI to detect therapeutic efficacy.

1246. Separation of T_1 and T_2* Shortening Effects using Simultaneous T_1/T_2* Gradient Dual Echo Pulse Sequence

Eun-Ju Kim[1], Dae-Hong Kim[1], Hee Jo Lee[1], Yong Min Huh[1], Sang hoon Lee[2], Jin-Suck Suh[1]
[1]Yonsei University, Seoul, Republic of Korea; [2]Ulsan University, Seoul, Republic of Korea

To obtain separated T1 and T2* shortening effects during one bolus injection of Gd-DTPA, we developed pulse sequence, post processing and perfusion phantom experiment. The perfusion images obtained using simultaneous T1/T2* gradient dual echo pulse sequence, and corrected $\Delta R2^*$- and $\Delta R1$- time curves from separated T2* and T1 shortening effects through postprocessing. The perfusion values (water volume, permeability) calculated by our method were greater than those by conventional method. These more accuracy results provide more practical information related with angiogenesis.

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
Cancer: Perfusion and Permeability

Room 718B | Sunday 13:30 - 15:30 | Chairs: Truman R. Brown and June S. Taylor

13:30 1247. Arterial Spin Labeling for Monitoring Blood Flow Changes in Human Renal Carcinoma under Antiangiogenic Therapy

Cedric MJ de Bazelaire[1], Jenifer Zhang[1], Guillaume D. Duhamel[1], Daniel James George[2], Marc Dror Michaelson[3], Neil M. Rofsky[1], David C. Alsop[1]
[1]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA; [2]Dana Farber Cancer Institute, Boston, Massachusetts, USA; [3]Massachusetts General Hospital, Boston, Massachusetts, USA

Arterial Spin Labeling (ASL) was used to characterize tumor blood flow in 11 patients undergoing antiangiogenic treatment for complex renal cell carcinoma. The ASL sequence employed background suppression, single-shot RARE, and breathholding to limit the effects of motion. ASL successfully demonstrated perfusion contrast in abdominal, thoracic, and pelvic primary and metastatic tumors. Significant decreases in blood flow were measured after 1 and 2 months of treatment, while tumors were stable in size.

13:40 *1248*. Absence of Vascular Regrowth at 96hrs in Response to the Vascular-Targeting Agent ZD6126 Demonstrated by IAUC and Tofts' Analysis of DCE MRI

Dominick JO McIntyre[1], Simon P. Robinson[1], Franklyn A. Howe[1], John R. Griffiths[1], Anderson J. Ryan[2], David C. Blakey[2], Ian S. Peers[2], John C. Waterton[2]
[1]St George's Hospital Medical School, Tooting, London, UK; [2]AstraZeneca, Alderley Park, Macclesfield, UK

Tumour vasculature is an attractive therapeutic target as it differs structurally from normal vasculature and the destruction of a single vessel can lead to the deaths of many tumour cells. The efficacy and dose-response of the vascular targeting agent ZD6126 have previously been shown in GH3 prolactinomas. We have used IAUC and Tofts analysis of DCE-MRI data to investigate regrowth of GH3 tumours. Both parameters give similar results demonstrating absence of regrowth at up to 96 hours from ZD6126 treatment.

13:50 *1249*. Quantitative Tissue Perfusion Measurements in Head and Neck Carcinoma Patients before and during Radiation Therapy with a Non-Invasive MR Imaging Spin-Labeling Technique

Peter Schmitt[1], Markus Kotas[1], Michael Flentje[1], Axel Haase[1]
[1]University of Würzburg, Würzburg, Germany

A non-invasive MR spin-labeling technique was evaluated at 2T for measuring perfusion in head and neck carcinoma patients. Eleven patients were investigated, five were examined twice during radiotherapy. For perfusion quantification, T1 was measured with IR-Snapshot-FLASH imaging after both slice-selective and non-selective inversion. Perfusion maps were obtained employing a two-compartment-model. In-plane resolution was (1.9x2.8)mm2, scan time was 8:30min. Tumor perfusion and perfusion changes during therapy were heterogenous. In 4/5 patients, perfusion decreased, in one patient it increased. Without the need for exogeneous contrast agent, repetitive characterization of perfusion is possible. This may be very useful for stratification of vasomodulating treatments.

14:00 *1250*. Merits of Multiple Contrast Agents and Pixel-By-Pixel Analyses for Detection of Early Changes in Vascular Permeabilities in Murine Tumor Models Following Drug Therapy and/or Radiation Therapy

Mark David Pagel[1], Steven J. Baldwin[1], Janet M. O'Neal[1], Richard L. Ornberg[1], Thomas W. Davis[1], John J. Kotyk[1]
[1]Pharmacia Corp, St Louis, Missouri, USA

Temporal changes in MR image contrast were evaluated using Dynamic Contrast Enhancement (DCE) procedures in murine tumor models treated with anti-angiogenic drug therapy, radiation, and a combination of drug therapy with radiation. The pixel-by-pixel evaluation objectively detected significant differences between treated and untreated animals, which were less evident in similar evaluations of average normalized IAUC changes within the tumor. Normalized IAUCs indicated reduced permeability-surface area (PS) within one day of initial drug therapy or radiation therapy. However, an increase in normalized IAUC was observed within one day of combination therapy, suggesting that anti-angiogenic drug therapy increased radiation-induced vascular damage.

14:10 *1251*. Perfusion Imaging of the Liver using Time-Resolved, Contrast-Enhanced, Whole-Liver MR Imaging: Comparison of Fractional Arterial Flow in Cirrhotic versus Non-Cirrhotic Patients

Pari V. Pandharipande[1], Glenn A. Krinsky[1], Henry Rusinek[1], Vivian S. Lee[1]
[1]NYU Medical Center, New York, New York, USA

Our purpose was to develop a whole-liver MR perfusion imaging technique which, when interpreted with kinetic modeling, enables fractional arterial flow calculation in cirrhotic and non-cirrhotic patients. Thirty series were acquired in twelve patients (5 cirrhotic and 7 non-cirrhotic) using 3D gradient-echo imaging (2.3/0.8/ 9º, 3.22-sec acquisition) after Gd-DTPA injection (7-mL at 5-mL/sec). Using a dual-input one-compartment model, mean fractional arterial perfusion was found to be 15.8% (range=9.1-36.4%) in patients without cirrhosis and 27.2% (range=9.8-60.8%) in patients with cirrhosis; this difference was not statistically significant (p=0.23). Preliminary results support feasibility of whole-liver MR perfusion imaging using dual-input one-compartment modeling.

14:20 *1252*. Method for Quantitation of Dynamic MRI Contrast Agent Uptake in Colorectal Liver Metastases

Hanneke van Laarhoven[1], Mark Rijpkema[1], Cornelis Punt[1], Theo Ruers[1], Jan Hendriks[1], Jelle Barentsz[1], Arend Heerschap[1]
[1]UMC Nijmegen, Nijmegen, Netherlands

For the prediction and follow up of therapy outcome in cancer treatment by dynamic contrast enhanced MRI (DCE-MRI), reproducibility of DCE-MRI should be determined. We investigated the reproducibility of DCE-MRI in ten patients with colorectal liver metastases. The use of an arterial input function (AIF) from pixels in the aorta was compared with the use of a vascular normalization function (VNF) from the spleen. The use of the VNF was superior to the AIF in terms of reproducibility and is therefore recommended when this DCE-MRI technique is used for prediction and monitoring of therapy outcome in colorectal liver metastases.

14:30 *1253*. Longitudinal Changes of MRI Enhancement Kinetics Correlated with Vascular Density and Inflammation

Min-Ying Su[1], Michael Samoszuk[1], Jun Wang[1], Leonard Leoner[1], Luis Villarreal[1], Orhan Nalcioglu[1]
[1]UC, Irvine, California, USA

Gene therapy and immunotherapy have demonstrated their potential for cancer treatment. However, the induced responses are very complicated. We investigated whether early volumetric changes, contrast enhancement kinetics, histologically measured vessel density, as well as the degree of inflammation may be used to predict the response of tumors after adenovirus treatment. To improve the measurement of vascular properties, we used a mid-sized agent Gadomer-17 along with Gd-DTPA. Tumors were classified into different groups according to their growth-shrinkage pattern over time. The enhancement of both contrast agents were the lowest in the group of tumors which shrank after treatment.

14:40 *1254*. Detection of Brain Tumor Invasion

Kevin M. Bennett[1], James S. Hyde[1], Kelly Rebro[1], Scott Rand[1], Daniel B. Rowe[1], Kathleen M. Schmainda[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

The stretched exponential model of diffusion-related signal decay in MRI was developed to account for changes in heterogeneity accompanying C6 glioma invasion in rats. The model is preferred to the bi-exponential model, because there is no a priori information about the diffusion values present. Six rats were inoculated with tumor cells and imaged 14-15 days later. Sub-voxel (0.5mmx0.5mmx1mm) heterogeneity, as measured by the model, increased in tumor-inoculated rats in regions of contrast enhancement. Second and third moments of the diffusion distribution increased in a region inferior to the contrast –enhanced area, possibly delineating regions of latent tumor cell invasion.

14:50 *1255*. T_1-Weighted DCE-MRI Applied to Lung Tumours: Pre-Processing and Modelling

Geoffrey James Martin Parker[1], David Clark[1], Yvonne Watson[1], David L. Buckley[1], Cheryl Berrisford[2], Heather Anderson[2], Alan Jackson[1], John C. Waterton[3]
[1]University of Manchester, Manchester, UK; [2]Wythenshawe Hospital, Wythenshawe, Manchester, UK; [3]AstraZeneca Pharmaceuticals, Macclesfied, Cheshire, UK

A methodology is presented for robust quantitative T1-weighted dynamic contrast-enhanced MRI (DCE-MRI) of the lung. It utilises fast volumetric gradient echo image acquisition in conjunction with serial time point registration, automated arterial input function definition, and custom-built analysis software. Measurements of blood flow (F), Extraction-flow product (ktrans) and extravascular extracellular volume (ve) are obtained.

15:00 *1256*. Cluster Analysis of Multi-Dose Dynamic Contrast Enhanced MRI Studies of Tumours

Ian J. Rowland[1], Claus Andrup Kristensen[2], Lise Vejby Søgaard[1], Helle J. Simonsen[1], Egill Rostrup[1], Paul EG Kristjansen[2]
[1]Copenhagen University Hospital, Hvidovre, Denmark; [2]Institute for Molecular Pathology, Copenhagen, Denmark

The study aim was to develop a method of assessing early vascular changes following administration of a drug targeted to tumour vasculature. When used with a cytotoxic agent, the combined efficacy is likely to depend on the timing between agent administrations. A multi-dose dynamic contrast enhanced MRI study was performed and the whole enhancement profile for ROIs, including normal muscle and tumour following hydralazine administration, was used for segmentation of the tissues using k-cluster analysis. Such a method of monitoring early heterogeneous vascular changes could be used to optimize a specific combination therapy and would therefore be of clinical utility.

15:10 *1257*. Gd-DTPA Calibration Curves in Human Blood as a Function of Haematocrit for the Quantification of the Arterial Input Function in Femoral Arteries

Nathalie Just[1], Dow-mu Koh[1], David John Collins[1], Martin O. Leach[1]
[1]Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, UK

In order to accurately determine Gd-DTPA concentration in blood after bolus intravenous injection, it is important to define the relationship between the observed signal and Gd-DTPA concentration. In this study, calibration curves for Gd-DTPA in human blood samples were obtained taking into account the haematocrit value for each sample. R2*-Gd-DTPA concentration time curves were obtained for different haematocrit values and compared to a calibration curve for bovine Serum albumine (BSA) samples. Arterial input functions in femoral arteries were then estimated using the calibration curve of Gd-DTPA in human blood for the corresponding haematocrit value of the patient analyzed.

15:20 *1258*. The Importance of Contrast Agent Leakage Correction on Tumor CBF Measurements Using DSC MRI

Christopher Chad Quarles[1], Kathleen M. Schmainda[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

The extravasation of contrast agent is known to result in underestimation of CBV using Dynamic Susceptibility Contrast (DSC) MRI. However, the influence of contrast leakage on CBF has not been investigated. Using a model-based strategy, $\Delta R2^*$ time curves were corrected for leakage and then used to calculate CBF in a rat 9L tumor model. A significant difference was found in three of the five rats between the CBF calculated with uncorrected and corrected $\Delta R2^*$ time curves. The results indicate that dynamic leakage correction is both possible and necessary.

Dynamic Contrast-Enhanced MR Imaging of Tumors: Clinical

Hall D Monday 13:30 - 15:30

1259. Effect of Accurate T_1 Calculation on Pharmacokinetic Analysis of Primary Breast Cancer.

Scott I K Semple[1], Thomas W. Redpath[1], Trevor S. Ahearn[1], Fiona J. Gilbert[1], Andrew W. Hutcheon[2], Steven D. Heys[1]
[1]University of Aberdeen, Aberdeen, Grampian, UK; [2]Aberdeen Royal Hospitals NHS Trust, Aberdeen, Grampian, UK

Dynamic contrast-enhanced MRI (DCE-MRI) is used to diagnose and stage breast cancer. One promising method of analysing DCE-MRI data is the use of pharmacokinetic analysis of the contrast agent uptake curve. Using the Tofts model approach, the change in T1 value of the tissue in question during contrast uptake is characterised by two parameters. In order for these parameters to be accurately estimated, the intrinsic T1 of the tissue must also be accurately estimated. We show that not considering slice profile effects when estimating T1 can result in large variations in pharmacokinetic parameters.

1260. Improvement in Breast Lesion Characterization Using Pharmacokinetic Modeling with Bookend T1 Measurements

Greg Cron[1], Frederick Kelcz[2], Giles Santyr[1]
[1]Carleton University, Ottawa, Ontario, Canada; [2]University of Wisconsin - Madison, Madison, Wisconsin, USA

Dynamic contrast-enhanced breast MRI was performed with slice-selective spoiled gradient-recalled echo (SSSGRE) imaging (4 cancers, 9 benign). Lesion T1 vs time was estimated using these images plus conventional T1 measurements performed before (T1pre) and after (T1post) SSSGRE imaging. The extraction-flow product was extracted using a) T1pre only, which assumes a priori B1 and slice profile knowledge, and b) T1pre and T1post , which corrects B1 and slice profile imperfections. The sensitivities and specificities were a) 75% & 66% and b) 100% & 78%. Therefore, both T1pre and T1post are necessary for optimum sensitivity and specificity.

1261. First Pass DCE True-FISP MR Perfusion Imaging of Hepatic Tumors: Characterization of Tumor Vascularity using Parameters to Describe Contrast Enhancement Uptake

Jeffrey P. Goldman[1], Niels Oesingmann[1], Jonathan Schwartz[1], Myron Schwartz[1]
[1]Mount Sinai Medical Center, New York, New York, USA

First pass T1W perfusion imaging has shown potential for tumor imaging. We optimized and tested T1W truefisp for first pass perfusion imaging of hepatic tumors. True fisp offers increased signal to noise over gradient echo imaging. Analysis of first pass contrast kinetics was performed by fitting the uptake curve to a gamma variate function and measuring parameters which describe the uptake curve of tissue enhancement. Comparison of time to peak and mean transit time of hepatic tumors with that of the portal vein and liver provides a relative measure of tumor vascularity.

1262. Equilibrium Transcytolemmal Water Exchange Effects on Human Osteosarcoma CR Pharmacokinetic Parameter Evaluation

Thomas E. Yankeelov[1], Jonathan P. Dyke[2], Jason A. Koutcher[3], William D. Rooney[1], Charles S. Springer[1]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]Weill Cornell Medical College, New York, New York, USA; [3]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

Contrast reagent (CR) bolus-tracking (B-T) data are sensitive to equilibrium transcytolemmal water exchange (CWX) kinetics. Neglect of this in analysis results in significant underestimation of human osteosarcoma pharmacokinetic parameters.

1263. The Influence of an AIF Corrected for Haematocrit on the Calculated Vascular Parameters of a 2-Compartment Model in Prostate Cancer

Nathalie Just[1], Andrzej Dzik-Jurasz[1], Chris Parker[1], David J. Collins[1], Martin O. Leach[1]
[1]The Institute of Cancer Research, Sutton, Surrey, UK

Quantitative dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) is being increasingly used for the characterization of normal and diseased tissue in terms of vascular permeability and blood volume estimates. Using a 2-compartment model corrected for haematocrit and a calibrated AIF from the femoral artery has shown to improve the correlation between kinetic parameter estimates compared to other modelling methods incorporating an a priori AIF. We present preliminary results from 4 patients with biopsy proven prostatic adenocarcinoma.

1264. Automated Arterial Input Function Extraction for T_1-Weighted DCE-MRI

Geoffrey James Martin Parker[1], Alan Jackson[1], John C. Waterton[2], David L. Buckley[1]
[1]University of Manchester, Manchester, UK; [2]AstraZeneca Pharmaceuticals, Macclesfied, Cheshire, UK

We present a method for the automatic identification of an arterial input function (AIF) for T1-weighted dynamic contrast-enhanced MRI (DCE-MRI). The method uses a set of heuristics to identify voxels within the DCE-MRI dataset in which the time course of contrast agent concentration changes indicates the presence of voxels containing arteries with minimal partial volume contamination. We demonstrate applicability in a range of body areas, including the brain, lung, and prostate, and investigate the reproducibility of the technique in the brain.

1265. Dynamic Study of Sarcoma with Reduced-encoding Imaging by Generalized-series Reconstruction

Jingfei Ma[1], Haesun Choi[1], Jim Ji[2], Edward F. Jackson[1], Zhi-Pei Liang[2]
[1]The University of Texas M. D. Anderson Cancer Center, Houston, Texas, USA; [2]The University of Illinois at Urbana-Champain, Urbana-Champain, Illinois, USA

Data from two different sarcoma patients were used to evaluate the feasibility and performance of the Two-reference Reduced-encoding Imaging by Generalized-series Reconstruction (TRIGR) for contrast enhanced dynamic imaging. The quality of the TRIGR images with various phase encoding was compared with that of the fully encoded images. Preliminary results indicate that when patient motion is minimal, TRIGR can be used to increase significantly the spatial coverage and/or spatial-temporal resolution. When motion is noticeable, however, TRIGR images degrade quickly and motion correction may be needed in the reconstruction algorithm.

1266. Statistical Evaluation of dMRI Region of Interest (ROI) Analysis for Cancer Assessment

Wendy Midwinter[1], Larry White[2], Michael D. Noseworthy[1]
[1]The Hospital for Sick Children, Toronto, Ontario, Canada; [2]Mt. Sinai Hospital, Toronto, Ontario, Canada

Often region of interest (ROI) analysis is performed on dynamic MRI (dMRI) data where clinically similar image pixels are averaged. Pixel ROI values are assumed to have a Gaussian distribution, implying routine parametric statistics can be used for subsequent between and within tumour comparisons. We performed a pixel-wise analysis of whole osteosarcomas and clinically similar ROIs within the tumours. Pixels were distributed as a Gaussian most often (87%) for maximal % signal change (ΔS) while permeability ($k^{PS\rho}$) values were almost always (82%) exponentially distributed. We suggest assessment of ROI statistical distribution be done for all ROI statistics.

1267. Evaluation of Area under Curve [Gd] Data Derived from DCE-MRI Time Series in Brain Tumours

Simon Walker[1], Andrzej Dzik-Jurasz[1], James d'Arcy[1], Martin Leach[1], David J. Collins[1]
[1]Cancer Research UK Clinical Magnetic Resonance Research Group, Sutton, Surrey, UK

Area under the Gd concentration-time curve (a.u.c [Gd]) is used as an alternative to pharmacokinetic model based methods of dynamic contrast-enhanced (DCE) MRI data analysis [1]. DCE-MRI is widely used in the evaluation of response to therapy and the detection of malignant tumours [2]. We have investigated the relationship between data derived from a.u.c [Gd] and two pharmacokinetic model-based methods of data evaluation. The DCE-MRI data were obtained in-vivo from malignant tumours in brain. We show that a strong correlation exists between estimates of the extra-cellular extra-vascular space (Ve) derived from the standard Tofts model and the a.u.c

1268. A Modified Two-Component Model to Evaluate Blood-Brain-Barrier Permeability using Single-Echo Dynamic Contrast-Enhanced T_2*-Weighted MR Imaging

Wen-Chau Wu[1], Yi-Jui Liu[1], Tzu-Chao Chuang[1], Cheng-Yu Chen[2], Hsiao-Wen Chung[1]
[1]National Taiwan University, Taipei, Taiwan; [2]Tri-Service General Hospital, Taipei, Taiwan

Although highly effective at preventing the passage of most non-lipophilic compounds from the blood into the brain, BBB permeability can increase to a number of compounds after stroke or traumatic brain injury etc. Once paramagnetic contrast agents leak into the interstitial space, they cause T1 shortening effect. In this study, based on the two-component model, we propose a “self-correcting” method to eliminate extravascular T1 contamination. Both computer simulation and experiments were used to evaluate the corrected rCBV and permeability. Results showed satisfactory elimination of T1 effect and validate the feasibility of self-correction.

1269. Fractal Analysis of Parametric Images Derived from Dynamic Contrast Enhanced MRI Data *In-Vivo:* Methods for Describing Dispersion in Parametric Data

David J. Collins[1], Simon Walker[1], Andrzej Dzik-Jurasz[1], Martin Leach[1]
[1]Cancer Research UK Clinical Magnetic Resonance Research Group, Sutton, Surrey, UK

Dynamic contrast enhanced MRI (DCE-MRI) provides a powerful means of evaluating functional properties of tumours and changes in response to treatment [1]. Calculated parameters derived from model fitting to the contrast agent uptake curves allows a number of quantitative descriptors of uptake behaviour to be obtained. These can be calculated on a pixel by pixel basis, often resulting in a large range of values obtained from within the tumour. Analysis of these values is often performed using histogram analysis [2]. Histograms have the benefit of demonstrating and tracking changes in the often heterogenous distribution, but have the disadvantage that

Cancer MR Imaging: Clinical

Hall D Tuesday 13:30 - 15:30

1270. Relationship between Intensity of Radiation Exposure and Decline in Volume of Normal-Appearing White Matter in Children Treated for Medulloblastoma

Wilburn E. Reddick[1], Qing Ji[1], John O. Glass[1], Raymond K. Mulhern[1], Amar Gajjar[1], Thomas E. Merchant[1]
[1]St. Jude Children's Research Hospital, Memphis, Tennessee, USA

This project combines quantitative longitudinal MR imaging of 32 children treated for medulloblastoma with digital radiation dosimetry fused with the initial MR examination to establish the response of normal-appearing white matter (NAWM) to varying doses of therapeutic irradiation. Changes in the NAWM volume per year were observed to trend toward larger declines with increasing dose exposure. NAWM exposed to greater than 45 Gy exhibited statistically significant rates of decline in volume. This study established a significant relationship between intensity of irradiation and decline in NAWM volumes which have been associated, in previous studies, with deficits in neurocognitive function.

1271. VSI and BV MRI of Human Brain Tumours

Laurent Lamalle[1], Stéphane Kremer[2], Irène Troprès[3], Sylvie Grand[2], Chantal Rémy[4], Christoph Segebarth[4], Jean-François Le Bas[2]
[1]INSERM IFR 1, Grenoble, France; [2]CHU de Grenoble, Grenoble, France; [3]ESRF, Grenoble, France; [4]INSERM U 438, Grenoble, France

Vessel Size Index (VSI) MRI aims at providing quantitative insight on the microvascular architecture. Recently introduced, this technique has been validated on healthy and tumour bearing rat brain, which established its potential as a non-invasive tool for cerebral tumour diagnosis and treatment follow-up. We applied it here on patients bearing several kinds of brain tumours, using a standard 1.5 T clinical scanner. Diffusion, dual gradient echo (GE) and dual spin echo (SE) sequences were used. The two latter were applied before and after Sinerem injection at 45 µmol Fe/kg body weight. Blood Volume (BV) and VSI maps were computed.

1272. MRI Biological Maps to Target Radiation Treatment of Brain Tumors

Kathryn M. McMillan[1], Baxter P. Rogers[1], Wolfgang Tome[1], Hazim A. Jaradat[1], Minesh P. Mehta[1], M Elizabeth Meyerand[1]
[1]University of Wisconsin-Madison, Madison, Wisconsin, USA

The use of advanced magnetic resonance methods should better delineate and describe the physiology of glioblastoma muliforme (GBM) brain tumors in preparation for treatment by radiation therapy. We hypothesize that the use of these advanced imaging modalities will result in more precise radiotherapy treatment planning. Our data indicates chemical shift imaging (CSI), perfusion and diffusion imaging and MR-based hypoxia mapping each add information related to tumor physiology that can be added to the treatment plan with the goal of decreasing the rate of tumor recurrence.

1273. Multi-Organ Cancer Staging with Gadobenate Dimeglumine (Gd-BOPTA): Assessment of Feasibility

Tiziano Frattini[1], Piervitto Cipolla[2], Miles Kirchin[2], Alberto Martegani[1]
[1]Valduce Hospital, Como, Italy; [2]Bracco Imaging SpA, Milan, Italy

The high T1 relaxivity of Gd-BOPTA and its partial uptake by functioning hepatocytes are advantageous properties for metastases detection in the CNS and liver. The present study evaluated Gd-BOPTA for multi-organ cancer staging in a single session. 12 patients received a dynamic evaluation of the liver and upper abdomen, followed by an examination of the brain, and thereafter by a delayed examination of the liver. Metastases were detected in 9/12 patients. Multi-organ metastases were detected in 5 of these 9 patients. The feasibility of the imaging protocol was “excellent” for 10/12 patients and “good” for 2/12 patients

1274. Comparison of Whole-Body MRI with Whole-Body Dual-Modality PET/CT for Staging of Different Malignant Diseases

Gerald Antoch[1], Florian M. Vogt[1], Lutz S. Freudenberg[1], Thomas C. Lauenstein[1], Stefan G. Ruehm[1], Hilmar Kuehl[1], Joerg F. Debatin[1]
[1]University Hospital Essen, Essen, Germany

To compare the value of whole-body MRI with whole-body PET/CT for tumor staging. 50 patients with different malignant diseases were prospectively evaluated. Images were read by two blinded physicians each and results were compared with either histology or radiologic follow-up. MRI was able to more accurately determine bone metastases, whereas PET/CT proved superior in detecting lymph node metastases and pulmonary metastases. Whole-body PET/CT and whole-body MRI examinations complement one another in staging of malignant diseases.

1275. Application of Navigator Techniques to Breath-Hold DCE-MRI Studies of the Liver

N Jane Taylor[1], Katharine J. Lankester[1], J James Stirling[1], Gordon JS Rustin[1], James A. D'Arcy[2], Martin O. Leach[2], Anwar R. Padhani[1]
[1]Mount Vernon Hospital, Northwood, Middlesex UK; [2]Royal Marsden Hospital, Sutton, Surrey, UK

A navigator guided gradient-recalled echo (GRE) sequence was used for dynamic contrast medium-enhanced MR imaging (DCE-MRI) of liver metastases. With breath holding between acquisitions, this sequence gave sets of three T1-weighted images with a time resolution of 11-12s and very good slice and tumour position reproducibility. Pixel-by-pixel quantification was carried out and resulting parametric maps showed few artefacts and good consistency. This technique will enable reliable data to be acquired from patients with liver and lung tumours for inclusion in clinical trials of vascular targeting anticancer treatments.

1276. Assessing Angiogenesis in Pulmonary Carcinoma with Dynamic Contrast Enhanced MRI

Minming Zhang[1], Yu Zou[1], Guowei Yu[1], Guang Cao[2]
[1]First Affiliated Hospital, Medical School of Zhejiang University, Hangzhou, People's Republic of China; [2]GE Medical Systems, Hong Kong

Dynamic contrast-enhanced MRI (DCE-MRI) was used on patients with pulmonary carcinoma to asseess tumor vascular characteristics. 50 patients were examined. Patterns of Time-Signal Intensity(T-SI) curve, including Steepest Slope (SS), Peak Height (PH) and the signal intensity change rates at the first (E1), second (E2), and fourth (E4) minute of T-SI curve were assessed, and compared with mircovessel density (MVD) of the resected specimens. Results showed that there were significant correlations between SS, PH, E1, E2, E4, and MVD. DCE-MRI can be used to characterize microvasculature, providing quantitative information about tumor microvessel structure and function.

1277. Evaluation of Prostate Cancer with Dynamic Contrast Enhanced MRI for the Diagnosis of Prostate Cancer: A Comparison of Analytic Techniques

Johnny O. Alexander[1], Peter L. Choyke[1], Jianhua Yao[1], Cynthia Menard[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Dynamic Contrast Enhanced Magnetic Resonance Imaging (DCE-MRI) with T2 weighted MRI has been proposed as an accurate method for prostate cancer diagnosis, however, standard criteria for diagnosis have not been established. Endorectal/pelvic coil MR was performed on 11 patients, which included T2 FSE and 3-D FSPGR dynamic sequence. A dynamic curve of signal enhancement versus time was divided into three phases: arrival, takeoff, and washout phase. Preliminary results demonstrate cancerous tissues show up clearly in the takeoff slope parameter map. These maps are superior to pharmacokinetic modeling in detecting prostate cancer.

Cancer MR Spectroscopy: Models

Hall D Saturday 14:00 - 16:00

1278. Effect of Choline Kinase Inhibition using Hemicholinium-3 on Choline Phospholipid Metabolism of Human Mammary Epithelial Cells

Noriko Mori[1], Kristine Glunde[1], Zaver M. Bhujwalla[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Spectroscopic NMR imaging studies have shown that an increase of phosphocholine is one of the signatures of cancer, and this elevation is closely related to malignant transformation, invasion and metastasis. We are currently investigating pathways in the choline phospholipid cycle which contribute to the elevation of phosphocholine and total choline using ^{1}H NMR spectroscopy. Here we have used a choline kinase inhibitor, hemicholinium-3, to determine the effect of choline kinase inhibition on the choline phospholipid metabolites of malignant and nonmalignant human mammary epithelial cell lines. Parallel assays were performed to determine the effect of the compound on cell viability.

1279. Gene Expression Profiling of Choline Metabolism in Human Breast Cancer Cells

David Morse[1], Danielle Carroll[1], Sherif Morgan[1], Brenda Baggett[1], Robert J. Gillies[1]
[1]The University of Arizona, Tucson, Arizona, USA

31P and 1H MRS investigations have shown that tumors almost invariably contain elevated levels of choline-containing compounds. This is illustrated in Figure 1, which shows 1H and 31P spectra from extracts of non-cancerous MCF-10A breast epithelial cells, compared to the relatively benign MCF-7 human breast cancer tumor cells and the highly aggressive MDA-mb-231 breast cancer cells. Although the pathways are well-characterized, the biochemical mechanisms underlying these differences are not known. In order to investigate the mechanisms in more detail, we have begun to characterize the expression patterns of genes involved in this pathway.

1280. Variation in the Augmentation of Phosphocholine in Breast Cancer; the Cause and the Sense

Hadassa Degani[1], Edna Rushkin[1], Galit Eliyahu[1]
[1]Weizmann Institute of Science, Rehovot, Israel

Cancer cells of epithelial origin contain high amounts of phosphocholine as compared to their normal counterparts. We have measured systematically the levels of phosphocholine in five human breast cancer cells and normal human mammary epithelial cells. These levels were then correlated with the activity of choline kinase and phospholipase D. Variation in Phosphocholine levels closely paralleled changes in choline kinase activity. Phospholipase D activity was elevated only in two cell lines. The levels of phosphocholine and the activity of the enzymes did not show a correlation with estrogen responsiveness or the tumorgenicity and invasiveness of the cells.

1281. Lovastatin Potentiates Phenylbutyrate-Induced NMR-Visible Lipid Accumulation in Perfused DU145 Prostate Cancer Cells

Matthew Milkevitch[1], Stephen Pickup[1], Jerry D. Glickson[1], Edward Delikatny[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Previous studies have shown that treatment of human prostate cells with the differentiating agent phenylbutyrate causes increases in neutral lipids as measured by diffusion-weighted 1H NMR, electron microscopy and Nile Red staining. In this study, DU145 cells were treated with PB and the HMG-CoA reductase inhibitor lovastatin, and the results monitored by 1H and 31P NMR. Lovastatin caused a significant time and dose dependent potentiation of NMR-visible lipids, evidenced by an increased 1.3 ppm resonance. Total choline at 3.2 ppm also increased with PB or PB/lovastatin treatment and 31P NMR indicated that this was due to increased glycerophosphocholine.

1282. *In Vivo* and *In Vitro* Effects of the Differentiating Agents Phenylacetate and Phenylbutyrate on Prostate Tumors

Matthew Milkevitch[1], Harish Poptani[1], Stephen Pickup[1], David S. Nelson[1], Jerry D. Glickson[1], Edward J. Delikatny[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

The effects of the differentiating agents phenylacetate (PA) and phenylbutyrate (PB) on DU145 prostate cancer cells were investigated in perfused cell culture and in vivo mouse xenografts. Diffusion-weighted (DW) 1H NMR of perfused cells and single voxel STEAM of xenografts show a significant time-dependent increase in the resonance at 1.3 ppm upon treatment with PA and PB. This resonance corresponds to methylene groups on fatty acid chains of triglycerides and cholesterol esters. These results indicate that differentiation agents increase neutral lipids in prostate tumors, and this effect can be observed non-invasively in both perfused cell culture and in vivo models.

1283. DNA Breakdown Products as Detected by ^{1}H MAS NMR Spectroscopy *Ex Vivo* in a Rat Glioma Undergoing Gene-Therapy Induced Programmed Cell Death

Kimmo K. Lehtimäki[1], Piia K. Valonen[1], Julian Griffin[2], Olli H.J. Gröhn[1], Mikko I. Kettunen[1], Seppo Ylä-Herttuala[1], Asla Pitkänen[1], Jeremy K. Nicholson[2], Michael G. Garwood[3], Risto A. Kauppinen[1]
[1]University of Kuopio, Kuopio, Finland; [2]Imperial College of Science, Technology and Medicine, London, UK; [3]University Of Minnesota, Minneapolis, USA

Metabolite changes associated with programmed cell death (PCD) in a glioma were studied both *in vivo* (STEAM TE=2 ms, 4.7T) and *ex vivo* (magic angle spinning =MAS 1H NMR, 14.1T). Inositol, glycine and taurine declined drastically, but no changes in the upfield peaks were evident *in vivo*. MAS spectroscopy of funnel frozen tumour samples *ex vivo* revealed peaks between 7.5 and 8.5 ppm, during PCD. These peaks were assigned to DNA breakdown products. Thus cell loss during PCD is reflected by metabolite decline and interestingly, at high field novel peaks peculiar to the cell death pathway can be revealed.

1284. Non-Invasive ^{19}F MR Spectroscopy Evaluation of *Salmonella*-Based Suicide Gene Transfer in Rodent Tumor Models.

Tom Dresselaers[1], Paul Van Hecke[1], Jan Theys[2], Hanne Callewaert[1], Philippe Lambin[2], Jozef Anne[1], Willy Landuyt[3]
[1]KUL, Leuven, Belgium; [2]Exp. Radiobiology/Rad. Oncol., Leuven/Maastricht, Belgium, Netherlands; [3]Exp. Radiobiology/LEO, Leuven, Belgium

We report the first non-invasive 19F MRS monitoring of intra-tumoral activity from attenuated *Salmonella typhimurium* recombinant for cytosine deaminase (TAPET-CD). This non-mammalian enzyme enables the conversion from 5-fluorocytosine (5-FC) systemically given, to 5-fluorouracil (5-FU). In the present study 5-FC was injected intra-tumorally in mice xenografted with the human colon tumors HCT116 and HT29 and in rats transplanted with a syngenic rhabdomyosarcoma tumor. The results clearly demonstrate the necessity to apply repeat 'longitudinal' measurements of the 5-FC to 5-FU conversion in the individual tumors to optimize the therapy protocol.

1285. Invading Prostate Cancer Cells Exhibit Metabolic Differences in the Presence of Endothelial Cells.

Ellen Ackerstaff[1], Dmitri Artemov[1], Robert J. Gillies[2], Zaver M. Bhujwalla[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; [2]Arizona Health Sciences Center, Tucson, Arizona, USA

Understanding the role of endothelial – cancer cell interaction in cancer invasion under normoxia and under hypoxia is important to understand and prevent invasion and metastasis. In this study, we investigated the effects of the presence of human umbilical vein endothelial cells (HUVEC) on the invasiveness and metabolism of the human prostate cancer cell line PC-3 under oxygenated and under hypoxic conditions. HUVEC conferred an advantage in invasion of PC-3 under hypoxia and altered cancer cell metabolism.

1286. Monitoring of Orthotopic Prostate Cancers in Rats by Dynamic MR-Tomography and Proton MR Spectroscopy

Heinz-Peter Schlemmer Wilhelm Schlemmer[1], Peter Huber[2], Rainer Grobholz[3], Melanie Heilmann[2], Jörg Meding[2], Matthias Lichy[2], Christian Fink[2], Martin Krix[2], Peter Peschke[2], Fabian Kiessling[2]
[1]University Hospital Tuebingen, Tuebingen, Baden-Württemberg, Germany; [2]German Cancer Research Center, Heidelberg, Baden-Württemberg, Germany; [3]University Hospital Mannheim, Mannheim, Baden-Württemberg, Germany

Orthotopic grown prostate cancers models are essential to investigate treatment effects, because tumor growth and metastatic potential can dramatically be influenced by the interaction of tumor with surrounding tissue. Purpose of this work was to establish an experimental setting, which allows to monitor perfusion and metabolism in irradiated orthotopic prostate cancers in rats using a clinical 1.5T MR scanner. Follow-up examinations included quantitative, contrast-enhanced dynamic MR imaging (dMRI) and proton MR spectroscopy (MRS) and findings were compared with immuno-histological results.

1287. Site Dependence of Choline Concentration in HT29 Tumours Studied by *In Vivo* ^{1}H MR Spectroscopy

Basetti Madhu[1], Helen Troy[1], Simon P. Robinson[1], Franklyn A. Howe[1], Marion Stubbs[1], John R. Griffiths[1]
[1]St. George's Hospital Medical School, London, UK

Apparent choline content (in mM) and lactate/water ratio in HT29 xenografts grown on the back or the flank of nude mice were estimated using PRESS and MQC lactate edited ^{1}H MRS. Choline was significantly higher in back tumours (7.37 + 0.48 mM) when compared with flank tumours (4.37 + 0.33 mM). There were no significant differences in lactate/water ratio or in choline and water T_2s of the tumours at different implantation sites.

1288. ^{31}P MR Diffusion Spectrocopy in Human Muscle and Tumors

Rama Jayasundar[1]
[1]All India Institute of Medical Sciences, New Delhi, India

In this study, diffusion coefficients (D) of phosphorus metabolites were measured in vitro and in vivo (calf muscle in normal volunteers and patients with extremity tumor). While the D values of the various P-31 metabolites in vitro are in agreement with those in literature, the values obtained in vivo are, probably, the first such report in humans. The following D values were significantly different ($p < 0.05$) - PCr in normal & tumor, Pi & PCr in tumor.

Cancer MR Spectroscopy: Clinical

Hall D Monday 13:30 - 15:30

1289. Improved Detection of Choline in Breast MRS

L. N. Ryner[1], V. Fraser[2], S. Latosinsky[3], M. Wilson[4], I. C.P. Smith[1]
[1]National Research Council Canada, Winnipeg, Manitoba, Canada; [2]Abbott Clinic, Winnipeg, Manitoba, Canada; [3]Health Sciences Centre, Winnipeg, Mabitoba, Canada; [4]WRHA Breast Health Centre, Winnipeg, Manitoba, Canada

Greatly improved detection of choline, a potentially important marker of malignancy in MR spectroscopy of breast abnormalities, was accomplished using a modified PRESS sequence with a spectral/spatial 90o excitation pulse. Use of this sequence allowed the acquisition of short echo time spectra with the benefit of increased signal due to reduced T2 losses, with a reduced level of overlapping lipid signal. Of the 25 patients who were scanned, the lipid signal was reduced by a factor of 30 (versus TE=50ms) while choline was observed with double the signal-to-noise ratio (versus TE=288ms).

1290. Short Echo Time Prostate MRSI

L.N. Ryner[1], L. Leboldus[2], A. Hussain[2], I.C.P. Smith[1], T. Bezabeh[1]
[1]National Research Council Canada, Winnipeg, Manitoba, Canada; [2]Health Sciences Centre, Winnipeg, Manitoba, Canada

The use of short echo time in MRSI of the prostate allows increased SNR from citrate, choline and creatine due to reduced T2 losses; improved observation of the multiplet structure of citrate, which may be useful in assessing changes in certain disease states; as well as new information obtained from short T2 metabolites not observable in standard long TE acquisitions. Eight patients were scanned comparing the short and long TE acquisitions. Choline and the multiplet structure of citrate were observed with increased SNR. Methods to reduce contamination from periprostatic lipid, a larger problem at short TE, are under development.

1291. ^{1}H MRSI Findings in Prostatitis

A. Shukla-Dave[1], J. A. Koutcher[1], S. Eberhardt[1], M. Muruganandham[1], K. Sircar[1], P. Scardino[1], V. Reuter[1], H. Hricak[1], K. L. Zakian[1]
[1]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

In the peripheral zone (PZ) of the prostate, proton MRSI has been shown to discriminate cancer from healthy tissue based on the (choline+creatine)/citrate ratio. Prostatitis - an inflammatory condition of the prostate gland - may confound interpretation of MRSI. To test this hypothesis, we retrospectively analyzed MRSI data from 24 patients with histologically proven chronic prostatitis. In 7/10 patients with prostatitis in the peripheral zone, MRSI demonstrated elevated choline-containing compounds mimicking cancer. Because of potential overlap in MRSI findings between cancer and prostatitis, MRSI data must be interpreted in the light of both MR results and clinical information.

1292. Assessment of Malignancy in Brain Tumors by 3T MR Spectroscopy

Boyoung Choe[1], Sinsoo Jeun[2], Byoungchul Son[2], Yonggil Hong[2], Moonchan Kim[2], Bumsoo Kim[2], Jaemun Lee[2], Sungtaek Chung[3], Changbeom Ahn[4], Changhyun Oh[5], Sunil Kim[6], Hyoungkoo Lee[1], Taesuk Suh[1]
[1]Catholic University of Korea, Seoul, Republic of Korea; [2]Kangnam St. Mary's Hospital, Seoul, Republic of Korea; [3]Medinus Co., Yongin, Kyunggi-do, Republic of Korea; [4]Kwangwun University, Seoul, Republic of Korea; [5]Korea University, Seoul, Republic of Korea; [6]Hanyang University, Seoul, Republic of Korea

To assess clinical proton MRS for evaluating brain tumor malignancy at 3T system.Using this system,localized water-suppressed single-voxel technique was employed to evaluate spectra with peaks of NAA, Cho, Cr and lactate. NAA/Cr ratio of all tumor tissues was significantly lower than that of the normal tissues,but Cho/Cr ratio of all tumor tissue was significantly higher. Cho/Cr ratio of high-grade gliomas was significantly higher than that of low-grade gliomas.Higher grade of brain tumors was correlated with higher Cho/Cr ratio,indicating a significant dependence of Cho levels on malignancy of gliomas.

1293. Proton Magnetic Resonance Spectroscopy of Intraventricular Tumors

Tariq Shah[1], Rama Jayasundar[1], Virender Paul Singh[1], Chitra Sarkar[1]
[1]All India Institute of Medical Sciences, New Delhi, Delhi, India

Single voxel Proton Magnetic Resonance Spectroscopy (MRS) was carried out on twenty intraventricular tumors prior to surgery. The study has shown that central neurocytomas and meningiomas can be differentiated from each other using NAA/Cr, NAA/Cho, Cho/Cr and Gly/Cho and also from other intraventricular tumors (OIV) on the basis of Gly/Cho ($p < 0.001$). Cho/Cr was also significantly between meningiomas and OIV tumors.

1294. In Vivo Measurements of Temperature and Diffusion Coefficient in Brain Tumors

Rama Jayasundar[1]
[1]All India Institute of Medical Sciences, New Delhi, Delhi, India

In this preliminary study, diffusion coefficient (D) of water and temperature (T) were measured in vivo in brain tumors using proton MRS and compared. A statistically significant ($p < 0.04$) positive correlation was observed between T and D. This confirms the known direct relationship between the two parameters - however, for the first time in vivo.

1295. Spectral Profile of Cerebral Tumors - a Proton MRS Study

Tariq Shah[1], Rama Jayasundar[1], Virender Paul Singh[1], Chitra Sarkar[1]
[1]All India Institute of Medical Sciences, New Delhi, India

The potential of proton Magnetic Resonance Spectroscopy (MRS) in diagnosing cerebral tumors (n=156) prior to surgery has been evaluated using single voxel MRS. The study has shown that a combination of spectral parameters such as Cho/Cr and distribution of metabolites such as lactate, lipids, taurine and alanine can be used to differentiate various types of tumors. For example, differentiation between low grade and high grade gliomas could be based on Cho/Cr and distribution of lactate & lipids and between medulloblastomas and glioblastomas can be based on Cho/Cr and distribution of lipid, inositol and taurine.

1296. Post-Therapy Evaluation of Cerebral Tumors Using MRS and SPECT

Tariq Shah[1], Rama Jayasundar[1], Virender Paul Singh[1], Chandra Shekhar Bal[1], Chitra Sarkar[1]
[1]All India Institute of Medical Sciences, New Delhi, Delhi, India

Evaluation of tumor recurrence is as important as its pre-operative diagnosis in patient management. In the present study, fifteen patients were studied pre-surgery by Magnetic Resonance Spectroscopy (MRS) and by both MRS and Single Photon Emission Tomography (SPECT) post-therapy. MRS and SPECT showed agreement in 73% of the patients. The follow up studies have shown that MRS can have as useful a role in evaluation of post-therapy changes as SPECT does.

1297. Metabolic Profiles of Grade II Astrocytomas and Oligodendrogliomas Suggest Different Mechanisms of Energy Utilization

Tracy R. McKnight[1], Tonya D. Love[1], Kathleen Lamborn[1], Mitchel S. Berger[1], Andrew Bollen[1]
[1]UCSF, San Francisco, California, USA

In vivo 3D-MRSI was performed on 10 patients with untreated low grade oligodendroglial or astrocytic tumors. No mixed tumors were investigated. Immunohistochemical assays of cellular proliferation and density were performed on MRSI-directed tumor biopsies. Oligodendrogliomas were found to have higher cell density, lower creatine levels, and exhibited lactate/lipid peaks more often than astrocytomas. The two tumor types could be classified with 84.2% accuracy using the lactate/lipid index and creatine levels alone. The combined MRSI and histologuc findings suggest a difference in the energetic and oxidative status of these tumors.

1298. Predicting Clinical Grading of CNS Tumors in Children with Proton MRSI

Loukas G. Astrakas[1], David Zurakowski[2], Maria K. Zarifi[3], Tina Young Poussaint[2], Douglas C. Anthony[2], Liliana Goumnerova[2], Peter McL Black[2], A. Aria Tzika[1]
[1]Massachusetts General Hospital, Boston, Massachusetts, USA; [2]The Children's Hospital Boston, Boston, Massachusetts, USA; [3]Agia Sophia Children's Hospital, Athens, Attiki, Greece

We evaluated proton MRSI exams on 76 children with CNS tumors of childhood. Normalized biologically important intracellular molecules such as choline-containing compounds (Cho), N-acetylaspartate (NAA), total creatine (tCr), lipids and/or lactate (L) were measured at the "highest Cho region" and were normalized to the tCr of surrounding healthy tissue. Variables were examined by multivariate logistic regression. Normalized Cho (Cho/ntCr) and normalized L (L/ntCr) were higher in high-grade (26) than low-grade (50) tumors ($P<0.001$). Multiple stepwise logistic regression analysis confirmed that Cho/ntCr and L/ntCr were significant independent predictors that correlated positively with tumor grade.

1299. Proton Magnetic Resonance Spectroscopic Imaging of Radiation Effects in Normal Human Brain

Michael C. Lee[1], Tracy R. McKnight[1], Sarah J. Nelson[1]
[1]University of California, San Francisco, California, USA

The effect of radiation on metabolite concentrations in the healthy brain and the impact on the identification of recurrent tumor were investigated. Proton magnetic resonance spectroscopic imaging was performed on 11 patients before and at two-month intervals following radiotherapy. High doses (> 50 Gy) induced a decline in choline, creatine, and NAA concentrations in normal appearing white matter. This was followed by a dose-dependent rapid recovery of choline, and incomplete recovery of creatine and NAA. This effect reduced the differences in metabolite levels between tumor and healthy tissues, suggesting that dose distributions should be considered when evaluating post-radiotherapy spectroscopy.

1300. Proton MR Spectroscopic Follow–Up of Irradiated Gliomas: Assessment of Intra-Reader and Inter-Reader Agreement

Matthias Philipp Lichy[1], Christian Plathow[1], Peter Bachert[1], Ivan Zuna[1], Jürgen Debus[1], Heinz-Peter Schlemmer[2]
[1]German Cancer Research Centre, Heidelberg, Germany; [2]University Tübingen, Tübingen, Germany

Using stereotactic radiotherapy therapy for glial brain tumours, increased contrast enhancement during follow–up as radiation–induced tissue alterations can occur. For correct diagnosis of such findings, combination of MRI and 1H spectroscopic imaging [SI] is used. In this study, a detailed analysis of intra– and inter–reader variation of these methods has been performed to explore the clinical value. It could be demonstrated, that application of SI improved sensitivity and specificity significantly for intra– and inter–reader agreement. Comparison of spectra from lesions with individual signal intensity ratios in apparently healthy brain tissue enhanced correct interpretation of spectroscopic data.

1301. Magnetic Resonance Spectroscopy Assessment of Glioma Response to Chemotherapy

Casilda Balmaceda[1], Xiangling Mao[1], Dana Critchell[1], Susan C. Pannullo[1], K Cheung[1], Robert L. DeLaPaz[1], Dikoma C. Shungu[1]
[1]Columbia University, New York, New York, USA

This study reports the magnetic resonance spectroscopy (MRS) assessment of glioma response to chemotherapy in fourteen patients with recurrent brain tumor. The result suggest that compared to MRI and clinical outcomes, MRS may play a helpful tool in evaluating tumor response, particularly in nonenhancing tumors where standard response criteria may not apply.

1302. Detection of Melanoma Lymph Node Metastases by ^{1}H MRS of Fine-Needle Aspirates using a Statistical Classification Strategy

Roger Bourne[1], John Thompson[2], Richard Scolyer[2], Jonathan Stretch[2], Lawrence Li[2], Theresa Dzendrowskyj[1], Brion Dolenko[3], Ray Somorjai[3], Carolyn Mountford[1], Cynthia Lean[1]
[1]Institute for Magnetic Resonance Research, Sydney, New South Wales, Australia; [2]Sydney Melanoma Unit, Sydney, New South Wales, Australia; [3]Institute National Research Council, Winnipeg, Manitoba, Canada

Staging of melanoma requires assessment of lymph nodes for the presence of metastases. Sentinel lymph node biopsy is accurate but invasive with a 5 – 10% complication rate and requires labour-intensive, expensive histology. Fine needle aspiration biopsies from lymph nodes (n=112) from melanoma patients were analysed using ^{1}HMRS. Diagnostic correlation of spectra and pathology using a Statistical Classification Strategy distinguished benign and malignant nodes with an accuracy of 94.7%. An accuracy of 91.2% was obtained for an independent validation set. Proton MRS provides a rapid, accurate technique to assess lymph nodes in patients with melanoma.

1303. *In Vivo* Measurement of Capecitabine Metabolism in Human Liver by 19-Fluorine Magnetic Resonance Spectroscopy

Hanneke van Laarhoven[1], Dennis Klomp[1], Yvonne Kamm[1], Cornelis Punt[1], Arend Heerschap[1]
[1]UMC Nijmegen, Nijmegen, Netherlands

In advanced colorectal cancer oral capecitabine is used as an alternative to intravenous 5-fluorouracil (5FU). The last step of capecitabine metabolism into 5FU is the conversion of 5'deoxy-5-fluorouridine (5'DFUR) by thymidine phosphorylase (TP). The rate of 5'DFUR conversion has been related to the level of TP in tumors, which was correlated with tumor response. 5FU catabolites have been associated with 5FU systemic toxicity. Here we demonstrate for the first time that potentially clinically relevant metabolism of capecitabine can be monitored in vivo by 19-fluorine magnetic resonance spectroscopy (19F MRS) in the liver of patients with metastatic colorectal cancer.

Mouse MR Phenotyping

Hall D Tuesday 13:30 - 15:30

1304. *In Vivo* High-Field Multiple-Mouse MRI

Nicholas A. Bock[1], Philip J. Beatty[2], X Josette Chen[1], Lori M. Davidson[1], Jun Dazai[1], Nir Lifshitz[1], Brian J. Nieman[1], John G. Sled[1], R Mark Henkelman[1]
[1]Hospital for Sick Children, Toronto, Ontario, Canada; [2]Stanford University, Palo Alto, California, USA

We present a method to increase the throughput of an in vivo MRI study of many mice by imaging them concurrently at 7 Tesla in shielded transmit/receive (T/R) radiofrequency (RF) coils with parallel receivers and transmitters in a common magnet and set of gradient coils. We present high-resolution three-dimensional (3D) brain images that were simultaneously acquired in four live mice with the same imaging time as for one mouse.

1305. Correlation between NAA and Neuronal Area in Transgenic Mouse Models of Huntington's Disease

Bruce G. Jenkins[1], Alpaslan Dedeoglu[2], Robert J. Ferrante[2], M. Flint Beal[3]
[1]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, Massachusetts, USA; [2]VA Medical Center, Boston University, Bedford, Massachusetts, USA; [3]Weill Medical College of Cornell University, New York, New York, USA

Loss of N-acetyl aspartate is a MRS marker for neuronal dysfunction in a variety of neurodegenerative conditions such as Alzheimer's disease and Huntington's disease (HD). Loss of NAA can correlate with both neuronal death as well as with neuronal dysfunction. We show here that in two different mouse models of HD that in the absence of neuronal death, NAA decreases show a tight temporal correlation with decreases in neuronal area.

1306. Localised *In-Vivo* ^{31}P MRS in a Mouse Model of Huntington's Disease

Rupert A. Page[1], Ernest B. Cady[2], Andrew Nicholas Priest[2], Alan Bainbridge[2], Daniel A. West[3], John Stephen Thornton[3], Ben Woodman[4], Gillian P. Bates[4], Roger John Ordidge[3], Charles Davie[1]
[1]Royal Free Hospital, London, UK; [2]UCL Hospitals NHS Trust, London, UK; [3]University College London, London, UK; [4]Guy's Hospital, London, UK

Huntington's disease (HD) is a neurodegenerative disorder, in which altered energy metabolism is thought to contribute to inexorable neurological decline. Bio-energetic defects, similar to those seen in HD, have been demonstrated in vitro in the R6/2 mouse model of the condition. However, to our knowledge in vivo 31P MRS has not previously been used in a murine model of HD. The preliminary results of an in vivo 31P MRS study of the R6/2 mouse are reported. Altered phosphate metabolism, with reduced inorganic phosphate is apparent from an early time point, with relative preservation of phosphocreatine and ATP.

1307. ^{1}H Spectroscopic Imaging of the *In Vivo* Mouse Brain with 2ul Voxels

Hoby P. Hetherington[1], Tsukasa Nagaoka[1], Richard P. Kennan[1]
[1]Albert Einstein College of Medicine, Bronx, New York, USA

Although high resolution in vivo imaging of the mouse brain has been demonstrated by many investigators, most in vivo spectroscopy studies reported to date in the in vivo mouse brain have used relatively large volumes (27-100 ul) and single voxel methods. . Therefore, the goal of this study was to develop and evaluate a spectroscopic imaging sequence to measure NAA and other metabolites in the in vivo mouse brain at resolutions of 2ul.

1308. Validation and Application of a Magnetic Resonance Spectroscopy Method for Estimating Body Composition in Conscious Mice

Michael D. Cockman[1], Darren P. Trokhan[1], Dawn M. Eckstein[1], Karen M. Hodge[1], Melissa B. Jones[1], Ofer Reizes[1], Russell J. Sheldon[1]
[1]Procter and Gamble Pharmaceuticals, Mason, Ohio, USA

To support studies of potential therapies for weight management, the ability to quantify body composition over time is very desirable. Proton MRS allows the non-invasive quantification of the water and lipid within an animal body. We have been actively exploring the application of proton MRS to studies of mouse models of obesity. Since proton MRS is very rapid, a spectrum can be obtained from a conscious mouse, and animal throughput can be very high (>10 mice per hour).

1309. Exendin(1-30) Decreases Abdominal Fat in a Mouse Model of Type 2 Diabetes

Patrick McConville[1], Richard Spencer[1]
[1]NIH/National Institute on Aging, Baltimore, Maryland, USA

Chronic treatment of db/db mice with a truncated form of Exendin-4 (Ex-4), Ex(1-30), significantly reduced the amount of visceral abdominal fat, relative to saline treated controls as quantified by MRI. Improved hemoglobin A_{1c} (HbA_{1c}), and glucose and insulin levels of the treated animals also resulted, but suggested reduced potency of Ex(1-30) compared with Ex-4.

1310. An MRS Study of Murine Macrophages: Unexpected Presence of the Inhibitory Neurotransmitter GABA

Daniel Stuckey[1], Daniel Anthony[2], John Lowe[1], Peter Styles[1], Andrew Blamire[1], Niki Sibson[1]
[1]University of Oxford, Oxford, UK; [2]University of Southampton, Southampton, UK

Macrophages are key components of the inflammatory response, but their actions can exacerbate neuropathology. MRS was used to identify metabolite levels in quiescent and activated cultured macrophages. Over 25 metabolites were identified, including GABA, an inhibitory neurotransmitter, not previously reported to be present in macrophages, and glutathione, a metabolite not evident in normal brain spectra. On activation, lactate, glutamine, glutamate and taurine levels were significantly elevated, while GABA and alanine were reduced. Our findings suggest that either a specific combination of metabolite changes, or glutathione alone, may be viable clinical indices of macrophage recruitment to the CNS.

1311. Liver Flux Profiling of Various Inbred Strains of Mice

Shawn C. Burgess[1], Natasha Hausler[1], Charles Storey[1], Angela Richman[1], A Dean Sherry[1], Craig T. Malloy[1]
[1]University of Texas Southwestern Medical Center, Dallas, Texas, USA

Many human disorders of fat and glucose metabolism have been modeled using genetically engineered mice. However, it is difficult to evaluate the consequences of these interventions for metabolic fluxes in the mouse in vivo. Mouse strains also have variable susceptibility to obesity and hyperglycemia, and for this reason others have suggested that results from genetic manipulations may reflect the background strain rather than the intervention itself. Here we present a simple method for determining the liver flux profile (LFP) which was used to evaluate gluconeogenic pathways in three standard strains used in genetic engineering experiments (FVB, 129 and C57Bl/6).

1312. pH Imaging of Mouse Kidneys

Natarajan Raghunand[1], Robert J. Gillies[1]
[1]University of Arizona HSC, Tucson, Arizona, USA

Deviations of systemic and renal pH from normal are typical of diseases such as renal tubular acidosis. We have employed the pH-sensitive contrast agent GdDOTA-4AmP to image renal pH in mice, with a view to developing a tool for the non-invasive assessment of renal disease extent, progression, and response to therapy. Previous results indicate that the greatest uncertainty in calculated pH is in the calyx and ureters, due to the very high accumulated concentration of contrast agent in this region of the kidneys. We present the results of our efforts to account for these errors.

1313. Magnetic Resonance Lung Deformation Map of Normal Mice and Transgenic Mice Model of Sickle Cell Disease

Shigeru Kiryu[1], Masaya Takahashi[1], Tessa A. Sundaram[2], James C. Gee[2], Yasutane Mori[1], Hidemasa Uematsu[2], Toshio Asakura[3], Hiroto Hatabu[1]
[1]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [3]The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA

Our purpose was to investigate the feasibility of assessing lung motion from the registration of successive images in serial MR acquisitions during normal respiration in an animal model. We scanned the coronal images of the lung in inspiratory and expiratory phases of the respiration cycle in normal mice (n=6). The same series of imaging was performed in transgenic sickle cell disease mice (Tg mice: n=3) before and after hypoxic exposure (5% O2). MR assessment of pulmonary motion was enabled to assess pulmonary parenchymal biomechanics in all animals. Further, the amplitude of each displacement tensor was diminished especially at lung base

1314. T_2-weighted ^{1}H-MRI of Lung Tumors in Mice Using Partial Liquid Ventilation with Water-in-Perfluorocarbon Emulsions

Ming Qiang Huang[1], Per H. Basse[2], Qin Yang[2], T. Kevin Hitchens[1], Qin Ye[1], Chien Ho[1]
[1]Carnegie Mellon University, Pittsburgh, Pennsylvania, USA; [2]University of Pittsburgh Cancer Institute , Pittsburgh, Pennsyllvania, USA

We have developed an ^{1}H-MRI technique of lungs using partial liquid ventilation (PLV) with water-in-perfluorocarbon (PFC) emulsions, which has achieved high sensitivity and spatial resolution. T_2-weighted ^{1}H-MRI of mouse lungs has been performed to detect lung tumors in mice using both conventional and new method. We have demonstrated that T_2-weighted ^{1}H-MRI using PLV with PFC improves the sensitivity and is able to detect lung tumors as small as 1-2 mm in mice. The specificity of MRI in tumor detection has been verified by histology.

Body MR: *Ex Vivo* and Animal Models

Hall D Saturday 14:00 - 16:00

1315. Macrophage labeling by SPIO as Early Marker of Allograft Chronic Rejection in a Rat Model of Kidney Transplantation

Nicolau Beckmann[1], Catherine Cannet[1], Madeleine Fringeli-Tanner[1], Diana Baumann[1], Charles Pally[1], Marc Bigaud[1], Christian Bruns[1]
[1]Novartis Institute for Biomedical Research, Basel, Switzerland

MRI was applied to the life-supporting Fisher-Lewis kidney transplantation (tx) model. Renography and perfusion analyses were carried out with Gd-DOTA and small particles of iron oxide (SPIO), respectively. Starting 12 weeks post-tx, grafts exhibited signal attenuation in the cortex. Significant negative correlation was found between the MRI cortical signal intensity and the histologically determined iron content in macrophages located in the cortex. Renography revealed a reduced kidney functionality at week 33, while no changes in perfusion occurred. These results suggest the feasibility of detecting signs of graft rejection significantly earlier than changes in function occur, by labeling macrophages with SPIO.

1316. Evaluation of Normal, Inflammatory, and Tumor-Invaded Lymph Nodes by Interstitial MR Lymphography in Rabbits

Christoph Ulrich Herborn[1], Florian Matthias Vogt[1], Thomas Colon Lauenstein[1], Mathias Goyen[1], Olaf Dirsch[1], Claire Corot[2], Jörg Felix Debatin[1], Stefan Günther Ruehm[1]
[1]University Hospital Essen, Essen, Germany; [2]Guerbet, Paris, France

To assess different contrast agents (Gd-DOTA, P760, P792) for differentiation of normal, reactive, and tumor-bearing (VX2) lymph nodes of rabbits with interstitial MR lymphography. Six NZW rabbits per agent underwent MR examination prior and following induction of inflammatory lymph nodes or implantation of VX2-tumor to the flank. Each agent was injected subcutaneously into both dorsal foot pads followed by repeated 3D MR imaging. No significant changes were seen between normal and reactive nodes. Reduced contrast uptake and signal void in tumor-invaded lymph nodes following injection of P960 and P792 permitted detection thereof, while results of Gd-DOTA were less reliable.

1317. *Ex Vivo* High Resolution Magic Angle Spinning MR Spectroscopy Suggests a Lipid-Mediated Apoptosis in Burn Injury

Loukas G. Astrakas[1], Shingo Yasuhara[1], Yong Ming Yu[1], Laurence G. Rahme[1], Jeevendra A. Martyn[1], Ronald G. Tompkins[1], A Aria Tzika[1]
[1]Massachusetts General & Shriners Burns Hospitals, Boston, Massachusetts, USA

NMR visible lipids have been associated with apoptosis. We report that Ex vivo Magic Angle Spinning (MAS) MR Spectroscopy has detected, with high resolution, differences in lipid profiles of muscles from control and burned rabbits. The lipid profile of the latter was linked to apoptosis as detected by the U-tunnel method. We suggest that a NMR visible lipid-mediated apoptosis in burns results in muscle wasting. This has led us to the concept that suppression of certain lipids, such as sphingolipids may represent a candidate strategy for a partial relief of muscle wasting (or cachexia) resulting from burns.

1318. High-Throughput Analysis of Total Body Fat Content for Pharmaceutical Research

Markus von Kienlin[1], Basil Kuennecke[1]
[1]F. Hoffmann-La Roche Pharmaceuticals, Basel, Switzerland

Obesity is a major risk factor contributing to hypertension, impaired glucose tolerance or diabetes. A modality to determine the body composition in obese animal models is required to evaluate potential drugs. Anesthesia is not acceptable, as it may influence the feeding behavior. We have implemented MR-relaxometry as a very fast measurement of lean and fat mass in awake rodents, with a body weight of up to 1 kg. The coefficient of variance of repeated measures is better than 3%, equivalent to a fat mass precision of 150 mg in mice. Throughput is greater than 200 animals per day.

1319. Time Resolved Flow Measurement in the Isolated Rat Heart - Characterization of the Left Coronary Artery Stenosis

Sascha Köhler[1], Karl-Heinz Hiller[1], Peter M. Jakob[1], Wolfgang R. Bauer[2], Axel Haase[1]
[1]Physikalisches Institut, Wuerzburg, Germany; [2]Medizinische Universitätsklinik, Wuerzburg, Germany

For quantification of blood flow velocities, phase contrast techniques have been validated in several studies [1]. Most applications focus on large vessels. This is due to the fact that systematic errors strongly increase with decreasing number of image pixels that cover the vessel lumen [2]. The purpose of the present study is to demonstrate that the flow behavior in small vessels such as the coronary arteries can be quantified in the isolated rat heart with high-resolution 2D phase contrast MRI experiments. In addition the flow behavior in hearts with acute stenosis was investigated and the degree of stenosis was quantified.

1320. *In Vivo* Quantification of Absolute Perfusion in the Murine Myocardium at 7 T.

JUG Streif[1], M Nahrendorf[2], KH Hiller[1], C Waller[2], F Wiesmann[2], E Rommel[1], WR Bauer[2], A Haase[1]
[1]Physikalisches Institut, Würzburg, Germany; [2]Medizinische Universitätsklinik, Würzburg, Germany

Absolute perfusion in the myocardium of NMRI mice was assessed in vivo with spin labelling MRI. The group average myocardial perfusion under anesthesia with isoflurane was 701 +/- 53 ml/(100g min) (N=11). For anesthesia with propofol, myocardial perfusion decreased to 383 +/- 40 ml/(100g min) (N=7, p<0.05 vs. isoflurane). A third group of seven mice with myocardial infarction was examined under isoflurane four weeks post MI and showed a significantly reduced perfusion of 476 +/- 81 ml/(100g min) in the remote myocardium (p<0.05 vs. sham). The presented method is a promising tool for the characterization of murine mycardial microcirculation.

1321. Pharmacokinetic Analysis of MRI Data Obtained with a Hepatocyte Bioreactor Perfused with Gd-DTPA and Gd-BOPTA

Corinne Planchamp[1], Marianne Gex-Fabry[1], Marko K. Ivancevic[1], Christophe Dornier[1], Luc Balant[1], Catherine Pastor[1], François Terrier[1], Jean-Paul Vallée[1]
[1]Geneva University Hospitals, Geneva, Switzerland

To better characterize the hepatic pharmacokinetics of MRI contrast agents, a newly developed hollow fiber bioreactor (HFB) was perfused with two contrast agents: Gd-DTPA, an extracellular contrast agent, and Gd BOPTA, an intracellular contrast agent. The signal intensity (SI) - time curves were submitted to pharmacokinetic analysis and were successfully fitted by a two-compartment model. The relation between the Gd-BOPTA SI in hepatocytes and the concentration of Gd-BOPTA perfused suggests that the uptake occurs through a membrane receptor. Such information is important to completely understand the cellular uptake of Gd-BOPTA in normal and injured hepatocytes.

1322. The Assessment of Tumoral Necrosis in Rat Tumor Model using Dynamic T_1/T_2* Gradient Dual Echo Sequence with Gd-DTPA and Gadomer-17 as a MR Contrast Agent

Yong-min Huh[1], Jin-suck Suh[1], Dae Hong Kim[1], Eun Joo Kim[1], Sang Hoon Lee[2], Woo Ick Yang[1]
[1]Yonsei University College of Medicine, Seoul, Republic of Korea; [2]Asan Medical Center, Seoul, Republic of Korea

The purpose of this study is to test the feasibility of rBF and rBV in the assessment of R004 sarcomas of the rat and to compare the results obtained by using Gd-DTPA and Gadomer-17 as a MR contrast agent, on the basis of the histological findings of tumor necrosis. Compared to solid non-necrotic area, the decrease of rBF and rBV in necrotic area showed 59.2%, 69.2% in the Gd-DTPA group and 78.8%, 86.7% in Gadomer-17 group, respectively. The rBF and rBV extracted from corrected ƒ´R2*-curves may be useful as in vivo marker for monitoring the tumoral necrosis.

1323. Metabolic Analysis using J-Resolved HSQC with *Ex Vivo* HRMAS

Loukas G. Astrakas[1], Igor Goljer[2], Yong Ming Yu[1], Laurence G. Rahme[1], Ronald G. Tompkins[1], A Aria Tzika[1]
[1]Massachusetts General & Shriners Burns Hospitals, Boston, MA, USA; [2]Varian NMR Systems, Columbia, Maryland, USA

NMR detection of multiple labeled compounds in biological samples is often used to follow metabolic pathways. J-HSQC is a modified version of an HSQC sequence which allowed us to measure singly and doubly labeled compounds in the same spectrum and has been applied successfully to study metabolism in tissue extracts. Here we demonstrated, for the first time, that J-HSQC can be applied using ex vivo HRMAS spectroscopy in intact tissue samples with promising results for metabolic flux analysis.

1324. Monitoring the Inflammatory Process in the Colon of Carrageenan-fed Rats by ^{1}H MRS

Tedros Bezabeh[1], Natasa Sabljic[2], Rakesh Patel[1], Ranjana Bird[2]
[1]National Research Council of Canada, Winnipeg, Manitoba, Canada; [2]University of Manitoba, Winnipeg, Manitoba, Canada

In the investigation of the increased risk of colon cancer associated with inflammatory bowel disease, rodent models are becoming increasingly utilized. Among various agents which induce inflammation in the colon of animals, is the degraded form of Carrageenan. Proton magnetic resonance spectroscopy was used herein to assess the inflammatory process in the colon of rats fed with a diet containing Carrageenan. Our results show the presence of significantly elevated (p < 0.05) levels of choline and taurine, and a significant reduction (p < 0.05) in the methylene to methyl spectral resonance intensity ratio in the Carrageenan-fed rats.

1325. Visualization of the Formaldehyde Fixation Process in Liver Preparations by means of MRI

Burkhard Ludescher[1], Joerg Subke[1], Beate Wietek[1], Hansjoerg Graf[1], Claus D. Claussen[1], Fritz Schick[1]
[1]University of Tuebingen, Tuebingen, Baden-Wuerttemberg, Germany

In this study we investigated the fixation process in formaldehyde-embedded pig livers and the influence of different temperatures on the penetration speed by means of Magnetic Resonance Imaging (MRI). The penetration of the fixative could be best visualized by T1- and proton-density-weighted TSE-Sequences. In the first few days the penetration speed is maximal and declines until around the 14th day. From then on no visible changes took place any more. There was no influence of the temperature on the penetration speed but there was an influence on the extend of gas production in the unfixed inner parts of the organs.

Body Techniques

Hall D Sunday 13:30 - 15:30

1326. Alternative T_1-weighted In-phase/Out-of-phase Imaging For Body MRI at 3T

A. T. Vu[1], V. M. Mai[1], P. V. Prasad[1], R. R. Edelman[1]
[1]Evanston Northwestern Healthcare, Feinberg School of Medicine, Northwestern University, Evanston, Illinois, USA

An alternative T1-weighted fat/water in-phase/out-of-phase gradient echo imaging pulse sequence is proposed for routine body MRI at 3T. The pulse sequence provides T1-weighting using single shot inversion recovery prepared technique and has lower overall SAR requirement. It is also less sensitive to respiratory motion and can be used as a breath-held insensitive technique.

1327. Quantitative Measurements of T_1 and T_2 for the Abdomen in a 3 Tesla Whole-Body Imager

Chloe Chhor[1], Eric Han[2], Jeffrey Stainsby[3], Graham Wright[3], Jean Brittain[2], Robert Herfkens[1]
[1]Stanford University Medical School, Stanford, California, USA; [2]GE Medical Systems ASL West, Menlo Park, California, USA; [3]Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada

A 2-D gradient echo spiral sequence was used to generate T1 and T2 image sets in the abdomen of healthy volunteers at 3T using Look-Locker and T2-prep techniques respectively. Relaxation times were calculated by fitting signal magnitude to a monoexponential decay using a least squares fit. Range of T1 and T2 values at 3T were compared to 1.5T values found in the literature. As expected, T1 values at 3T increased with respect to T1 values at 1.5T. T2 values remained largely unchanged. The results can be used to optimize abdominal imaging at 3T by allowing for better tissue structure differentiation.

1328. Fast Breath-Hold Imaging of the Liver with SMASH and Interleaved Water/Fat Acquisition

Wingchi Edmund Kwok[1], Zhigang You[1], Jianhui Zhong[1]
[1]University of Rochester, Rochester, New York, USA

We recently developed a new fast MR imaging technique that combines interleaved water/fat (IWF) technique with VD-AUTO-SMASH parallel imaging technique. The former saves half of the imaging time over conventional fat-suppressed and non-fat-suppressed imaging, and the latter reduces scan time by another half or more. In this study, we test the feasibility of applying this technique to breath-hold imaging of the liver. Results of normal subject studies using a 4-element torso array coil show that this technique can reduce imaging time by a factor of 4. This technique may be particularly useful for imaging patients who cannot tolerate long breath-hold.

1329. Abdominal and Cardiac Imaging using a Multi-Element Phased Array Coil at 1.5T

James W. Monroe[1], Neil R. Williams[1], Dennis Zuck[1], David Keach[1], Keith Levesque[1]
[1]W.L. Gore & Associates, Inc., Newark, Delaware, USA

A phased array coil consisting of 5 coil elements, two symmetrical paddles and minimum mutual inductance between adjacent neighbors is developed. Phantom and clinical comparisons were conducted and SNR computed. Phantom data demonstrate that the multi-element phased array coil had an 83% increase in SNR over the body coil and 23% increase over a cardiac coil. In the abdominal section there was a 45% increase in SNR over the body coil and equal to a commercially available torso array. Acquisition of both the cardiac region and abdominal region may be advantageous in terms of reducing scan times and repositioning.

1330. Abdominal MRI: Evaluation of Binomial Water Excitation for Fat Suppression

Evis Sala[1], Martin J. Graves[1], Victoria Louise Jardine[1], Ilse Joubert[1], David John Lomas[1]
[1]Addenbrookes Hospital and University of Cambridge, Cambridge, UK

Prospective study to compare two fat suppression techniques for breath-held T2w abdominal imaging in volunteers. Binomial selective water excitation was compared with standard spectral fat suppression. Two observers evaluated axial image sets for efficacy and homogeneity of fat suppression, homogeneity of water excitation and overall diagnostic quality. Binomial water excitation provided significantly better efficacy ($p=0.02$) and homogeneity ($p<0.005$) of fat suppression close to isocentre, but failure of water excitation in some of the peripheral cranial and caudal images resulted in artefacts and loss of diagnostic quality in all 12 volunteers.

1331. True FISP MR Imaging of the Uterus: Comparison with Routine Fast Spin Echo T_2-Weighted Images

Izumi Imaoka[1], Akihiko Wada[1], Michimasa Matsuo[1], Kazuro Sugimura[2]
[1]Tenri Hospital, Tenri, Nara, Japan; [2]Kobe Graduate School of Medicine, Kobe, Hyogo, Japan

The purpose of this study was to compare true FISP (fast imaging with steady-state precession) sequences with routine T2-weighted FSE (fast spin echo) sequence of the uterus for image quality, uterine anatomy, benign lesion detection, and signal intensity measurements. We also assessed whether or not fat-suppression technique improved the quality of true FISP images

1332. Moving Table Imaging at 1.5 and 3.0 Tesla

Charles L. Dumoulin[1], Robert D. Darrow[1], Yudong Zhu[1], Amy N. Critchley[1]
[1]General Electric Global Research Center, Niskayuna, New York, USA

A new method for MR imaging of the entire body was developed and demonstrated on 1.5 and 3.0 Tesla scanners. The method employs continuous table motion during data acquisition while sweeping the frequency of the receiver at a rate matching the table's speed. Sub-images are collected and combined after reconstruction to obtain a full FOV image. A new user interface to control the scanner during moving table imaging has also been constructed. The interface permits the operator to graphically specify scan limits and to view the acquired data as the scan progresses.

1333. Whole Body-MRI Imaging with a Continuously Moving Table Platform in Detection of Metastatic Disease in Cancer Patients First Results of a Feasibility Study

Nadir Alexander Ghanem[1], Hans Peter Fautz[1], Matthias Weigel[1], Oliver Speck[1], Jürgen Hennig[1], Thorsten Bley[1], Mathias Langer[1]
[1]University Hospital Freiburg, Freiburg, Germany

The purpose of this study was to evaluate a new protocol for axial Whole Body-MRI imaging performed with a continuously moving table platform in comparison to Whole Body-MRI using a multi-station coronal Turbo-STIR as a staging and screening method in cancer patients.The first results of our study demonstrated that Whole Body-MRI as a fast and accurate examination in cancer patients in nearly 10 minutes is feasible and comparable to Whole Body-MRI using a turbo-STIR-sequence combined with a rolling table platform. Whole Body-MRI imaging may compete with the established imaging technique like skeletal scintigraphy and FDG-PET in cancer patients.

1334. Adrenal Adenomas: Correlation between Histologic Lipid Content and Chemical Shift Ratio at MR Imaging with In/Opposed-Phase Sequences

Haoran Sun[1], Renju Bai[1], Enhui Wu[1]
[1]Tianjin Medical University, Tianjin, People's Republic of China

The accuracy and diagnostic value of chemical shift MR imaging for differentiating adrenal masses has been well documented. However, overlap has been found between benign and malignant adrenal masses. Although lipid in adenomas has been accepted as the biochemical basis for signal intensity (SI) decrease, the quantitative relationship has not been explored between them. The purpose of our study was to correlate the amount of lipid in resected adrenal masses with their presurgical SI ratios on opposed-phase (OP) images to in-phase (IP) images images, so as to establish the optimal threshold for determining SI decrease on OP images

1335. The Potential Role of Dual-Echo In and Out of Phase MRI in the Diagnosis of Adrenal Adenomas that are Hyperdense on CT

Sangeet -. Ghai[1], Kartik Sudhir Jhaveri[2], Masoom A. Haider[2]
[1]University Health Network and Mount Sinai Hospital, Toronto, Ontario, Canada; [2]University Health Network -Mount Sinai Hospital, University of Toronto, Toronto, Ontario, Canada

Recently washout CT has been reported to have high accuracy in the diagnosis of hyperdense adrenal nodules and the role of MRI has been questioned. However in these MRI was not performed with dual echo sequences .With dual echo in and out of phase MR, images being obtained in the same acquisition results in no slice misregistration or signal variation due to varying receiver gain. The purpose of this study was to determine if the sensitivity of MRI, in diagnosing hyperdense adrenal adenoma, is improved with the use of Dual-Echo In and Out-phase MRI.

Body MR Angiography Techniques

Hall D Monday 13:30 - 15:30

1336. MR-Based Assessment Of Atherosclerosis: Combined Total-Body Vessel Lumen and Vessel Wall Imaging - Initial Experience

Florian Matthias Vogt[1], Gerald Antoch[1], Mathias Goyen[1], Christoph Ulrich Herborn[1], Jörg Felix Debatin[1], Stefan G. Rühm[1]
[1]University Hospital, Essen, Germany

3D whole-body MR angiography allows non-invasive display of the entire arterial vasculature. The technique has been shown to accurately detect and quantify vessel stenoses in atherosclerotic disease. However, atherosclerotic disease may progress without compromising the lumen. Therefore a technique, which permits both depiction of vascular occlusive disease and detection of plaque and quantification of plaque burden appears desirable. Aim of this study was to assess a protocol combining 3D whole body MR angiography with axial T1-w GRE imaging to detect and quantify atherosclerotic plaque burden. MR findings showed excellent correlation with CT data for the detection of atherocslerotic plaques.

1337. Comparison of the Iron-Oxide-Based Blood-Pool Contrast Medium VSOP-C184 with Gd-DTPA in First-Pass MRA of the Aorta and Renal Arteries in Pigs.

Jörg Schnorr[1], Susanne Wagner[2], Claudia Abramjuk[1], Ines Wojner[1], Bernd Hamm[1], Herbert Pilgrimm[2], Matthias Taupitz[1]
[1]Charité, Berlin, Germany; [2]Ferropharm GmbH, Teltow, Brandenburg, Germany

VSOP-C184 is bolus-injectable and is an efficient bloodpool contrast medium for equilibrium MRA at a dose of 45 µmol Fe/kg. We investigated whether VSOP-C184 is also suitable for first-pass MRA. The abdominal vasculature of minipigs was examined at 1.5 T using a 3D-FLASH MRA sequence after intravenous administration of VSOP-C184 at doses of 15, 25, and 35 µmol Fe/kg as well as of Gd-DTPA (100 and 200 µmol Gd/kg) (n=3 examinations per dose). VSOP-C184 is suitable for first-pass MRA at doses of 25 and 35 µmol Fe/kg and the results are similar to those obtained with Gd-DTPA.

1338. Preliminary Evaluation of Code 7228 as an Iron Oxide Based Blood Pool Contrast Agent for CE-MRA

Pottumarthi Vara Prasad[1], Linda Pierchala[1], Qun Chen[1], Anthony Vu[1], Wei Li[1], Jerome Lewis[2], Robert R. Edelman[1]
[1]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [2]Advanced Magnetics Inc., Cambridge, Massachusetts, USA

Code 7228 is an ultrasmall particle iron oxide (USPIO) based MRI contrast agent that is currently in Phase II clinical trials. Its selective blood pool compartmentation, long blood half life (~14 hours in humans), high T1 relaxivity (38 mMol s-1 @ 20 MHz), high concentration (i.e. small volume for administration), and ability to bolus administer allow for MR angiography (MRA) with high spatial and contrast resolution. We present our pre-clinical data and preliminary results in human subjects using this agent to perform contrast enhanced MRA.

1339. Gadobenate Dimeglumine (Multihance®) in Contrast-Enhanced Magnetic Resonance Angiography

Roberto La Ferla[1], Massimo Daprà[1], Gianpaolo Pirovano[2], Miles Kirchin[1]
[1]Bracco Imaging SpA, Milan, Italy; [2]Bracco Diagnostics Inc., Princeton, New Jersey, USA

Gadobenate dimeglumine (Gd-BOPTA) has a high T1 relaxivity in human plasma (9.7 mM 1s 1) due to a capacity for weak and transient interaction with serum albumin. This high relaxivity may prove beneficial for contrast-enhanced MRA. To determine the optimum dose of Gd-BOPTA for MRA, three Phase II clinical trials in three different vascular territories (carotid, renal/abdominal, pelvic) were conducted in parallel. Each study evaluated four doses of Gd-BOPTA (0.025, 0.05, 0.1 and 0.2 mmol/kg) in terms of overall diagnostic quality compared with unenhanced MRA. Overall, a dose of 0.1 mmol/kg was indicated to be the dose of choice.

1340. Detecting Aortic Stent Graft Endoleak with Blood Pool Agent MRA

Craig K. Kent[1], Hale Ersoy Erel[1], Martin R. Prince[1]
[1]Cornell University, New York, New York, USA

Iron oxide blood pool MRA identifies more aortic stent graft endoleaks compared to CTA. Imaging at 24 hours following blood pool agent administration showed 50% more endoleaks compared to the arterial phase imaging. Endoleak rate can be calculated based on the endoleak volume at 15-min delayed imaging.

1341. Delayed Contrast Arrival in Stented Aneurysms in CE-MRA

Liangder Jou[1], David Saloner[1]
[1]University of California at San Francisco, San Francisco, California, USA

The potential for using CE-MRA to evaluate the use of stents in treating aneurysms is investigated. In CE-MRA, the delayed arrival of contrast agent in an aneurysm makes it difficult to differentiate an unthrombosed aneurysm from a thrombosed aneurysm. An aneurysm phantom after deployment of an open stent was imaged with CE-MRA. The aneurysm appearance was shown to correlate well with the flow pattern predicted by our flow simulations. The delayed arrival of injected contrast agent at the aneurysm results in signal reduction.

1342. Renal MRA: Multiparametric Evaluation of Clinical and Scanning Parameters to Imaging Results Using Automated Bolus Detection

Gilberto Szarf[1], Aylin Tekes[1], Shiquan Ren[1], Shenghan Lai[1], Donna Green[1], Tracy Borman[1], David Alan Bluemke[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Renal MRA is a well established technique for evaluation of renal artery stenosis. It is noninvasive, does not require iodinated contrast, and is reliable. Prior studies have evaluated optimization of contrast injection parameters, primarily optimization of the acquisition delay time (time from injection to the start of image acquisition), and different pulse sequences/parameters. In the setting of automated bolus detection, however, there remains considerable variation in renal MRA examination quality. The purpose of this study is to access the relationship between clinical and imaging parameters on overall CNR/SNR.

1343. On Improving Temporal and Spatial Resolution in 3D Contrast-enhanced Body MRA with Parallel Imaging

Qun Chen[1], Carla V. Quijano[1], Vu M. Mai[1], Saravanan Kokila Krishnamoorthy[2], Wei Li[1], Pippa Storey[1], Robert R. Edelman[1]
[1]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [2]Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA

This study investigated a parallel imaging technique (ASSET) to improve temporal and spatial resolution of 3D contrast enhanced body MR angiography. Thirty studies were acquired in five groups to compare ASSET with standard MRA. Our results show that the use of ASSET to increase imaging speed by factors of 2 and 4 produced images with SNR and CNR almost equivalent to those obtained with standard MRA. Such preservation of SNR and CNR was likely a result of increased contrast concentration in ASSET-accelerated scans. ASSET can also achieve higher spatial resolution, although with reduced SNR and CNR.

1344. Subsecond Three-dimensional Renal MR Angiography with Sensitivity Encoding (SENSE) and Half Fourier Technique in Patients with Renal Cell Cancer

Masaaki Hori[1], Tomoaki Ichikawa[1], Tatsuaki Tsukamoto[1], Tsutomu Araki[1], Toshiyuki Okubo[1], Eiji Okamoto[2], Makoto Obara[2]
[1]University of Yamanashi, Nakakoma, Yamanashi, Japan; [2]Philips Medical Systems, Minato-ku, Tokyo, Japan

Purpose of this study was to evaluate a 3D CE-MRA protocol using SENSE for the evaluation of renal artery, tumor enhancement and renal vein before surgery. Five patients with suspected renal cell cancer underwent this MRA. Arterial phase and venous phase were clearly separated in subsecond 3D MR angiographic images and early venous return was no problematic in this condition with high temporal resolution. Subsecond 3D contrast enhanced MR angiography with sense is useful test for evaluating renal cell cancer

1345. Renal MR Angiography with Recessed Elliptical Centric Ordering of K-space

Bernard Ho[1], Minh Chao[1], Richard Watts[1], Martin R. Prince[1]
[1]Cornell, New York, New York, USA

The ability to improve contrast bolus timing by recessing the absolute center of k-space a few seconds in from the beginning of an elliptical centric ordered acquisition was investigated in 50 patients undergoing renal MRA. With recessed elliptical centric ordering there is increased arterial SNR, decreased renal venous enhancement as well as less ringing (Maki) artifact compared to standard elliptical centric ordering. This improves renal artery Gd:MRA image quality.

1346. Contrast Enhanced MRA in Children

Greg Irwin[1], Andrew James Watt[1]
[1]The Royal Hospital for Sick Children, Glasgow, UK

Aim:To review the utility of contrast enhanced magnetic resonance angiography (CE-MRA) in children. CE-MRA is an established technique for the assessment of the vascular tree in adults but children do not suffer from the same vascular problems and angiography is technically more difficult. Materials & Methods: A retrospective review of all cases where CE-MRA was performed. Data capture included patient age, indication, body region examined, scan parameters and contrast administration. Each examination was assessed for technical success (diagnostic images being obtained) and an attempt was made to identify any additional information gained that would not otherwise have been available.

1347. MRA of Arteries Supplying the Spinal Cord

Robbert Nijenhuis[1], Walter Backes[1], Tim Leiner[1], Erwin Cornips[1], Jan Wilmink[1], Michael Jacobs[1], Jos van Engelshoven[1]
[1]Maastricht University Hospital, Maastricht, Limburg, Netherlands

Purpose: Visualisation of the major blood supplying vessel of the spinal cord: Adamkiewicz' artery (AKA) using contrast-enhanced (CE) MRA. *Methods*: In 9 patients with either an aortic aneurysm or a thoracic herniated nuclei pulposus (tHNP) first pass CE-MRA images were acquired. Images were analysed using MPR and MIP. *Results*: In all patients the AKA was found between the vertebrae T8-L1. *Conclusion*: With CE-MRA it is possible to detect the AKA, which may be of considerable benefit for pre-surgical planning to avoid neurological complications.

1348. Analysis of First-Pass Bolus Geometry in Contrast-enhanced MRA: Which Factors Influence Most?

Karl-Friedrich J. Kreitner[1], Christian Weschler[1], R Peter Kunz[1], Sebastian Ley[1], Wolfgang G. Schreiber[1], Manfred Thelen[1]
[1]Johannes Gutenberg-University, Mainz, Germany

For analysis of bolus geometry in thoracic vessels, a SR-Turbo-Flash sequence was acquired. 3 ml of Gd-DTPA diluted with NaCl-solution to a total of 20 ml were used. Contrast injection rates varied between 1, 2 and 4 ml/sec. Cardiac function was assessed by Cine- and phase-contrast measurements. Bolus curves were fitted, T1 and [Gd] were calculated. With increasing injection rate, there was a significant decrease of MTT in all territories. Minimal blood T1 did not differ significantly between target vessels and injection rates with values between 38 and 76 msec. Cardiac function marginally influenced bolus curve parameters.

1349. Polar Phase Encode Placement for 3D Acquisition with Time-Resolved Projections

David Henry Gurr[1], Ann Shimakawa[1], Graham Wright[2], Juan Santos[3], Johnathon Levin[3], Reed Busse[1], Bob Herfkens[3], Jean Brittain[1]
[1]GE Medical Systems, Menlo Park, California, USA; [2]University of Toronto, Toronto, Ontario, Canada; [3]Stanford University, Stanford, California, USA

A method of utilizing phase encoded projection gives efficient simultaneous 2D and 3D acquisition for time resolved contrast enhanced angiography below the knee is demonstrated. This technique acquires 2D complex subtraction images, every 1 sec, MIP images (at multiple angles) every 5s and a 3D data set with sliding window update recons every 5 sec. Phase encoded projections combine the robustness of spin warp imaging with benefits of undersampled projection reconstruction.

1350. Targeted ROTational Magnetic Resonance Angiography (TROTA)

James William Goldfarb[1]
[1]St. Francis Hospital, Roslyn, New York, USA

Development of MR Angiography has provided a robust technique for the detection of stenoses throughout the body, but the modality still remains limited in the measurement of stenosis severity and morphology. TROTA is an extension of the 2D complex-subtraction MR-DSA method. The method yields 2D time-resolved targeted projection angiograms around the vessel of interest using a rotating slice-selective snapshot FLASH pulse sequence. These projection angiograms can be reformatted with similar techniques used in rotational x-ray DSA yielding three-dimensional pixel data. The data can be displayed using MIP, 3D rendering and multi-planar slice reformatting to accurately depict vessel morphology.

1351. Reducing Acquisition Time in High Resolution 3D MR Angiography by Optimizing a Small Subset of k-Space Samples

Yun Gao[1], Stanley J. Reeves[2], Jie Zheng[1], Robert J. Gropler[1]
[1]Washington University in St. Louis School of Medicine, St. Louis, Missouri, USA; [2]Auburn University, Auburn, Alabama, USA

Time of flow (TOF) images may lose signal in carotid bulbs where plaques most likely occur. In comparison, contrast enhanced 3D MR angiography (MRA) is capable of faithfuly imaging vessels. However, good quality 3D images require a long data acquisition. Central k-space sampling causes blur and poor resolution. In this study, we use sequential forward array selection (SFAS) to optimize a subset of phase encoding and partition encoding steps based on localized activities of MRA. Acquisition time is reduced without losing resolution and with noise amplification control.

1352. The Evaluation of an Automated Power Injection System for High Flow- Rate Perfusion and Sub-Second MR Angiography Sequences

Frederick Scott Pereles[1], Benjamin Hammelman[1], Sharon Grouper[1], Jeremy Collins[1], Syam Vasireddy[2], Visveshwar Baskaran[1], Gina Song[1], Anish Babu Zachariah[1], James Carr[1], Elizabeth Krupinski[3], Reed Omary[1]
[1]Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA; [2]University of Illinois College of Medicine, Chicago, Illinois, USA; [3]University of Arizona, Tucson, Arizona, USA

We examined the efficacy of an MR compatible automated power injector for intravascular gadolinium-based contrast injections. While injection rates of up to 2ml/s are FDA-approved, the advent of subsecond angiography techniques and perfusion imaging has required faster "off-label" injection rates. We timed injection bolus durations in over 500 trials and found them to be extremely accurate at rates of 4ml/s and below, marginally different from prescribed rates at 4-6ml/s and markedly less than prescribed at rates greater than 8ml/s We also observed injector behavior to elucidate the causes of bolus duration deviation.

1353. SNR Comparison of 3D and Matched-Filtered 2D Projection Contrast-Enhanced MRA

Yuexi Huang[1], Naeem Merchant[2], Graham A. Wright[1]
[1]University of Toronto, Toronto, Ontario, Canada; [2]Toronto General Hospital, University Health Network, Toronto, Ontario, Canada

Signal-to-noise ratios (SNR) of elliptical centric-ordered 3D MRA and matched-filtered 2D projection MRA are compared by computer simulation and clinical studies. For vessels 1 pixel wide, 3D MRA has a better SNR than 2D projection MRA, due primarily to the signal reduction by the 'zero integral' of the matched filter to null constant background signals. For vessels 2 pixel wide and larger, 2D projection MRA has better SNR because of the integral projection and optimal signal weighting. The comparable SNR and timing-insensitive nature of 2D projection MRA makes it a potentially useful tool for applications such as carotid MRA.

1354. SNR Detectability Threshold for Stenoses

Sarah Jervis[1], Daniel Wilson[1], David Brettle[1]
[1]Leeds Teaching Hospitals, Leeds, West Yorkshire, UK

Low signal to noise ratio (SNR) in contrast-enhanced MRA images can adversely affect an observer's ability to detect and characterise stenoses. This study used computer generated stenotic models to measure the SNR detectability threshold for discriminating between (a) 50% and 30% stenoses and (b) 70% and 30% stenoses. These detectability thresholds were measured using an interleaved two alternative forced choice (2AFC) staircase test. The SNR detectability threshold was lower for the discrimination of 70% and 30% stenoses compared with that of the 50% and 30% stenoses.

1355. Evaluation of a New Multislab 3D b-TFE Technique for Angiographic Imaging of The Abdominal Arteries without the Use of a Contrast Agent.

Kenneth Coenegrachts[1], Hilde Bosmans[1], Romhild Hoogeveen[2], Johan Vaninbroukx[1], Didier Bielen[1], Geert Maleux[1], Frederik Maes[1], Pascal Hamaekers[1], Raymond Oyen[1], Guy Marchal[1]
[1]Catholic Universities of Leuven, Leuven, Belgium; [2]Philips Medical Systems, Best, Netherlands

The b-TFE technique without contrast agents has been proposed recently for MRA of renal arteries. The goal of the study is to compare balanced-TurboFieldEcho (b-TFE) to contrast enhanced (CE) MRA (in 42/42 patients) and DSA (in 28/42 patients). Image quality of b-TFE was excellent in 40/42 patients. The quality of the MIP should be further improved. Compared to CE MRA and DSA, neither false positive lesions nor false negative arteries were observed. Present technique seems a valuable technique in an all-in-one approach for patients in which contrast agents should be used for other purposes (e.g. perfusion of renal parenchyma).

1356. Clinical Usefulness of Non-Contrast-Enhanced MRDSA to Evaluate Hemodynamics of Arterial Diseases -Initial Experience-

Katsumi Nakamura[1], Akiyoshi Yamamoto[1], Mitsue Miyazaki[2], Satoshi Kawanami[3], Yuko Shioya[1], Yuka Matsufuji[4]
[1]Tobata Kyoritsu Hospital, Kitakyushu, Fukuoka, Japan; [2]Toshiba Medical R&D Center, Otawara, Tochigi, Japan; [3]University of Occupational and Environmental Health, Kitakyushu, Fukuoka, Japan; [4]Toshiba Medical Systems Company, Fukuoka, Japan

Non-contrast-enhanced MR digital subtraction angiography (DSA), which provides hemodynamic information, is evaluated in patients with arterial diseases. Multiple cardiac phase images with a 10-msec interval were obtained using ECG-gated 2D half-Fourier FSE. Dynamic subtraction images between diastolic-triggered images and systolic images, provided flow information like IVDSA. In a patient with arteriosclerosis, the arteries distal to the stenosis appeared slightly later and disappeared earlier in non-contrast-enhanced MRDSA compared to the opposite normal leg. In a case with soft tissue arterio-venous fistula, flow transmission from artery to draining veins was clearly demonstrated.

1357. The Production of Vascular Casts for Light Microscopic and MR Imaging Investigations

Ian J. Rowland[1], Lise Vejby Søgaard[1], Helle J. Simonsen[1]
[1]Copenhagen University Hospital, Hvidovre, Denmark

The aim of this study was to develop a method of producing vascular casts for investigating tissue vasculature using light microscopic and both direct and indirect MR imaging methods. Using standard corrosion casting methods, materials were assessed for their suitability for casting and MRI. Silicone based materials were found to exhibit properties suitable for both casting and obtaining 2D and 3D images from the casts. The incorporation of paramagnetic gadolinium containing complexes enables the production of phantoms with known vascular dimensions suitable for assessing and validating indirect MR methods of obtaining vascular information.

1358. A Two-stage Method for the Correction of Phased-Array Surface Coil Inhomogeneity in MR Angiography Images

Rem van Tyen[1], David Saloner[1]
[1]UCSF and VA Medical Center, San Francisco, California, USA

We developed a two-stage method for phased-array surface coil inhomogeneity correction of MR angiography images, consisting of an automatic first-pass correction based on an analytic correction of exponential sensitivity fall-off, followed by an automatic numerical correction algorithm, previously published in the literature. This method allows for reliable, comprehensive correction of major spatial intensity variations, without requiring additional patient scan time.

1359. Real-time Contrast Bolus Monitoring with Thick Slab Projection Dephaser Technique for Body MRA

A. T. Vu[1], W. Li[1], M. A. Bernstein[2], P. V. Prasad[1], R. R. Edelman[1]
[1]Evanston Northwestern Healthcare, Feinberg School of Medicine, Northwestern Univeristy, Evanston, Illinois, USA; [2]Mayo Clinic and Foundation, Rochester, Minnesota, USA

A simple technique is described for real-time monitoring of contrast bolus arrival using thick slab projection dephaser imaging pulse sequence. The technique is implemented and validated for contrast-enhanced body MRA. The method is simple, robust and efficient. It can be used alone for timing the bolus or in combination with fluoro-triggered MRA technique.

1360. Contrast Enhanced Flow Quantification in Small Vessels using Breath hold and Conventional Gradient Echo Imaging Techniques

Michael Panoutsopoulos[1], John Ridgway[2], Scott Alexander Reid[1], Mohan Sivananthan[2], Peter Geofrey Walker[1]
[1]University of Leeds, Leeds, West Yorkshire, UK; [2]Leeds General Infirmary, Leeds, West Yorkshire, UK

We have assessed in-vitro the influence of contrast agents in small vessel flow imaging using high-resolution Breath hold and conventional gradient echo techniques. Fast and accurate flow quantification was achieved when high-resolution breath hold imaging was used. The imaging signal to noise ratio was improved for low FOVs however dependence between contrast agents and flow measurements was found only in low resolution Breath hold imaging. Contrast agents are mostly related to the accuracy of the ROI placement rather than the measuring improvement due to signal enhancement. High-resolution Breath hold flow imaging may be applied in clinical studies.

Pulmonary MRA, Perfusion, Ventilation, and Masses

Hall D Tuesday 13:30 - 15:30

1361. 2D First Pass MRA of Pulmonary Circulation in Congenital Heart Diseases: Preliminary Results

Yuesong Yang[1], Yiyang Liu[2], Yonghao Gui[2], Jingtao Miao[3], Graham A. Wright[1]
[1]Sunnybrook &Women's College Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada; [2]Children's Hospital, Fudan University, Shanghai, People's Republic of China; [3]Shanghai First People's Hospital, Shanghai, People's Republic of China

Pulmonary circulation evaluation is very important for clinical treatment of patients with CHD. In this study CHD patients were classified as having decreased or increased pulmonary vascularity. The blood perfusion was evaluated by 2D first pass MRA and the vascular morphology was evaluated by gated-TOF, 3D CE and 2D first pass MRA. In depicting the vascular morphology, 2D first pass and 3D CE MRA was similar. The blood perfusion parameters were also calculated. The results showed that 2D first pass MRA was feasible for quickly evaluating the state of pulmonary circulation including pulmonary blood perfusion.

1362. Early Diastolic Dip; Observation of Signal Change of the Lung Caused by Pulmonary Venous Flow during a Rapid Inflow Period

Katsumi Nakamura[1], Akiyoshi Yamamoto[1], Satoshi Kawanami[2], Mitsue Miyazaki[3], Yuka Matsufuji[4]
[1]Tobata Kyoritsu Hospital, Kitakyushu, Fukuoka, Japan; [2]University of Occupational and Environmental Health, Kitakyushu, Fukuoka, Japan; [3]Toshiba Medical R&D Center, Otawara, Tochigi, Japan; [4]Toshiba Medical Systems Company, Fukuoka, Japan

MR signals of the lung periodically change during cardiac cycle, so that low signal at systolic and high signal at diastolic phase. Furthermore temporal signal decrease was observed during diastole. In this study, we compared the signal changes of the lung with the velocity changes of pulmonary vessels, which revealed the temporal signal decrease during diastole was related to pulmonary venous flow at rapid inflow period, so we called this was "early diastolic dip." Systolic-diastolic phase subtraction images can demonstrate such a pulmonary venous flow as well as systolic arterial flow.

1363. Pulmonary MRA Venography Facilitates Electrophysiologic Pulmonary Venous Ablation

F Scott Pereles[1], Jeremy Douglas Collins[1], David Bello[1], Timothy Betts[1], Eugene Huo[1], J Paul Finn[1]
[1]Northwestern University, Chicago, Illinois, USA

Atrial Fibrillation, the most common arrhythmia, affects more than 1.5 million Americans. Electrophysiology studies indicate that in patients with paroxysmal atrial fibrillation (PAF), >95% of arrhythmogenic foci are located within the pulmonary veins. Therefore, electrical disconnection of pulmonary venous (PV) atrial tissue by radiofrequency catheter ablation at the PV ostia is performed clinically. Cure rates with this technique have been reported as high as 80%. Pre-ablative PV MRA demonstrates normal and abnormal PV and left atrial anatomy permitting appropriate pre-procedural planning when common PV ostia are present. Intra-operative viewing of MRA images facilitates ostial identification and significantly reduces fluoroscopy times.

1364. How Good is MR Angiography in Acute Pulmonary Embolism?

Bartlomiej Pleszewski[1], Carl Chartrand-Lefebvre[1], Pierre Perreault[1], Vincent Oliva[1], Renée Déry[1], Julie Prénovault[1], Gilles Soulez[1]
[1]University of Montreal, Montreal, Quebec, Canada

While CT and conventional angiography are accurate in the diagnosis of acute pulmonary embolism (PE), they have some counterindications and side effects. Gadolinium-enhanced MR angiography (MRA), using 1.5 Tesla coronal gradient echo images, was prospectively compared to conventional angiography, CT angiography, VP scintigraphy and to the clinical negative predictive value in 48 patients with suspected PE. The sensitivity of MRA was 82%, while specificity was 100%. Given the paucity of counterindications and side, we believe MRA may be used as a rule-in diagnostic test in patients with allergy to iodine, renal failure, and possibly during pregnancy.

1365. 3D-Gd-Enhanced MR Angiography (MRA) for Establishing Venous Thrombo-Embolic Disease: One Stop Shop Imaging of Pulmonary Arteries, Vena Cava, Pelvic and Both Lower Extremity Veins in 30 Minutes

Manuela Aschauer[1], Andrea Obernosterer[1], Horst Portugaller[1], Hannes Deutschmann[1], Rudolf Stollberger[1], Franz Ebner[1]
[1]University Hospital Graz, Graz, Styria, Austria

Background: Treatment of patients with acute pulmonary embolism depends also on the extent of venous thrombosis and therefore the risk of recurrent life-threatening embolism (1,2). In emergency diagnosis is done routinely by spiral-CT and bipedal i.v. conventional venography (CV) both together lasting more than 1 hour including the transportation of the patient to different operating rooms. Purpose: To access the feasibility and image quality for diagnosis of PAE and venous thrombosis in a one stop shop after PAE has been diagnosed with CT and/or V/Q scan, within max. 48 hours prior.

1366. Contrast-Enhanced 3D MR Perfusion Imaging of the Lungs using Parallel Imaging Techniques

Christian Fink[1], Michael Bock[1], Michael Puderbach[1], Astrid Schmähl[2], Klaus-Peter Lodemann[3], Stefan Delorme[1]
[1]DKFZ, Heidelberg, Germany; [2]Thoraxklinik Heidelberg, Heidelberg, Germany; [3]Altana Pharma AG, Byk Gulden, Konstanz, Germany

The aim of this study was to evaluate the potential of parallel acquisition techniques for contrast-enhanced 3D MRI of lung perfusion. A good intermodality agreement with conventional radionuclide perfusion scintigraphy was observed. Parallel imaging techniques allow a substantial reduction of scan time which is a prerequisite for the imaging of lung perfusion.

1367. Novel Application of Model-Free Analysis in the MR Assessment of Pulmonary Perfusion Dynamics

Kai-Hsiang Chuang[1], Ming-Ting Wu[1], Hsiao-Wen Chung[2], Ming-Long Wu[2], Shang-Yueh Tsai[2]
[1]Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan; [2]National Taiwan University, Taipei, Taiwan

Accurate estimation of pulmonary perfusion is important in assessing the function of the lung. Conventional quantitative analysis of contrast enhanced pulmonary perfusion MRI relies on the assumption of gamma-variate function and an arterial input function for deconvolution. However, these assumptions were too simple and may not be valid for patients. We compared two data-driven methods to extract the dynamics in the vessels and parenchyma without these assumptions. Results showed that temporal clustering was superior in discriminating different parts of the vessels. These methods could provide more insight to the perfusion dynamics that would be overlooked by conventional model-based analysis.

1368. MR Dynamic Contrast Pulmonary Images Analyzed by Independent Component Analysis: More Accurate Assessment of Pulmonary Perfusion

Ming-Long Wu[1], Shang-Yueh Tsai[1], Yi-Ru Lin[1], Teng-Yi Huang[1], Ming-Ting Wu[2], Hsiao-Wen Chung[1], Cheng-Yu Chen[3], Huay-Ben Pan[2]
[1]National Taiwan University, Taipei, Taiwan; [2]Kao-Hsiung Veterans General Hospital, Kao-Hsiung, Taiwan; [3]Tri-Service General Hospital, Taipei, Taiwan

Dynamic contrast enhanced MRI has been demonstrated to assess the pulmonary perfusion. To result in a more accurate depiction of pulmonary perfusion, a time-series of MR pulmonary perfusion images were analyzed with independent component analysis (ICA). Mask of arteries and veins was constructed from independent spatial components resulted from ICA. Relative mean transit time (rMTT), relative pulmonary blood volume (rPBV) and relative pulmonary blood flow (rPBF) were then calculated in lung parenchyma, with confounding large vessels excluded.

1369. Assessing Regional Pulmonary Perfusion using Dynamic Contrast-Enhanced MR Imaging with Pulmonary Artery and Vein

Shen-Yueh Tsai[1], Ming-Ting Wu[2], Chun-Ching Huang[1], Yi-Ru Lin[1], Fu-Nien Wang[1], Teng-Yi Huang[1], Hsiao-Wen Chung[1]
[1]National Taiwan University, Taipei, Taiwan; [2]Kao-Hsiung Veterans General Hospital, Kao-Hsiung, Taiwan

Dynamic contrast-enhanced MR imaging with sub-millisecond TE has been shown effective to assess relative pulmonary perfusion. This study investigates the accuracy of two computational methods that eliminate the effects of arterial inputs, such that the regional difference in lung perfusion within an isogravitational plane can be more objectively compared. Simulation results indicate that deconvolution based on singular value decomposition is prone to estimation errors, whereas subtraction of mean transit time yields reliable measurements. Experimental data from healthy subjects show consistently shorter mean transit time with similar pulmonary blood flow in the superior lung parenchyma compared with the inferior region.

1370. High-Resolution MRA and Fast Perfusion Imaging using Integrated Parallel Acquisition Techniques (iPAT) in the Diagnosis of Pulmonary Arterial Hypertension

Konstantin Nikolaou[1], Stefan Schoenberg[1], Ulrike Attenberger[1], Mathias Nittka[2], Juergen Behr[1], Maximilian Reiser[1]
[1]University of Munich, Munich, Germany; [2]Siemens Medical, Erlangen, Germany

In 26 patients with pulmonary arterial hypertension (PAH), the use of MR angiography (MRA) and MR perfusion imaging with integrated parallel imaging techniques (iPAT) was assessed for the differentiation of patients with primary and secondary PAH. Using iPAT, dynamic perfusion imaging with a temporal resolution of 1,2 s per phase and high-resolution angiography with a submillimeter voxel size was feasible. MRA and MR perfusion imaging highly agreed with results of pulmonary angiography (agreement 91%) and scintigraphy (agreement 88%). Combined morphological and functional MR imaging using iPAT enables the differentiation of patients with primary and secondary PAH with high diagnostic accuracy.

1371. Functional Lung Imaging by MRI - Is There a Simple Solution for a Complex Problem?

Thomas Rupprecht[1], Rainer Kuth[2], Michael Deimling[2], Maren Wagner[1]
[1]University Hospital for Sick Children, Erlangen, Germany; [2]Siemens Medical Solutions, Erlangen, Germany

Recently, a simple and fast trueFISP thick slice imaging technique was developed to examine the lung parenchyma. With a modification of this sequence to a cine mode defined volumes within the lung may be investigated during the respiratory cycle giving us a simple technique for quantitative calculation of regional pulmonary ventilation. Presented are preliminary results in 2 patients. The measured values were in concordance to the clinical expectations and the values given by 3He MRI. Important advantages are the missing need for external contrast agents, which will influence the ventilation, low costs, simplicity. Ventilation maps could easily be reconstructed.

1372. Anatomical and Functional Lung ^{1}H MR Imaging in Patients with Cystic Fibrosis

Tungte Wang[1], Georg Schultz[1], Helge Hebestreit[1], Alexandra Hebestreit[1], Dietbert Hahn[1], Peter M. Jakob[1]
[1]University of Würzburg, Würzburg, Bavaria, Germany

A clinical protocol combining anatomical 1H MRI with the assessment of both oxygen transfer function and pulmonary perfusion was established for the human lung and applied to three patients with cystic fibrosis (CF). In the selected group of CF-patients, areas with reduced oxygen enhancement showed reduced perfusion as confirmed by spin labeling perfusion imaging. These functional imaging results also correlated with anatomical MT-STIR-HASTE imaging results. The results demonstrate that this completely noninvasive lung function test shows promising potential for clinical use in the serial diagnosis of lung diseases such as CF.

1373. FID Projection Pulse Sequences for Imaging Lung Tissue and Inflammation

Dean O. Kuethe[1], Natalie L. Adolphi[1], Rebecca Montaño[1]
[1]New Mexico Resonance, Albuquerque, New Mexico, USA

With the goal of imaging inflammation in lungs, we are developing T1-weighted FID-projection sequences, which eliminate the problem of susceptibility-induced magnetic inhomogeneity when imaging lung tissue. Rat lungs are easier to image than we suspected. We can include relaxation weighting for detecting disease.

1374. STIR Turbo Spin-echo Imaging: Utility for Improvement of Diagnostic Capability of Contrast-Enhanced T_1WI in Patients with Solitary Pulmonary Nodule

Takanori Higashino[1], Yoshiharu Ohno[1], Hirokazu Watanabe[1], Daisuke Takenaka[2], Masahiko Fujii[1], Kazuro Sugimura[1]
[1]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [2]Kobe Ekisaikai Hospital, Kobe, Hyogo, Japan

The purpose of present study was to demonstrate the utility of STIR turbo SE imaging for improvement of diagnostic capability of contrast-enhanced T1WI in patients with solitary pulmonary nodule (SPN). 103 pathologcally diagnosed SPNs were were included in this study. Diagnostic capability of contrast-enhanced T1WI, STIR turbo SE image, and contrast-enhanced T1WI with STIR turbo SE image were statistically compared. When combined with STIR turbo SE image, specificity of contrast-enhanced T1WI was significantly improved. In conclusion, STIR turbo SE imaging is useful for improvement of diagnostic capability of contrast-enhanced T1WI in patients with SPN.

1375. CXR vs MRI in the Detection of Pulmonary Nodules

Florian Matthias Vogt[1], Christoph Ulrich Herborn[1], Tobias Schröder[1], Peter Hunold[1], Jörg Felix Debatin[1], Jörg Barkhausen[1]
[1]University Hospital, Essen, Germany

The aim of this study was to evaluate an un-enhanced MR-HASTE sequence regarding the detection of pulmonary masses. 65 patients with underlying diseases were included. All patients underwent chest radiography (CXR) Multidetector-CT rand MRI of the lung based on axial HASTE imaging. MD-CT served as standard of reference. MR performed well compared to MD-CTwith satisfactory sensitivity and high specificity and was far superior to CXR which tended to underestimate disease.

1376. Short Inversion Time Inversion Recovery (STIR) Turbo Spin-echo Imaging: Quantitative Assessment of Mediastinal and Hilar Lymph Node Metastasis in Non-Small Cell Lung Cancer Patient

Yoshiharu Ohno[1], Hiroto Hatabu[2], Takanori Higashino[1], Hideaki Kawamitsu[3], Daisuke Takenaka[4], Kazuro Sugimura[1]
[1]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [2]Beth Israel Deconess Medical Center, Boston, Massachusetts, USA; [3]Kobe University Hospital, Kobe, Hyogo, Japan; [4]Kobe Ekisaikai Hospital, Kobe, Hyogo, Japan

The purpose of the present study is to determine the capability of STIR turbo SE imaging for diagnosis of lymph node metastasis. 802 pathologically diagnosed lymph nodes in 110 lung cancer patients were analysed. Signal-intensity of lymph node was normalized by signal-intensity of saline phantom (LSR). When 0.6 was adapted as the threshold of LSR, sensitivity and specificity were 93% and 87% on per patient basis. Sensitivity of STIR turbo SE imaging was significantly higher than that of CT. In conclusion, STIR turbo SE images is useful for diagnosis of lymph node metastasis.

1377. STIR Turbo Spin-echo Imaging: Utility for Diagnosis of Chest Wall Invasion in Lung Cancer Patients

Daisuke Takenaka[1], Yoshiharu Ohno[2], Takanori Higashino[2], Hideaki Kawamitsu[3], Hirokazu Watanabe[2], Kazuro Sugimura[2]
[1]Kobe Ekisaikai Hospital, Kobe, Hyogo, Japan; [2]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [3]Kobe University Hospital, Kobe, Hyogo, Japan

The purpose of the present study was to demonstrate the utility of STIR imaging for diagnosis of chest wall invasion in lung cancer patients. Contrast ratios (CRs) between chest wall and muscle were compared according to the pathological diagnoses. Then, the diagnostic capability was comparison with CT, when the feasible threshold value of CR was determined. CR had significant difference between presence and absence of chest wall invasions. Accuracy of STIR imaging was significantly higher than that of CT. In conclusion, STIR imaging is useful for diagnosis of chest wall invasion.

Hyperpolarized Gas Imaging: New Methods

Hall D Saturday 14:00 - 16:00

1378. Multi-exponential Analysis of CPMG T_2 Decay Curves for ^{129}Xe Dissolved in Perfluoro-octyl Bromide Emulsions: Implications for Hyperpolarized Xenon Contrast Agent Development

Julia Wallace[1], Mihai Gherase[1], Lisa Bernas[2], Marzieh Nezamzadeh[1], Ian Cameron[3], Albert Cross[1], Giles Santyr[1]
[1]Carleton University, Ottawa, Ontario, Canada; [2]McMaster University, Hamilton, Ontario, Canada; [3]Ottawa Hospital, Ottawa, Ontario, Canada

Quantification of blood flow using hyperpolarized xenon (HXe) dissolved in perfluoro-octyl bromide (PFOB) emulsions will depend on the T_2 relaxation of HXe. We have obtained T_2 relaxation times of HXe dissolved in two PFOB emulsions containing two different droplet sizes (1.4 µm and 4.7 µm diameters) and compared them to values of T_2 derived from a model of chemical exchange. The CPMG decay of HXe in the smaller droplet emulsion is primarily due (>95%) to T_2 relaxation times less than 10ms whereas 30% of the decay from the larger droplet emulsion arises from longer T_2 components.

1379. Field Dependence of Chemical Exchange of Hyperpolarized ^{129}Xe Dissolved in Perfluorcarbon Emulsions: Toward Low Field MR Imaging of Tissue-Dissolved Hyperpolarized Xenon

Juan Parra-Robles[1], Albert R. Cross[1], Giles E. Santyr[1]
[1]Carleton University, Ottawa, Ontario, Canada

Perfluorooctyl bromide (PFOB) emulsions have proven to be a promising injectable carrier for Hyperpolarized 129Xenon (H-Xe). In this work the chemical exchange contribution to line broadening for H-Xe dissolved in a PFOB emulsion was measured at 1.9 T and 8.5 mT and compared to a theoretical model. High field spectra presented significant broadening (462 Hz for 5% PFOB) of the dissolved H-Xe peak, showing that fast exchange between the PFOB and aqueous compartments is a major contributor to line broadening. At low field no broadening was observable, which suggest the possibility of low field multiecho imaging of dissolved H-Xe.

1380. Co-registration of Proton and Hyperpolarized ^{3}He Gas MRI of Paranasal Sinuses in a Porcine Model

Punam K. Saha[1], Binquan Wang[1], Aman Jalali[1], Masaru Ishii[2], Johan M. Edvinsson[1], Iman Khodaei[1], David A. Roberts[1], Rahim R. Rizi[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

The purpose of this study is to examine the efficacy of a proposed object based registration method, which utilizes correlation of fuzzy distance transform map, in allowing for simple localization of the sinuses in anatomical space. The proposed registration method implemented was tested using proton density and 3He MR (magnetic resonance) images.

1381. Proton and Hyperpolarized Helium MR Analysis of Radiation-induced Pneumonitis in Rats

Laurence William Hedlund[1], Erika Ward[1], William Kurylo[1], Gary Cofer[1], Charles Wheeler[1], Zeljko Vujaskovic[1]
[1]Duke University Medical Center, Durham, North Carolina, USA

In previous work, we showed that estimates of the apparent diffusion coefficient (ADC) of hyperpolarized (HP) helium in the lung reflected changes in the micro-architecture of the gas exchange regions (Chen et al. 2000). In a model of emphysema, rats treated with elastase exhibited a smaller difference in 3He ADC between full inspiration and end-expiration than untreated rats, suggesting that alveolar volumes were persistently enlarged. In the present study, we extend the use of hyperpolarized 3He to assess radiation-induced lung injury. Our purpose was to determine if in vivo proton and HP helium MR imaging was sufficiently sensitive to detect

1382. Simultaneous Imaging of Hyper-Polarised ^{3}He and ^{129}Xe.

Peter Blümler[1], Stefan Appelt[2], Robert Graf[1], Wolfgang Häsing[2], Song-I Han[1], Manfred Hehn[1], Werner Heil[3], Ernst W. Otten[3], Hanspeter Raich[1], Jörg Schmiedeskamp[3], Hans W. Spiess[1]
[1]MPI for Polymer Research, Mainz, Germany; [2]Forschungszentrum, Jülich, Germany; [3]Institut für Physik, Mainz, Germany

3Helium and 129Xenon both possess nuclear spins, can be hyperpolarised and are used for clinical imaging of air spaces. The advantages of 3He are high-sensitivity and no physiological effects, while 129Xe provides extra chemical shift information and is lipophilic. The first images of a mixture of both gases in a hyperpolarised state are reported. The very different gyromagnetic ratios easily allow double-resonance experiments and hence simultaneous excitation and detection. The setup, associated problems and exemplary results on phantoms as well as on animal tissues are discussed together with possible clinical applications.

1383. Measurement of Partial Pressure of Oxygen in Paranasal Sinuses Based on Hyperpolarized Gas MRI

Johan M. Edvinsson[1], Masaru Ishii[2], Aman Jalali[1], Iman Khodaei[1], Jiangshang Yu[1], Rahim R. Rizi[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

Paranasal sinus oxygen concentration is a measure of paranasal sinuses health (1). We hypothesize that hyperpolarized 3He MRI can be used to determine paranasal sinus oxygen concentrations. We tested this hypothesis in a porcine animal model. Our results show that He3 MRI can be used to measure local paranasal sinus oxygen concentrations. This suggests that 3He MRI may play a significant role in monitoring sinus diseases such as acute and chronic sinusitis.

1384. T_2CPMG in Human Lungs with Hyperpolarized Helium-3 at 0.1T and 1.5T: Sensitivity to Lung Filling Conditions

Alexandre Vignaud[1], Elana Brief[1], Xavier Maitre[1], Ludovic De Rochefort[1], Emmanuel Durand[1], Luc Darrasse[1], Genevieve Guillot[1], Jamal Choukeife[2], Pierre-Jean Nacher[2], Genevieve Tastevin[2]
[1]U2R2M (CNRS UMR 8081), Orsay, France; [2]ENS-CNRS-U.Paris 6, Paris, France

Gas confinement within human airways plays an important role in hyperpolarized helium-3 MRI. Very long transverse decays were already observed using CPMG acquisition at 0.1T and 3mT. We present the first in vivo T2cpmg measurements at 1.5T. The influence of lung filling was also assessed at two magnetic field intensities. At 0.1T, T2cpmg sensitivity appeared limited. At 1.5T, T2cpmg was shorter by 2 orders of magnitude than at 0.1T and 3mT, but much more sensitive to lung filling, with longer T2s for larger inspiratory volumes, qualitatively in agreement with recent measurements of HP 3He T2* on guinea pigs.

1385. Minimizing Diffusion Losses in Low Field Hyperpolarized Gas MRI Using Centrally Ordered RARE

Tina Pavlin[1], Greig Scott[2], Blaine Chronik[2], Emlyn Hughes[1], Steven Conolly[2]
[1]California Institute of Technology, Pasadena, California, USA; [2]Stanford University, Stanford, California, USA

Single shot RARE sequences offer greater SNR efficiency than small tip angle sequences but are limited by diffusion losses for hyperpolarized gas MRI. Here we show with simulation and phase encoded projection images that central ordering of RARE k-space acquisition significantly reduces diffusion losses of hyperpolarized gas magnetization.

1386. The Effect of SNR on Helium-3 ADC Values in the Lung

Michael Salerno[1], James R. Brookeman[1], Eduard E. de Lange[1], John P. Mugler III[1]
[1]University of Virginia, Charlottesville, Virginia, USA

The effect of SNR on ADC images calculated with b-values of 0 and 1.6 s/cm2 was studied. A SNR greater than 15 is needed to avoid biases in the calculated ADC values, and a SNR greater than 20 is needed to determine the ADC values with a standard deviation of 0.1cm2/s. We determined that to achieve an uncertainty in ADC value of 10% over the range of diffusion values of 0.2-0.6 cm2/s, one would need to use b-values that are separated by 3 s/cm2, with a SNR in the low b-value image of 35.

1387. Signal to Noise (SNR) for *In Vivo* MRI of Hyperpolarized (HPG) ^{3}He Gas at 1.5T and 0.1T

Elana Brief[1], Alexandre Vignaud[2], Luc Darrasse[2], Genevieve Guillot[2], Xavier Maitre[2], Emmanuel Durand[1], Jamal Choukeife[3], Pierre-Jean Nacher[3], Genevieve Tastevin[3]
[1]CIERM, CHU Bicetre, Le Kremlin Bicetre, France; [2]University Paris-Sud XI, Orsay, France; [3]LKB Ecole Normal Superieur, Paris, France

Unlike standard proton imaging, for HPG-3He MRI the nuclei are polarized outside the magnet, and their magnetization is independent of field strength. SNR for proton imaging increases with field, but this is not necessarily true for HPG-3He. SNR of HPG-3He MRI was analyzed at 1.5T and 0.1T and theoretically calculated based on the reciprocity principle. Our results demonstrate that the reciprocity principle can predict absolute SNR in vivo under the assumption that TE<<T2*. The reciprocity principle presented in this manner allows for the separation of instrumental factors in order to compare different MRI systems at different fields.

1388. Finite Difference Simulations of Helium-3 Diffusion in the Lungs

Stan Fichele[1], Jim M. Wild[1], Martyn N. Paley[1], Neil Woodhouse[1], Andrew Swift[1], Paul D. Griffiths[1], Edwin JR van Beek[1]
[1]University of Sheffield, Sheffield, UK

A vast amount of work has been conducted on the theory of restricted diffusion using NMR. However, in heterogeneous structures that possess complex geometries, there are no definitive analytical solutions. We are thus exploring the use of numerical simulations using finite difference techniques to understand the restricted diffusion of 3He in the lungs. The results highlight that care must be taken in measuring the ADC value in lung tissue, since it changes as a function of b value. This could have implications for the diagnostic use and the repeatability of ADC measurements.

1389. ^{3}He MR Imaging of Excised, Dried Lungs

Jason C. Leawoods[1], Dmitriy A. Yablonskiy[1], Kimiaki Chino[1], John A. Pierce[1], Joel D. Cooper[1], Mark S. Conradi[1]
[1]Washington University, St. Louis, Missouri, USA

Excised lungs dried at full inflation will allow for comparisons of ^{3}He MR diffusion measurements with histological examination. A pressure-balanced approach for ventilating dried lungs is presented, with short- and long-range diffusion measurements in a dried emphysematous human lung. The absence of saline results in little Q reduction in the rf coil and high S/N despite the small flip angles. The ^{3}He T_1 was 800 s, allowing many experiments with a single bolus of polarized gas. The dried lung ADC results appear larger than from similar lungs in vivo, but spatial variation indicates that some physiological information remains.

1390. Lung Fixation in the State of Inhalation for MRI with Hyperpolarized Gases

Peter Blümler[1], Angelika Thomas-Semm[2], Stefan Reuss[2], Andreas Morbach[3], Rodolfo H. Acosta[1], Jörg Schmiedeskamp[4], Wolfgang Schreiber[3]
[1]MPI for Polymer Research, Mainz, Germany; [2]Anatomisches Institut, Mainz, Germany; [3]Universitätsklinik, Mainz, Germany; [4]Institut für Physik, Mainz, Germany

MRI investigations of lungs require reproducible models for sequence evaluation. The procedures for the fixation of entire lungs of small rodents up to pigs are presented. Therefore the lung/heart complex is excorporated and filled with various liquids for fixation using a lower pressure on the outside. Finally it is dried and can be stored in an non-collapsed state of inhalation. Light-, SEM-Microscopy and MRI techniques using hyperpolarised 3He were employed to verify the intact state of the alveolae on a microscopic level and the entire morphology of the entire lung.

1391. On-site Production of Hyperpolarised Helium-3 Gas for Lung MRI

Jamal Choukeife[1], Xavier Maitre[2], Geneviève Tastevin[1], Pierre-Jean Nacher[1]
[1]Laboratoire Kastler Brossel, Paris, France; [2]U2R2M (CNRS UMR8081), Orsay, France

Laser-polarised 3He-MRI has emerged as a promising non invasive tool for morphological and functional lung imaging. We have developed compact systems for on-site production of hyperpolarised 3He, and implemented them in two laboratories and a university hospital for systematic in vivo studies at 3mT, 0.1T and 1.5T. These small footprint devices (based on dedicated peristaltic compressors) allow to routinely produce 0.2 bar*l/h of gas with polarisation rates reaching 40% at moderate laser power (2W). Newly developed fibre lasers are expected to make this simple and flexible way to polarise 3He gas even more efficient.

1392. Large Scale Production and Handling of Spin-Polarised Helium-3 for MRT of Lungs

Joerg Schmiedeskamp[1], Anselm Deninger[1], Michael Ebert[1], Werner Heil[1], Stefan Hiebel[1], Ernst W. Otten[1], Reinhard Surkau[1], Daniel Rudersdorf[1], Michael Wolf[1], Tino Grossmann[1]
[1]Institute of Physics, Mainz, Germany

Spin-polarised gases as Helium-3 offer the possibility for morphological and functional imaging of airspaces as the lungs via MRT . We have developed a large scale polariser to produce 3bar*l /h of hyperpolarised 3He at a polarisation of more than 60% (Pmax=84%). In addition, the necessary infrastructure for storage, transport, application and recovery was developed. Since years lungs of volunteers and patients are being imaged at the university clinics in Mainz, weekly. Amounts of bar*l are shipped regularly by plane to Sheffield (GB) for clinical lung studies. Low field imaging has been performed at Orsay (F) with our gas recently.

1393. T_1 Relaxation Times and Chemical Shifts of Hyperpolarized Xenon Dissolved in PFOB Emulsions Mixed in Blood Plasma: Comparison of Large and Small Droplet Sizes

Julia Wallace[1], Lisa Bernas[2], Albert Cross[1], Mihai Gherase[1], Greg Cron[1], Giles Santyr[1]
[1]Carleton University, Ottawa, Ontario, Canada; [2]McMaster University, Hamilton, Ontario, Canada

Perfluoro-octyl bromide (PFOB) emulsions may preserve the signal from hyperpolarized xenon (HXe) to enable blood flow measurements. We have compared the T_1 relaxation times and chemical shifts of HXe dissolved in two sizes of PFOB emulsion droplets (d ~ 1.4 μm and d ~ 4.6 μm) mixed with blood plasma. In 1:2 emulsion to plasma dilution, the T_1 for both emulsions was ~ 60s, a 200% increase over plasma alone. While dilutions of the smaller droplets predominantly exhibited a single, broad (250 Hz linewidth) lineshape, two narrower peaks were observed for dilutions of the larger droplet emulsion.

1394. *In Vivo* Spectroscopy of Hyperpolarized ^{129}Xe in Fungal-Spore Inflamed Rat Lungs

Albert R. Cross[1], Giles Santyr[1], Thomas Rand[2], Greg Cron[1], Julia Wallace[1], Nishard Abdeen[1]
[1]Carleton University, Ottawa, Ontario, Canada; [2]Saint Marys University, Halifax, Nova Scotia, Canada

Hyperpolarized xenon (H-Xe) was used to obtain spectra from the lung region of rats. The spectra from a group of normal rats was compared to a group exposed to *Stachybotrys chartarum* spores. While there was a severe inflammatory response to the spore toxins, the spectra of the H-Xe diffused in the lung tissues (ie. parenchyma, adipose, blood) change only marginally. Only in the most severe cases of inflammation was there an observable shift and narrowing of the spectral peak in the region of the adipose tissue (191 ppm).

Hyperpolarized Gas Imaging: Pulmonary Applications

Hall D Sunday 13:30 - 15:30

1395. Follow-Up of Lung Transplant Recipients: Comparison of ^{3}He-MRI and Pulmonary Function Tests

Julia Zaporozhan[1], Klaus Kurt Gast[1], Sebastian Ley[1], Alexander Biedermann[2], Frank Knitz[1], Balthasar Eberle[1], Jörg Schmiedeskamp[1], Claus Peter Heussel[1], Eckard Mayer[1], Hans-Ulrich Kauczor[1]
[1]Johannes Gutenberg-University, Mainz, Germany; [2]University Hospital, Mainz, Germany

Follow-up of patients after lung transplantation (LTX) for early and sensitive prediction of rejection. We examined 9 lung recipients using ^{3}He-MRI on a 1.5 T MR scanner and pulmonary function tests (PFTs). Images were visually evaluated for ventilated defects. The ventilated lung volume was determined by threshold-based segmentation for each lung separately. FEV1% from PFT served as the early clinical indicator for rejection. In all four patients with follow-up rejection ^{3}He-MRI suspected rejection earlier than FEV1%. ^{3}He-MRI may have an important impact on sensitive early detection of rejection in lung transplant recipients.

1396. Analysis and Quantification of Regional Pulmonary Ventilation using HP-^{3}He-MRI

Frank Lehmann[1], Frank Knitz[2], Norbert Weiler[3], Klaus Gast[1], Sebastian Ley[1], Matthias Erich Bellemann[4], Hans Ulrich Kauczor[1], Wolfgang Guenther Schreiber[1]
[1]Dept. of Radiology, Johannes Gutenberg-University, Mainz, Germany; [2]Dept. of Anesthesiology, Johannes Gutenberg-University, Mainz, Germany; [3]Dept. of Anesthesiology, Christian Albrechts-University, Kiel, Germany; [4]University of Applied Sciences, Faculty of Medical Engineering, Jena, Germany

Aim of the study was the development of a new postprocessing method for the quantitative analysis of regional distribution of lung ventilation by hyperpolarized ^{3}He. Images were acquired after inhalation of 300 ml ^{3}He (2D-FLASH sequence, temporal resolution 128 ms). In a pilot study the method was applied to lung-healthy volunteers as well as patients with α1-antitrypsin deficiency and COPD. Different quantitative parameters (rise time, delay time, signal amplitude, peak flow) were calculated and visualized as parameter maps. Maps in patients showed a more inhomogeneous distribution of most parameters due to regional ventilation defects.

1397. Multiplanar Reformations to Allow Direct Comparison of ^{3}He-MRI and HR-CT Acquired in Different Orientations

Klaus Kurt Gast[1], Julia Zaporozhan[1], Sebastian Ley[1], Michael Ulrich Puderbach[2], Balthasar Eberle[1], Alexander Biedermann[1], Frank Knitz[1], Joerg Schmiedeskamp[3], Andreas Morbach[1], Wolfgang Günter Schreiber[1], Eckhard Mayer[1], Claus-Peter Heussel[1], Manfred Thelen[1], Hans-Ulrich Kauczor[1]
[1]Klinikum Universitaet Mainz, Mainz, Germany; [2]German Cancer Research Center, Heidelberg, Germany; [3]Institut fuer Physik der Universitaet Mainz, Mainz, Germany

^{3}He-MRI has been shown to be a sensitive method for functional imaging of the lung. To investigate its specificity, comparison to other methods such as CT has been performed. Addressing the different slice orientation between ^{3}He-MRI and CT, multiplanar reformations of both methods in the orientation of the method to be compared with have been compiled and studied regarding their contribution in the solution of this problem.

1398. Determining the Spartial Distribution of Gas Flow During the Respiratory Cycle Using He-3 MRI

Masaru Ishii[1], Aman Jalali[2], Johan M. Edvinsson[2], Mitchell Schnall[2], John S. Leigh[2], Rahim R. Rizi[2]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Determining the distribution of gas flow throughout the respiratory cycle often proves to be a difficult and elusive task. In the following work we introduce a hyperpolarized helium MRI technique for performing these measurements. This technique involves imaging the pulmonary distribution of small aliquots of hyperpolarized helium gas introduced at different portions of the respiratory cycle. This method was tested in a porcine animal model. We demonstrate the surprising results that the spatial distribution of gas is not uniform throughout the respiratory cycle.

1399. Reduction of Ventilated Lung Volumes in Smokers vs Non-Smokers as Measured by Single Shot Fast Spin Echo ^{1}H MRI and Hyperpolarized ^{3}He MRI

Neil Woodhouse[1], Andrew J. Swift[1], Jim M. Wild[1], Stan Fichele[1], Sally Fleming[1], Martyn N. Paley[1], Edwin J. van Beek[1]
[1]University of Sheffield, Sheffield, S.Yorks, UK

Synopsis: A combination of 3He ventilation MRI and 1H anatomical MRI was used to assess reduction in ventilated lung volumes in age matched groups of healthy non-smokers, healthy smokers and smokers with diagnosed obstructive lung disease. The ventilated volume from the 3He images was subtracted from the thoracic volume calculated from the Single Shot Fast Spin Echo images. A reduction in ventilated volume was observed in all groups, the largest reduction being in the group with diagnosed obstructive disease.

1400. Functional Evaluation of Emphysema Using Diffusion-weighted ^{3}Helium-MRI, HRCT and Pulmonary Function Tests

Sebastian Ley[1], Julia Zaporozhan[1], Klaus Kurt Gast[1], Alexander Biedermann[2], Andreas Morbach[1], Frank Knitz[3], Joerg Schmiedeskamp[4], Wolfgang G. Schreiber[1], Norbert Weiler[3], Hans Ulrich Kauczor[1]
[1]Department of Radiology, Mainz, Germany; [2]Department of Pneumology, Mainz, Germany; [3]Department of Anesthesiology, Mainz, Germany; [4]Institute of Physics, Mainz, Germany

Assessment of emphysematous enlargement of distal airspaces using 3He-MRI (ADC), HRCT (MLD, EI) and PFT. 8 patients after SLTx due to emphysema, 5 after double LTx and 7 patients with á1-Antitrypsin-deficiency were examined. ADC values were normal in transplanted and increased in emphysematous lungs. Correlations between 3He-MRI and HRCT were high (r=0.8). PFT highly correlated (r=0.9) with 3He-MRI and moderately (r=0.5) with HRCT. In patients with α1-Antitrypsin-deficiency, correlations between ADC, HRCT and PFT data were moderate (r between 0.5 and 0.7). Diffusion-weighted 3He-MRI yields good correlations with HRCT. In patients after SLTx 3He-MRI showed better correlations with PFT than HRCT

1401. Measurement of Regional Pulmonary Perfusion from Hyperpolarized Gas Ventilation Images

Masaru Ishii[1], Johan M. Edvinsson[2], Aman Jalali[2], Ryotaro Kime[2], Johee Im[2], Louis-Serge Bouchard[3], Rahim R. Rizi[2]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [3]Princeton University, Princeton, New Jersey, USA

Noninvasive measurements of regional pulmonary perfusion are of great importance and interest to pulmonologists and respiratory physiologists. We hypothesize hyperpolarized 3He MRI can be used to determine regional pulmonary perfusion. Our method relates the local rates of change in pulmonary oxygen tensions, measured by 3He MRI, to regional pulmonary perfusion. We tested this hypothesis in a porcine animal model. The success of this technique suggests that it may play an important role in diagnosing lung disorders with perfusion defects such as pulmonary embolism.

1402. Anterior to Posterior Variations of the ADC of Inhaled ^{3}He in Healthy Lungs

Andrew J. Swift[1], Stan Fichele[1], Neil Woodhouse[1], Martyn NJ Paley[1], Edwin JR van Beek[1], Jim M. Wild[1]
[1]Academic Radiology, University of Sheffield, Sheffield, UK

Previously, it has been shown that measurement of 3He gas diffusivity in the lung air spaces has potential for identifying changes in lung structure due to emphysema at the alveolar level. This work describes changes observed in 3He gas diffusivity in the anterior regions when compared to the posterior lung regions in a study of six healthy normals. Significantly lower values of gas diffusivity were found in the posterior regions.

1403. Hyperpolarized Helium-3 MR Imaging of Asthma Induction

Talissa Altes[1], Samee Sara[1], Jonathan M. Ciambotti[1], Jaime F. Mata[1], Thomas M. Platts-Mills[1], Eduard E. de Lange[1]
[1]University of Virginia, Charlottesville, Virginia, USA

Eleven subjects, 9 asthmatics and 2 healthy, non asthmatic volunteers, underwent H3He MRI before and after either methacholine challenge (n=4), or exercise challenge (n=7). All asthmatics had reduced ventilation on the post challenge study (mean percent non-ventilated lung: pre 8% and post 23%, p=0.040), while there were no changes in the healthy volunteers. Thus, H3He MRI depicts regional worsening of ventilation with a medically induced asthma exacerbation.

1404. Experimental Pulmonary Hypertension: Assessment by He-3 Gas MRI

Margaret Ferrante[1], Johan M. Edvinsson[2], Aman Jalali[2], Masaru Ishii[3], Mitchell Schnall[2], John S. Leigh[2], Rahim R. Rizi[2]
[1]University of California Los Angeles, Los Angeles, California, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [3]Johns Hopkins University, Baltimore, Maryland, USA

The purpose of this study is to investigate the use hyperpolarized 3He MRI ventilation images and dynamic gadolinium perfusion images to observe changes occurring with acute pulmonary hypertension. The results indicate that the changes can be observed and the said techniques could potentially have diagnostic impact.

1405. Improving the Construction of 3D Airway Tree Models from Hyperpolarized ^{3}He MR Images

Yang-Sheng Tzeng[1], Jim Yen[1], Joey Mansour[1], Zachary Handler[1], Mitchell Albert[1]
[1]Brigham & Women's Hospital, Boston, Massachusetts, USA

Hyperpolarized ^{3}He multi-slice airway images have been demonstrated to enable the construction of 3D airway tree models using 3D Slicer, a segmentation software. However, the labor intensive aspect of such construction makes it clinically impractical, its end result variable from user to user, and prone to missing legitimate airways. Our attempt to automate the airway tree construction process led to the finding that using three-dimensional connectivity is a compromise between improving the rigor of the procedure, and visualizing smaller airways and filtering out noise around larger airways.

1406. Visualization of Methacholine-Induced Airway Constriction Using Hyperpolarized ^{3}He

Tina A. Lewis[1], Erin McKinstry[1], Angela Tooker[1], Zachary Handler[1], Joey Mansour[1], Mary Mazzanti[1], Mitchell Albert[1]
[1]Brigham & Women's Hospital, Boston, Massachusetts, USA

This study demonstrates the application of a dynamic HP ^{3}He imaging method studying drug induced broncoconstriction in a human subject. A standard Fast Gradient-Echo (Fast GRE) pulse sequence was used to acquire dynamic images during the inhalation phase of a HP ^{3}He breathing protocol. Gas distribution before and after methacholine induced airway constriction was assessed. Constriction changes in the airways following methacholine administration were clearly detectable as evidenced by the disappearance of signal in discrete segments of the airway tree. The resulting decline and heterogeneity of gas distribution in the lung periphery could also be visualized.

Breast MR Imaging

Hall D Sunday 13:30 - 15:30

1407. Intra-Operative MRI-Guided Breast Lumpectomy for Malignant Tumors

Daniel F. Kacher[1], James Rosato[1], Darrell N. Smith[1], Carolyn M. Kaelin[1], Masanori Hirose[2], Ferenc A. Jolesz[1]
[1]Brigham and Women's Hospital, Boston, Massachusetts, USA; [2]Showa University, Tokyo, Japan

The feasibility of utilizing a 0.5T vertical open scanner to guide the resection of malignant breast lesions is presented here. The goal of MRI-guided lumpectomy is to achieve negative histologic tumor margins to obviate the need for a second surgical procedure. The procedure would be particularly valuable when the lesion is non-palpable and/or is not visible with any other imaging modality. Twenty female patients underwent MRI-guided breast lumpectomy in a Signa SP. Four were spared a second surgery due to detection of residual lesion in the MR images.

1408. Bilateral Breast Imaging Using Spiral Acquisition with Parallel Imaging

Lisa Angelos[1], Ann Shimakawa[2], Bruce Daniel[3], Cynthia Maier[1], Jean Brittain[2]
[1]GE Medical Systems, Milwaukee, Wisconsin, USA; [2]GE Medical Systems, Menlo Park, California, USA; [3]Stanford University, Stanford, California, USA

A new method is described for a simultaneous acquisition of sagittal MR images of both breasts. We combine a 3D “stack of spirals” acquisition with SENSE (ASSET) using a field of view reduction in the slice-encoding direction. This technique allows a true-simultaneous bilateral breast scan with excellent temporal and spatial resolution.

1409. Breast Lesion Conspicuity on an"Open" System.

Bernice E. Hoppel[1], Tonya J. Hollrith[2], Lynn Mastey[2], Cynthia F. Maier[1], Lisa C. Angelos[1], Lynda L. Yanny[2], Yu Liu[2], Robert K. Breger[2]
[1]GE Medical Systems, Waukesha, Wisconsin, USA; [2]St Lukes Medical Center, Milwaukee, Wisconsin, USA

Our work evaluated the effectiveness of using lower field “open” vertical field systems for high resolution and dynamic imaging of the breast. We show that with appropriate parameters selection, such as low flip angle, high quality images can be acquired on larger or claustrophobic patients. Results indicate a flip angle of approximately 10 to 15 degrees will allow for the greatest contrast to noise (CNR) as well as signal to noise (SNR). Speed was also a criteria, temporal resolution of 2 or less minutes was required. Slice Asset, showed promise in sagittal bilateral imaging within the same time frame..

1410. Application of SENSE for High Spatial and Temporal MR Imaging of the Breast

Adrian Knowles[1], Sri Swaminathan[2], Edward Fobben[3], Paul Friedman[3], Linda Sanders[3], Ronald Sharo[3], Robert Smith[3]
[1]Philips Medical Systems, Best, Noord Brabant, Netherlands; [2]Philips Medical Systems, Bothell, Washington, USA; [3]St Barnabas Ambulatory Care Center, Livingston, New Jersey, USA

Debate still continues as to the optimum method of data acquisition for MR contrast enhanced dynamic studies in the breast. High temporal and spatial resolution techniques both offer benefits. This study explores the feasibility of parallel imaging techniques to allow scan time reduction in pre and post-contrast imaging, artefact reduction in breast diffusion imaging whilst also comparing different dynamic imaging strategies. Both high spatial and temporal dynamic studies were performed and correlated with diffusion imaging. Post contrast 3D imaging allowed the generation of high-quality MIP’s and multi-planar reformats due to the use of a 0.75mm slice thickness.

1411. MRI Morphologic Classification by Loss of Containment (LOC) Predicts Breast Tumor Response to Neoadjuvant Chemotherapy

Nola M. Hylton[1], Laura J. Esserman[1], Savannah C. Partridge[1], Jessica E. Gibbs[1], Dulcy Wolverton[1], Margarita Watkins[1], Evelyn Proctor[1], Niles Bruce[1], Shelley Hwang[1], Hope Rugo[1], Cheryl Ewing[1], Debasish Tripathy[2]
[1]UCSF, San Francisco, California, USA; [2]UT Southwestern, Dallas, Texas, USA

MRI can play an important role in the evaluation of pre-operative treatment for breast cancer. A study of 64 women with locally-advanced breast cancer was conducted to investigate the value of MR parameters for predicting treatment response and time-to-recurrence following neoadjuvant chemotherapy. In this study, the initial morphologic distribution of disease was classified from 1 to 5 according to the loss of containment (LOC) of tumor on MR images, with 1 representing a well-marginated uni-centric tumor and 5 representing diffuse disease. LOC was found to be a strong predictor of volumetric response and the option for breast conservative surgery.

1412. Assessment of Tumor Response in Locally Advanced Breast Cancer (LABC) Patients Monitored Through *In-Vivo* ^{1}H MRS

Mahesh Kumar[1], V. Seenu[1], P.K. Julka[1], G.K. Rath[1], N.R. Jagannathan[1]
[1]All India Institute of Medical Sciences, Ansari Nagar, New Delhi, India

Sequential In vivo 1H MRS has been carried out on patients suffering from locally advanced breast cancer (LABC) both prior to and neoadjuvant chemotherapy (NACT). Water to fat (W-F) ratio has been used as an index to monitor the response of these patients to NACT. W-F ratio was found to be higher in tumor compared to that obtained for the normal breast tissues and decreases with the progression of chemotherapy.

1413. Application of True FISP for Evaluating Dynamic Breast Enhancement on MR

Bonnie N. Joe[1], Pornpim Fuangtharnthip[1], Jie Zheng[1], Premsri Barton[1], Vamsidhar Narra[1], Kyongtae Bae[1]
[1]Mallinckrodt Institute of Radiology, St. Louis, Missouri, USA

An ongoing protocol to study dynamic enhancement of breast tumors required fast imaging at 1-second temporal resolution as well as the capability to image gadolinium contrast in the heart. Early trials with a turbo FLASH technique showed substantial cardiac motion artifact and noisy signal intensity-time curves. T1-weighted trueFISP sequence which can yield much higher signal-to-noise ratio can be used to measure contrast enhancement in breast. We have successfully employed a trueFISP technique in patients (n=23) to measure the signal intensity-time curves of both breast tumor enhancement and circulating gadolinium in the heart.

Hepatobiliary MR Imaging

Hall D Monday 13:30 - 15:30

1414. Hepatocellular Carcinomas Treated with Transcatheter Arterial Chemoembolization (TACE) and High Intensity Focused Ultrasound (HIFU) : Evaluation with Multiphase Gadolinium-Enhanced MR Imaging

Huiyi Ye[1], Wei Wang[2], Wenzhi Chen[3], Maoqiang Wang[1], Youquan Cai[1], Zhibiao Wang[3]
[1]PLA General Hospital, Beijing, People's Republic of China; [2]PLA 307 Hospital, Beijing, People's Republic of China; [3]2nd Affiliated Hospital of Chongqing University of Medical Science, Chongqing, People's Republic of China

To evaluate the usefulness of MR imaging in follow-up of hepatocellular carcinomas (HCCs) treated with transcatheter arterial chemoembolization (TACE) and high intensity focused ultrasound (HIFU). METHODS: Twenty-four patients with 36 HCCs pathologically confirmed were examined with nonenhanced and multiphase gadolinium-enhanced MR imaging before and after TACE and HIFU treatment, and on the 1~4th, 6~8th and 12th month follow-up. RESULTS: The enhancement of 17 HCCs disappeared after treatment, and Coagulative necrosis was confirmed by pathologic findings and supported by MR imaging of follow-up. CONCLUSION: MR imaging is an invaluable modality monitoring the effects of TACE and HIFU.

1415. Detection and Characterization of Focal Hepatic Lesions: Manganese vs SPIO-enhanced MR imaging

Joo Hee Kim[1], Myeong Jin Kim[1], Young Taik Oh[1], Joon Seok Lim[1], Jae Joon Chung[1]
[1]Yonsei University College of Medicine, Seoul, Republic of Korea

We compared manganese-enhanced and SPIO-enhanced MR imaging for detection and characterization of focal hepatic lesions. From our results, we found that SPIO-enhanced MR images provide better accuracy in the detection of focal hepatic lesions, but determination between hepatocellular and non-hepatocellular origin is superior on the manganese-enhanced images. Manganese and SPIO-enhanced MR images have comparable accuracy in the differentiation of benign and malignant lesions.

1416. SPIO Contrast Enhanced Dynamic MRI: Is it Possible?

Johannes T. Heverhagen[1], Annette Althaus[2], Klaus J. Klose[2], Marga B. Rominger[2]
[1]The Ohio State University, Columbus, Ohio, USA; [2]Philipps University, Marburg, Hessen, Germany

In our study, we intended to show the capability of SPIO enhanced dynamic MRI to assess perfusion of tissues in addition to the usual contrast enhancement of liver masses. After SPIO application (1mL followed by a flush of saline solution), a 3D Gradient echo sequence was acquired dynamically with a temporal resolution of 3.75s. Vascular structures demonstrated a first pass effect, whereas liver tissue showed a constant accumulation of SPIO. Metastases exhibited a lower uptake of SPIO resulting in enhanced liver-metastasis contrast. Therefore, in addition to contrast enhancement in liver tissue, SPIOs are also able to demonstrate tisuue perfusion.

1417. Detection and Characterization of Focal Liver Lesions: Can Breathhold Balanced Turbo Field-Echo (B-TFE) MR Images Replace Fat-Saturated, Fast Spin-Echo T_2-Weighted MR Images ?

Hiroki Haradome[1], Tomoaki Ichikawa[2], Utarou Motosugi[2], Takatoshi Kitamura[2], Tatsuaki Tsukamoto[2], Ryouji Amemiya[3], Kouji Miyazaki[3], Eiji Okamoto[4], Tsutomu Araki[3], Junichi Hachiya[1]
[1]Kyorin University, School of Medicine, Mitaka, Tokyo, Japan; [2]Yamanashi Medical University, Nakakoma, Yamanashi, Japan; [3]Yamanashi Kouseiren Health Center, Nakakoma, Yamanashi, Japan; [4]Philips Medical System, Nakakoma, Yamanashi, Japan

To assess smaller size of focal liver lesions with T2-weighted FSE imaging, further improvement of special resolution is needed, but it doesn't have enough intrinsic SNR to do it. The B-TFE sequence may be suitable for T2-weighted liver imaging because of maintaining SNR with high special image resolution. In this study, we compare B-TFE MR images with respiratory-triggered T2-weighted FSE and breathhold T2-weighted FSE MR images in the detection of focal liver lesions. Based our result, there may be a possibility that FS-B-TFE imaging can replace any T2-weighted FSE imaging in the detection of the solid hepatic lesions.

1418. Clinical Imaging of the Liver with Ultrashort TE (Ute) Pulse Sequences

Karyn E. Chappell[1], Peter D. Gatehouse[2], Andreanna D. Williams[1], Joanne Holmes[1], Graeme M. Bydder[1], Simon D. Taylor-Robinson[1]
[1]Imperial College, London, UK; [2]MRRS, Guildford, Surrey, UK

Ultrashort TE imaging (TE = 80 msecs) of the liver was performed on seven volunteers, six cirrhotic patients, one with congenital fibrosis and five others with focal disease. Short T2 components were decreased in some tumors, cystic lesions, hemangiomas and in a region of the liver treated with thermal ablation. Short T2 components were increased in area of presumed subcapsular hematoma and parts of a hepatocellular carcinoma. T2 values in the normal subjects were 22.6± 2.23 msecs, while those in the patients with cirrhosis were increased with a mean of 38.4 ±15.4 msecs (p=0.05).

1419. Ferumoxides-Enhanced MR Imaging of the Liver at a Low Field-Strength MR Unit (0.2-T) for Detecting Hepatic Malignancies

Hiroki Haradome[1], Tomoaki Ichikawa[2], Hironobu Sou[2], Massaki Hori[2], Hiroto Nakajima[2], Takatoshi Kitamura[2], Tsutomu Araki[2], Junichi Hachiya[1]
[1]Kyorin University School of Medicine, Mitaka, Tokyo, Japan; [2]Yamanashi Medical University, Nakakoma, Yamanashi, Japan

The usefulness of hepatic MR imaging at a low field-strength is still challenging because its image has insufficiently low CNR and SNR for evaluating focal hepatic lesions. Ferumoxides also allows to improving the low CNR images at low field-strength. In this study, we evaluate the efficacy of ferumoxides-enhanced MR imaging at a low field-strength compared to those at a 1.5-T MR unit and multidetector-row CT (MDCT) for detecting hepatic malignancies. Based on our results, KCI, T2*WI, and 3D-FIESTA sequences at a 0.2-T MR unit can provide similar detectability of hepatic malignancies to those at 1.5-T MR unit and MDCT images.

1420. Why Some Hepatic Lesions Are Hyperintense on Ferumoxides-enhanced T_1WI?

Zhenghan Yang[1], Cheng Zhou[1], Min Chen[1], Weifeng Zhao[1], Wenchao Wang[1], Ye Tan[1], Min Zhang[1], Guozhen Li[1]
[1]Beijing Hospital, Beijing, People's Republic of China

The purpose of this study is to investigate the mechanism of hyperintensity of focal hepatic lesions on ferumoxides-enhanced T1WI. Unenhanced and FERUMOXIDES-enhanced SE and SPGR T1WI with different TE were performed in 47 patients with 69 focal liver lesions. On ferumoxides-enhanced T1WI, when the TE was prolonged, the signal intensity of the liver decreased, while the signal intensity of the lesions increased relatively and some lesions appeared hyperintense. In summary, T2* effect of ferumoxides on surrounding liver is an important cause of hyperintensity of some focal hepatic lesions on ferumoxides-enhanced T1WI.

1421. Mn-DPDP Enhancement 24 Hours Delayed Scan MRI of Hepatocellular Carcinoma is Correlated with Histology

Deng Bin Wang[1], Kang Rong Zhou[2], Meng Su Zeng[2], Ke Min Chen[1], Yi Xiang Wang[1]
[1]Shanghai Second Medical University Rui Jin Hospital, Shanghai, People's Republic of China; [2]Fudan University Zhong Shan Hospital, Shanghai, People's Republic of China

Thirty-four patients with hepatocellular carcinoma (HCC) had Mn-DPDP enhanced liver MRI. In total there were 47 tumors, MRI detected 43 of them. A semi-quantitative “Enhancement Index” was estimated on tumor central axial images acquired 24hrs after Mn-DPDP infusion. High enhancement index value indicates high Mn-DPDP uptake by HCC cells and/or its slow elimination. It was found all the poorly differentiated HCC had low Enhancement Index, and higher “Enhancement Index” indicated better differentiation. Tumors with higher “Enhancement Index” were more likely to have an intact capsule and tumors with lower “Enhancement Index” were less likely to have an intact capsule.

1422. The Effect of Gd-EOB-DTPA on T_2-Weighted Images in the Diagnosis of Malignant Hepatic Tumors

Shinji Hirohashi[1], Nagaaki Marugami[1], Satoru Kitano[1], Junko Takahama[1], Kimihiko Kichikawa[1], Hajime Ohishi[1]
[1]Nara Medical University, Kashihara, Nara, Japan

The purpose of this study is to clarify the effect of gadolinium ethoxybenzyl diethylenetriaminepentaacetic acid (Gd-EOB-DTPA) on T2-weighted images in the diagnosis of malignant hepatic tumors. Twelve patients with 16 hepatic tumors underwent breath holding T2-weighted fast spin echo MR images before, 5-7 and 13-17 minutes after the administration of Gd-EOB-DTPA. No significant decrease of tumor-to-liver contrast between T2-weighted images before and after Gd-EOB-DTPA administration by the visual assessment or the quantitative assessment. We conclude that T2-weighted images can be obtained after the administration of Gd-EOB-DTPA instead of the pre-contrast images to shorten the whole examination time.

1423. WITHDRAWN

1424. Hepatic Steatosis Quantification by MRI: Serial Measurement and Normal Variation

David J. Lomas[1], Richard T. Black[1], Johanna Pinney[1]
[1]Addenbrookes Hospital and University of Cambridge, Cambridge, UK

A protocol using a modified Dixon breath-hold gradient echo sequence to estimate hepatic steatosis for serial non-invasive in vivo studies is described. A stable water/fat phantom was used to demonstrate minimal MR system variation. Repeatability in vivo was assessed in a group of six healthy volunteers. Serial observations were made in the volunteers that indicate both daily and weekly small but significant variations of hepatic steatosis. This work indicates that robust serial estimation of hepatic steatosis in vivo is feasible and could be used to monitor therapeutic interventions and physiological responses.

1425. Potential of Gd-EOB-DTPA for Differential Diagnosis of Hepatic Tumors

Natsuko Tsuda[1], Naoki Kato[1], Chie Murayama[1], Michiko Narazaki[1], Takashi Yokawa[1]
[1]Nihon Schering, Osaka, Japan

The purpose of this study was to investigate the potential of Gd-EOB-DTPA on the differential diagnosis of various hepatic tumors, such as hepatocellular carcinoma (HCC, including each differentiated type), hemangiomas (HE), and hyperplastic nodule (HPN) using dynamic and delayed MRI. The time course of relative enhancement (RE) in rat hepatic tumors was examined and compared. Our results suggest that HE, HPN, and HCC can be classified after injection of Gd-EOB-DTPA. In addition, Gd-EOB-DTPA shows the possibility to evaluate the degree of malignancy in HCC.

1426. Clinical Use of Resovist® in the Characterization of Liver Focal Lesion in MRI

Xavier Montet[1], Jean-Paul Vallée[1], Gilles Mentha[1], Christoph Becker[1], François Terrier[1]
[1]Geneva University Hospital, Geneva, Switzerland

The apparition of new superparamagnetic iron oxide (SPIO) contrast media allows to realize MR exam in both static and dynamic manners. We wanted to studied a new SPIO particles, the SHU 555-A (Schering) in the characterization of focal liver lesions and to compare the SHU 555-A with another SPIO, the ferumoxides. Both contrast media are safe for the use in magnetic resonance imaging of the liver, but the major advantage of SHU 555-A is the possibility of a bolus administration allowing dynamic images during the injection and a 3 times shorter exam duration.

1427. Dynamic MR Imaging and Multi-detector Helical CT for Detecting Hypervascular Hepatocellular Carcinoma

Akihiko Arakawa[1], Yoshiko Hayashida[1], Yasuyuki Yamashita[1]
[1]Kumamoto University Hospital, Kumamoto, Japan

The purpose of this study is to evaluate the sensitivities and positive predictive value of multislice dynamic MR imaging and dynamic multi-detector helical CT for detecting hypervascular HCCs using CT during arterial portography and CT hepatic arteriography as a gold standard. The overall sensitivities of dynamic MDCT (76.4%) is superior to that of dynamic MR (70.1%), although it is not statistically significant. There is no difference in detectability of tumors less than 1 cm in diameter. The sensitivity of dynamic MDCT for small HCCs is almost equal to dynamic MR imaging.

1428. SPIO-Enhanced T_2-weighted Gradient- and Spin-Echo (GRASE) Imaging in Detection and Characterization of Focal Liver Lesions.

Takeshi Yoshikawa[1], Yoshiharu Ohno[2], Shozo Hirota[3], Jyun Yoshigi[1], Kazushige Oda[1], Koji Sugimoto[2], Shinichi Matsumoto[4], Hajime Kitagaki[1], Kazuro Sugimura[2]
[1]Shimane Medical University, Izumo, Shimane, Japan; [2]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [3]Hyogo Medical College, Nishinomiya, Hyogo, Japan; [4]Tenri Hospital, Tenri, Nara, Japan

Superparamagnetic iron oxide (SPIO) is a liver-specific contrast agent that is taken up by the Kupffer cells and is mainly used in T2- or T2*-weighted liver imaging. In numerous studies, it has been reported that SPIO improved the detectability of malignant liver lesions. However, there is no consensus regarding the optimum imaging sequence. Gradient- and spin-echo (GRASE) sequence is a fast T2-weighted imaging sequence that is a combined gradient-echo and spin-echo technique and appears to be a candidate for use with SPIO-enhancement. Our goal was to evaluate SPIO-enhanced breath-hold T2-weighted GRASE imaging in detection and characterization of focal liver lesions.

1429. Branching Steatosis in Islet Cell Transplant Recipients: A Possible Marker of *In Vivo* Islet Cell Function

Mark Alan Rosen[1], Erik Insko[1], James Markmann[1], Ali Naji[1], Evan Siegelman[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

We report a unique pattern of branching periportal steatosis in islet cell transplant (ICT) patients as shown on chemical shift MR imaging. A reticular pattern of signal intensity on opposed-phase imaging was present, presumably secondary to high local insulin concentrations secreted by engrafted islet cells. A simple method for quantitation of this phenomenon is shown which may be useful in future clinical trials of ICT.

1430. Does Variant Hepatic Arterial Anatomy in a Liver Transplant Recipient Increase the Risk of Post-Transplant Hepatic Arterial Complications?

Yan Zhang[1], Kousei Ishigami[1], Stephen C. Rayhill[1], Youmin Wu[1], Alan H. Stolpen[1]
[1]University of Iowa Hospitals and Clinics, Iowa City, Iowa, USA

Our goal was to determine if variant hepatic artery (HA) anatomy in a liver transplant recipient increases the risk of HA complications after liver transplantation. The study group consisted of 63 liver transplant recipients who underwent pre-operative three-dimensional gadolinium-enhanced magnetic resonance angiography to assess HA anatomy. After transplantation, HA stenosis and thrombosis occurred in 6 of 19 patients with variant HA anatomy (31.7%) and 2 of 44 patients with classical HA anatomy (4.5%). The difference was statistically significant ($P<0.01$). The odds ratio was 9.69. Thus, variant HA anatomy in a liver transplant recipient increases the risk of post-transplant HA complications.

1431. First Pass DCE TrueFISP Abdominal Perfusion MR in Patients with Portal Hypertension: Preliminary Results

Jeffrey P. Goldman[1], Niels Oesingmann[2], Michael Schilsky[1]
[1]Mount Sinai Medical Center, New York, New York, USA; [2]Siemens AG, Erlangen, Germany

There is a need for a noninvasive test which reflects changes in portal pressure. The purpose of our study was to perform pharmacokinetic analysis of first pass perfusion of the spleen, liver and portal vein in-order to identify whether abnormal splenic and portal perfusion can be measured by DCE MR. Patients with portal hypertension had significantly increased time to peak and mean transit times of the liver, spleen and portal vein. Kinetic analysis of first pass perfusion imaging of the spleen and liver offers the potential to noninvasively follow abnormalities in portal flow.

1432. Effects of Inflow Correction on Estimated Hepatic Perfusion Parameters

Frank Peeters[1], Laurence Annet[1], Laurent Hermoye[1], Bernard Van Beers[1]
[1]St-Luc University Hospital, UCL, Brussels, Belgium

Hepatic perfusion measurements were performed on patients using dynamic T1-weighted MRI. The perfusion curves were inflow corrected on the basis of time resolved flow measurements and an analytical model that was calibrated using phantom measurements and numerical simulations. The data were analyzed in terms of a dual input first order linear system. It is shown that, in the absence of inflow correction, systematic errors of typically 30-40% are obtained for the estimated perfusion parameters. Therefore, inflow correction is necessary to obtain accurate perfusion models.

1433. Pilot Study of the Efficacy of Perfusion MRI as a Technique in the Detection of Changes in the Hepatic Perfusion Index.

John Totman[1], Ruth O'Gorman[1], Pauline Kane[1], John Karani[1], Adam Waldman[2], Paul Summers[3]
[1]Kings College Hospital, London, UK; [2]Charing Cross Hospital, London, UK; [3]University Hospital of Zurich, Zurich, Switzerland

The aim of this study was to adapt the methodology established for dynamic CT measurements of the hepatic perfusion index to MRI, and to assess the potential of MRI measurements of the HPI in the detection of changes in liver perfusion between patients with colorectal liver metastases and controls. Significant differences were found between the hepatic perfusion index calculated between the two groups, with the patients demonstrating significantly higher hepatic arterial perfusion and lower portal perfusion. These results suggest that hepatic perfusion indices can be derived using MRI-based methods and that these perfusion indices represent reliable indicators of liver perfusion.

1434. Perfusion-Weighted MR Imaging of Cirrhotic Liver with a Turbo FLASH T_1-Weighted Imaging Sequence

Zhenghan Yang[1], Cheng Zhou[1], Min Chen[1], Ye Tan[1], Min Zhang[1], Jingxia Xie[2], Guozhen Li[1]
[1]Beijing Hospital, Beijing, People's Republic of China; [2]The 3rd Hospital of Peking University, Beijing, People's Republic of China

This study was designed to investigate the role of perfusion-weighted MR imaging in evaluation of cirrhotic liver. With a trubo fast low angle shot (Turbo-FLASH) T1WI sequence, PWI was performed in 12 dogs with half-liver cirrhosis of various degrees. Decreased perfusion was observed in the half liver with cirrhosis, but not in the half liver without cirrhosis. The reduction of portal blood perfusion in the SS correlated with the severity of cirrhosis proved pathologically. The results indicate that, to some degree, perfusion-weighted MR imaging can reflect the severity of cirrhosis.

1435. Pancreatic Lesions: The Accuracy of 3D MR Imaging (Including MR Angio) in the Preoperative Evaluation of Fifty Prospectively Included Patients with Suspected Pancreatic Tumor

Nils Albiin[1], Gunnar Herlin[1], Johan Permert[1], Bo Persson[1], Anders Franck[1], Urban Arnelo[1], Maria Kristoffersen-Wiberg[1], Lena Bronge[1], Peter Aspelin[1]
[1]Karolinska, Stockholm, Sweden

Conclusion: 1) All pancreatic lesions were detected with the dynamic 3D MRI, VIBE sequence. 2) The VIBE was most accurate in differentiating benign from malignant lesion in patients without chronic pancreatitis. However, the accuracy was low when the pancreatic tissue was chronically inflamed. 3) Enlargement of lymph nodes did not correlate with lymph node metastases. Small liver metastases (¡Ü5 mm) could not be detected. 4) VIBE was the most efficient sequence in preoperative evaluation of patients with suspected pancreatic tumor.

1436. Anti-Angiogenic Therapy Monitoring by Dynamic MR Imaging in an Orthotopic Pancreatic Carcinoma Model

Christopher Bangard[1], Axel Gossmann[1], Christiane Bruns[2], Arnulf Hölscher[2], Klaus Lackner[1]
[1]Department of Radiology, Cologne, Germany; [2]Department of Surgery, Cologne, Germany

The aim was to investigate the anti-angiogenic effect of endothelial-growth-factor-receptor (EGF-R)-antibodies, known inhibitors of angiogenesis, in an orthotopic pancreatic carcinoma model in rats using dynamic MR imaging. Human pancreatic adenocarcinoma cells (L3.6pl) were injected orthotopically in the pancreas of 12 rats. Six rats were treated intraperitoneally with EGF-R-antibodies and the others with saline. EGF-R-antibody-treated animals showed significantly ($p<0.05$) less tumor volume progression, corresponding with significantly ($p<0.05$) lower values for microvascular permeability (KPS) and fractional plasma volume (fPV) than the control group. Intraperitoneal injection of EGF-R-antibodies shows anti-angiogenic effect that can be quantified non-invasively by dynamic MR imaging.

1437. The Non-Invasive Investigation of Human Gallbladder Bile *In-Vivo* using Single-Voxel Proton MRS

Andrew P. Prescot[1], David J. Collins[1], Martin O. Leach[1], Andrzej SK Dzik-Jurasz[1]
[1]Institute of Cancer Research, Sutton, Surrey, UK

The development and application of ^{1}H-MRS methodology to non-invasively investigate the biochemical composition of human gallbladder (GB) bile in vivo is demonstrated. The acquisition of individual free induction decays (FIDs) and subsequent co-addition of power spectra provided a means for eliminating motion-induced spectral artifacts and controlling lipid contamination. The spectra acquired in vivo are compared to the corresponding data acquired from model bile and porcine bile in vitro. Additional quantitative analyses have been undertaken and the concentration of GB bile phosphotidylcholine was estimated to range from 25.9 mM to 48.4 mM (mean: 35.8 mM, SD: 9.8).

1438. 3D MRCP Employing Fast Recovery Fast Spin Echo and Steady State Free Precession Sequences: Comparison with 2D Single Shot Fast Spin Echo

James F. Glockner[1], David W. Stanley[2], Anand Kumar[2], Atsushi Nozaki[2], Michael Wood[2]
[1]Mayo Clinic, Rochester, Minnesota, USA; [2]GE Medical Systems, Milwaukee, Wisconsin, USA

Two 3D MRCP sequences (3D FRFSE and 3D FIESTA) were compared with conventional single shot fast spin echo techniques in 10 consecutive patients referred for MRCP. Results indicate that the 3D sequences were often preferred and occasionally provided additional information.

1439. Intensity and Contrast Characteristics of Biliary Trees and Surrounding Splanchnic Vessels with Fat Saturated 3DFIESTA before and after the Administration of Gadolinium Chelate

Satoshi Isogai[1], Yasuo Takehara[1], Mamoru Takahashi[2], Katsutoshi Ichijo[2], Norihiro Tooyama[2], Masako Takahashi[2], Harumi Sakahara[1], Atsushi Nozaki[3]
[1]Hamamatsu University School of Medicine, Hamamatsu, Shizuoka, Japan; [2]Seirei Mikatahara General Hospital, Hamamatsu, Shizuoka, Japan; [3]General Electric Yokogawa Medical Systems, Ltd., Hino, Tokyo, Japan

To establish intensity and contrast characteristics of biliary trees and surrounding splanchnic vessels, 28 consecutive patients were examined with newly implemented fat saturated 3DFIESTA before and after the administration of gadolinium chelate. Before contrast administration, the sequence had enough biliary contrast (SNR of common hepatic duct: 47.4) that can be used as usual MRCP. After contrast administration, biliary and splanchnic vessels were almost equally delineated (SNR of portal vein: 49.2, SNR of common hepatic duct: 45.9), which might help evaluate the anatomy of the biliary tree and the neighboring vessels before laparoscopic cholecystectomy.

1440. T_2-Weighted MRCP Techniques: Comparison of Multi-Thin-Slice HASTE and True FISP Sequences

Ming Yang[1], Diego Martin[1]
[1]West Virginia University, Morgantown, West Virginia, USA

This study compared gradient-echo based fast imaging with 2 dimensional steady-state precession (True FISP)1 and conventional heavily T2 weighted MRCP half-Fourier single shot echo-train spin echo (HASTE)2 sequence to evaluate their ability to depict the pancreaticobiliary ductal system. True FISP shows True FISP images showed significantly superior anatomic conspicuity of all evaluated structures except the gall bladder, and similar ability in lesion detection. It implied that True FISP might replace conventional heavy-T2 weighted MRCP sequence in the future.

1441. MRCP with a Combination of Respiratory-triggered 3D Fast Recovery Fast Spin-echo (FRFSE) Sequence and a Parallel Imaging Technique: A Comparison with 2D Single-shot Fast Spin-echo (SSFSE) Sequence

Masatoshi Hori[1], Takamichi Murakami[1], Tonsok Kim[1], Satoru Takahashi[1], Eiji Sugihara[1], Hisashi Abe[1], Masatomo Kuwabara[1], Kaname Tomoda[1], Yoshifumi Narumi[1], Hironobu Nakamura[1]
[1]Osaka University Graduate School of Medicine, Suita-city, Osaka, Japan

The purpose of this study was to determine efficacy of 3D MRCP imaging with a combination of respiratory-triggered 3D FRFSE sequence and a parallel imaging technique by comparison with 2D SSFSE MRCP imaging. Twelve patients were included in this study. Images were subjectively graded based on the conspicuity of pancreatobiliary structures. Respiratory-triggered 3D FRFSE sequence showed statistically significant superior mean grading score to breath-hold 2D SSFSE sequence. Thus, it was concluded that respiratory-triggered 3D FRFSE MRCP imaging is efficient technique for evaluation of pancreatobiliary diseases.

1442. Evaluation of Hepatocellular Carcinoma within Dysplastic Nodules with MR Imaging

Zhenghan Yang[1], Cheng Zhou[1], Min Chen[1], Ye Tan[1], Min Zhang[1], Guozhen Li[1]
[1]Beijing Hospital, Beijing, People's Republic of China

The purpose of this study is to investigate the role of MRI in the detection and characterization of heptocellular carcinoma within dysplastic nodules (HCC within DN). Study population included 11 patients with 13 lesions of ¡ HCC within DN¡±. MRI and dynamic spiral CT were performed in all 11 patients, Feridex-enhanced T2WI in 2 patients, and Gd-BOPTA-enhanced T1WI in 1 patient. MRI detected more lesions than spiral CT (10 versus 6). The signs to suggest "HCC within DN" included "nodule-in-nodule," mild or moderate hyperintense on T2WI, increased size, increased arterial blood supply, and decreased intake of Feridex or Gd-BOPTA.

1443. Evaluation of Liver Cirrhosis with Diffusion-weighted MR Imaging: An Experimental Study in Animal Model with Half-liver Cirrhosis

Zhenghan Yang[1], Cheng Zhou[1], Min Chen[1], Weifeng Zhao[1], Wenchao Wang[1], Ye Tan[1], Min Zhang[1], Xiaohua Ye[1], Guozhen Li[1]
[1]Beijing Hospital, Beijing, People's Republic of China

The purpose of this study is to investigate the mechanism of ADC value reduction in the cirrhotic liver. DWI was performed in 12 dogs with half-liver cirrhosis before and after the hepatic blood flow was blocked. The mean ADC value in the half-liver with cirrhosis was lower than that in the half liver without cirrhosis. After block of liver blood supply, the difference of ADC value between the two half-liver disappeared. Our results indicate that the reduction of ADC value in the cirrhotic liver is mainly due to the decreased blood perfusion in the hepatic parenchyma.

1444. Affection of Blood Supply on ADC of Hepatic Focal Lesions

Zhenghan Yang[1], Cheng Zhou[1], Min Chen[1], Jingxia Xie[2], Ye Tan[1], Min Zhang[1], Guozhen Li[1]
[1]Beijing Hospital, Beijing, People's Republic of China; [2]The 3rd Hospital of Peking University, Beijing, People's Republic of China

The aim of this study is to investigate if the lesion blood supply will affect the apparent diffusion coefficient (ADC) of focal hepatic mass. Diffusion-weighted imaging (DWI) with different b values was performed in 87 patients with 159 focal hepatic lesions. On DWI with small b value and small b value remainder, ADCs were affected by blood perfusion of tissues or lesions. The mean ADC of hypervascular lesions was significantly higher than that of hypovascular lesions on DWI with small b value. Blood perfusion affects ADC of focal hepatic lesion, particularly on DWI with small b value.

1445. Breath-Hold T_2-weighted Gradient- and Spin-Echo (GRASE) Imaging in Detection and Characterization of Focal Liver Lesions.

Takeshi Yoshikawa[1], Yoshiharu Ohno[2], Shozo Hirota[3], Jyun Yoshigi[1], Takaki Maeda[2], Koji Sugimoto[2], Shinichi Matsumoto[4], Hajime Kitagaki[1], Kazuro Sugimura[2]
[1]Shimane Medical University, Izumo, Shimane, Japan; [2]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [3]Hyogo Medical College, Nishinomiya, Hyogo, Japan; [4]Tenri Hospital, Tenri, Nara, Japan

Recently available fast-imaging techniques including fast spin-echo (FSE), fast gradient-echo, half-Fourier single-shot FSE (HASTE), and echo planar imaging (EPI) have further improved T2-weighted liver imaging. However, FSE sequences provide less susceptibility contrast and high standard absorption rate loads and EPI sequence has poor image quality. Optimal T2-weighted sequences have been controversial. Gradient- and spin-echo (GRASE) sequence is a fast T2-weighted imaging sequence that has image contrast similar to spin-echo sequence. Our hypothesis was that T2-weighted GRASE sequences with breath-hold technique gain image contrast and keep image qualities with short examination time in detection and characterization of focal liver lesions.

Gastrointestinal MR Imaging

Hall D Tuesday 13:30 - 15:30

1446. Dark Lumen MR Colonography: Comparison between Water and Air Enema

Waleed Ajaj[1], Thomas Lauenstein[1], Nickolas Papanikolaou[2], Stefan G. Ruehm[1], Jörg F. Debatin[1]
[1]Department of Diagnostic and Interventional Radiology, Essen, Germany; [2]Department of Radiology, Crete, Greece

Water used to distend the colon for MR-Colonography harbours the risk of spillage and may be associated with more discomfort than air or CO2. Using a short TE-sequence to mitigate susceptibility effects, five volunteers and five patients underwent air-distended MR colonography. The volunteers were examined a second time using water for colonic distension. Following intravenous administration of paramagnetic contrast image quality was sufficient with both techniques to assess the enhancing colonic wall and detect colorectal masses. Colonic wall enhancement was superior with water distension however ($p<0.05$). Discomfort levels for air and water were not different.

1447. Optimization of Barium-Based Fecal Tagging for MR Colonography

Thomas C. Lauenstein[1], Dennis Hibbeln[1], Hubert Schneemann[1], Stefan G. Rühm[1], Jörg F. Debatin[1]
[1]University Hospital Essen, Essen, Germany

Fecal tagging can obviate the need for bowel cleaning prior to MR colonography (MRC). Aim of this study was to optimize a barium-based fecal tagging model for MRC. 10 volunteers underwent MRC on 9 separate occasions using different tagging protocols. Amount, concentration and time range of the barium ingestion was varied. SI values of colonic feces was measured. Maximal reduction of the fecal material SI was achieved with the application of 210% bariumsulfate at a dosage of 4x200ml in conjunction with the additives iron-oxide and lactulose.

1448. Combined MRI of Small and Large Bowel

Thomas C. Lauenstein[1], Burcu Narin[1], Eva Wembacher[1], Jörg F. Debatin[1], Stefan G. Rühm[1]
[1]University Hospital Essen, Essen, Germany

Aim of this study was to assess the feasibility of a combined approach for small and large bowel MR imaging in patients with suspected inflammatory bowel disease. For small bowel distension, patients ingested a solution containing mannitol and locust bean gum. For large bowel distension, a rectal enema with water was performed. A T1w 3D GRE sequence was acquired following i.v. administration of paramagnetic contrast. MR findings were compared with endoscopy and histology. An excellent correlation between the diagnostic modalities was found. Besides, MRI was able to detect additional inflammatory disease in the proximal small bowel not visualized by endoscopy.

1449. MR Colonography in a Rodent Polyp Model: Initial Experience and Demonstration of Feasibility

Christoph Ulrich Herborn[1], Fan Yang[1], Jacques Bara[2], Christine Laclédère[2], Xavier Violas[2], Philippe Robert[2], Claire Corot[2], Jörg Felix Debatin[1], Stefan Günther Ruehm[1]
[1]University Hospital Essen, Essen, Germany; [2]Guerbet, Paris, France

The purpose of the study was to assess the feasibility to detect colorectal polyps in a rodent model by using a water enema in conjunction with contrast-enhanced MR colonography (CE-MRC). With histopathology as gold standard we examined 14 rats suspected of having colorectal lesions with a 3D T1-w gradient recall echo sequence. Quantitative analysis was performed and sensitivity and specificity of the method were determined. Beyond statistically significant increases in SNR and CNR CE-MRC detected 8/9 polyps resulting in a sensitivity/specificity of 0.89/1.0. Hence, dark lumen CE-MRC warrants evaluation in a clinical study.

1450. **Rectal Carcinoma: Pre-Operative Staging of MR Imaging**

Han Ouyang[1], Hongmei Zhang[1], Xinghua Yuan[1], Cuiliu Yang[1], Chunwu Zhou[1]
[1]Cancer Hospital of Peking Union Medical College, Chinese Academy of Medical Sciences, Beijing, People's Republic of China

The purpose of this study is to evaluate the accuracy of the extent of extramural spread into the mesorectum and staging of rectal carcinoma by using MR imaging. 33 patients histologically proved rectal carcinoma were examined. MR imaging was performed in 33 patients with histologically proved rectal carcinoma. MRI showed 100% sensitivity and 83% specificity in stage T1, 91.3% sensitivity and 100% specificity in stage T3, 100% sensitivity and specificity in stage T4, and 90.9% of total accuracy in all patients. Our results indicate that MRI is an important tool in preoperative staging of rectal carcinoma.

1451. **Magnetic Resonance (MR) Evacuation Proctography in the Upright Anatomic Position.**

Tushar Agarwal[1], Paul Wragg[1], Wadilslaw Gedroyc[1], Ara Darzi[1], Stuart William Thomas Gould[1]
[1]Imperial College of Medicine, London, UK

To develop a technique for dynamic pelvic floor assessment and examine all three compartments during straining and defecation in the physiological sitting position. 75 patients with anorectal dysfunction symptoms had MR Imaging carried out at rest, maximal squeeze,maximal strain and repeated with the patient defecating after instilling Gadolinium & potato starch mixture rectally. Images were assembled into cine loop for dynamic assessment. Quantitative assessment was carried out to study bladder base descent, anorectal angle and descent of anorectum. An abnormality was detected in 79% patients. MR Defecating proctography allows dynamic assessment of all three pelvic compartments in one examination.

1452. **Does Gravity Really Have an Effect on Gastric Physiology?**

Andreas Steingoetter[1], Reto Treier[1], Mark Fox[2], Dominik Weishaupt[2], Michael Fried[2], Peter Boesiger[1], Werner Schwizer[2]
[1]ETHZ, Zurich, Switzerland; [2]University Hospital, Zurich, Switzerland

In this study we used MRI to test the hypothesis if gastric emptying is mainly driven by a intragastric pressure gradient between proximal stomach and duodenum. Therefore 5 volunteers were measured in an 0.5T open MR system after the ingestion of 300 ml of water once in sitting and once in upside down position. A difference in gastric motility and relaxation was observed between the sitting and the upside down position, however gastric emptying times were similar. The use of open configuration MR systems allow further investigations of the effect of gravity on gastric emptying pattern and physiology.

1453. **Measuring Tongue Volumes and Visualizing the Chewing und Swallowing Process Using Real-Time TrueFISP Imaging in Patients With Acromegaly – Initial Clinical Experience**

Waleed Ajaj[1], Mathias Goyen[1], Florian M. Vogt[1], Burkhard Herrmann[2], Jörg F. Debatin[1], Stefan G. Ruehm[1]
[1]Department of Diagnostic and Interventional Radiology, Essen, Germany; [2]Department of Endocrinology, Essen, Germany

The examination of the chewing and swallowing process needs an imaging modality with high temporal resolution and adequate soft tissue visualization. The purpose of this study was to determine if real-time True-FISP MR imaging is able to document tongue volumes as well as the chewing and swallowing process in 50 healthy volunteers and in 10 patients with acromegaly. The study has shown that real-time True-FISP imaging can be used to visualize the chewing and swallowing process in volunteers as well as in patients with acromegaly and that the applied protocol is capable to detect several pathologies associated with acromegaly.

1454. **Can Esophageal Magnetic Resonance (MR) Fluoroscopy Assess Gastro-Esophageal Reflux (GER)? Initial Experience**

Tomoko Manabe[1], Hideaki Kawamitsu[1], Takanori Higashino[1], Masahiko Fujii[1], Kazuro Sugimura[1]
[1]Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan

In a prior study, we determined the optimal sequence for esophageal MR fluoroscopy. Using this sequence, we observed GER in patients with gastro-esophageal reflux disease (GERD). Frequency and extension of the reflux could be evaluated, while analysis of images obtained allowed us to infer the mechanism of the reflux. One patient revealed spike-shaped GER only one time, so we deduce it was due to TLESR. Another patient reveled continuous GER during all image acquisitions, and we assumed this was due to spontaneous free GER. The last patient reveled GER, which caused TLESR, with some free GER

1455. **MR Peritoneography Using Saline-Injected MR Imaging Through Implanted Catheter-Port System**

Masao Obuchi[1], Hideharu Sugimoto[1], Atsushi Shimizu[2], Minoru Honda[1], Hayato Kubota[1]
[1]Showa University Fujigaoka Hospital, Yokohama, Kanagawa, Japan; [2]Yokohama Shinmidori Hospital, Yokohama, Kanagawa, Japan

The purpose of this study is to assess intraperiotoneal drug distribution and complication during intraperitoneal chemotherapy using saline-injected MR imaging through implanted catheter-port system. All subjects had primary ovarian tumor, and a subcutaneous implanted catheter-port system was positioned pouch of Douglas at the initial surgical removal of the primary ovarian tumor for intraperitoneal chemotherapy. T2 weighted coronal images of the abdomen were obtained before and after manually saline injection through the implanted catheter-port system. Intraperitoneal saline distribution and complication such as catheter migration, adhesions of the bowel loop and mesenteries could be diagnosed.

1456. Real-Time High-Resolution TrueFISP Imaging for Gastric Motility: Pre- and Post Pharmacological Stimuli

Waleed Ajaj[1], Thomas Lauenstein[1], Nickolas Papanikolaou[2], Jörg F. Debatin[1], Stefan G. Ruehm[1]
[1]University Hospital Essen, Essen, Germany; [2]Department of Radiology, Crete, Greece

Aim of this study was to evaluate the practicability of real-time MRI regarding the assessment of gastric motility. Besides, the effect of motility-modifying agents were determined. Six healthy volunteers were examined using a real-time TrueFISP sequence before and after the intravenous application of scopolamine as well as metoclopramide. A motility index was calculated depending on antral peristalsis. Antral motility was quantified: administration of scopolamine led to a decrease, metoclopramide to an increase of gastric motility compared to the data lacking intravenous drug application.

Renal, Pelvic, and Fetal MR Imaging

Hall D Saturday 14:00 - 16:00

1457. Rapid *In-Vivo* Measurement of Gadolinium Concentration: Feasibility for Application to Determine Renal Function

David Michael Thomasson[1], Diego R. Martin[2]
[1]Siemens Medical Solutions, Malvern, Pennsylvania, USA; [2]West Virginia University, Morgantown, West Virginia, USA

We have developed and validated a 2-dimensional double-echo gradient-echo strategy producing R2* parametric data for quantitative measure of gadolinium concentration which overcomes some of the inherent physical and instrumental limitations of previous methods. This method will be applied to measure gadolinium concentration differences to assess glomerular filtration. Straightforward 2-dimensional linear ordered GRE with high flip angles overcomes both the relaxation effects of inversion or saturation pre-pulse techniques and higher gadolinium concentration saturation effects while maintaining good contrast sensitivity. Parametric images are more accurate for quantitative measurements as they compensate the inherent system variabilities, such as non-uniform coil profile.

1458. Perfusion-weighted Imaging of the Kidneys without Susceptibility Artefacts

Petros Martirosian[1], Uwe Klose[1], Irina Mader[1], Fritz Schick[1]
[1]University of Tübingen, Tübingen, Germany

Susceptibility artefacts substantially limit the usefulness of the common FAIR-EPI sequences for perfusion measurements of organs with inherent field inhomogeneities. The novel FAIR True-FISP technique eliminates magnetic susceptibility artefacts and image distortions commonly observed in FAIR-EPI images. FAIR True-FISP studies on the kidneys of healthy volunteers and of patient with a kidney transplant were performed. Perfusion-weighted images showed diagnostic image quality with sufficient signal-to-noise ratio. It was demonstrated that the FAIR True-FISP technique provides sufficient quality for a clinical perfusion-weighted imaging of the kidneys. Its possible clinical application is perfusion imaging especially of transplant kidneys without potentially nephrotoxic contrast media.

1459. Validation of a Graph Cuts Algorithm for Semi-Automated Segmentation of Magnetic Resonance Renographic Images

Ambrose John Huang[1], Yuri Boykov[2], Henry Rusinek[1], Vivian S. Lee[1]
[1]New York University School of Medicine, New York, New York, USA; [2]Siemens Corporate Research, Princeton, New Jersey, USA

Manual segmentation of dynamic magnetic resonance (MR) renographic images is prohibitively time-consuming and highly operator-dependent. We have developed a semi-automated tissue segmentation algorithm and have tested it on simulated data constructed from 3D MR renography examinations of patients with normal and abnormal renal function. Across three readers, segmentation resulted in average intrarenal compartmental volume errors of between 10% and 27% compared to known volumes. However, corresponding root-mean-square errors in time-signal intensity curves averaged less than 5%. With segmentation times averaging eight minutes per study, this technique shows promise for rapid renal segmentation, thus facilitating analysis of dynamic MR renographic images.

1460. Evaluation of Kidney with T2-Weighted MR Imaging: Comparison of Breath-hold Fast-Recovery Fast Spin-Echo, Breath-hold Single-Shot Fast Spin-Echo and Respiratory-Triggered Fast Spin-Echo Sequence

Motoyuki Katayama[1], Takayuki Masui[1], Shigeru Kobayashi[1], Nobuko Ohkubo[1], Atsushi Nozaki[2]
[1]Seirei Hamamatsu General Hospital, Hamamatsu, Shizuoka, Japan; [2]GE Yokogawa Medical Systems, Hino, Tokyo, Japan

T2-weighted imaging is useful to assess the location and characterization of lesions in kidney. Use of RARE technique has enabled to acquire T2-weighted imaging within 30 seconds, that is, breath-holding time. However, T2-weighted fast spin-echo sequences with short TR has suffered from low signal intensities. Fast-recovery (FR) technique has sequential 180 degree and -90 degree radiofrequency pulses, applied at the end of the fast spin-echo (FSE) sequence to recover saturated spins. Therefore, we speculate breath-hold FSE sequence with FR technique might be useful. Our goal is to assess the value of breath-hold FRFSE images with the comparison of breath-hold

1461. Verification of Absolute Blood Flow Values Determined By Pulsed Arterial Spin-Labeling in an *In Vitro* Porcine Kidney

Carsten Warmuth[1], Lutz Lüdemann[1], Stefan Nagel[1], Bernd Hamm[1]
[1]Charité, Berlin, Germany

Our intention was to test the validity of the general kinetic model for blood flow quantification in arterial spin-labeling measurements. Physiologically accurate perfusion phantoms are difficult to implement. We used an in vitro porcine kidney, perfused with blood under physiological conditions including pulsating blood flow. Absolute values of blood flow and arterial transit times were determined in the cortex using FAIR measurements at two different TI's. Flow was calibrated by an ultrasound flow-meter. At high flow (300ml/100g*min) absolute errors were less than 5%. At low flow comparable to that in brain errors of about 45% were measured.

1462. 3Tesla Imaging of the Prostate with a Rigid Endorectal Coil

Bruce L. Daniel[1], Charles Dumoulin[2], Ronald Watkins[2], Ken Rohling[2], Randall Giaquinto[2], Joseph Presti[1], Kim Butts[1], Roland Bammer[1], Michael Moseley[1]
[1]Stanford University, Stanford, California, USA; [2]GE Corporate Research and Development Center, Schenectady, New York, USA

A 3.0T rigid endorectal coil was developed and tested in 4 volunteers with biopsy proved prostate cancer. The high signal-to-noise ratio afforded by the combination of an optimally tuned and matched fixed geometry coil combined with the increased magnetization at 3.0T enabled very high quality T2-weighted images of prostate anatomy and high quality diffusion-weighted echo-planar images.

1463. Dynamic Gadolinium-Enhanced MR Imaging for Radiation Therapy Monitoring in Prostate Cancer Patients

Annette Barke[1], Kamil A. Il'yasov[1], Valery G. Kiselev[1], Gregor Bruggmoser[1], Fred Roehner[1], Martin Buechert[1], Juergen Hennig[1]
[1]University Medical Center of Freiburg, Freiburg, Germany

Imaging in radiooncology is traditionally focused on the staging, localizing and measuring of tumors in size by indicating anatomic landmarks. Indication of physiological change is the traditional domain of nuclear medicine. In this study MRI was used to investigate the effect of brachytherapy and external radiation on blood distribution, perfusion and permeability in the prostate gland. The changes in prostate perfusion caused by radiation therapy were well detected with a fast dynamic gadolinium-enhance MRI. Such MRI measurements of changes in vessel perfusion and permeability may be a new powerful tool to monitor efficiency of radiation therapy.

1464. Assessment of Prostatic Ductal Volume Using Combined Dynamic Contrast-Enhanced MRI and Diffusion MRI

Susan Moyher Noworolski[1], Albert P. Chen[1], Daniel B. Vigneron[1], John Kurhanewicz[1]
[1]The University of California San Francisco, San Francisco, California, USA

Prostatic ductal volume decreases with cancer grade. To assess whether Gadolinium-DTPA can reach the ducts, MRI, 3D-MRSI, dynamic contrast-enhanced MRI and diffusion were performed on nine prostate cancer patients. Using peak enhancement and ADC, the ductal tissues (normal peripheral zone and glandular BPH) were well separated from the less-ductal tissues (central gland and stromal BPH). This indicates that Gd-DTPA does not reach the ducts; DCE-MRI doesn't seem to reflect the intact ductal volume whereas ADC seems to. Cancer spanned a range of peak enhancement and ADC values. Combining DCE-MRI and ADC yields ductal volume and may help characterize prostate cancers.

1465. Cine Magnetic Resonance (MR) Urography for the Evaluation of the Upper Urinary Tract Function

Masao Obuchi[1], Hideharu Sugimoto[1], Minoru Honda[1], Hayato Kubota[1], Wakako Yamamoto[1], Akifumi Fujita[1]
[1]Showa University Fujigaoka Hospital, Yokohama, Kanagawa, Japan

The purpose of this study is to assess the upper urinary tract function using consecutive heavily T2-weighted images (cine MR urography), 30 images per 5 minutes. This study consists of a phantom study and a clinical study. The phantom study, an evaluation of the correlation between saline volume and its signal intensity, showed that there is a significant correlation between them. The clinical study, consisting of five asymptomatic volunteers, revealed the number of urine bolus that is defined as an abrupt increase of signal intensity in a ROI and the change of it after intravenous injection of a diuretic.

1466. A Mixture-Based Computer Aided Detection System for Virtual Cystoscopy

Lihong Li[1], Zigang Wang[1], Donald P. Harrington[1], Wei Huang[1], Zhengrong Liang[1]
[1]State University of New York, Stony Brook, New York, USA

We present a mixture-based computer aided detection (CAD) system using multispectral (T1- and T2-weighted) MR images. As multispectral images are spatially registered over three-dimensional (3D) space, information extracted from them is more valuable than that extracted from each image individually. In addition, because bladder tumors tend to develop gradually and migrate slowly from the mucosa into the bladder wall/muscle, we focus on analyzing the mucosa layer. Our system provides dual states of bladder scans and extracts both geometry and texture information for tumor detection. Experimental results demonstrate its feasibility towards mass screening of bladder tumor.

1467. Comparison of Uterine Tissue Development Measured during the Normal Menstrual Cycle using MRI and 3D Ultrasound

Caroline Hoad[1], Nick Raine-Fenning[2], Jon Fulford[1], Jeanette Clewes[2], Nigel Kendall[2], Bruce Campbell[2], Ian Johnson[2], Penny Gowland[1]
[1]Nottingham University, Nottingham, UK; [2]University Hospital, Nottingham, UK

Endometrial and junctional zone development were studied in a group of healthy, ovulatory women using MRI and 3D Ultrasound. Development was assessed using T_2-weighted MRI and 3D Ultrasound of the pelvis, by measuring tissue volume and thickness at different times in the menstrual cycle. Statistically significant changes were seen in the MRI and US data, for the endometrial volume and thickness, and junctional zone volume between follicular and peri-ovulatory scans, however no changes in the junctional zone thickness were observed. Overall good correlation was seen between MRI and ultrasound in the follicular phase of the cycle.

1468. MR Imaging of Anomalies of the Mullerian Ducts

Gisela Christa Mueller[1], Hero Hussain[1], Ruth Carlos[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

Objective: to assess the clinical value of MRI in evaluating anomalies of the mullerian ducts. Material and Methods: 86 patients (age 22 days to 43 years, mean 25 years) underwent pelvic MRI for evaluation of a possible mullerian duct anomaly between October 1998 and August 2002. We retrospectively compared MRI diagnoses with available clinical, surgical or hysteroscopic data or, if performed, with findings on other imaging studies. Results: In 73 of the 86 patients MRI confidently characterized the uterine anomaly (Table 1). Conclusion: MRI is useful for evaluating anomalies of the mullerian ducts.

1469. Does Magnetic Resonance Imaging Have a Definitive Role in the Evaluation of Women with Pelvic Pain Syndrome?

Lisa Grosvenor[1], Alan Moody[2], Beverly Collett[1], Amanda Liddicoat[1]
[1]Leicester Royal Infirmary, Leicester, UK; [2]Queens Medical Centre, Nottingham, UK

Pelvic Pain Syndrome (PPS) is a common gynaecological complaint in young multiparous women, leading to extensive investigation and laparoscopy without identification of an agreed pathological cause. Our study assessed whether magnetic resonance imaging (MRI) has a definitive role in the evaluation of PPS. We studied 19 women, 10 with PPS and 9 controls. MRI detected a similar incidence of gynaecological conditions and pelvic venous congestion with reflux in both groups. There was no correlation between findings of pelvic venous congestion with reflux and symptoms. MRI does not provide a definitive diagnostic role for PPS.

1470. Evaluation of Pelvic Adhesions with a Combination of Multiphase and Multislice Single-Shot Fast Spin-Echo T_2-Weighted Imaging and Gadolinium Enhanced T_1-Weighted Spoiled Gradient Recalled Echo imaging

Motoyuki Katayama[1], Takayuki Masui[1], Shigeru Kobayashi[1], Nobuko Ohkubo[1], Atsushi Nozaki[2]
[1]Seirei Hamamatsu General Hospital, Hamamatsu, Shizuoka, Japan; [2]GE Yokogawa Medical Systems, Hino, Tokyo, Japan

Introduction: Magnetic resonance imaging has played an important role in assessment of various pelvic diseases. In order to evaluate pelvic adhesions, however, static imaging is still not useful. In our previous report, we demonstrated the clinical utility of multiphase and multislice (kinematic) T2-weighted imaging. Combined evaluation of other image sequences might enhance the utility of kinematic imaging. Therefore, we studied combined evaluation of kinematic T2-weighted imaging and gadolinium-enhanced static T1-weighted imaging. Methods: This study included 37 patients who underwent pelvic MR imaging (age range 15 - 76 years old; mean age 41.9 years old) Twenty-two uterine lesions (uterine fibroids

1471. MR Imaging with True FISP and HASTE Sequences in Cases of Placenta Accreta: Evaluation of the Uteroplacental Interface

Jeong-Ah Kim[1], Vamsidhar R. Narra[1], Jay P. Heiken[1], Jeffrey J. Brown[1], Jeong-Ah Kim[2]
[1]Mallinckrodt Institute of Radiology, Washington University in St. Louis, St. Louis, Missouri, USA; [2]Samsung Cheil Hospital, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea

Placenta accreta is direct adherence of the placenta to the myometrium and may result in significant intrapartum morbidity and mortality. MRI has been useful when ultrasound findings are equivocal [1,2]. HASTE sequence has provided good resolution minimizing fetal and maternal motion artifacts [3]. True FISP has been reported to provide image quality superior to that of the HASTE due to less blurring effect in the fetal CNS [4]. We speculate that fast T2-weighted imaging with both sequences can improve visualization of the uteroplacental interface. We reviewed the MRI with both sequences retrospectively in four cases of suspected placenta accreta.

1472. Diffusion MR of Fetal Brain Lesions: Preliminary Clinical Experience

Andrea Righini[1], Elena Bianchini[1], Cecilia Parazzini[1], Cristina Baldoli[2], Umberto Nicolini[1], Salvatore Zirpoli[1], Fabio Triulzi[1]
[1]Istituti Clinici di Perfezionamento, Milan, Italy; [2]Universita' Vita e Salute, Milan, Italy

We report the abnormal DWI findings and ADC determinations in the brain of seven fetuses undergoing prenatal MRI for ischemic lesions, acute cerebral death, increased cellular proliferation disorder, tuberous sclerosis: in all these conditions some degree of ADC decrease was noticed. Also a cystic lesion, which showed ADC increase, is reported. This preliminary clinical experience suggests that prenatal DWI can add valuable data in order to better characterize fetal brain lesions.

1473. Flow Characteristics of the Placental Basal Plate

Jonathan Fulford[1], Rachel Duckett[2], Phillip Baker[3], Ian Johnson[2], Penny Gowland[1]
[1]University of Nottingham, Nottingham, UK; [2]University Hospital, Nottingham, UK; [3]St Mary's Hospital, Manchester, UK

The presence of coherent blood flow within the basal plate was investigated with a PGSE sequence. Differences in average phase values for ROIs within the same slice were determined with non-flow and flow encoding images allowing net phase shifts and subsequently coherent flow velocity within the basal plate to be calculated.An average net coherent flow velocity measured in 13 subjects at gestational ages betweeen 25 and 37 weeks was 1.86mms^{-1}.

1474. TrueFISP vs. Half-Fourier Rapid Acquisition with Relaxation Enhancement Imaging: Differences of Appearances in Fetal MR Imaging

Kazuyuki Ohgi[1], Takashi Furukawa[1], Akiyoshi Yamashita[1], Masayuki Motonishi[1], Kouichirou Murata[2], Katsuhito Gotoh[3], Tomoko Matsubara[3], Minako Higashi[3]
[1]Japanese Red-Cross Medical Center, Shibuya-ku, Tokyo, Japan; [2]Kitasato-Institute Hospital, Minato-ku, Tokyo, Japan; [3]Toshiba Medical Corp., Chuo-ku, Tokyo, Japan

This study illustrates differences of appearances in TrueFISP and half-Fourier (HF) rapid acquisition with relaxation enhancement (RARE) sequence in fetal MR imaging (MRI). TrueFISP can reduce flow-void motion artifacts of the amniotoc fluid. The lumen of cardiovascular system shows high signal intensity (SI) in TrueFISP, whereas they showed flow-void in HF RARE. Umbilical cords show central high SI in TrueFISP, whereas they show low SI or signal-void in HF RARE. TrueFISP provides different signal patterns of various structures from those with HF RARE, allowing possibilities of yielding additional valuable informations in fetal MRI.

MR Spectroscopy of the Abdomen and Pelvis

Hall D Sunday 13:30 - 15:30

1475. Use of Three Dimensional Magnetic Resonance Spectroscopic Imaging in Detection of Prostate Carcinoma in Patients with Previous Transurethral Prostatectomy

Wang Xiao Ying[1], Jiang Xue Xiang[1], Zhou Liang Ping[1]
[1]Peking University First Hospital, People's Republic of China

Synopsis: MR imaging and 3DMRSI examination were performed in 12 patients with previous TURP for treatment of BPH. The patients had a continuously increasing PSA value and were examined to differentiate whether there was recurrence of BPH or emergence of a prostatic carcinoma. MRI, 3DMRSI and pathological findings were compared. Sensitivity and specificity for MRI were 73.1% and 64.5% respectively. The 3DMRSI diagnosis of cancer had significantly higher sensitivity (82.9%, $P<0.05$) and higher specificity (80.3%, $P<0.05$). Receiver operating characteristic analysis showed significant ($P<0.01$) improved tumor detection when 3DMRSI was added to MR imaging.

1476. MR Imaging and MR Spectroscopy of Prostate at 3 Tesla

Yasushi Kaji[1], Kagayaki Kuroda[2], Takaki Maeda[1], Yuri Kitamura[1], Yuichiro Matsuoka[2], Tsuyoshi Matsuda[3], Tetsuji Tsukamoto[3], Kazuro Sugimura[1]
[1]Kobe University School of Medicine, Kobe, Hyogo, Japan; [2]Institute of Biomedical Research and Innovation, Kobe, Hyogo, Japan; [3]GE Yokogawa Medical Systems, Hino, Tokyo, Japan

To improve patients' comfort while maintaining a high signal to noise in prostate MRI and MRS, we have developed a specially tuned pelvic coil for prostate study at 3 tesla. The prostate structural details and metabolite signals were demonstrated with the coil avoiding use of an endorectal surface coil, which is common in 1.5 tesla study. The potential to diagnose early morphological and spectral changes of prostate metabolites was greatly expected.

1477. Prediction of Histologic Type of BPH based on Metabolites Information with Proton MR Spectroscopy: Comparison with MR Imaging Findings

Yasushi Kaji[1], Takaki Maeda[1], Akihiko Wada[2], Izumi Imaoka[2], Michimasa Matsuo[2], Kazuro Sugimura[1]
[1]Kobe University School of Medicine, Kobe, Hyogo, Japan; [2]Tenri Hospital, Tenri, Nara, Japan

The purpose was to determine whether the information of MR spectroscopy (MRS) consists with MRI findings about the prediction of histologic types of benign prostatic hyperplasia (BPH). 22 patients were examined. MRI and MRS were performed on a 1.5 T scanner using a phased-array coil. The signal intensities on T2-WI and the enhancement pattern were compared with (choline + creatine) / citrate peak area ratios (CC/C). The CC/C of H-NE voxels (glandular BPH) were significantly lower than those of L-E voxels (stromal BPH). The histologic classification of BPH could be possible based on spectroscopic metabolic information.

1478. *In-Vitro* and *Ex-Vivo* Proton Magnetic Resonance Spectroscopy (^{1}H-MRS) Findings for the Stomach Tissue of Patients

Ji Youn Cho[1], Jong Woon Cho[1], Woon Jae Shin[2], Hyun Yong Lee[2], Chung Ki Eun[1], Sang Hee Nam[1], Chi Woong Mun[1]
[1]Inje University, Kimhae, Kyungnam, Republic of Korea; [2]Busan Paik Hospital, Busan, Kyungnam, Republic of Korea

In-vitro 1H MRS examinations were performed to distinguish between abnormal and normal tissue of stomach.

1479. Defects of Postprandial Hepatic Glucose Metabolism in Type 2 Diabets Mellitus.

Martin Krssak[1], Attila Brehm[1], Elisabeth Bernroider[1], Chiara Dallaman[2], Peter Nowotny[1], Claudio Cobelli[2], Gerald I. Shulman[3], Werner Waldhäusl[1], Michael Roden[1]
[1]University of Vienna, Wien, Austria; [2]University of Padova, Padua, Italy; [3]Yale University, New Haven, Connecticut, USA

Type 2 diabetic patients (T2DM) exhibit postprandial hyperglycemia which could result from defects in hepatic glycogen metabolism. We assessed hepatic glycogen synthesis and glycogenolysis with *in vivo* ^{13}C NMRS, endogenous glucose production (EGP) with [6,6-$^2H_2$]glucose and meal absorption with [1-^{13}C]glucose in 7 T2DM and 7 matched nondiabetic volunteers after meal ingestion. Postprandial glycogen synthesis was 33% lower and EGP remained 50% higher for 60-180 min postptrandialy in T2DM. They also exhibited 50% lower glycogenolytic rates during the late postprandial period. In conclusion, excessive postprandial hyperglycemia in T2DM is associated with incomplete suppression of EGP due to defective hepatic glycogen metabolism.

1480. Measurement of Hepatocellular Lipid Content and Relaxation Times of Water and Lipids in Patients with Chronic Hepatitis C using ^{1}H NMR Spectroscopy at 3T.

Martin Krssak[1], Harald Hofer[1], Martin Meyerspeer[1], Ewald Moser[1], Peter Ferenci[1], Michael Roden[1]
[1]University of Vienna, Wien, Austria

Measurement of hepatocellular lipid (HCL) content by localized ^{1}H NMRS at 3T was compared with routine histological grading of the respective liver biopsies in 31 chronic hepatitis C patients. HCL measured by NMRS linearly correlates with HCL as assessed histologically both in the total group (r=0.705, p<0.001) and in the subgroup of patients with second grade of fibrosis (n=16, r=0.733, p<0.001). T_2 relaxation times ranged from 20.1-81.8 ms (mean:32.7±2.4 ms) for water and 38.3-118.1 ms (mean:60.5±6.7 ms) for lipids. No correlation was observed between relaxation times for water or lipid signal, the HCL and/or tissue fibrosis grade.

1481. Phosphorus MRS of Uterine Cervical Cancer using Transvaginal Coil

Takayuki Obata[1], Hiroo Ikehira[1], Tatsuya Ohno[1], Yoshiyuki Suzuki[1], Shuji Tanada[1], Hirohiko Tsujii[1], Takashi Nakao[1]
[1]National Institute of Radiological Sciences, Chiba, Japan

Phosphorous-31 magnetic resonance spectroscopy (31P MRS) is helpful for this purpose because the in vivo metabolisms of energy and membrane phospholipid can be measured by this modality. However, the uterine cervix is located so deep from the body surface that the 31P MR signals there can not be acquired with the usual surface coil. Therefore, we developed a transvaginal coil tuned for phosphorous-31 and measured MRS of the uterine cervical carcinoma.

Musculoskeletal MR Imaging: Clinical Studies

Hall D Monday 13:30 - 15:30

1482. MRI in Rheumatoid Arthritis. Suggested Core Set of MRI Acquisitions, Joint Pathology Definitions and Scoring System (OMERACT 2002 RAMRIS)

Mikkel Østergaard[1], Charles Peterfy[2], Philip Conaghan[3], Fiona McQueen[4], Paul Bird[5], Bo Ejbjerg[1], Ron Shnier[6], Phil O'Connor[3], Mette Klarlund[1], Paul Emery[3], Harry Genant[7], Marissa Lassere[5], John Edmonds[5]
[1]Copenhagen University Hospital, Hvidovre, Denmark; [2]Synarc Inc, San Francisco, California, USA; [3]University of Leeds, Leeds, UK; [4]Auckland University, Auckland, New Zealand; [5]St. George Hospital, University of New South Wales, Sydney, Australia; [6]Mayne Nickless, Sydney, Australia; [7]University of California, San Francisco, California, USA

This paper describes a rheumatoid arthritis (RA) MRI scoring system (OMERACT 2002 RAMRIS) for evaluation of inflammatory and destructive changes in RA hands and wrists, which has been developed by an international MRI-OMERACT group. Furthermore, MRI definitions of important RA joint pathologies and a "core set" of basic MRI sequences for use in RA are suggested.

1483. The Role of Metacarpophalangeal Joint Anatomical Factors on the Sistribution of Synovitis and Bone Erosions in Early Rheumatoid Arthritis.

Steven Frederick Tanner[1], Ai Lyn Tan[2], Aleksandra Radjenovic[1], Philip Conaghan[2], Philip O'Connor[2], John Philip Ridgway[1], Paul Emery[2], Dennis McGonagle[2]
[1]University of Leeds, Leeds, Yorkshire, UK; [2]Leeds General Infirmary, Leeds, Yorkshire, UK

Magnetic resonance measurements have been made in patients with early rheumatoid arthritis to show that both the synovitis and subsequent bone erosions are distributed predominantly on the radial side of the metacarpophalangeal joints. This asymmetric distribution suggests that local joint factors (relating to the radial collateral ligaments and microtrauma) may profoundly influence the pathogensis of early rheumatoid arthritis.

1484. Identification of Wrist and MCP Joint Erosions Using a Portable, Low-Field, Extremity MR System: Results Compared to Conventional X-ray

John V. Crues[1], Orrin M. Troum[2], Siamak Dardashti[1], Timothy James[3], Frank G. Shellock[4]
[1]Radnet Management, Los Angeles, California, USA; [2]University of Southern California, Los Angeles, California, USA; [3]MagneVu, Carlsbad, California, USA; [4]Institute for Magnetic Resonance Safety, Education, and Research, Los Angeles, California, USA

Prior studies using whole-body scanners have shown MRI to be sensitive for detection of erosions in rheumatoid arthritis and other arthropathies. This study compares MR images obtained using a portable, extremity MRI system (PE-MRI) to conventional x-rays (XR) in the detection of erosions of the wrist and metacarpophalangeal (MCP) joints in 82 patients. The findings indicated superior sensitivity to bone damage for the PE-MRI compared to XR, suggesting that MRI performed using this unique scanner is extremely promising in the assessment of inflammatory arthropathies.

1485. Comparison of MRI T_2 Maps and Arthroscopy in Evaluation of Cartilage Pathology of the Knee

Timothy J. Mosher[1], Yi Liu[1], Kevin P. Black[1], Scott A. Lynch[1], Bernard J. Dardzinski[2], Michael B. Smith[1]
[1]Penn State University College of Medicine, Hershey, Pennsylvania, USA; [2]University of Cincinnati College of Medicine, Cincinnati, Ohio, USA

The purpose of this technique is to validate T2-mapping with arthroscopic evaluation in detection and grading of cartilage pathology. A comparison of quantitative MRI T2 maps and arthroscopic grading of cartilage lesions was performed using a prospective double-blinded study of 18 volunteers age 18 to 67 years. MRI T2 maps over estimated disease compared to that detected at arthroscopy, likely secondary to inherent differences in pathology evaluated with the two techniques. Using less stringent criteria of presence or absence of disease, there was better agreement comparing Z-score maps with arthroscopy.

1486. Evaluation of 3D SSFP Imaging in Knee Joint

Yuichi Yamashita[1], Mosatugu Mori[1], Satoshi Sugiura[2], Takashi Ishimori[3], Satoru Nakano[3], Motoomi Ohkawa[3]
[1]Toshiba Medical Systems Co., Ltd., Takamatu, Kagawa, Japan; [2]Toshiba Corp Medical R&D Cener, Ootawara, Tochigi, Japan; [3]Kagawa Medical University, Miki, Kagawa, Japan

The purpose of this study is to determine the optimum scanning parameter for 3D SSFP sequence and to assess the feasibility of this technique, especially in the knee joint region. The phantom and volunteer studies were carried out in comparison with other techniques such as T1W, T2W and T2*W. As the result, 3D SSFP with FA of 30 showed the best contrast to noise ratio between meniscus tear and ligament. Since 3D technique provides thin slice images with wide coverage, used in combination with MPR, this sequence is useful in diagnosis for knee joint within relatively short examination time.

1487. Musculoskeletal Imaging with Phase Sensitive SSFP

Shreyas S. Vasanawala[1], Brian A. Hargreaves[1], Krishna S. Nayak[1], Garry E. Gold[1], John M. Pauly[1], Dwight G. Nishimura[1]
[1]Stanford University, Stanford, California, USA

Fully refocused imaging (SSFP or TrueFISP) offers high SNR efficiency, but intense fat signal. Multiple sequence modifications have been proposed to suppress fat signal. Here we present a phase-based SSFP technique for fat-water separation. With echo time half the repetition time, fat and water signals are 180 degrees out of phase. Positive signal thus gives a water image and negative signal yields a fat image. The potential utility of this method for musculoskeletal imaging is demonstrated by scanning several knees of normal volunteers.

1488. 3D,Weight Bearing MRI Analysis of Meniscal Displacement

Yasuyuk Mizuno[1], Shigeru Nishiguchi[2], Noboru Okuuchi[3], Yasuaki Nakagawa[1], Sadami Tutumi[1], Takashi Nakamura[1], Takashi Azuma[1]
[1]Kyoto University, Kyoto, Japan; [2]Kobe City Hospital, Kobe, Hyougo, Japan; [3]Biomedical Research and Innovation, Kobe, Hyougo, Japan

The purpose of this study was to analysis meniscal displacement and its change of shape during a physiologic motion. Using an open MR scanner, both weight-bearing and non-weight-bearing imaging was performed on six volunteers. Each joint was imaged from full extension to ninety degrees of knee flexion. Using 3D reconstruction, meniscal displacement and change of shape relative to the tibia and flexion angle was measured. The result revealed large change of shape in the lateral meniscus and small displacement in the posterior horn of the medial meniscus. The radial displacement did not change significantly.

1489. Kinematic MRI of the Patellofemoral Joint: Evaluation of Ironman Triathletes

Frank G. Shellock[1], George R. Ainge R. Ainge[2], W. Douglas B. Hiller[3], David W. Brown[2], Laura Dierenfield[4]
[1]Institute for Magnetic Resonance Safety, Education, and Research, Los Angeles, California, USA; [2]North Hawaii Community Hospital, Kamuela, Hawaii, USA; [3]North Hawaii Community Hospital and Labman Hawaii, Kamuela, Hawaii, USA; [4]Labman Hawaii, Kamuela, Hawaii, USA

The Ironman Triathlon competition involves a 2.4-mile swim, a 112-mile bike race, and 26.2-mile run. The patellofemoral joint is a frequently injured joint and site of painful symptoms for athletes. A recent report indicated that (32%) of Ironman Triathletes experienced patellofemoral joint symptoms. However, prior research has generally indicated a poor correlation between symptoms and patellofemoral dysfunction. The "state-of-the-art", active-movement against-resistance, kinematic MRI technique, was used to evaluate Ironman Triathletes. The findings indicated that 19% of the patellofemoral joints had an abnormality. Importantly, there was a strong correlation between symptoms and patellofemoral joint abnormalities in these Ironman Triathletes.

1490. Patellar Tendon Volume as Compared to Anthropomorphic and Epidemiologic Characteristics

Joseph M. Carabetta[1], Mark E. Schweitzer[1], Laurence Parker[1]
[1]Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA

We hypothesized that patellar tendon volume was related to certain anthropomorphic and epidemiologic characteristics. Consequently, we used knee MR and 3D volume software to perform a retrospective analysis of patellar tendon volume, correlating it with patient age, gender, height, weight, and BMI. We found that gender affects patellar tendon size. Also, in the overall population, taller and heavier, but not stouter patients have larger patellar tendons. This effect is mostly relatable to gender differences.

1491. Evaluation of Previously Published Staging Systems of Osteochondral Lesions of the Talus in Follow-Up MR Imaging of Non-Surgically Treated Ankles

Jennifer W. Jung[1], William B. Morrison[1], Steven M. Raikin[1], John A. Carrino[1]
[1]Thomas Jefferson University, Philadelphia, Pennsylvaia, USA

Many systems have been proposed to stage osteochondral defects of the talus using criteria including stability of the lesion, bone marrow edema (BME), cysts and interface signal intensity. The purpose of this study is to evaluate four previously published staging systems for talar OCDs in a cohort of patients with follow-up MR imaging studies who were not treated surgically. We found that cysts and BME around talar OCDs may resolve on MR images and therefore may not be a reliable sign of lesion severity. Since these findings determine stage of the disease using some classification systems, these may require adjustment.

1492. Neutral and Stress MR Imaging of the Ankle Using a Multidirectional Kinematic Device: Unreliability of Morphologic Criteria for Diagnosis of Lateral Ligament Insufficiency

Stacie Irene Ringleb[1], Sorin Siegler[1], Jayaram K. Udupa[2], Mark Schweitzer[3], William B. Morrison[3], Enyi Okereke[2], Bruce Elliot Hirsch[1], Neil Roach[2]
[1]Drexel University, Philadelphia, Pennsylvania, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [3]Thomas Jefferson University, Philadelphia, Pennsylvania, USA

Purpose: Test the reliability of MRI as a diagnostic tool for ATFL injuries in chronic ankle instability. Methods: Two radiologists evaluated MR images obtained from 22 normal and 6 chronically unstable ankles in neutral, inversion, and anterior drawer. Results: There was low correlation between radiological exam, physical exam, and clinical symptoms. 59% agreement between the two testers was identified. Conclusions: MR diagnosis in neutral or stressed configuration correlates poorly with clinical symptoms and physical examination of chronic ankle instability. The low inter-rater agreement farther suggests low reliability of this technique.

1493. *In Vivo* Assessment of Function in Human Plantar Flexors Following Achilles Tendon Rupture and Surgical Repair -- a Phase Contrast MR study

Shantanu Sinha[1], Alex Lai[1], Taija Finni[1], John A. Hodgson[1], John Grinstead[1], Reggie V. Edgerton[1]
[1]University of California, Los Angeles, California, USA

We examined the utility of MR based techniques on 3 patients with Achilles tendon rupture and surgical repair, to assess changes in contraction velocities of different muscles during isometric contraction, muscle volume and MVC. These were used as quantitative measures of the functional status of the limb at different times during rehabilitation. Marked decrease of volume and MVC of MG and Sol-DPF which did not normalize after 6 weeks of rehab was noted. Changes in contraction velocities suggest that the Sol and not the MG was primarily affected by injury and the DPF increased in activity as a compensatory adaptation.

1494. MR Evaluation of Extracorporeal Shock-Wave Therapy Response in Patients with Chronic Plantar Fasciitis

Fang Zhu[1], Kyongtae T. Bae[1], Jeffrey E. Johoson[2]
[1]Mallinckrodt Institute of Radiology, Saint Louis, Missouri, USA; [2]Department of Orthopeadic Surgery, Saint Louis, Missouri, USA

Extracorporeal shock-wave therapy has been used as a noninvasive treatment for chronic plantar fasciitis. The purpose of this study is to evaluate the somatic changes in the foot before and after the treatment using serial MR imaging studies. All 11 cases showed significant thicken proximal plantar fascia that had no change before and after treatment. All cases had greater edema after treatment but most of them resolve later. The resolution of soft tissue edema appears highly associated with positive outcome of the treatment. MRI is a possible utility to evaluate and predict the progress of the therapy.

1495. High-Resolution MR Imaging of Triangular Fibrocartilage Complex (TFCC): Comparison Microscopy Coils with a Conventional Small Surface Coil.

Hiroshi Yoshioka[1], Teruko Ueno[1], Toshikazu Tanaka[2], Masashi Shindo[3], Yuji Itai[1]
[1]University of Tsukuba, Tsukuba, Ibaraki, Japan; [2]Tsukuba Memorial Hospital, Tsukuba, Ibaraki, Japan; [3]Tsukuba University Hospital, Tsukuba, Ibaraki, Japan

High-resolution MR images of the wrist of normal volunteers were obtained using microscopy coils with proton-density weighted and T2*-weighted sequences. The S/N and C/N of ulnar side structures of the wrist, including the TFCC showed significantly higher values on MR images with microscopy coils than those with a conventional small surface coil. In the qualitative image analysis to delineate each structure of the TFCC, the former showed higher score than the latter. Therefore, high resolution MRI with microscopy coils would be a promising method to diagnose TFCC lesions.

1496. A 2 Year Longitudinal Study of Trabecular Bone Parameters in Post-Menopausal Osteoporosis

Sharmila Majumdar[1], David Newitt[1], Charles Chesnut[2], Andrew Shields[2], E Lachansky[2], Audrey Kriegman[3], M Olsen[3], F Hornig[3], Moise Azria[3], Linda Mindelholm[3]
[1]University of California San Francisco, San Francisco, California, USA; [2]University of Washington, Seattle, Washington, USA; [3]Novartis Pharma, Basel, Switzerland

Magnetic resonance images were used to measure trabecular bone architecture in the distal radius and calcaneus, and relaxation time T2* in the hip of postmenopausal women undergoing Calcitonin therapy for osteoporosis. Increases in trabecular bone structure was significant in regions of the radius, while they increased in the calcaneus, the results did not reach signifcance. Hip T2* also showed a significant decrease, commensurate with increasing bone density and structure in the treated cohort.

1497. Perfusion MR Imaging of Diseased Vertebra; Evaluation of the Differentiation between Benign and Metastatic Lesions with and without Compression Fracture.

Osamu Tokuda[1], Noriko Hayashi[1], Naofumi Matsunaga[1]
[1]Yamaguchi University, Ube, Yamaguchi, Japan

To our knowledge, there have been a limited number of articles evaluating bone marrow blood perfusion in normal and diseased vertebrae [1, 2]. Cova et al. [3] reported that bone marrow perfusion when evaluated with gadolinium-enhanced dynamic MRI showed a strong correlation between MR data and microsphere blood-flow measurements. The present study investigated peak enhancement, steepest slope, slope, and time intensity curve (TIC) patterns in the first pass of contrast in diseased vertebral bodies to analyze the perfusion characters of benign and metastatic vertebral lesions with and without fractures.

1498. Quantitative Assessment of Diffusion Abnormalities in Myxoid and Non-myxoid Type Soft Tissue Tumors by Line Scan Diffusion-weighted Imaging

Masayuki Maeda[1], Akihiko Matsumine[1], Hajime Sakuma[1], Stephan Maier[2], Kan Takeda[1]
[1]Mie University School of Medicine, Tsu, Mie, Japan; [2]Brigham and Women's Hospital, Boston, Massachusetts, USA

Our purpose was to evaluate the apparent diffusion coefficient (ADC) of myxoid and non-myxoid type soft tissue tumors and to determine if interstitial myxoid matrix influences the ADC of soft tissue tumors. Line scan diffusion-weighted imaging was prospectively performed for 22 myxoid and 20 non-myxoid soft tissue tumors. The ADC values were 1.82 +/- 0.37 x 10-3 mm2/s in myxoid type and 0.99 +/- 0.33 x 10-3 mm2/s in non-myxoid type. There was significant difference in ADC values between the two ($p<0.01$).

1499. Evaluation of Tumor Blood Flow by Using Dynamic MRI and Deconvolution Analysis

Yoshifumi Sugawara[1], Kenya Murase[2], Keiichi Kikuchi[1], Masaaki Hirata[1], Hitoshi Miki[1], Teruhito Mochizuki[1], Junpei Ikezoe[1], Kenshi Sakayama[1]
[1]Ehime University School of Medicine, Shigenobu, Ehime, Japan; [2]Osaka University Medical School, Osaka, Japan

Although tumor blood flow is increased by angiogenesis, quantitative measurement of tumor blood flow (TBF) in vivo has not been established. In this study, we evaluated TBF by using dynamic MRI and deconvolution analysis. In 22 patients with musculoskeletal tumors, quantitative TBF maps (ml/100ml/min) were generated pixel by pixel. TBF maps showed wide variances in tumors: the lowest of 2.72 mL/100mL/min in a case of lipoma, and the highest of 191.19 mL/100mL/min in a case of metastatic bone tumor from thyroid cancer. Substantial changes of TBF were demonstrated in cases of follow-up measurements of TBF.

1500. MR Imaging Findings of Recurrent Soft Tissue Tumors Treated with High Intensity Focused Ultrasound “HIFU”: Preliminary Results

Huiyi Ye[1], Wei Wang[2], Wenzhi Chen[3], Youquan Cai[1], Yan Liang[1], Guo Yu[1]
[1]PLA General Hospital, Beijing, People's Republic of China; [2]PLA 307 Hospital, Beijing, People's Republic of China; [3]2nd Affiliated Hospital of Chongqing University of Medical Science, Chongqing, People's Republic of China

PURPOSE: To assess the value of MR imaging in follow-up of recurrent soft tissue tumors treated with high intensity focused ultrasound (HIFU). METHODS: Nonenhanced and multiphase gadolinium-enhanced MR imaging before and after HIFU treatment in seven patients with pathologically proved recurrent soft tissue tumors were interpreted prospectively in a blinded fashion. RESULTS: Strong enhancement of those tumors disappeared after HIFU treatment. Coagulative necrosis was confirmed by pathologic findings and supported by MR imaging of follow-up. CONCLUSION: MR imaging is a reliable monitoring modality in evaluation of HIFU and HIFU is an effective local therapy for recurrent soft tissue tumors.

1501. Diffusion Tensor Imaging of Peripheral Nerve

Janaki N. Ramanathan[1], Julie H. Harreld[1], Evelyn E. Babcock[1], David A. Fenyes[1], James L. Fleckenstein[1]
[1]University of Texas Southwestern Medical Center, Dallas, Texas, USA

Diffusion tensor images of the forearm at four different b-values were obtained to study median nerve anisotropy and diffusivity in 7 healthy subjects. Anisotropy ratio was greater in the median nerve compared to muscle at all b values. Nerve diffusion in the zz direction was greater than all other directions. Both the ADC and Dzz of nerve decreased linearly with b, a known phenomenon of brain tissue. Establishing this data in healthy subjects allows for future systematic evaluation of diseased peripheral nerve.

Musculoskeletal MR Imaging: Cartilage

Hall D Tuesday 13:30 - 15:30

1502. Age-development of Articular Cartilage Structures of Sheep

Uta Reibetanz[1], Wilfried Gründer[1]
[1]University of Leipzig, Leipzig, Saxony, Germany

Resulting from anisotropic dipolar coupling of semi-free matrix water it is possible to investigate network structuring of articular cartilage by means of MR imaging. Earlier studies have demonstrated that radial and tangential cartilage structures can be identified from the angle-dependence of the signal intensities (1-3). Here, we report investigations of sheep cartilage structures in dependence of age. Based on the angle-dependent changes of the signal intensities a model was proposed describing zonal collagen network structure as composite of radial, tangential and isotropic dues. A scheme of development of collagen network structure of sheep knee joint was derived.

1503. A Multinuclear NMR Study of the Maturation of Pig Articular Cartilage

Keren Keinan-Adamsky[1], Hadassah Shinar[1], Gil Navon[1]
[1]Tel-Aviv University, Tel-Aviv, Israel

The maturation of articular cartilage is caracterized by an increase in the density of collagen fibers and in their alignment. In the present work we demonstrate how this process can be followed by ^{2}H and ^{23}Na quadrupolar splitting and by the proton T_2. A significant increase in both the ^{2}H and ^{23}Na quadrupolar splitting and a decrease in T_2 with age were observed, indicating a larger extent of interaction of water and sodium ions with the collagen fibers. Moreover, with age, the degree of alignment increased and at maturation at least two types of fibers could be observed.

1504. A MRI Study of Spatial and Temporal Variation in Fixed Charge Density in Developing Chick Sterna

Kenneth W. Fishbein[1], Yehezkiel A. Gluzband[1], Archana Ranganathan[1], Richard G.S. Spencer[1]
[1]NIH/National Institute on Aging, Baltimore, Maryland, USA

Gadolinium-enhanced T1-weighted MR imaging was used to examine the spatial and temporal variation in matrix fixed charge density (FCD) in chick sterna explants cultured for up to 7 days ex vivo. Substantial variation in post-gadolinium T1 contrast was observed along the length of each sternum, indicating maximum FCD at the proximal end with a steady decrease toward the distal tip. From 2 to 7 days of incubation, this spatial variation became more pronounced and nonlinear. These trends were observed in both MRI and biochemical measurements, although the ratio of MRI to biochemical FCD was dependent on position along the sternum.

1505. Improved Method for Cartilage T_2 Mapping at 1.5T

Cynthia F. Maier[1], Steve G. Tan[1], Hollis G. Potter[2]
[1]GE Medical Systems, Waukesha, Wisconsin, USA; [2]Hospital for Special Surgery, New York, New York, USA

In previous work at clinical field strength (1.5T), we have shown that use of a conventional multi-slice, multi-echo (MSME) sequence for T2-mapping of articular cartilage results in significant error due to stimulated echoes and magnetization transfer contrast (MTC) (1). In this study, we show preliminary results from a modified MSME sequence that is optimized for T2-mapping of cartilage.

1506. dGEMRIC, T_2 and $T_{1\rho}$ MRI of Articular Cartilage Degradation

Nina Menezes[1], Martha Gray[1], James Hartke[2], Deborah Burstein[3]
[1]Harvard - Massachusetts Institute of Technology, Cambridge, Massachusetts, USA; [2]Pharmacia Corporation, St. Louis, Missouri, USA; [3]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

dGEMRIC (delayed Gadolinium Enhanced MRI of Cartilage), T2, T1rho were compared in macromolecular suspensions, native and degraded bovine cartilage, and human cartilage. In suspensions, dGEMRIC demonstrated dependence on [GAG] but not [collagen]; T2, T1rho demonstrated dependencies to both macromolecules. dGEMRIC showed homogeneously high [GAG] in native cartilage; T2, T1rho showed heterogeneity, presumably not due to [GAG]. dGEMRIC showed lower [GAG] post trypsin and interleukin-1 degradation; T2, T1rho increased with trypsin but decreased / stayed constant with interleukin-1—suggesting T2, T1rho are not affected by concentration alone. In human samples, parameters were overall uncorrelated, indicating dGEMRIC, T2, T1rho provide independent information.

1507. $T_{1\rho}$ Magnetic Resonance Imaging of Human Articular Cartilage *Ex Vivo*

Francis L. Casey[1], Andrew J. Wheaton[1], Alexander J. Gougoutas[1], Arijitt Borthakur[1], Jess H. Lonner[2], Ravinder Reddy[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Pennsylvania Hospital, Philadelphia, Pennsylvania, USA

The purpose of this study was to discern the correlation between FCD as measured by sodium MRI and $T_{1\rho}$ relaxation rate in *ex vivo* human osteoarthritic cartilage. $T_{1\rho}$ relaxation rate and sodium concentration maps were computed using MR data from human articular cartilage specimens obtained following knee replacement surgery. The data were strongly correlated indicating an accurate measurement of PG. The results validate $T_{1\rho}$ mapping as a quantitative measurement of PG content in human tissue.

1508. $T1_\rho$ Relaxation Rate and Dispersion of Cartilage at 1.5 and 4T

Sarma V. S. Akella[1], Ravinder R. Regatte[1], Arijitt Borthakur[1], Ravinder Reddy[1]
[1]University of Pennsylvania Medical Center, Philadelphia, Pennsylvania, USA

The purpose of the study was to compare T1ρ relaxation rate and dispersion of chondroitin sulfate phantoms and cartilage measued at two field strengths. The imaging experiments were performed on 1.5 and 4T GE signa clinical imaging scanners. The results show that T1ρ relaxation rates and relaxivities at 4T are higher than those at 1.5T indicating T1ρ is more sensitive at higher fields.

1509. Quantification of MR Changes in Articular Cartilage with *In Situ* Mechanical Loading of the Knee

Gary Paul Liney[1], David Nag[2], Ken Sherman[2], Paul Gillespie[2]
[1]University of Hull, Hull, UK; [2]Hull & East Yorks Hospitals, Hull, East Riding, UK

This study evaluates the MR signal characteristics in articular cartilage of the knee following compression. A mechanical loading device was constructed and used to deliver physiologically relevant loading forces to the knee in situ. Measurements were taken in both anatomical T_1-weighted images and T_2 relaxation time maps prior to and during loading in the lateral and medial aspects of the femoral and tibial cartilage. Results show significant age, spatial and load-related changes in MR signal characteristics, which may reflect the load-bearing status. The study demonstrates the feasibility of using quantitative MRI to assess cartilage prior to structural changes.

1510. Determination of Zonal Varying Collagen Network Organisation and Resulting Elastic Properties of Articular Cartilage Using Pressure-dependent High-Resolution MRI (NMR Microscopy)

Peter Seidel[1], Lucien Aucouturier[1], Wilfried Gründer[1]
[1]University of Leipzig, Leipzig, Saxony, Germany

In T2-weighted MR-images of articular cartilage zones of anisotropic, collageneous network structuring are visible as hypointense zones. The intensity of these zones depends on the grad of network anisotropy. Under load the network organisation and hence MR-intensities are changed in a characteristic way. Based on these findings, the zonal varying grade of collagen-network anisotropy and the resulting mechanical properties can be derived from changes of the MR signal intensities as function of the applied pressure.

1511. The Effect of Decalcification on the ^{2}H Double Quantum Filtered Spectroscopic Images of Articular Cartilage

Keren Keinan-Adamsky[1], Hadassah Shinar[1], Gil Navon[1]
[1]Tel-Aviv University, Tel-Aviv, Israel

The ^{2}H quadrupolar splitting in the different zones of bovine articular was measured by one-dimensional ^{2}H double quantum filtered spectroscopic imaging of cartilage bone plugs before and after decalcification. Two quadrupolar split satellites are observed on the intact as well as in the decalcified cartilage bone plug, with the same splitting. However, the intensity of the large splitting, especially in the calcified zone, increases dramatically. These results prove that the orientations of the collagen fibers are not mediated by the calcium and that the calcium resides mostly within the denser collagen fibers.

1512. The Effects of Glutaraldehyde Crosslinking on T_2 and MT Contrast in Articular Cartilage Explants

Kenneth W. Fishbein[1], Mitsuo Yamauchi[2], Richard G.S. Spencer[1]
[1]NIH/National Institute on Aging, Baltimore, Maryland, USA; [2]University of North Carolina, Chapel Hill, North Carolina, USA

Proton T2 relaxation and MT ratio were measured for calf articular cartilage samples before and after crosslinking with various concentrations of glutaraldehyde. For each of the three cartilage layers observed, MT ratio exhibited little dependence on glutaraldehyde concentration, while T2 relaxation was biexponential with T2slow strongly dependent on the dose of fixative used. Subsequent HPLC analysis of digested samples showed that changes in T2slow were not correlated with increased derivitization of collagen amino acids above 1% fixative concentration. This result has implications for both the characterization of natural crosslinks and the estimation of collagen content in fixed cartilage by MRI.

1513. The Effect of Proteoglycan On MR Parameters of Articular Cartilage

Shadi F. Othman[1], Barjor S. Gimi[1], Amarjit S. Virdi[2], Richard L. Magin[1], Dale R. Sumner[2]
[1]University of Illinois at Chicago, Chicago, Illinois, USA; [2]Rush University, Chicago, Illinois, USA

Proteoglycan (PG) is a principal component in articular cartilage, contributing to its elasticity and resilience. PG is non-uniformly distributed within the cartilage. MR of cartilages is difficult to interpret because of orientation changes of the collagen fibril network, and the “magic angle” effect. Depletion of PG is expected to change key MR parameters (T1, T2, and Apparent Diffusion Coefficient (ADC)). Immersing cartilage in chymopapain to deplete PG resulted in a decrease of the ADC. In addition, the ADC near the articular surface was higher than near the subchondral region.

1514. High-Resolution Cartilage Imaging at 3T using Fat-Suppressed SSFP

Garry Gold[1], Eric Han[2], Ann Shimakawa[2], Brian Hargreaves[1], Jean Brittain[2], Christopher Beaulieu[1]
[1]Stanford University, Stanford, California, USA; [2]GE ASL West, Menlo Park, California, USA

Fat-suppressed steady-state free precession (FS-SSFP) imaging is an efficient 3D imaging technique with high cartilage signal and high cartilage to fluid contrast. In five normal volunteers, we compared FS-SSFP to 3D Spoiled Gradient-Recalled Echo (3D-SPGR) in imaging articular cartilage in the knee at 3T. FS-SSFP has superior SNR when compared with 3D-SPGR, and may allow higher resolution cartilage imaging for volume or thickness measurements.

1515. Imaging of Articular Cartilage at 3T with Multi-Point “Dixon” Fat-Water Separation and SSFP

Scott B. Reeder[1], Jean H. Brittain[2], Ann Shimakawa[2], Zhifei Wen[1], Garry E. Gold[1], Norbert J. Pelc[1]
[1]Stanford University, Stanford, California, USA; [2]ASL-West GE Medical Systems, Menlo Park, California, USA

This work describes a new approach to multi-point “Dixon” fat-water separation and its application to imaging articular cartilage at 3T using steady-state free precession (SSFP) imaging. Using a novel iterative least squares method that decomposes water and fat images from source images acquired at short echo time increments, images with high SNR and uniform separation of water and fat are obtained. Examples of fat-water decompositions obtained from SSFP images acquired at 3T are shown in the knee and ankle, as well as fat-saturated spoiled gradient echo (SPGR) images for comparison.

1516. Time-Course Macromolecular Changes in Articular Cartilage of the Rabbit Knee as Measured *In Vivo* by MT and Gd-MRI in a Surgical Model of Osteoarthritis

Didier Laurent[1], Dongming Sun[1], Hem Nalini Singh[1], Vincent Blancuzzi[1], Elizabeth O'Byrne[1]
[1]Novartis Pharmaceuticals Corporation, East Hanover, New Jersey, USA

This study examined the severity of macromolecular alterations in articular cartilage of rabbit knees over a 3-month observation period after medial meniscectomy. Results obtained from magnetization transfer (MT) and Gd(DTPA)2- enhanced MRI showed subtle changes in the collagen framework along with a significant loss of proteoglycans (PG) up to 6 weeks after the insult. However at 12 weeks, kinetics of Gd(DTPA)2- uptake were back to almost baseline values indicating that PG contents may be partially restored. Histological sections are being processed to compare with MR observations. Such data may help designing appropriate pharmacological studies evaluating potential anti-arthritic compounds.

1517. Quantitative *In-Vivo* 3D MRI to Assess Disease Modification in the Guinea Pig Model of Osteoarthritis

Jean J. Tessier[1], Jonathan Bowyer[1], Nicola Brownrigg[1], Russell Westwood[1], John C. Waterton[1], Rose Maciewicz[1]
[1]AstraZeneca, Macclesfield, Cheshire, UK

The aim of the study was to use 3D MRI to assess longitudinally, the effect of a metalloproteinase inhibitor (MPi) on joint integrity and cartilage destruction in the Dunkin Hartley guinea pig model of Osteoarthritis. The quality of the MR images was sufficient to permit acurate quantification of cartilage volume and intensity. Treatment with MPi resulted in an unexpected increase of cartilage volume, suggesting that MPi inhibited the degradative and not the reparative process. This data shows that MRI can be used successfully to assess the effect of OA disease modifier compounds such as MPi.

1518. Three-Dimensional Cartilage Thickness Distribution of Dysplastic Hips with and without Osteoarthritis: Assessment with a Fully Automated Computer Analysis from 3D MR Imaging

Takashi Nishii[1], Yoshinobu Sato[1], Hisashi Tanaka[1], Nobuhiko Sugano[1], Hidenobu Miki[1]
[1]Osaka University Medical School, Suita, Osaka, Japan

Acetabular cartilage thickness distribution in dysplastic hips and normal hips were compared three-dimensionally using a fully automated computational analysis from 3D MR images. In dysplastic hips before osteoarthritic changes, specific trend of thick cartilage distribution was observed at the anterosuperior portion, however, in dysplastic hips with osteoarthritic changes, such specific trend disappeared and decrease of cartilage thickness was found at the anterosuperior portion. The precise quantitative assessment of cartilage thickness may be effective in discriminating inherent cartilage morphology of dysplastic hips, monitoring subtle change of cartilage in longitudinal studies, and performing periacetabular osteotomy to achieve satisfactory cartilaginous congruency.

Musculoskeletal MR Imaging: Basic and Animal Studies

Hall D Saturday 14:00 - 16:00

1519. Determination of Skeletal Muscle Perfusion in the Mouse Leg at Rest with SATIR Arterial Spin Labeling Sequence

Didier Bertoldi[1], Dominique Von Euw[1], Yves Fromes[1], Claire Wary[1], Pierre G. Carlier[1]
[1]Institute of Myology, Paris, France

Arterial spin labeling (ASL) combined to imaging has demonstrated a potential for mapping perfusion non invasively in various organs, with good temporal and spatial resolution. In the skeletal muscle, several studies in men and in rats have quantified hyperperfusion during and after exercise, and during post-ischemic reactive hyperemia [1-3]. Due to the limited perfusion contrast-to-noise ratio of these sequences, it was uncertain whether ASL could detect perfusion at rest in skeletal muscle, where it is considerably lower than in most organs. Also, there was little data available on skeletal muscle perfusion in mice [4], and this despite the pivotal

1520. Muscle Damage and Regeneration Following Cast-Immobilization using T_2 Weighted Magnetic Resonance Imaging

Tiffany N. Frimel[1], John D. Gibbs[2], Dorothy Bloy[2], Gabriel Gaidosh[1], Xeve S. Silver[1], Glenn A. Walter[1], Krista Vandenborne[1]
[1]University of Florida, Gainesville, Florida, USA; [2]Temple University, Philadelphia, Pennsylvania, USA

This study implemented noninvasive magnetic resonance (MR) imaging techniques to monitor muscle damage and regeneration. A cast immobilization and reambulation model was utilized to induce skeletal muscle damage and to initiate muscle regeneration. Proton transverse relaxation time (T2) proved to be a sensitive marker of muscle damage as increases in T2 values correlated well with histological indexes of muscle damage. In addition, regions with increased T2 were enhanced following the intraperitoneal (ip) administration of Gd-DTPA.

1521. Field Strength Dependence of Transient BOLD Signal Changes in Skeletal Muscle After Single Contractions.

Ted F. Towse[1], Robert W. Wiseman[1], Ronald A. Meyer[1]
[1]Michigan State University, East Lansing, Michigan, USA

The magnitude of transient increases in anterior tibialis muscle signal intensity after single, brief ankle dorsiflexion contractions was measured by GRE-EPI in human subjects at 1.5 vs. 3T. The peak magnitude was increased by 2.5-fold at 3T vs. 1.5T, corresponding to apparent $\Delta R2^*$ of 0.85/s vs. 0.35/s, respectively. The results confirm that these muscle transients arise from the BOLD effect.

1522. Functional MR Characterization of Atrophied Human Triceps Surae Muscle following Four Weeks of Lower Limb Suspension.

Shantanu Sinha[1], Alex Lai[1], John A. Hodgson[1], Taija Finni[1], John Grinstead[1], Reggie V. Edgerton[1]
[1]University of California, Los Angeles, California, USA

The effect of physiological adaptations of individual compartments of the muscle tendon complex to atrophy, on the movement of the MTC as a whole, is uncertain. The objective of this study was to determine if 28 days of unloading induces alterations in contraction velocities of the MG and Sol, and changes in muscle volume and strength, and how these were affected by rehabilitative procedures. Significant changes in muscle volume and MVC and alterations in the dynamics as estimated by contraction velocities, of the Sol but not the MG muscle, were observed. All changes subsequently normalized after the period of rehabilitation.

1523. Pharmacokinetics and Relaxivity of Lithium in Rat Thigh Muscle by MR Studies

Elzbieta Rzepka[1], Subbaraya Ramaprasad[1]
[1]University of Nebraska Medical Center, Omaha, Nebraska, USA

Lithium salts are effective in the treatment and prophylaxis of mania and depression. However, lithium's clinical side effects and its potential for neurotoxicity lead to a narrow therapeutic window. Thus a frequent monitoring of lithium is a necessity. Plasma lithium is a necessity during the course of therapy. Currently it has been the practice to frequently monitor and maintain plasma lithium level in the range of 0.5-1.2 meq/L. The advances in magnetic resonance techniques have brought new possibilities of investigating the relevance of tissue lithium levels to clinical response

1524. Quantitative Differentiation of Myositis and Atrophied Muscle using MR Imaging

Judith Kilgallon[1], Charles Hutchinson[2], Glyn Coutts[1], Jamie Fairfoul[1], Andrew Jones[1]
[1]Christie Hospital NHS Trust, Manchester, UK; [2]Hope Hospital, Salford, UK

Myositis is a connective tissue disease whose onset is characterised by muscle inflammation and oedema, with long term disease producing fat infiltration and muscle atrophy. In this work, STIR and T1 images have been used to demonstrate, respectively, the presense and extent of oedema and fat infiltration in tissues with suspected myositis. By combining the information from the STIR and T1 images via scatterplot, autodetection and tissue quantification techniques it is possible to detect myositic oedema or fatty atrophy in diseased tissue and monitor the progress of disease during treatment.

1525. Correlation between Lipid Contents of Different Muscle Groups in the Lower Leg and Dependence of Muscular Fat on Body Mass Index and Gender

Jürgen Machann[1], Claus Thamer[2], Beate Wietek[1], Michael Haap[2], Michael Stumvoll[2], Claus D. Claussen[3], Hans U. Haering[2], Fritz Schick[1]
[1]Section on Experimental Radiology, Tuebingen, Germany; [2]Department of Endocrinology and Metabolism, Tuebingen, Germany; [3]Department of Diagnostic Radiology, Tuebingen, Germany

Muscular lipid content (LC) of six muscle groups in the lower leg was assessed in 67 volunteers by fat-selective MRI. Correlations between LC values of the muscle groups and between LC and body mass index (BMI), percent body fat (PFAT), and gender were analyzed. Mean LC of all subjects was between 2.0% (Tibialis ant. and post.) and 3.7% (Peroneus). Intermuscular correlation coefficients ranged between 0.39 and 0.90. LC of different muscles correlated moderately with BMI ($0.39<r<0.53$) and PFAT ($0.38<r<0.62$). BMI-matched gender related analysis showed females having significantly higher LC in all muscle groups than males ($p<0.05$).

1526. PG-PS (proteoglycan-polysaccharide)-Induced Rheumatoid Arthritis in the Rat Ankle: First Characterisation by MRI and X-ray CT *Ex Vivo*

K J. Brooks[1], K K. Changani[1], J B. Buckton[2], A E. White[1], D G. Reid[1], A L. Busza[1], B P. Hayes[2], P F. Life[2]
[1]GSK, Welwyn, UK; [2]GSK, Stevenage, UK

Rheumatoid arthritis (RA) appears in rat ankles after injection of Streptococcus pyogenes peptidoglycan polysaccharide (PGPS) [1] leading to cartilage and subchondral bone destruction. Micro-CT (μCT) has been used to measure bone destruction in arthritis and osteopenia [2,3]. This *ex vivo* study suggests MRI is sensitive to ankle joint changes in rats injected with PGPS. MRI correlates with μCT, so should be effective in detecting changes in joint structure and as an accurate and sensitive non-invasive measure of disease in this model, which is supposed to closely resemble the human condition [4].

1527. A Novel Magnetic Resonance Imaging Based Method Accurately Assesses Three-Dimensional Joint Motion *In Vivo*

Nicholas A. Hill[1], Robert A. Fellows[1], H S. Gill[2], Norma J. MacIntyre[1], Shawn C. Leclaire[1], Thomas SY Tang[1], Mark M. Harrison[3], Randy E. Ellis[1], David R. Wilson[4]
[1]Queen's University, Kingston, Ontario, Canada; [2]University of Oxford, Oxford, UK; [3]Kingston General Hospital, Kingston, Ontario, Canada; [4]University of British Columbia, Vancouver, British Columbia, Canada

We evaluated the accuracy of a Magnetic Resonance Imaging (MRI)-based method to measure three-dimensional joint motion in vivo. This method determines the relative positions of bones in the joint by shape-matching high-resolution three-dimensional bone models to fast low-resolution scans taken at fixed angles of flexion. The method's accuracy was determined by comparing measurements made using this method and Roentgen Stereophotogrammetric Analysis (RSA) on four cadaver specimens. Mean error in tilt and spin measurements was approximately one degree, while mean error in position measurements was about one millimeter. This MRI-based method determines joint alignment more accurately than current two-dimensional imaging methods.

1528. A 3D Visualization of the TMJ Disc Deformation during Jaw Opening/Closing

Dominik Benedikt Goessi[1], Luigi Maria Gallo[1], Diana Rebecca Dembski[1], Sandro Palla[1]
[1]University of Zurich, Zurich, Switzerland

The articular disc of the temporomandibular joint (TMJ) is strongly deformed during function. Its altered mechanical properties, modifying stress distribution and lubrication, might increase the likelihood of osteoarthritis. Since TMJ disc load cannot be studied in vivo, we use finite element analysis, in which large deformations of the disc must be known. To date, MR scanners do not allow accurate direct measurements of the whole joint anatomy in real time. Aim of this study was therefore to investigate TMJ disc deformation during jaw opening/closing by sequencing 3D-reconstructed MR scans statically recorded at different positions.

1529. Trabecular Bone Volume Fraction Measurements of Female Volunteers using a Dedicted Compact MRI System: Comparative Study with QUS Measurements

Katsumi Kose[1], Yoshimasa Matsuda[1], Takeaki Kurimoto[1], Seitarou Hashimoto[1], Yukako Yamazaki[1], Tomoyuki Haishi[2], Shin Utsuzawa[2], Shigemasu Okada[3]
[1]University of Tsukuba, Tsukuba, Ibaragi, Japan; [2]MR Technology Inc., Tsukuba, Ibaragi, Japan; [3]Sumitomo Special Metals Company, Osaka, Japan

Trabecular bone volume fraction (TBVF) of the calcaneus was measured using a dedicated compact MRI for two healthy female volunteer groups and the TBVF values were compared with the stiffness measured using a quantitative ultrasound (QUS) system. The results have shown high positive relations (R2=0.4107, 0.2846) between the TBVF and stiffness.

1530. Water Content Predicts Bone Mineral Density and Mechanical Properties

Maria A. Fernandez-Seara[1], Suzanne L. Wehrli[2], Masaya Takahashi[3], Felix W. Wehrli[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Children Hospital, Philadelphia, Pennsylvania, USA; [3]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

A technique combining 1H NMR spectroscopy and isotope exchange was used to measure water in cortical bone specimens from two groups of rabbits: a control and a group fed a low-phosphorus diet to induce hypomineralization of the bone. Water content is higher in the treatment group, showing an inverse relationship with mineral content (measured by 31P spectroscopy). Hypomineralized bone is weaker than normal bone as demonstrated by mechanical testing. More importantly, the data show a strong inverse correlation between water content and bone material properties suggesting water content to serve as a surrogate measure for the bone's degree of mineralization.

1531. Monitoring the Acute Microvascular Effects of Anti-Inflammatory Steroid Treatment in a Rat Arthritis Model Using Macromolecular Contrast-Enhanced Magnetic Resonance Imaging

Vincenzo Lucidi[1], Laure S. Fournier[1], Viktor Novikov[1], David M. Shames[1], Robert C. Brasch[1]
[1]UCSF, San Francisco, California, USA

Dynamic MRI enhanced by macromolecular contrast medium (MMCM) was applied to measure the microvascular changes that occur in periarticular soft tissues of monoarticular arthritis in a rat knee following treatment. The signal intensity values for venous blood and soft tissues for each time point were analyzed using a unidirectional two-compartment model. Administration of methylprednisolone (IP injection of a pulsed dose of 30mg/kg) induced significant reduction in MR measured fractional plasma volume (fPV) and microvascular permeability (K^{PS}) within 24h after the treatment, corresponding to a clinical elimination of limp.

1532. MRI Evaluation of Needle-Free Injectors

N. M. Szeverenyi[1], J. Tompkins[1], S. Blatt[1], R. Quinn[1], C. Cunningham[1], G. Tillapaugh-Fay[1], N. D'Antonio[2], L. D'Antonio[2]
[1]SUNY Upstate Medical University, Syracuse, New York, USA; [2]DCI, Inc., Syracuse, New York, USA

A technique for rapid mass immunization is now a pressing issue. Needle-free injection technology is one solution to this need. With this technology a bolus of liquid is forced through a small orifice under high pressure, imparting enough energy to penetrate the skin and underlying tissue. We have developed an animal model to human skin and have studied these injectors using 3D MRI techniques. Automated software was written to characterize the spatial distribution of injectate in these MRI images. The effects of orifice size and operating pressure were examined quantitatively using this software and MRI technology.

1533. Short TE Double Echo 3D SPGR Acquisition for Short T_2 Imaging

Seong-Eun E. Kim[1], Nikhil S. Phatak[1], Henrey R. Buswell[1], Eun-Kee K. Jeong[1], Jeffrey A. Weiss[1], Dennis L. Parker[1]
[1]Deaprtment of Radiology, Unversity of Utah, Salt Lake City, Utah, USA

Collagen-containing structures such as ligaments, tendons, and menisci are viewed as dark signal voids with clinical MRI settings due to a rapid decay of signal intensity. Ligaments can have a transverse relaxation time constant (T2) of less than 2 ms. This study applies a dual-echo acquisition technique to image the medial collateral ligament (MCL) and menisci of a human knee.

1534. Gender-Based Differences in Phenotype in G93A SOD1 Mice Detected by MRI

K J. Brooks[1], D G. Reid[1], A E. White[1], H L. Lloyd[1], J K. Latcham[1], S D. Skaper[2], C Dingwall[1], M Demestre[3], A H. Pullen[3]
[1]GSK, Welwyn, UK; [2]GSK, Harlow, UK; [3]Institute of Neurology, London, UK

We have recently shown that significant decreases in the hindlimb muscle mass of the female G93A SOD1 mouse, can be detected by MRI (1) before any other overt pathology appears. This is evident from 10 weeks of age; by 15 weeks the muscle volume has decreased by 30% compared to 7 weeks. The present study shows that substantially less muscle wastage occurs in male G93A SOD1 mice over the same time period. This observation serves to emphasise the possible importance of gender in the use of transgenic models in therapeutic tartget evaluation and testing of treatments.

Musculoskeletal MR Spectroscopy

Hall D Sunday 13:30 - 15:30

1535. Correlation of Muscle Fiber Type Composition with Intra-myocellular Lipids by ^{1}H MR Spectroscopic Imaging and Single Voxel MRS.

Peter Vermathen[1], Beat Schmitt[2], Jacques Decombaz[3], Hans Hoppeler[2], Chris Boesch[1], Roland Kreis[1]
[1]University & Inselspital Berne, Berne, Switzerland; [2]University Berne, Berne, Switzerland; [3]Nestlé Research Center, Nestec Ltd, Lausanne, Switzerland

Intramyocellular Lipids (IMCL) were measured in tibialis anterior (TA) using single voxel ^{1}H MR Spectroscopy (SVS) and high resolution MR Spectroscopic imaging (MRSI) in order to investigate muscle fiber type composition. A significant correlation between IMCL from single voxel spectra and muscle fiber type composition from biopsy data was obtained, confirming previous morphometry results and suggesting that IMCL correlates well with % fiber type within a muscle, while between muscles other factors may dominate. IMCL levels from MRSI data were homogeneously distributed across large parts of TA suggesting homogeneous fiber type composition.

1536. Cluster Analysis of Muscle Functional MRI Data

Bruce M. Damon[1], Danielle M. Bartholomew[2], Zhaohua Ding[1], John C. Gore[1], Jane A. Kent-Braun[2]
[1]Vanderbilt University, Nashville, Tennessee, USA; [2]University of Massachusetts at Amherst, Amherst, Massachusetts, USA

The purpose of this study was to develop a model-independent method of identifying functionally distinct regions of synergistic muscle groups using muscle functional MRI data. An algorithm was developed that 1) compared the signal intensity time courses of activated voxels and 2) clustered together similarly behaving voxels. The algorithm was validated in simulated data sets and applied to experimental data acquired in a time series from subjects performing sustained isometric ankle dorsiflexion. The data were analyzed using cluster analysis and with traditional (model-based) analysis. Cluster analysis made fine functional separations between regions that were not seen with traditional analysis.

1537. The Effects of Dicholoroacetate on the Kinetics of Intramuscular [ADP] and Pulmonary Oxygen Uptake during High-Intensity Exercise in Humans

Harry B. Rossiter[1], Susan A. Ward[2], Franklyn A. Howe[3], David M. Wood[3], John M. Kowalchuk[4], John R. Griffiths[3], Brian J. Whipp[3]
[1]University of California San Diego, La Jolla, California, USA; [2]University of Glasgow, Glasgow, Scotland, UK; [3]St. George's Hospital Medical School, Tooting, London, UK; [4]University of Western Ontario, London, Ontario, Canada

[ADP], a prime candidate for mediating the control of muscle O_2 consumption (QO_2) during exercise, is dependent on both [PCr] and pH. Dicholoroacetate (DCA) reduces PCr hydrolysis and blood [lactate] during exercise, suggesting that [ADP] and QO_2 kinetics would be speeded. Subjects performed heavy-intensity exercise after DCA or placebo while VO_2, muscle ^{31}PMRS, and blood [lactate] were determined in concert. DCA reduced Δ[ADP] by ~25%, ΔVO2 by ~8% and the initial d[PCr]/dt by ~20%, but had no effect on τADP, τPCr and τVO_2. This suggests that [ADP] feedback control may not exclusively mediate VO_2 control during high-intensity exercise.

1538. Acute Increase of Intramyocellular Lipids During Fasting

Beate M. Wietek[1], Claus Thamer[1], Juergen Machann[1], Michael M. Haap[1], Claus D. Claussen[1], Hans U. Haering[1], Fritz Schick[1]
[1]University of Tuebingen, Tuebingen, Baden-Wuerttemberg, Germany

The amount of intramyocellular lipids (IMCL) in skeletal muscle was assessed by proton magnetic resonance spectroscopy during a voluntary fasting period of five days in four healthy lean volunteers. The aim of the study was to find out whether muscular lipid uptake in the presence of high plasma lipid levels, or lipid oxidation due to lacking glycogen as a fuel in musculature, are dominating effects on IMCL levels under fasting conditions. IMCL were quantified in the tibialis anterior and the soleus muscle before and on the first, third and fifth day of the fasting period.

1539. Under Which Conditions Exists a Correlation between IMCL Detected by ^{1}H-MRS and Insulin Sensitivity?

Claudia Neumann-Haefelin[1], Johanna Kuhlmann[1], Ulrich Belz[1], Hans-Paul Juretschke[1], Andreas W. Herling[1]
[1]Aventis Pharma Deutschland GmbH, Frankfurt, Germany

IMCL is believed to reflect insulin resistance in humans and animals. However, there are many other factors affecting IMCL concentration like age, gender, exercise or diet. The aim of the study was therefore, to validate the correlation between insulin sensitivity and IMCL in two different animal models of insulin resistance, at different ages and varying stages of the progression to type 2 diabetes. We demonstrate that the negative correlation of IMCL content and insulin sensitivity is only present under certain conditions and highly influenced by age and diabetes itself.

1540. Which Muscle Reflects Best Insulin Resistance?

Claudia Neumann-Haefelin[1], Johanna Kuhlmann[1], Ulrich Belz[1], Hans-Paul Juretschke[1], Andreas W. Herling[1]
[1]Aventis Pharma Deutschland GmbH, Frankfurt, Germany

Increased levels of intramyocellular lipids are involved in the development of insulin resistance. Therefore exists a growing interest in using non-invasively (1H-NMR spectroscopy) observed IMCL levels as surrogate markers to detect insulin resistance. However, muscle lipid metabolism differs between individual muscle types. In the present study we investigated the correlation between IMCL and insulin sensitivity in two different muscle types and found statistically significant differences. In conclusion, we believe that only a white muscle, such as the M. tibialis anterior, is suited to detect insulin resistance.

1541. Fat Fractions and Spectral T_2 Values in Vertebral Bone Marrow in HIV and non-HIV Infected Men: A ^{1}H Spectroscopic Imaging Study

Robert Vincent Mulkern[1], Sridhar Vajapeyam[1], Koichi Oshio[2], Jeannie Huang[3], Steven Grinspoon[3]
[1]Children's Hospital, Boston, Massachusetts, USA; [2]Brigham and Women's Hospital, Boston, Massachusetts, USA; [3]Massachusetts General Hospital, Boston, Massachusetts, USA

A Carr-Purcell-Meiboom-Gill (CPMG) based spectroscopic imaging technique was used to determine a reduced mean vertebral fat fraction in a group of HIV-infected men undergoing anti-retroviral therapy compared to an age matched control group. The water and fat T2 values did not show systematic differences between the two groups but were a) independent of fat fraction and b) substantially longer than literature values (1) reported using alternative spectroscopic methods based on STEAM or PRESS.

1542. Study of the Energy Metabolism of Post-Polio Paralysis (PPRP) Patients by *In-Vivo* ^{31}P MRS

N. R. Jagannathan[1], Uma Sharma[1], Virendra Kumar[1], Sanjay Wadhwa[1]
[1]All India Institute of Medical Sciences, New Delhi, Delhi, India

The energy metabolism of patients affected by post polio residual paralysis (PPRP) and controls (normal volunteers) were investigated using in-vivo ^{31}P MRS Statistically significant decrease in PCr/Pi and PCr/ATP ratios and an increase in the PME/PCr and PDE/PCr ratios were observed in PPRP patients compared to controls. The changes in the metabolite ratios are found to be related to the severity of paralysis.

1543. *In Vivo* Proton MR Spectroscopy: Demonstration of the Effect of Dialysis on Carnosine in Uremic Skeletal Muscles

Sanjeev Chawla[1], Raj K Sharma[1], Monika Garg[1], Sajja Rao[2], Rajesh Kumar[1], Rakesh K Gupta[1]
[1]Sanjay Gandhi Postgraduate Istitute of Medical Sciences, Lucknow, Uttar Pradesh, India; [2]Indian Institute of Technology, Kanpur, Uttar Pradesh, India

We performed in vivo proton MR spectroscopy (PMRS) of the skeletal muscles in patients of chronic renal failure (CRF) to compare the changes in metabolite pattern from pre to post dialysis. Seven patients with CRF and 5 control subjects were studied. Various metabolites assigned in all control subjects and in CRF patients before dialysis were total creatine (tCr; 3.03 ppm), betaine (3.2 ppm) and carnosine (Car; 7.8 ppm). 5/7 cases of CRF showed complete disappearance while 2 showed reduction of Car following dialysis. We conclude that there is a significant reduction of carnosine following dialysis in uremic skeletal muscles.

1544. A ^{31}P Study of Bioenergetics in Skeletal Muscle Lacking Muscle LIM Protein.

Justin M. Smith[1], James R. Wilding[1], Mark A. Cole[1], Kay E. Davies[1], Kieran Clarke[1], Peter Styles[1]
[1]University of Oxford, Oxford, UK

Mutations of the muscle LIM protein (MLP) gene in patients, and disruption of the same gene in mice results in cardiomyopathy, but with little known as to the consequences on skeletal muscle function. In this study muscle energetics and function were examined in the hindlimb of mice lacking MLP using 31P MRS in conjunction with electrical nerve stimulation. No significant differences in intra-cellular pH, PCr, ADP or force production were noted at rest, during, or recovery from exercise, suggesting normal metabolism and pHi regulation in these mice.

1545. Utility of *In-vitro* ^{1}H MRS in the Diagnosis of Mitochondrial Myopathy

Uma Sharma[1], Surinder Atri[1], M. C. Sharma[1], Chitra Sarkar[1], N. R. Jagannathan[1]
[1]All India Institute of Medical Sciences, Delhi, India

The potential of in-vitro ^{1}H NMR in the diagnosis of myopathy of patients in whom the histopathological investigations were inconclusive and within normal histological limits (WNHL), was investigated. NMR data revealed significantly higher concentration of Glc, Lac, Ala and Glu+Gln metabolites in the skeletal muscle of WNHL and mitochondrial myopathy (MM) patients compared to normal subjects (controls). However, there was no significant difference in the concentration of these metabolites between the WNHL and MM patients suggesting mitochondrial defect in both the WNHL and MM patients.

1546. Biochemical Characterization and Metabolic Differences in DMD and BMD patients studied by *In-Vitro* ^{1}H NMR

Uma Sharma[1], Surinder Atri[1], M. C. Sharma[1], Chitra Sarkar[1], N. R. Jagannathan[1]
[1]All India Institute of Medical Sciences, New Delhi, Delhi, India

The skeletal muscle metabolism in patients with Duchenne muscular dystrophy (DMD), Becker muscular dystrophy (BMD) and controls were investigated using ^{1}H NMR. The concentration of Glc, Lac, Ala, Glu+Gln and Cr+PCr were significantly lower in DMD compared to BMD and controls. There is no significant difference in the concentration of these metabolites between controls and BMD. Low level of Lac suggests reduction in the rate of anaerobic glycolytic activity while lowered concentration of Glc may be attributed to decreased gluconeogenic substrates in DMD.

1547. Effects of Carbonic Anhydrase Inhibition on Muscle Metabolism by *In Vivo* ^{31}P Magnetic Resonance Spectroscopy

Min Liu[1], Glenn A. Walter[1], Raquel T. Torres[1], Simon Spalthoff[2], Un-Jin Zimmerman[2], Zhang Wei[2], John D. Gibbs[3], Robert E. Forster[2], Krista Vandenborne[1]
[1]University of Florida, Gainesville, Florida, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [3]Temple University, Philadelphia, Pennsylvania, USA

The goal of this study was to investigate the biological importance of carbonic anhydrase (CA) in energy metabolism of skeletal muscle. 31P- Magnetic Resonance spectra were acquired from rabbit gastrocnemius muscles in the presence and absence of the CA inhibitor, acetazolamide (AZ). Spectra were collected at rest, during ischemia, and recovery. Inhibition of CA retarded the recovery of phosphocreatine (PCr) and inorganic phosphate (Pi) following ischemia. This study confirms that CA plays a role in the maintenance of muscle energy metabolism.

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
New Frontiers in Cardiovascular MR

Room 718B — Monday 13:30 - 15:30 — Chairs: Frederick H. Epstein and Michael Horn

13:30 1548. MRS/MRI Assessment of *In Vivo* Murine Cardiac High-Energy Phosphates During Dobutamine Stress

Anna V. Naumova[1], Vadappuram P. Chacko[1], Robert G. Weiss[1]
[1]The Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Image-guided, spatially-localized 31P MRS was used to study murine cardiac metabolism under resting and stress conditions. Experiments were performed in adult mice using an Omega spectrometer equipped with a 4.7 T Oxford magnet. Intravenous infusion of dobutamine increased the mean heart rate by 39% to 669±77/min but myocardial PCr/ATP ratio remained unchanged: 2.04±0.4 at baseline versus 2.16±0.4 during dobutamine-induced stress. Therefore, a significantly increased heart rate does not result in a decline in the cardiac PCr/ATP ratio. This is consistent with studies in large animals that showed that global levels of high-energy phosphates do not regulate myocardial respiration.

13:40 *1549*. Reduced Glutamate Signal from *In Vivo* Dog Heart Oxidizing ^{13}C Acetate at High Workloads Result from Increased Mitochondrial Oxidation Rates and Reduced Transmembrane Metabolite Exchange

Michael O'Donnell[1], Raymond Kudej[2], Larry White[1], Kathryn LaNoue[3], Steven Vatner[4], Douglas Lewandowski[1]
[1]University of Illinois at Chicago, Chicago, Illinois, USA; [2]Tufts University School of Veterinary Medicine, Boston, Massachusetts, USA; [3]Pennsylvania State University Medical School, Hershey, Pennsylvania, USA; [4]New Jersey Medical School, Newark, New Jersey, USA

We explored the mechanism for reduced NMR signal from 13C enriched glutamate (GLU) at high workloads in the in vivo dog heart oxidizing [2-13C] acetate. As previously shown, GLU is over 90% cytosolic and becomes labeled via transamination following efflux of 13C alpha-ketoglutarate (AKG) from mitochondria (MITO). We compared 13C enrichments of GLU, as a marker of AKG efflux to the cytosol, to enrichment of succinate, the product of AKG oxidation in MITO, at baseline and high workload. 13C acetate was oxidized to succinate at both workloads, but exchange of label between mitochondrial metabolites and the cytosolic GLU became limited.

13:50 *1550*. *In Vivo* ^{1}H MRS of Myocardial Triglyceride: Does Obesity Induce Concentric Left Ventricular Hypertrophy?

Jason S. Reingold[1], Robert L. Dobbins[1], Greta Sartoni D'Ambrosia[1], Ronald G. Victor[1], Lidia S. Szczepaniak[1]
[1]UTSouthwestern Medical School, Dallas, Texas, USA

Recent experimental data in animal models suggest that adiposity directly damages heart by promoting ectopic deposition of triglyceride within myocytes. It was also demonstrated in humans that 1H MRS with cardiac and respiratory gating measures myocardial triglyceride content in vivo. The goal of this study was to further characterize the process of MTG deposition within human myocytes as well as its potential for affecting myocardial function using cardiac proton spectroscopy and imaging.

14:00 *1551*. Peak Troponin I Release Correlates with Infarction Size Measured with Delayed Enhancement MRI

Cory Swingen[1], Robert Gallegos[1], Xiaoen Wang[1], Avinash Jayaswal[1], Catherine Verfaillie[1], R. Morton Bolman[1], Michael Jerosch-Herold[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

This study compared the peak chemical levels of the cardiac isoform contractile protein troponin I with MR estimates of infarct volume in a chronic canine infarct model. Results indicate a strong correlation between peak troponin levels and infarct size with MRI.

14:10 *1552*. High-Resolution 2D Myocardial Strain Imaging with Breath-Hold Cine DENSE

Daniel Kim[1], Wesley D. Gilson[1], Christopher M. Kramer[1], Frederick H. Epstein[1]
[1]University of Virginia, Charlottesville, Virginia, USA

Displacement-encoding with stimulated echoes (DENSE) is a new technique for imaging high-resolution myocardial strain without the need for tag detection. Current implementations of DENSE acquire data at only one cardiac phase. We developed and evaluated a breath-hold 2D cine DENSE sequence. This sequence uses complementary spatial modulation of magnetization for time-independent suppression of the artifact-generating echo due to T1 relaxation and fast gradient echo/echo-planar imaging for rapid data acquisition. Sequence evaluation included measuring SNR, correlating strain measurements by DENSE and conventional myocardial tagging, differentiating subendocardial versus subepicardial Ecc, and determining the importance of background phase correction in cine DENSE.

14:20 *1553*. High-Resolution, Cine-Imaging of Mouse Hearts at 12T in Vertical Position – A Challenge

Juergen E. Schneider[1], Paul J. Cassidy[1], Craig Lygate[1], Damian J. Tyler[1], Kieran Clarke[1], Stefan Neubauer[1]
[1]University of Oxford, Oxford, UK

Previously, exclusively horizontal MR-systems have been used for quantifying cardiac function and left-ventricular mass in mice non-invasively. However, many MR centres equipped with high field vertical bore magnets, the preferred design for perfused heart experiments, potentially also want to image mice in vertical position. Thus, we investigated whether cardiac function in normal mice is affected by positioning them body upright in a vertical high-field magnet and using magnetic resonance micro-imaging. Quantitative analysis demonstrated an agreement of cardiac function between horizontal and vertical position.

14:30 *1554*. Optimised Gating Strategies in Mice for Cardiac MRI at High Field Systems

Paul J. Cassidy[1], Juergen E. Schneider[1], Stuart M. Grieve[1], Kieran Clarke[1], Stefan Neubauer[1]
[1]University of Oxford, Oxford, UK

ECG and respiratory gating strategies were investigated in mice using a customised gating device with automatic rate tracking and ECG determined steady state maintenance during respiration. The performance of the gating strategies was investigated by observing the level of image artefacts in vivo. Image artefact levels were significantly reduced using ECG- and respiration-gating with steady cardiac gated steady state maintenance during respiration. Optimised in vivo cardiac MRI in mice at 11.75 Tesla was then achieved with a resolution of 50µm.

14:40 *1555*. Multi-Slice Displacement-Encoded Imaging in Mice

Wesley D. Gilson[1], Frederick H. Epstein[1]
[1]University of Virginia, Charlottesville, Virginia, USA

Displacement-encoding with stimulated echoes (DENSE) is a high resolution method for measuring myocardial strain and has been used to assess myocardial function in humans [1] and mice [2,3]. For mouse studies at 4.7T, DENSE can map myocardial motion with very high spatial resolution (0.23 x 0.23 x 1.0 mm3). However, the acquisition time is typically long for single-slice imaging (around 45 minutes). We developed a multi-slice DENSE pulse sequence for cardiac MR studies in mice.

14:50 *1556*. Assessment of Global and Regional Myocardial Function in the Mouse using Cine and Tagged MRI

Rong Zhou[1], Stephen Pickup[1], Jerry D. Glickson[1], Craig H. Scott[1], Victor A. Ferrari[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

MRI methods for determining global and regional cardiac function in the mouse are demonstrated. ECG-gated images were generated on 4.7T horizontal bore spectrometer from mice maintained at 37ºC and heart rate of 500±50 bpm. Left ventricular mass, ejection fraction and cardiac output from C57Bl/6 mice were determined. Tagged cardiac images were generated by application of two-dimensional spatial modulation of magnetization (SPAMM) in combination with the cine protocol. The quality of the resulting images was sufficient to allow mapping of myocardial strains and displacements. The work demonstrates the first characterization of regional myocardial function in the mouse via SPAMM techniques.

15:00 *1557*. Manganese Ions as Intracellular Contrast Agents: A Study of T_1 Relaxation and Water Exchange in Rat Myocardial Tissue.

Wibeke Nordhøy[1], Henrik W. Anthonsen[2], Morten Bruvold[1], Per Jynge[1], Jostein Krane[2], Heidi Brurok[1]
[1]Faculty of Medicine, Trondheim, Norway; [2]Faculty of Chemistry and Biology, Trondheim, Norway

Manganese ions (Mn2+) enter cardiomyocytes and are retained intracellularly (ic). T1 and Mn-content were examined after washin-washout of MnCl2 in isolated rat hearts. T1 was resolved in a short ic T1-1 and a longer extracellular (ec) T1-2. Calculations of water exchange revealed a slow exchange, an ic water lifetime of 10.1 s, and an ic relaxivity 10 times higher than with MnCl2 in water. Mn2+ releasing agents are potential viability markers in cardiac MRI and tools in cardiac research. In this study we have used Mn2+ enrichment, relaxographic analyses and secondary calculations to study cell compartments and transmembrane exchange.

15:10 *1558*. Preliminary Investigation of Myocardial Infarction Imaging using a Manganese-Based Agent EVP 1001-1

Pippa Storey[1], Qun Chen[1], Laura Fogelson[1], Kathleen Harris[2], Farah Rahman Ghazala[1], Wei Li[1], Peter Seoane[3], Phillip Harnish[3], Pottumarthi Vara Prasad[1]
[1]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [2]Northwestern University, Chicago, Illinois, USA; [3]Eagle Vision Pharmaceutical Corp., Exton, Pennsylvania, USA

Magnetic resonance imaging was performed with a manganese-based contrast agent EVP 1001-1 (Eagle Vision Pharmaceutical Corp., Exton, PA) in two animal models of myocardial infarction. In a rabbit model, post-contrast images exhibited signal enhancement consistent with uptake of the agent only in viable tissue, but lesion conspicuity and quantification were limited by inadequate spatial resolution. In a dog model, clear delineation of the infarction was observed following administration of the agent, and T1 measurements confirmed uptake in viable tissue, with little effect on non-viable myocardium

15:20 *1559*. Dark Flow Artifacts in SSFP Cine Imaging

Pippa Storey[1], Qun Chen[1], Robert Edelman[1], Wei Li[1]
[1]Evanston Northwestern Healthcare, Evanston, Illinois, USA

Steady-State Free Precession (SSFP) cine images are frequently corrupted by dark flow artifacts, which can usually be eliminated by reshimming. We provide a theoretical explanation for the artifacts in terms of spins moving through an inhomogeneous magnetic field, and validate the theory using phantom experiments. The signal from the flowing spins is found to depend on their velocity relative to the magnetic field gradient, and also on whether their motion is directed through or within the imaging slice.

Cardiac Function

Hall D Tuesday 13:30 - 15:30

1560. Functional Imaging of the Heart in a Single Breath-Hold using 3D SSFP with SENSE

Andrea Kassner[1], David Barmby[2], John P. Ridgway[2], Gavin Bainbridge[2], Mohan Sivananthan[2]
[1]Philips Medical Systems, Leeds, UK; [2]Leeds General Infirmary, Leeds, Yorkshire, UK

Steady state free precession (SSFP) imaging has become of increased clinical value in the evaluation of LV volume, function and mass. We describe the use of single breath-hold (bh) 3D SSFP with SENSE for measuring cardiac function. Furthermore, we compare this with a conventional 2D bh SSFP technique. Our results show that a single bh 3D bFFE sequence combined with SENSE is a feasible technique to evaluate cardiac function. EDV and EF measurements made using the 3D technique are comparable to those obtained by conventional 2D bFFE. LV end-diastolic mass measurements were significantly different between 3D and 2D techniques.

1561. Non-Breathhold Cardiac Functional Imaging with Radial k-Space Sampling.

Srirama Swaminathan[1], Anthon Fuisz[2]
[1]Philips Medical Systems, Monmouth Junction, New Jersey, USA; [2]Washington Hospital Center, Washington, DC, USA

A non-breathhold B-FFE technique with a Radial k-space sampling for cardiac function is proposed. Multi slice short axis images were acquired on 5 patients referred for CMR and was compared with SENSE enabled breathhold Cartesian sampling. Identical scan parameters were maintained between the two techniques. Two observers on a dedicated workstation measured EF, SV and other functional parameters. Bland-Altman and Inter and intra observer analysis was performed. Radial sampling yields diagnostically good quality images and the EF compares well with Cartesian breathhold. Radial imaging is found to be faster and reliable than the respiratory compensation techniques.

1562. Double/Triple IR Dual Contrast FSE of the Heart with ASSET

Agus Priatna[1], David C. Zhu[2]
[1]GE Medical Systems, Waukesha, Wisconsin, USA; [2]University of Chicago, Chicago, Illinois, USA

Recently, black-blood dual-contrast FSE imaging technique has been introduced. This technique provides images with two different contrasts obtained at the same cardiac cycle through a single acquisition. However, the acquisition requires a long breath-hold period and thus limits its clinical application. In this study, the ASSET (or SENSE) technique has been applied to reduce the required breath-hold time to complete the dual-contrast FSE image acquisition.

1563. 2D CINE FIESTA Imaging for the Assessment of Cardiac Function in Combination with Parallel Imaging: A Comparison Study

Ralph Noeske[1], Daniel Messroghli[2], Matthias Friedrich[2], Thoralf Niendorf[3]
[1]GE Medical Systems, Berlin, Germany; [2]Franz-Volhard-Klinik, Charité, Berlin, Germany; [3]GE Medical Systems, Boston, Massachusetts, USA

In this study a rapid breath held steady state free precession based CINE imaging technique (2D CINE FIESTA) was applied in combination with a parallel imaging technique (ASSET) for the assessment of the cardiac function. 30 patients were examined with and without ASSET. Overall image quality, perceived Signal-to-Noise Ratio and image artifacts were classified and compared. The increase in image artifacts due to the parallel imaging technique did not impair the overall image quality and the slightly reduced perceived SNR, thus making ASSET in combination with CINE FIESTA an important add-on for the spectrum of LV function analysis approaches.

1564. Accelerating Cardiac Cine 3D SSFP Imaging Using *k-t* BLAST with Integrated Training

Sebastian Kozerke[1], Jeffrey Tsao[1], Klaas P. Pruessmann[1], Peter Boesiger[1]
[1]University and ETH Zurich, Zurich, Switzerland

By exploiting spatio-temporal correlations in cardiac acquisitions using *k-t* BLAST, gated cine 3D acquisitions of the heart are accelerated by a factor of 4.8 making single breath-hold acquisitions possible. The acquisition of low resolution training data necessary to resolve residual aliasing in the *k-t* BLAST method is interleaved into the sampling process to improve acquisition efficiency. The comparison of functional parameters derived from single slices of the 3D data set with values extracted from separate single slice acquisitions shows no significant difference indicating the validity of the approach.

1565. 3D CSPAMM Tagging Accelerated with kt-BLAST

Salome Ryf[1], Sebastian Kozerke[1], Jeffrey Tsao[1], Peter Boesiger[1]
[1]University and ETH, Zurich, Switzerland

The objective of the current work was to accelerate data acquisition for 3D CSPAMM using k-t BLAST. This involves spatiotemporal undersampling and subsequent repopulation of missing data based on prior knowledge derived from low-resolution training data. The feasibility of this technique is shown with Acq.1: fully acquired and offline reduced k-space-data of a healthy volunteer and Acq.2: with an undersampled acquisition in a healthy volunteer.

1566. Displacement-Encoded MRI of the Heart using Cosine ANd Sine modulation to ELiminate (CANSEL) Artifact-Generating Echoes

Frederick H. Epstein[1], Wesley D. Gilson[1]
[1]University of Virginia, Charlottesville, Virginia, USA

Displacement-encoded imaging with stimulated echoes employs 1-1 SPAMM to cosine modulate the longitudinal magnetization at end diastole. Later in the cardiac cycle the modulated signal is sampled and myocardial strain is computed from the signal phase. The signal includes three distinct echoes: (a) the displacement-encoded echo, (b) the complex conjugate of the displacement-encoded echo, and (c) an echo from T1 relaxation. The "T1-relaxation" and "complex conjugate" echoes need to be suppressed to create a phase-reconstructed image representing just the displacement-encoded echo. We investigated using Cosine ANd Sine modulation to ELiminate (CANSEL) the "T1-relaxation" and "complex conjugate" echoes.

1567. Procedural Sedation for Prolonged Complex Pediatric Cardiac MRI: Propofol versus Prior Institutional Protocol

Rodney G. Shaffer[1], Khan M. Siddiqui[1], Cathleen A. Woomert[1], David F. McKinley[1], Frederick K. Emge[1]
[1]Geisinger Medical Center, Danville, Pennsylvania, USA

Cardiac magnetic resonance imaging (C-MRI) is increasingly being utilized to evaluate pediatric cardiovascular diseases. We retrospectively compared thirteen patients [mean 4 years] from the current Propofol pediatric sedation protocol with seventy-three patients [mean 9 years] from the prior sedation protocol that included Chloral Hydrate, Midazolam and Ketamine in conjunction or alone. Thirteen (100%) patients had successful Propofol sedation without complications compared to sixty-seven (92%) patients with the prior protocol. The recovery time was significantly less with the Propofol group. Propofol procedural sedation is safe for a selective population of children and should be considered in prolonged pediatric C-MRI.

1568. Dark Flow Artifacts in Steady-State Free Precession (SSFP) Cardiac Cine Imaging

Wei Li[1], Pippa Storey[1], Qun Chen[1], Belinda S. Li[2], Pottumarthi V. Prasad[1], Robert R. Edelman[1]
[1]Evanston Hospital and Northwestern University Feinberg School of Medicine, Evanston, Illinois, USA; [2]GE Medical Systems, Evanston, Illinois, USA

The goal of is study was to demonstrate the features of dark flow artifacts in Steady-State Free Precession (SSFP) cardiac cine images, and investigate the causes of the artifacts. Dark flow artifacts were recognized in 8 of 24 MR cardiac studies, which were reviewed retrospectively. The artifacts were characterized by low or inhomogeneous signal intensity in the blood pool, while the adjacent tissues showed little change. Flow phantom experiments indicated that this artifact is caused by spins moving within an inhomogeneous magnetic field, and has a periodicity that depends inversely on TR.

1569. Visualization of Radiofrequency Ablation Lesions Using Contrast-Enhanced Cardiovascular Magnetic Resonance Imaging in a Canine Model

Szilard Voros[1], James P. Hummel[1], David E. Haines[1], Robert Vernooy[1], Walter J. Rogers[1]
[1]University of Virginia, Charlottesville, Virginia, USA

Radiofrequency ablation (RFA) procedures are highly successful in the treatment of clinically significant cardiac arrhythmias, but recurrence may be seen in up to 10-15% of patients. It is thought that recurrence may be related to incomplete interruption of the re-entrant circuit. Successful ablation, an anatomically driven procedure, is defined by electrophysiologic demonstration of a bidirectional block. It would be highly desirable to have a non-invasive imaging modality, which could evaluate the tissue effects and the spatial extent of such RFA lesions. Contrast-enhanced cardiovascular magnetic resonance imaging (ceCMR) is a highly attractive tool for the assessment of RFA lesions.

1570. Predictive Motion Modelling for Adaptive Imaging

Nicholas Akbar Ablitt[1], Jianxin Gao[1], Jennifer Keegan[2], David Firmin[2], Lars Stegger[1], Guang-Zhong Yang[1]
[1]Imperial College, London, UK; [2]Royal Brompton Hospital, London, UK

Adaptive imaging with motion tracking is a promising field of study in cardiovascular MR where respiratory induced motion represents a major challenge in capturing detailed anatomical structures. To this end, a reliable motion prediction method is required so that patient specific deformation models can be established by using rapidly measurable 1D navigator traces. This paper proposes a novel approach for predictive motion modelling based on partial least squares regression, with results validated by data acquired from 9 subjects during free breathing. The method has its potential application beyond cardiovascular MR where real-time deformation tracking is necessary during imaging.

1571. Effects of Breath Holding on Right and Left Ventricular Stroke Volumes in Balanced-SSFP Cine MRI

Charles C. Liu[1], Frandics P. Chan[1]
[1]Stanford University Medical Center, Stanford, California, USA

Ventricular volumes are often measured with rapid MRI cine technique in breath-hold (BH). However, BH may alter the volumes of the left ventricle (LV) and right ventricle (RV) differently. In eight volunteers, we evaluated their RV's and LV's end diastolic volume, end systolic volume, and stroke volume (SV) during BH in inspiration and expiration. In expiration, we observed a significantly larger RV SV than LV SV (mean increase 16%, $P < 0.05$), while no such discrepancy was found in inspiration. Thus, one must be cautious with ventricular volumes measured by breath-held techniques.

1572. Combined Delayed Enhancement and Triple Inversion Recovery T_2 MR Imaging Differentiates Acute from Chronic Myocardial Infarction

Hassan Abdel-Aty[1], Nidal Al-Saadi[1], Jeanette Schulz-Menger[1], Daniel Messroghli[1], Andreas Kumar[1], Matthias G. Friedrich[1]
[1]Charite, Franz-Volhard Klinik, Berlin, Germany

Delayed enhancement (DE) MRI accurately detects the localization and size of myocardial infarction (MI). Both acute and chronic (MI) however show DE. STIR (Short TI inversion recovery) T2-weighted MRI identifies acute MI by virtue of infarct-associated myocardial edema, a pathological feature of acute but not of chronic MI. We investigated the clinical utility of a combined approach using DE and STIR to differentiate acute from chronic infarcts

1573. Myocardium Delayed Enhancement Imaging: Comparison between IR Prep Single Shot FIESTA and Conventional IR Prep FGRE Techniques

Wei Li[1], Belinda S. Li[2], Qun Chen[1], Vu M. Mai[1], Pottumarthi V. Prasad[1], Robert R. Edelman[1]
[1]Evanston Hospital and Northwestern University Feinberg School of Medicine, Evanston, Illinois, USA; [2]GE Medical Systems, Evanston, Illinois, USA

This study aimed to test the feasibility of using a Single Shot sequence for Myocardium Delayed Enhancement imaging (SSMDE) after injection of contrast agent. Eight subjects were scanned with both conventional MDE (IR Prep FGRE) and SSMDE (IR Prep single shot FIESTA) sequences in 2-chamber and 4-chamber views. The image quality of SSMDE is comparable to that of MDE, with much shorter acquisition time, but the sharpness of enhanced myocardium in SSMDE is not as good as in MDE. It is concluded that SSMDE sequence is feasible for MDE, especially useful for patients who have difficulty with holding their breath.

1574. Delayed Hyperenhancement Imaging without ECG-Gating or Breath Holding using Fast Interactive MRI

Michael A. Guttman[1], Alexander J. Dick[1], Venkatesh K. Raman[1], Andrew E. Arai[1], Robert J. Lederman[1], Elliot R. McVeigh[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Current methods for visualizing infarcted myocardium require ECG-gating and breath holding during contrast-enhanced segmented k-space inversion-recovery imaging. However, ECG-gating can be problematic in MRI and breath holding can be difficult for some patients,. We demonstrate that infarcted tissue can be visualized post-contrast as regions of hyperenhancement without ECG-gating or breath holding using intermittent inversion pulses during real-time interactive imaging. Infarcted regions and wall motion may be observed simultaneously in the real-time image stream. This method may reduce diagnostic scan time, expand the target population, and facilitate image-guided interventional treatment of infarcted myocardium.

1575. Preservation of Myocardial Viability in Hypertrophied Hearts after Potassium Channel Opener Nicorandil Therapy: Gadophrin-III Enhanced MRI

Maythem Saeed[1], Simon Schalla[1], Mitsuaki Chujo[2], Charles B. Higgins[1]
[1]University of California San Francisco, San Francisco, California, USA; [2]Chugai Pharmaceutical Company, Tokyo, Japan

Assessment of new therapies designed to reduce infarction size needs accurate and reproducible diagnostic methods. Gdaophrin II and III provide accurate delineation of acutely infarcted myocardium. The effects of nicorandil on myocardial viability and left ventricular function have not been tested in hypertrophied hearts. Nicorandil reduced the size of infarction from 19±2% to 8±3% (p=0.01) and increased the ejection fraction from 36±4% to 51±5% (p=0.01). MRI demonstrates the value of a new class of therapy in preseveing hypertrophied hearts.

1576. Role of Mitochondrial Potassium Channels in the Development of Hypertrophied Hearts

Maythem Saeed[1], Simon Schalla[1], Mitsuaki Chujo[2], Charles B. Higgins[1]
[1]University of California San Francisco, San Francisco, California, USA; [2]Chugai Pharmaceutical Co., Ltd,, Tokyo, Japan

The purpose of this MR study was to examine the involvement of ATP-sensitive potassium channels, using the potassium channel opener nicorandil, in the long-term development of left ventricular (LV) hypertrophy. Long-term oral treatment with nicorandil attenuates the progression of LV hypertrophy reflected by the reduction of LV mass compared to untreated rats. LV function was improved in treated compared to untreated animals. These results indicate that mitochondrial potassium channels play a role in the evolution of LV hypertrophy.

1577. Evaluation of Acute Reperfused Myocardial Injury by Using MnDPDP-enhanced MRI: Comparison with Cine-MRI

Dong Hyun Yang[1], Tae Hoon Kim[2], Jin Woo Choi[1], Sang Tae Kim[1], Jin Ho Yoon[1], Ji Hoon Shin[1], Joon Beom Seo[1], Tae Hwan Lim[1]
[1]Asan Medical Center, Seoul, Republic of Korea; [2]Sejong General Hospital, Pucheon, Kyunggido, Republic of Korea

MRI with MnDPDP can demonstrate retention of manganese, which is known to have physical properties similar to calcium, in myocardium. Calcium metabolism is related to the myocardial contractile function. Therefore, MnDPDP-enhanced MRI has a potential to delineate acutely injured myocardium, both infarcted and stunned, from normal myocardium. We directly compared MnDPDP-enhanced MRI with Cine-MRI in acute reperfused myocardial injury model using cats. The sizes of the unenhanced area on MnDPDP-enhanced MRI were well correlated with area with decreased myocardial contraction on cine-MRI. These results suggest that MnDPDP-enhanced MRI could be a promising modality showing acutely damaged myocardium from normal myocardium.

1578. A Predicted Relationship Between Atrial Function and the Ventricular Equilibrium Volume Can be Validated via Cardiac MRI

Andrew W. Bowman[1], Shelton D. Caruthers[2], Sandor J. Kovacs[1]
[1]Washington University School of Medicine, Saint Louis, Missouri, USA; [2]Washington University School of Medicine & Philips Medical Systems, Saint Louis, Missouri, USA

The constant-volume attribute of the heart predicts a linearly decreasing relationship between atrial ejection fraction (EF_A) and the ratio of ventricular chamber volume to atrial chamber volume at equilibrium, or diastasis (V_D/A_D ratio). This relationship can be validated using cardiac MRI. In eleven normal subjects, chamber volume measurements were made at ventricular end-diastole, end-systole, and diastasis (equilibrium). EF_A and V_D/A_D ratios were calculated for each subject. Linear regression yields $EF_A=-0.24*(V_D/A_D)+0.80$, r=-0.88. We conclude that, as predicted, EF_A and V_D/A_D are linearly related. This underscores a central feature of the heart whose evaluation is particularly well suited for cardiac MRI.

1579. Cine MR Imaging of Valvular Heart Disease with Segmented True Fast Imaging with Steady State Free Precession

Gabriele Anja Krombach[1], Harald Peter Kühl[1], Andreas Horst Mahnken[1], Arno Buecker[1], Elmar Spuentrup[1], Claudia Lipke[1], Joerg Schroeder[1], Rolf W. Guenther[1]
[1]University Hospital, Aachen, Germany

Cine true fast imaging with steady state free precession (SSFP) of the heart was evaluated for assessment of valvular dysfunction and compared to a standard gradient-recalled echo planar sequence (GE-EPI). Twenty patients with valvular dysfunction and 20 control subjects were included into the study. Presence of signal void arising from the valves and image quality were evaluated and results compared to cardiac catheterization or color Doppler. Valvular dysfunction could be delineated using SSFP with the same high sensitivity and specificity as GE-EPI. SSFP affords for semi quantitative assessment of valvular dysfunction.

1580. Can Regional MRI Data for Recovery of Dysfunctional Myocardial Segments Following Revascularization be Translanted into Indivdiual Patient Benefit?

Penelope R. Sensky[1], Graham Cherryman[1], Richard Keal[1], Norah Hudson[1], Nilesh Samani[1]
[1]Glenfield Hospital, Leicester, UK

Functional and prognostic benefit may be attained from revascularization of patients with chronic ischaemic left ventricular (LV) dysfunction. However, surgery carries increased peri-operative risk and no benefit may accrue if dysfunctional myocardium is predominantly scar. Aims: To evaluate potential MRI parameters of myocardial hibernation in chronic ischaemic LV dysfunction in order to determine (i) predictive value for segmental myocardial recovery following revascularization and (ii) potential translation into prediction of individual patient clinical benefit.

1581. Measuring Regional and Global Cardiac Function of Large Population in the MESA Study Using HARP

Li Pan[1], Iman A. El-Shehaby[1], Joao A.C. Lima[1], Nael F. Osman[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

We present a software tool to measure global and regional cardiac function from tagged MR images. This tool is used in the MESA (Multi-Ethnic Study of Atherosclerosis) study, which aims to assess global and regional myocardial dysfunction and thus elucidate the precursors of sub-clinical cardiovascular diseases. The tool allows both database management and HARP (harmonic phase) analysis which includes regional motion tracking, strain map computation, velocity field generation, and other regional and global function measurements. About 500 studies have been analyzed to date and the average analysis time is about 15 minutes per study.

1582. MR Measurements of Coronary Flow Reserve and LV Mass in Late Heart-Transplant Patients

Karen L. Kennedy[1], Maria Drangova[2], Alexander J. Dick[1], Amish Ravel[1], Chris Mahoney[1], Peter Pflugfelder[1]
[1]London Health Sciences Centre, London, Ontario, Canada; [2]Robarts Research Institute, London, Ontario, Canada

To evaluate disease severity, phase contrast MR was used to measure coronary flow reserve (CFR) in a group of heart transplant recipients more than 2.5 years post surgery. X-ray coronary angiography was used to establish evidence of vasculopathy. Left ventricular mass was measured using fast-cine imaging. CFR results were significantly different between patients with insignificant and significant disease in comparison to the control group. Patients with significant disease had higher LV mass than all other groups. Hyperemic flow normalized for mass was higher in patients with significant disease than in the control group.

1583. Myocardial Strain Before and After Surgical Repair of Left Ventricular Aneurysm

Randolph M. Setser[1], Patrick M. McCarthy[1], Nicholas G. Smedira[1], Richard D. White[1]
[1]The Cleveland Clinic Foundation, Cleveland, Ohio, USA

Left ventricular (LV) reconstructive surgery can be used to repair LV aneurysms or severe myocardial scarring. We have computed mid-wall circumferential strain (Ec) in 13 patients before and after reconstructive surgery, at 2 LV short-axis levels. Although ejection fraction (EF) improved in all patients, neither basal nor mid-ventricular Ec changed significantly following surgery. However, regional analysis showed that Ec in the lateral wall and septum did improve. Because LV shape is grossly altered by the surgical procedure, volume-based indices of LV function can be misleading, but measures of intramyocardial function, such as Ec, can more accurately reflect LV myocardial condition.

1584. The Feasibility of Cardiac MRI to Evaluate Arrhythmogenic Right Ventricular Dysplasia (ARVD)

Jongmin J. Lee[1], Yongkeun Cho[1], Taein Park[1]
[1]Kyungpook National University Hospital, Daegu, Republic of Korea

We evaluated the feasibility of the checkpoints of morphofunctional MRI to diagnose ARVD. 22 patients suspected as ARVD were examined by MRI and angiography with biopsy. MRI results were compared with angiography and pathology. The checkpoints of MRI were myocardial fat, ventricular morphology and motion abnormality. After biopsy, 17 cases were diagnosed as ARVD. The accuracy of the checkpoint "fatty infiltration" in MRI was 68%. The integration of all checkpoints showed the highest accuracy (86%) and sensitivity (100%). The morphofunctional MRI with considering all checkpoints was feasible to evaluate ARVD as a screening test.

1585. Diagnostic Value of Magnetic Resonance Imaging in Patients with Atrial Septal Defect in Comparison to Heart Catheterization and TEE

Christoph Weber[1], Gerhard Adam[1], Thorsten Dill[2]
[1]University Hospital Hamburg-Eppendorf, Hamburg, Germany; [2]Kerckhoff Clinic, Bad Nauheim, Hessen, Germany

Initial studies have shown that morphologic and functional MRI has the potential to evaluate atrial septal defects non-invasively before and after percutaneous occlusion with the Amplatzer Septal Occluder® (AOC; Fig. 1a,b). This study evaluates the MR techniques in comparison to established clinical standard techniques concerning preinterventional planning und postinterventional controlling.

1586. Comparison of the Anatomical and Electrical Cardiac Axes in Subjects with No History of Cardiac Disease

Thomas N. Martin[1], Galen S. Wagner[2], Bjoern A. Groenning[1], Alfred J. Albano[2], John E. Foster[1], Henrik Engblom[3], Tracey Steedman[1], Robin Roark[2], Alex T. Elliott[1], Henry J. Dargie[1]
[1]Glasgow Cardiac Magnetic Resonance Unit, Glasgow, Lanarkshire, UK; [2]Duke University Medical Centre, Durham, North Carolina, USA; [3]University Hospital of Lund, Lund, Skåne, Sweden

The aims of the study are to determine normal ranges of cardiac anatomical axes using MRI and to compare these with ECG assessment of cardiac electrical axes. Twenty-five subjects with acute chest pain, but no history of cardiac disease were examined with cardiac MRI and 12-lead ECG at baseline and 28 days. Cardiac anatomical frontal (reproducibility coefficient=16%) and horizontal (8.7%) axes measured by MRI were highly reproducible. There was no significant relationship at baseline between the anatomical and electrical frontal (R^2=0.004, p=0.77) or horizontal (R^2=0.04, p=0.32) axes. Therefore, current ECG acquisition and interpretation may not reliably reflect cardiac anatomical position.

1587. Single Breath-hold Real-time Evaluation of Cardiac Function: Improvement of Temporal Resolution using Generalized Autocalibrating Partially Parallel Acquisition (GRAPPA) Algorithms.

Bernd Juergen Wintersperger[1], Konstantin Nikolaou[1], Stefan O. Schoenberg[1], Mathias Nittka[2], Johannes Rieber[1], Berthold Kiefer[2], Maximilian F. Reiser[1]
[1]University of Munich, Munich, Germany; [2]Siemens Medical Solutions, Erlangen, Germany, Germany

The study compares real-time SSFP cine imaging with/without parallel imaging techniques (PAT) to segmented SSFP. Imaging was performed on 20 individuals using a 12-elemant array coil system. For PAT imaging GRAPPA algorithm was used. Real-time imaging and segmented SSFP was performed at identical positions. PAT real-time technique allowed a higher temporal resolution than nonPAT real-time imaging and adequately assessed global LV function without significant differences to segmented SSFP. NonPAT real-time imaging showed significant differences to segmented SSFP. Therefore real-time cine imaging with PAT techniques can be reliably used in assessment of global LV function.

1588. Quantitative Assessment of Regional Myocardial Function with MR-Tagging in a Multi-Center Study: Inter- and Intraobserver Agreement of Fast Strain Analysis with Harmonic Phase (HARP) MRI.

Ernesto Castillo[1], Boaz Rosen[1], Nael F. Osman[1], Iman A. El-Shehaby[1], Li Pan[1], Shenghan Lai[1], David A. Bluemke[1], Joao A.C. Lima[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

The inter- and intraobserver agreement of myocardial MR-tagged images analysis with HARP-MRI was assessed. Three independent reviewers performed 2 separate analyses of short-axis MR-tagged images from 24 healthy subjects obtained from 4 different centers. A total of 108 curves from each of the five types of strains were obtained in every subject. All systolic and diastolic strain data points were compared. Interobserver and intraobserver agreement in the systolic phase strains was excellent and was good in the diastolic phase.

1589. Millimeter In-Plane Resolution Myocaridal Strain Maps in Animal Models

Anthony Homer Aletras[1], Alex Natanzon[1], Gauri Tilak[1], Kwabena Agyeman[1], Andrew Ernest Arai[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

The application of strain myocardial imaging with Displacement Encoding with Stimulated Echoes (DENSE) at in-plane resolution of 1.1x1.1mm is explored. DENSE phase images were acquired from canines under ventilation over multiple breath-holds. The encoding strength of DENSE had to be adjusted in order to avoid data contamination from the stimulated anti-echo and the FID. Compared to single-breath-held DENSE (2.8x2.8mm pixel size) acquisitions, the higher resolution provides evidence that transitions between normal and infarcted myocardium can be directly investigated at high resolution without interpolation.

1590. MRI Myocardial Tagging and Strain Mapping with High Temporal Resolution: Regional Differences in Time to Onset of Relaxation

J.J.M. Zwanenburg[1], J.T. Marcus[1], J.P.A. Kuijer[1], M.J. W. Götte[1], AC van Rossum[1], R.M. Heethaar[1]
[1]VU University Medical Center, Amsterdam, Noord-Holland, Netherlands

The time to onset of regional relaxation (T_{rel}) may be a relevant parameter in case of intraventricular conduction delays, as it is probably linked to the onset of contraction but more straightforward to measure. Trel was assessed in 6 healthy volunteers, using MRI myocardial tagging and strain mapping with high temporal resolution. Regional differences in T_{rel} were found, with a maximum of 96 ± 10 ms (mean ± std. error) between the antero-septal and the postero-lateral region. Insight in the origin of these differences in healthy subjects is required to decide whether T_{rel} can be used to identify conduction delays.

1591. Characterization of Wall Thickening Mechanics in Cardiomyopathic Syrian Hamster by MRI Tagging

Wei Liu[1], Junjie Chen[1], J. Stacy Allen[1], Samuel A. Wickline[1], Xin Yu[1]
[1]Washington Unviersity, St. Louis, Missouri, USA

MR tagging allows noninvasive assessment of the intrinsic myocardial deformation. In this study, high-resolution MR tagging was employed to characterize alterations in regional myocardium wall motion in cardiomyopathic (CM) Syrian hamsters. LV wall thickening indexes, such as radial shortening and E1 strain, were calculated using homogenous 2D strain analysis. Compare to normal hamsters (F1-B strain), CM hamsters showed similar radial shortening and % wall thickening. However, E1 strain was significantly reduced in CM hamsters.

1592. Quantitative Analysis of Left Ventricular Stroke Volume in FIESTA: Comparison with Phase Contrast Angiography of the Ascending Aorta

Miguel Pontes[1], Mario Forjaz Secca[2], Nuno Jalles Tavares[3]
[1]Universidade Técnica de Lisboa, Lisboa, Portugal; [2]Universidade Nova de Lisboa, Caparica, Portugal; [3]Ressonancia Magnetica - SDI, Caselas, Lisboa, Portugal

Stroke Volume evaluation is very important in many cardiac applications, and 3D reconstruction applied to FIESTA CINE images can be often used to obtain this parameter. The aim of this study was to evaluate the coherence of this measurement process, comparing it with a completely different technique like phase contrast angiography of the ascending aorta. Detailed comparisons of ejected blood curves were made between the two. The results indicate a slight difference, with the FIESTA CINE values below the ones of the angiography.

1593. Can Cardiac Wall Motion Abnormalities be Detected by Color Encoded Cine MR?

Mustafa Karamanoglu[1], Andrew Bowman[1], Shelton D. Caruthers[2], Sandor J. Kovacs[1]
[1]Washington University School of Medicine, St Louis, Missouri, USA; [2]Washington University School of Medicine & Philips Medical Systems, St Louis, Missouri, USA

Color kinesis is a newly developed echocardiographic technique that helps online identification of regional wall motion abnormalities caused by myocardial infarction. Using color-encoded images, quantitative and qualitative measurements of the abnormally contracting myocardium can be made automatically. Cine MR can also be used to assess regional wall motion abnormalities, but it often requires time-consuming tracings of the endocardial border. In this study we derived color encoded cine MR stacks from gray scale cine MR stacks for identification of wall motion abnormalities. Results indicate that this new technique can depict the spatial and temporal contraction patterns in a single image.

1594. Quantitative Cardiac Wall Motion Analysis in Dobutamine Stress Tagged MRI Testing

Rosa Maria Volpi Piva[1], Jose Parga[1], Luiz Francisco Avila[1], Cláudio Campi de Castro[1], Giovanni Guido Cerri[1]
[1]Heart Institute (InCor), São Paulo, Brazil

This work shows the ability of regional wall motion parameters to detect myocardial viability and isquemia during high dose dobutamine/atropine tagged MRI stress testing. Tagged MRI provided quantification of the effect inotropic stimulation on left ventricle contraction in 10 patients with suspect of coronary artery disease, who underwent also to coronary angiography. The regions with significant decrease of displacement and main strains (E1 and E2) at peak doses of dobutamine correlate well with the territories supplied by stenosed coronary arteries, although the grade of occlusion could not be directly related with the grade of decrease of E1, E2 and displacement.

1595. Cardiac Contraction Under Ultra Low b Diffusion Weighted Imaging (ULOB DWI)

Masahiro Umeda[1], Chuzo Tanaka[1], Makoto Kitamura[1], Toshihiko Ebisu[1], Masaki Fukunaga[1], Ichio Aoki[1], Yuki Mori[1], Asuka Nakagoshi[1], Shoji Naruse[2]
[1]Meiji University of Oriental Medicine, Funai-gun, Kyoto, Japan; [2]Kyoto Prefectural University of Medicine, Kyoto, Japan

We investigated a cardiac muscle motion using a diffusion weight magnetic resonance imaging (DWI). It was reported that detection of cardiac muscle in vivo using DWI was difficult by cardiac motion. However we showed the signal intensity of skeletal muscle in DWI was decreased by contraction. The decrease of the signal intensity of contracted muscle using DWI depends on the velocity of muscle contraction. Therefore, we could demonstrate a cardiac contracted image using DWI. In this paper, we studied the changes of signal intensity corresponding with the systolic and diastolic cardiac muscle using DWI with a low b value.

1596. High Resolution Diffusion Tensor Imaging of an Excised Animal Heart, using Diffusion Weighted 3D Segmented SSFP (3D DW-SSSFP)

Eun-Kee Jeong[1], Seong-Eun Kim[1], Rob MacLeod[1], Ed di Bella[1], Dennis L. Parker[1]
[1]University of Utah, Salt Lake City, Utah, USA

Diffusion tensor imaging has proven useful for determining white matter orientation in the brain. Most diffusion imaging is accomplished using a DW-EPI pulse sequence, but since this is subject to severe artifacts arising from tissue heterogeneity, only brain DW imaging has been successful. We report a high-resolution diffusion method, diffusion weighted 3D segmented SSFP (3D DW-SSSFP), for imaging an excised animal heart. Preliminary results demonstrate that 3D DW-SSSFP has promise for understanding myocardial fiber architecture.

1597. Development of Magnetization Transfer Contrast in Canine Myocardium Following Infarction

Steven D. Buchthal[1], Ingrid M. Straeter-Knowlen[1], Yi-Chien Lee[2], Edward G. Walsh[1], Jan den Hollander[1]
[1]UAB, Birmingham, Alabama, USA; [2]UTMB, Galveston, Texas, USA

The time course of MTC development in infarcted myocardium was studied in dogs following LAD occlusion. The enhancement was significant after 8 days in both in vivo ($p<0.01$) and ex vivo.($p<0.05$) T2-weighted images, on the other hand, showed a correlation with infarct plus peripheral tissue in the first three days, but this correlation disappeared by 8 days. The area of MTC enhancement tracked with the area of the infarct, and not the peripheral tissue. MTC-weighted imaging is a promising technique to define the extent of irreversibly damaged myocardium without the use of contrast agents.

1598. Dobutamine Stress MR with Real-Time Spiral SSFP – Pilot Clinical Study

Patricia Nguyen[1], Krishna Nayak[1], Girish Narayan[1], David Liang[1], Ingela Schnittger[1], Jean Brittain[2], John Pauly[1], Michael McConnell[1], Bob Hu[1], Phillip Yang[1]
[1]Stanford University, Stanford, California, USA; [2]General Electric Medical Systems, Menlo Park, California, USA

A real-time SSFP (RT-SSFP) sequence has been developed to address some of the limitations of the current dobutamine stress MR (DSMR) protocols. The sequence contains both low- and high-frame rate capabilities to enable both rest and stress imaging. A pilot study was conducted to determine the clinical utility of RT-SSFP in DSMR by systematic comparison to dobutamine stress echocardiography (DSE), the current gold standard.

1599. Intensity Integration for Determining Left Ventricular Blood Pool Volume

Nicholas M. I. Noble[1], Derek L. G. Hill[1], Rado Andriantsimiavona[1], Marcel Breeuwer[2], David J. Hawkes[1], Reza Razavi[1]
[1]Guy's Hospital, Kings College London, UK; [2]Philips Medical Systems, Netherlands

This paper describes a technique for deriving the left ventricular blood volume at all points in the cardiac cycle from a single manual delineation of the endocardial surface, using intensity integration. The technique takes advantage of the signal homogeneity proffered by SSFP SENSE images. All results correlated well with manually derived results, this was significant in 8 out of the10 patients studied.

1600. Validation of HARP Myocardial Strain Measurements in Patients with Ischemic Cardiomyopathy

Randolph M. Setser[1], Richard D. White[1]
[1]The Cleveland Clinic Foundation, Cleveland, Ohio, USA

We sought to validate HARP analysis of tagged MR images in 11 patients with ischemic cardiomyopathy, by comparing HARP strain results with those of manual tagged image analysis. Mid-wall circumferential strain was -9.6 ± 3.5 by HARP and $-8.0 \pm 3.5\%$ by the manual technique ($p=0.02$); however the absolute difference in strain was >5% in only 2 patients, and repeated HARP results showed good reproducibility. Although the difference between techniques was statistically significant, we feel HARP is a valuable tool for clinical analysis of LV strain due to the significant time savings it affords compared to manual analysis.

Infarct Imaging

Hall D Saturday 14:00 - 16:00

1601. Loss of Cell Membrane Integrity Is the Mechanism of Signal Enhancement in Infarcted Myocardium

Gang Li[1], Bo Xiang[1], Jiankang Sun[1], Guangping Dai[1], Roxanne Deslauriers[1], Ganghong Tian[1]
[1]NRC, Winnipeg, Manitoba, Canada

Contrast-enhanced MR imaging has been extensively studied for its application in myocardial infarction. The exact mechanism underlying signal enhancement of infarcted myocardium has not been well defined. Using isolated pig hearts in conjunction with Gd-DTPA-enhanced MR imaging and localized 31P spectroscopy, we have found that loss of cell membrane integrity, not tissue edema, is the primary mechanism responsible for signal enhancement of infarcted myocardium.

1602. Quantification of Myocardial Infarct Size: Comparison of Contrast-Enhanced Magnetic Resonance Imaging and Cardiac Enzyme Indices

Christian Schlundt[1], Michaela Schmidt[2], Niels Oesingmann[2], Johannes von Erffa[1], Dieter Ropers[1], Ralph Maeffert[1], Robert Krähner[1], Josef Ludwig[1], Werner G. Daniel[1], Matthias Regenfus[1]
[1]Friedrich-Alexander-University, Erlangen, Bavaria, Germany; [2]Siemens Medical Solutions, Erlangen, Bavaria, Germany

INTRODUCTION Prognosis of patients with acute myocardial infarction depends on the mass of infarcted tissue and remaining left ventricular function. Contrast-enhanced magnetic resonance imaging (ceMRI) allows direct visualization and quantification of myocardial necrosis. For evaluation of the extent of infarcted myocardium, we compared enzyme indices of myocardial infarctions (MI) to the MRI measurements of infarct size. METHODS and RESULTS 47 patients (76% male, mean age: 60.9 ±11y) who suffered a first acute myocardial infarction underwent contrast-enhanced MRI on a 1.5 T scanner (SONATA, Siemens) within 7 days of MI. In 33 patients, reperfusion had been achieved by acute percutaneous coronary intervention.

1603. Automatic Quantification of Non-Viable Myocardium In Delayed Enhancement Magnetic Resonance Images

Arunark Kolipaka[1], George P. Chatzimavroudis[1], Richard D. White[2], Randolph M. Setser[2]
[1]Cleveland State University, Cleveland, Ohio, USA; [2]Cleveland Clinic Foundation, Cleveland, Ohio, USA

Four techniques for automatic segmentation of non-viable left ventricular myocardium (LVmyo) in delayed-enhancement (DE) MRI were evaluated in 9 patients. Techniques were based on the signal characteristics of the left ventricular blood pool (LVB) and the LVmyo. Mean percent scar obtained using the automatic techniques was in good agreement with results from manually thresholded images. Two techniques showed no statistically significant difference compared to manual results ($p<0.05$), and the maximum mean absolute difference for all techniques was ≤ 10%. The signal intensity characteristics of the LVB and LVmyo can be used for the automatic detection of non-viable myocardium in DE-MRI.

1604. Technique for Myocardial Viability Imaging using Radial Sampling

Orhan Unal[1], Walter F. Block[1], Frank R. Korosec[1], Aiming Lu[1], Thomas M. Grist[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

A technique for MR myocardial viability imaging using undersampled Projection Reconstruction (PR) technique that allows retrospective selection of inversion time (TI) to null myocardium by taking advantage of the oversampling of the center of the k-space is presented. The technique takes advantage of desirable properties including less sensitivity to motion artifacts and good tradeoff between spatial and temporal resolution.

1605. A Method for Broad T_1 Suppression in Delayed Enhancement Imaging Using Multiple Pre-Pulses

Puneet Sharma[1], Salil Patel[2], Josh Socolow[2], Roderic I. Pettigrew[2], John N. Oshinski[2]
[1]Georgia Institute of Technology, Atlanta, Georgia, USA; [2]Emory University, Atlanta, Georgia, USA

This study examines the efficacy of using two pre-pulses (90-180) for delayed enhancement imaging in vivo. The 90-180 pre-pulses offer insensitivity to arrhythmia along with robust suppression of normal myocardium without delay time modifications. The method was compared to a standard single IR technique in five patients at 20-30 minutes post contrast. SNR and CNR measurements of the two methods were comparable if steady-state free precession is used for readout in the two pre-pulse sequence.

1606. Influence of Contrast Agent Dose and Image Acquisition Timing on the Quantitative Determination of Non-viable Myocardial Tissue Using Delayed Contrast-enhanced Magnetic Resonance Imaging

Karl-Friedrich J. Kreitner[1], Steffen E. Petersen[2], Olliver K. Mohrs[3], Georg Horstick[1], Katja Oberholzer[1], Manfred Thelen[1]
[1]Johannes Gutenberg-University, Mainz, Germany; [2]University of Oxford, John Radcliffe Hospital, Oxford, UK; [3]Cardioangiologisches Centrum Bethanien, Frankfurt, Germany

The purpose was to investigate the impact of contrast agent (CA) dose and acquisition timing after CA injection on the size of hyperenhancement in chronic myocardial infarction. 9 patients underwent scanning at 1.5T. Ce-MR images were continuously acquired until 40 minutes after CA injection (0.1 mmol/kg BW=single dose), and LV mass showing hyperenhancement was determined. Measurement was repeated on the subsequent day with double dose CA. Total mass of hyperenhancement was lower for single dose CA between 20 and 28 minutes (9.0% vs. 14.2 [$p=0.03$]). 10 to 18 minutes after CA injection, there was no significant difference between the doses.

1607. Quantification of Infarct-Size using Contrast Enhanced Magnetic Resonance Imaging in Acute Myocardial Infarction

Tareq Ibrahim[1], Stephan Gerhard Nekolla[1], Mira Hörnke[1], Hubertus Peter Bülow[1], Josef Dirschinger[1], Jürgen Pache[1], Albert Schömig[1], Markus Schwaiger[1]
[1]Technischen Universität, München, Munich, Germany

Contrast enhanced MRI (ceMRI) was compared to Single Photon Emission Computed Tomography (SPECT) in patients with acute myocardial infarction for quantitative assessment of infarct-size. Regional contrast enhancement was present in all patients with acute myocardial infarction, but changed in intensity and extent over time after contrast injection. According to SPECT, determination of infarct-size by ceMRI showed the best correlation after 21 minutes. Myocardial infarct-size can be accurately assessed on ceMRI at specific times after application of contrast agent and may therefore be attractive to serve as a surrogate endpoint in clinical studies.

1608. Real Time Myocardial Delayed Enhancement: Initial Clinical Evaluation

James F. Glockner[1], David W. Stanley[2], Allison B. Robbins[2], Thomas K. Foo[2]
[1]Mayo Clinic, Rochester, Minnesota, USA; [2]GE Medical Systems, Milwaukee, Wisconsin, USA

A real time myocardial delayed enhancement sequence has recently been developed allowing acquisition of delayed enhancement images during quiet respiration. Preliminary results indicate that image quality and SNR are acceptable for the diagnosis of myocardial infarction.

1609. Combined Evaluation of Ventricular Wall Motion and Delayed Myocardial Enhancement Using a 3D-CINE Technique

Frandics P. Chan[1], Jonathan M. Levin[1], Marcus T. Alley[1], Robert J. Herfkens[1], Norbert J. Pelc[1]
[1]Stanford University Medical Center, Stanford, California, USA

Assessment of ventricular wall motion and delayed enhancement may be combined in a single study using a 3D-cine technique with fat-suppression. We report our initial clinical experience with this approach in 10 patients. Clinical findings from 3D-cine technique showed moderate to good correlation with traditional breath-held, 2D multi-slice methods. The 3D-cine technique demonstrated a substantial reduction in overall study time, and it is applicable to patient unable to perform consistent breath-holds. This may be a valuable tool for difficult or ill patients.

1610. Simultaneous Assessment of Myocardial Function and Viability

Qun Chen[1], Pippa Storey[1], Pottumarthi V. Prasad[1], Wei Li[1], Vu M. Mai[1], Robert R. Edelman[1], Kathleen Harris[2], David S. Fieno[2], Belinda S. Li[3]
[1]Evanston Hospital, Northwestern University, Evanston, Illinois, USA; [2]Northwestern University, Chicago, Illinois, USA; [3]GE Medical Systems, Waukesha, Wisconsin, USA

The objective of the study was to demonstrate the feasibility of MRI for the simultaneous assessment of myocardial function and viability. Using SSFP-based cine sequence (cine FIESTA), exploiting its intrinsic T1/T2 contrast, we have performed experiments both in patients with known myocardial infarction (MI) and in a dog model of MI after administration of Gd-DTPA. Results from the experiments show that the extent of MI can be readily identified in all phases of a cardiac cycle, in addition to the wall motion information. Such an approach may have a great potential for the accurate identification of reversible myocardial dysfunction.

1611. SENSE Accelerated 3D Imaging of Myocardial Infarction using Phase Sensitive Inversion Recovery

Peter Kellman[1], Yiu-Cho Chung[2], Elliot R. McVeigh[1], Orlando P. Simonetti[2]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]Siemens Medical Solutions, Chicago, Illinois, USA

Following administration of gadolinium, infarcted myocardium exhibits delayed hyperenhancement and can be imaged using a true-FISP (SSFP) sequence. We present experimental results that demonstrate 3-d imaging with phase sensitive inversion recovery (PSIR) acquired in a single breath-hold using parallel MR based on the SENSE method [1]. PSIR has a number of benefits [2] including consistent contrast and appearance over a relatively wide range of inversion recovery times (TI), improved contrast-to-noise ratio, and consistent size of hyperenhanced region.

1612. Delayed Contrast-enhanced Imaging of Left Ventricular Myocardial Scarring Using Single-shot Inversion Recovery (IR) TrueFISP

James Carr[1], FS Pereles[1], Richard McCarthy[1], Thomas Dunphy[1], Reed Omary[1], Orlando Simonetti[2], J Paul Finn[1]
[1]Northwestern University Medical School, Chicago, Illinois, USA; [2]Siemens Medical Systems, Chicago, Illinois, USA

Segmented IR TurboFLASH, used for assessment of left ventricular viability, has long acquisition times, resulting in respiratory motion artifact in susceptible patients. IR single-shot IR TrueFISP is an alternative faster technique, making it less susceptible to motion. Delayed post-contrast imaging was carried out in 22 patients using both techniques. Single-shot IR TrueFISP identified 92% of hyperenhancing regions detected with segmented IR TurboFLASH. Conspicuity of abnormality and image quality were slightly higher with IR TurboFLASH. IR TrueFISP is an accurate alternative method for detecting left ventricular myocardial scars and may be particularly useful in patients that cannot hold their breath.

1613. Gadobenate dimeglumine (Gd-BOPTA) - Enhanced MRI in the Detection of Right Ventricular Involvement in Myocardial Infarction

G Schneider[1], I. Kindermann[1], P Fries[1], F Ahlhelm[1], B Kramann[1], M Boehm[1]
[1]Universitaetskliniken des Saarlandes, Homburg, Saar, Germany

Isolated right ventricular (RV) infarction is relatively rare, accounting for less than 3% of all cases of infarction. Nevertheless, RV infarction may occur in a setting of acute inferior myocardial infarction when there is occlusion of the right coronary artery proximal to the marginal branches. The present study in 18 patients with acute inferior myocardial infarction revealed RV involvement in 16/18 patients. Specifically, clear delineation of the infarcted right ventricular tissue was achieved on late images acquired following the administration of Gd-BOPTA at a dose of 0.1 mmol/kg bodyweight.

1614. Comparison between Delayed Enhancement and Myocardial Function with Phase Contrast Velocity Mapping

Bernd André Jung[1], Cosima Jahnke[1], Daniela Föll[1], Jürgen Hennig[1]
[1]University Hospital, Freiburg, Germany

Patients with myocardial infarction in the left ventricle underwent MR examination with measurement of delayed contrast agent enhancement for the determination of the infarct region and also with phase contrast velocity mapping. The measured velocities were used to determine the affection of the infarct tissue by performing a correlation analysis for an improved detection of abnormalities in the motion pattern of the left ventricle. The two methods have shown a very good agreement. The results also have shown that the area of an akinetic or dyskinetic behavior can be smaller than the area of infarct tissue with enhanced signal intensity.

1615. Accentuation of High Susceptibility of Hypertrophied Hearts to Ischemia: Functional and Contrast-Enhanced MRI

Maythem Saeed[1], Simon Schalla[1], Michael F. Wendland[1], Wolfgang Ebert[2], Charles B. Higgins[1]
[1]University of California San Francisco, San Francisco, California, USA; [2]Schering AG, Berlin, Germany

Physiologic and histopathologic studies have demonstrated the high sensitivity of hypertrophied heart (HYPER) to ischemia. HYPER was produced in rats using aortic banding for 8 weeks and compared to control (NON-HYPER). Animals were subjected to ischemia/reperfusion. Gadophrin III. and functional MRI were used to delineate infarcted myocardium and to determine left ventricular (LV) function, respectively. LV mass and infarction size were greater (818±17mg, 19.0±1.4% LV) in HYPER than in NON-HYPER (616±17mg, 9.8±1.7%LV). These changes were associated with lower ejection fraction in HYPER (39±4%) than NON-HYPER 49±2% (p=0.01). This MR study demonstrates the differential effects of ischemia on HYPER and NON-HYPER.

1616. Assessment of Myocardial Infarction in Rats using 3D T_2-Weighted MR Imaging at 7T with Superparamagnetic Iron Oxide Nanoparticles

Catherine Chapon[1], Laurent Lemaire[1], Florence Franconi[2], Laurent Marescaux[3], Pierre Legras[4], Benoit Denizot[1], Jean-Jacques Le Jeune[1]
[1]Inserm ERIT-M 0104, Angers, France; [2]SCAS, Angers, France; [3]Ecole Nationale Vétérinaire, Nantes, France; [4]Animalerie Hospitalo-Universitaire, Angers, France

In order to accurately assess myocardial infarction in rats, 3D T2-weighted MR Imaging at 7T using superparamagnetic iron oxide (SPIO) nanoparticles was performed. Five hours after myocardial infarction, 3D images were acquired prior to and after nanoparticle injection and infarct volumes measured using MRI were compared to TTC staining. The SPIO nanoparticle injection induced a significant contrast between normal and infarcted area allowing the visualization of myocardial infarction. The infarct volumes measured using 3D imaging were significantly correlated with TTC staining. 3D T2-weighted imaging using nanoparticles can therefore be used for an accurate assessment of myocardial infarction in rats.

Coronary MR Imaging

Hall D Sunday 13:30 - 15:30

1617. Feasibility and Performance of Coronary MRA Using Parallel Acquisition

Jaeseok Park[1], Debiao Li[1]
[1]Northwestern University, Chicago, Illinois, USA

The purpose of this work was to investigate the feasibility and performance of k-space-based partially parallel acquisition (PPA) techniques for breath-hold coronary artery imaging using 3D true-FISP. Three methods were compared in healthy volunteers: GRAPPA (GeneRalized Auto-calibrating PPA), variable density (VD)-AUTO SMASH (Simultaneous Acquisition of Spatial Harmonics), and Generalized SMASH. GRAPPA was found to result in less image artifacts and better signal-to-noise ratio than the other two methods, and 38% and 30% of time savings for left anterior descending (LAD) and right coronary artery (RCA) imaging were possible using GRAPPA without apparent image artifacts.

1618. Motion Blur in High-Resolution Coronary MRA Protocols

Graham A. Wright[1], Osama Al-Kwifi[1], Jeff A. Stainsby[1], Warren D. Foltz[1], Marshall S. Sussman[1]
[1]Sunnybrook & Women's College Health Sciences Centre, Toronto, Ontario, Canada

This study evaluates the effect of cardiac and respiratory motion on various high-resolution non-invasive coronary imaging strategies. Coronary motion is characterized for various vessels using real-time MR under free-breathing and breath-holding conditions. The resulting motion data are used to estimate point spread functions associated with different high-resolution spiral acquisition strategies. Generally, cardiac-gated breath-hold scans with a single acquisition per cardiac cycle per slice yield higher effective spatial resolution than real-time studies or free-breathing studies with respiratory compensation. This work also lays the foundation for individually tailoring scan parameters for maximum spatial resolution based on a real-time pre-scan.

1619. Spiral MR Coronary Angiography at 1.5T and 3T: A Comparison of Image Quality, Coverage, SNR, and Susceptibility Artifacts

Patricia Nguyen[1], Ann Shimakawa[2], Jean Brittain[2], Bob Hu[1], Michael McConnell[1], Phillip Yang[1]
[1]Stanford University, Stanford, California, USA; [2]General Electric Medical Systems, Menlo Park, California, USA

MR coronary angiography (MRCA) has been demonstrated successfully in 3T. However, no systematic comparison of MRCA between 1.5T and 3T has been performed. We implemented identical spiral real-time localization (RT) and high-resolution (HR) imaging sequences in 1.5T and 3T to examine anatomic coverage, image quality, SNR, and susceptibility artifacts in 10 subjects.

1620. Reversed Spiral Imaging for Coronary MR Angiography

Peter Börnert[1], Bernd Aldefeld[1], Kay Nehrke[1], Holger Eggers[1]
[1]Philips Research Laboratories, Hamburg, Germany

Coronary MR angiography (CMRA) can benefit in the future from the principles of molecular imaging. Specific contrast agents will offer the opportunity to image arterial plaque directly, if appropriate image contrasts (T1 or T2*) can be introduced. Spiral imaging has been shown to be robust and efficient for CMRA, and reversed spiral imaging can generate strong T2* weighting. In the present work, the applicability of free breathing, sub-millimeter 2D and 3D reversed spiral coronary MRA with strong T2* contrast was studied to support future contrast agent studies.

1621. Artifact Reduction in TrueFISP Imaging of the Coronary Arteries by Adjusting Imaging Frequency

Vibhas S. Deshpande[1], Steven M. Shea[1], Debiao Li[1]
[1]Northwestern University, Chicago, Illinois, USA

Three-dimensional trueFISP is a promising technique for coronary artery imaging. A limitation of trueFISP is its sensitivity to resonance offsets. Poor field shimming in the heart can lead to erroneous setting of the synthesizer frequency, which in turn causes resonance offset artifacts. Artifacts can be reduced if the synthesizer frequency is shifted to the frequency that is optimal for the volume-of-interest. In this work, pre-scan methods to optimize the synthesizer frequency and fat saturation pulse frequency for trueFISP coronary artery imaging are described. Results show that shifting the frequency can reduce artifacts substantially.

1622. Retrospective Correction of Post Navigator Delays in Coronary MRA.

Michael Schacht Hansen[1], David Atkinson[2], Sebastian Kozerke[2]
[1]Aarhus University, Aarhus, Denmark; [2]King's College, London, UK

The efficiency of navigator based respiratory motion compensation is highly dependent on the delay between navigator and data acquisitions. This limits the amount of time during the cardiac cycle that can be used for imaging. This study presents a technique for interpolation of navigator offsets within the cardiac cycle and correction of imaging data. It is demonstrated that this technique can correct blurring caused by prolonged post navigator delays in vivo.

1623. Automatic Selection of Cardiac Acquisition Window Using an Image-Based Global Cross-Correlation of Multi Heart Phase Cine Scans

Kay Nehrke[1], Peter Börnert[1], Thomas Netsch[1]
[1]Philips Research Laboratories, Hamburg, Germany

For coronary MR Angiography a careful selection of the acquisition window is essential to minimize blurring due to cardiac motion. For the present study an image-based cross-correlation approach was implemented to extract the position of the cardiac rest period from multi heart phase cine scans. Initial experiments performed on healthy volunteers indicate the feasibility of this approach. The cardiac rest periods could be easily and automatically identified by comparing the correlation between consecutive images. Hence, this approach may be used to plan the cardiac acquisition window patient-specifically without user interaction.

1624. Comparison of Interleaved Spiral and Segmented FLASH Phase Velocity Mapping for the Assessment of Right and Left Coronary Artery Blood Flow

Jennifer Keegan[1], Peter Gatehouse[1], Guang-Zhong Yang[2], David Firmin[1]
[1]Royal Brompton Hospital, London, UK; [2]Imperial College, London, UK

Spiral phase velocity mapping can produce high temporal and spatial resolution coronary artery velocity maps. We have compared the velocity profiles obtained in 6 right and 5 left coronaries using interleaved spiral and segmented FLASH sequences. The free-breathing spiral sequence correlated closely with the free-breathing FLASH sequence, the latter taking 10x longer for the same spatial resolution. By comparison, the breath-hold segmented FLASH sequence failed to resolve the sharp peaks in the temporal flow profiles and underestimated the mean flow velocity in both the left (73.1mm/s vs 104.9mm/s, $p = 0.1$) and right (59mm/s vs 97.5mm/s, $p < 0.01$) arteries.

1625. Refined PAWS Algorithms for 3D Coronary MRA

Anthony Nuval[1], Thanh Nguyen[1], Yi Wang[1]
[1]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA

The phase ordering with automatic window selection (PAWS) algorithm is regarded to be the optimal gating method. The published version of PAWS can be refined to further improve image quality. The following modifications were explored: more frequent sampling of k-space, stricter criteria on determining a complete set, and intelligent bin assignment techniques. It was found that these refinements improved the effectiveness of navigator gating.

1626. Realistic 3D Numerical Simulations of Blood Flow Patterns and Wall Shear Stress in the Right Coronary Artery: A New Approach Combining MRI and Computational Fluid Dynamics . Preliminary Results.

Ernst Torben Fruend[1], Ch Baltes[2], Piotr Makowski[3], Maheshwaran K. Kolandavel[4], Peter Boesiger[2], Peter G. Walker[4], Erik Morre Pedersen[1], Steffen Ringgaard[1]
[1]Aarhus University Hospital, Aarhus N, Denmark; [2]University of Zurich and ETHZ, Zurich, Switzerland; [3]Technical University of Lodz, Lodz, Poland; [4]University of Leeds, Leeds, UK

A new method based on Computational Fluid Dynamics (CFD) using MR boundary conditions for realistic simulation of blood flow patterns and wall shear stresses (WSS) in the coronary arteries has been applied. The method provides an anatomically and hemodynamically realistic 3D simulation of the right coronary artery based on Magnetic Resonance Angiography (MRA) and MR inlet velocity profile measurements. The results show the capability for generating boundary conditions non-invasively with MRI for estimation of the WSS distribution throughout the artery. This will in the future allow the study of coronary WSS at different hemodynamic conditions entirely based on non-invasive techniques.

1627. Assessment of Coronary Vasodilation by MRA in Patients at High-Risk for Coronary Artery Disease

Patricia Nguyen[1], Craig Meyer[2], Jan Engvall[1], Phillip Yang[1], Michael McConnell[1]
[1]Stanford Medical Center, Palo Alto, California, USA; [2]University of Virginia, Charlottesville, Virginia, USA

Impaired coronary vasodilatory response has been associated with risk factors for coronary artery disease and an increase in future clinical events. In this study, high-resolution coronary MRA was used to directly measure the coronary vasodilatory response to nitroglycerine in volunteers and patients at high-risk for coronary artery disease. The change in coronary cross-sectional area with nitroglycerine was significantly impaired in high-risk patients and may be an indicator of subclinical atherosclerosis.

1628. Comparison of FLASH and TrueFISP Coronary Artery Imaging with an Intravascular Contrast Agent

Vibhas S. Deshpande[1], Brian E. Schirf[1], Friedrich Cavagna[2], Richard Tang[1], Reed A. Omary[1], Debiao Li[1]
[1]Northwestern University, Chicago, Illinois, USA; [2]Bracco Imaging, Milan, Italy

The benefits of an intravascular contrast agent in breath-hold coronary artery imaging were evaluated in swine. Pre-contrast trueFISP (fast imaging with steady-state precession), post-contrast inversion recovery (IR)-FLASH, and IR-trueFISP sequences were compared. Significant improvement in blood to background contrast-to-noise ratio was observed in post-contrast IR-trueFISP images than in post-contrast IR-FLASH images. The intravascular agent allowed the acquisition of high CNR images up to 1 hour after contrast administration using IR-trueFISP.

1629. Comparison of Motion-Corrected Navigator Breath-Holding and Free-Breathing Techniques for Coronary MR Angiography

Pamela K. Woodard[1], Dawei Gui[1], Gary R. McNeal[2], Faith E. Rowald[1], George S. Chrysant[1], Jie Zheng[1], Orlando P. Simonetti[2], Robert J. Gropler[1]
[1]Washington University School of Medicine, St. Louis, Missouri, USA; [2]Siemens Medical Solutions, Malvern, Pennsylvania, USA

There is no significant difference in SNR or CNR between breath-hold navigator motion-corrected and free-breathing navigator motion-corrected respiratory suppression techniques unless phase- or slice-oversampling is increased. This, however, causes a significant increase in the time of data acquisition. Overall vessel sharpness is better for breath-hold motion-corrected coronary MR angiography in comparison to motion-corrected free-breathing methods. This is especially true for the RCA in comparison to the LAD.

1630. Inhomogeneity-corrected Breath-hold 3D Spiral Coronary MRA

Zhenghui Zhang[1], Yi Wang[1], Thanh Nguyen[1], Anthony Nuval[1], Andrew V. Stenger[1]
[1]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA

A breath-hold 3D spiral coronary MRA sequence is implemented with field inhomogeneity correction. The field map acquired in 2 extra heartbeats was found to be adequate for suppressing inhomogeneity blurring. The whole data acquisition for both coronary images and field map can be completed within a 27-heartbeats breath-hold.

Vessel Wall MR Imaging

Hall D Tuesday 13:30 - 15:30

1631. Assessing the Value of Steady-State Free Precession as Part of a Comprehensive Carotid Artery Evaluation using MRI

Anna E. Zavodni[1], Derek J. Emery[1], Alan H. Wilman[1]
[1]University of Alberta, Edmonton, Alberta, Canada

Steady-state free precession (SSFP) was evaluated along with black-blood fast spin echo and time-of-flight MR Angiography (MRA) for visualization of the diseased carotid bifurcation in patients prior to carotid surgery. By comparing the resulting images to x-ray angiography, it is clear that none of these pulse sequences can stand alone as a definitive measure of carotid disease, however, when considered together a comprehensive evaluation of carotid disease is possible. The attributes of each MRA technique were verified through variable flow phantom experiments.

1632. Comparison of 2D and 3D Black-Blood Techniques for High-Resolution T_1-Weighted Imaging of Carotid Arteries

Vasily L. Yarnykh[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

High-resolution black-blood imaging of carotid arteries was performed in a group of carotid atherosclerosis patients and healthy subjects using two-(2D) and three-dimensional (3D) fast spin-echo sequences with double inversion-recovery preparation. A 3D sequence was developed in the present work. Both sequences were used to obtain T1-weighted images with TR=600-800ms. 3D black-blood imaging allowed for two-times decrease of slice thickness without image quality and scan time penalties and improved visualization of fine details of atherosclerotic plaques. At the same time, a 3D technique was found to be more prone to incomplete flow suppression limiting the slab thickness to 16-24 mm.

1633. Fast Interleaved Multi-Slice Black Blood Double Inversion Recovery Techniques for Vessel Wall Imaging.

Vitalii V. Itskovich[1], Venkatesh Mani[1], Juan Gilberto S. Aguinaldo[1], Michael Szimtenings[2], Daniel Samber[1], Gabor Miszei[1], Frank Macaluso[1], Zahi A. Fayad[1]
[1]Mount Sinai School of Medicine, New York, New York, USA; [2]Siemens Medical Solutions Inc, Malvern, Pennsylvania, USA

The purpose of this study was to compare signal-to-noise ratio (SNR) per unit time per slice and contrast-to-noise ratio (CNR) for several protocols of different multi-slice black blood imaging techniques. Interleaved double inversion recovery (DIR) turbo spin-echo (TSE) multislice acquisitions with a single 180-degree slab selective reinversion pulse and multiple 180-degree slice selective reinversion pulses were performed. A multi-slice interleaved black blood DIR-TSE parallel acquisition (GRAPPA) sequence for the optimal single slab selective reinversion protocols was developed. All measurements were made on a 1.5 T Siemens clinical MR scanner on the aortae of three human volunteers.

1634. Application of Cluster Analysis to *Ex-Vivo* 3D Magnetic Resonance Images of Atherosclerotic Human Coronary Arteries

Daniel D. Samber[1], Vitalii V. Itskovich[1], Juan Gilberto S. Aguinaldo[1], John T. Fallon[1], Venkatesh Mani[1], Cheuk Y. Tang[1], Zahi A. Fayad[1]
[1]Mount Sinai School of Medicine, New York, New York, USA

In the present study, ex-vivo multi-contrast magnetic resonance images and cluster analysis identified and quantified plaque components in human coronary arteries. Statistical analysis subsequently validated the efficacy of the technique as an aid to identifying stable and unstable plaque. Solid vessel models were rendered in 3D using composite and cluster analysis (CA) images.

1635. Quantitative Assessment of Carotid Plaque Composition Using Multi-Contrast MRI

Sharon Clarke[1], Robert Hammond[2], J. Ross Mitchell[3], Brian Rutt[1]
[1]Robarts Research Institute, London, Ontario, Canada; [2]University of Western Ontario, London, Ontario, Canada; [3]The University of Calgary, Calgary, Alberta, Canada

Multiple MR contrasts are required for identification of atherosclerotic plaque constituents. Nine carotid endarterectomy specimens were each imaged with eight MR contrasts. A classification technique was developed to create a tissue specific map by incorporating information from all MR contrasts. The classifier was validated by comparison with matched histological slices registered to MR images using a non-linear warping algorithm. A pathologist, blinded to the classifier results, manually segmented digitized histological images. The accuracy of the classifier, determined by pixel-by-pixel comparison to the pathologist's segmentation, was fibrous tissue 62%, necrosis 81%, calcification 98%, loose connective tissue 92%.

1636. Quantitative *In Vivo* MRI Characterization of Human Carotid Atheroma

Rikin Trivedi[1], Jean Uking-im[1], Martin Graves[1], Jo Horsley[2], Robert Merrifield[3], Martin Goddard[2], Guan-Zhong Yang[3], Peter Kirkpatrick[4], Jonathan Gillard[1]
[1]University of Cambridge, Cambridge, England, UK; [2]Papworth Hospital, Cambridge, England, UK; [3]Imperial College, London, England, UK; [4]Addenbrooke's Hospital, Cambridge, England, UK

Quantitative characterization of carotid atherosclerotic plaques from 20 patients scheduled for carotid endarterectomy was performed using in vivo high resolution multi-sequence MR imaging of the carotid artery. Comparison was made with plaque constituents identified on histological analysis following plaque retrieval. There was good correlation between linear ($p<0.05$) and area measurements ($p<0.01$) of fibrous cap: lipid core ratios, calcium and haemorrhage components determined by MR imaging and histological analysis.

1637. Fusion of Dynamic and Post Contrast Enhanced MRI to Determine Fibrous Matrix Density in Carotid Atherosclerosis

William Sean Kerwin[1], Annette Kampschulte[1], Marina Ferguson[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

Carotid atherosclerotic lesions can be characterized using both dynamic and steady-state contrast-enhanced (CE) MRI protocols. This study investigates whether fusion of information from dynamic images with that from steady-state images can augment the value of the steady-state images alone. Enhancing regions were identified on post-contrast T1-weighted (T1W) images and corresponding regions were analyzed in dynamic images to determine the fractional blood volume (fBV) and the total extracellular volume fraction (fEV) into which the contrast agent penetrated. Histological comparison showed that the dynamic parameters assisted in distinguishing vascularized from non-vascularized regions and in separating loose fibrous matrix from dense collagen.

1638. A Hidden Markov Model Classifier for the Classification of Patient Symptom State Based on High Resolution MR Images of Carotid Atherosclerosis

Ying Luo[1], Jenq-Neng Hwang[1], Thomas Hatsukami[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

Low level features such as morphological feature and gray level image features can be extracted from in vivo high resolution MR images of atherosclerotic carotid plaques from patients with known symptom status. In this study, we used hidden Markov models (HMMs) to map low level features to high level semantic classes (symptomatic/asymptomatic). This mapping was then used as classifiers to distinguish patients with symptoms from those without symptoms. Promising results were obtained for the classcification.

1639. Vascular Plaque Morphological Quantitation: Part I--Estimation of Vascular Wall Thickness

Chao Han[1], Thomas S. Hatsukami[1], Jenq Neng Hwang[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

Ultrasonographic studies showed that atherosclerotic plaque thickness is a better predictor of transient ischemic attack than percentage of vessel stenosis used in the clinic. So far, the thickness definition based on lumen and outer wall boundary has not been well established mathematically. An automatic vessel wall thickness measurement algorithm is proposed in this abstract, which combines two theories: Denaulay triangulation and multiresolution tiling. The MaxMin angle property of Delaunay triangulation is used to define the energy function for thickness computation. The multiresolution tiling provides a way to realize the triangulation MaxMin angle lemma and make thickness computation stable and unique.

1640. A Feature Selection Technique using Genetic Algorithm for the Classification of Patient Symptom State Based on High Resolution MR Images of Carotid Atherosclerosis

Ying Luo[1], Chao Han[1], Jenq-Neng Hwang[1], Thomas Hatsukami[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

This study was to test the hypothesis that morphological and gray-level features from in vivo high resolution MR images of atherosclerotic carotid plaque can be used to classify the patient's neurological symptom state. In order to obtain optimal performance of the classifier, a feature selection technique based on genetic algorithm and Bhattacharyya distances was proposed. The performance of this technique was tested on MR images acquired from patients with their symptomatic status known. Promising results were obtained. We conclude that this feature selection technique may be an effective method to characterize plaque features that are linked to patient symptoms.

1641. Accuracy of *In Vivo* Carotid Bifurcation Geometry Reconstructed from Serial Black Blood MRI

Jonathan B. Thomas[1], Jaques S. Milner[1], Brian K. Rutt[1], David W. Holdsworth[1], David A. Steinman[1]
[1]Robarts Research Institute, London, Ontario, Canada

MRI is increasingly being used to provide lumen boundary information for subject-specific models of carotid bifurcation hemodynamics. In this study we evaluated the accuracy of such models by comparing reconstructions from thick slice black blood MRI and 3D x-ray angiography of the same subject. The gross lumen geometry was consistent between the two models, although some differences in surface morphology were clearly evident. The boundaries agreed to within less than 1 mm at 95% confidence, while the average absolute difference was 0.3 mm. The impact of such reconstruction errors on the predicted hemodynamics remains to be seen.

1642. Detectability of Carotid Artery Calcification on High-Resolution MRI: A Pilot Study

Baocheng Chu[1], Annette Kampschulte[1], Marina Ferguson[1], Chun Yuan[1]
[1]University of Washington, Seattle, Washington, USA

Calcification is a common occurrence in the carotid atherosclerotic plaque. The relationship of calcification to the surrounding tissues may prove to be a critical factor in the determination of vulnerable plaque. The accuracy of MRI to distinguish calcification of variable sizes, however, is not established. This pilot study demonstrated the measurement of calcification size in the human carotid atherosclerotic plaque is accurate on in vivo multi-spectral MRI and contrast enhanced (CE) MRI may improve the detection of carotid calcification by enhancing adjacent neovasculature-rich tissues.

1643. Magnetic Resonance Imaging Detects In-Stent Thrombosis

Min Su Hyon[1], Fumiaki Ikeno[1], Hideaki Kaneda[1], Krishna Nayak[1], Craig H. Meyer[2], Alan C. Yeung[1], Michael V. McConnell[1]
[1]Stanford University, Stanford, California, USA; [2]University of Virginia, Charlottesville, Virginia, USA

Stent thrombosis is a rare but serious complication. MRI performed after copper-stenting in the rabbit aorta with follow-up angiography and intravascular ultrasound. Luminal irregularities indicative of thrombosis were seen within the stent in 9/9 rabbits 2-4 days after stenting, confirmed by IVUS. MRI in combination with a minimal-artifact stent allows detection of in-stent thrombosis.

1644. Computer Simulation of MR Carotid Plaque Imaging

K. Craig Goodrich[1], Dennis L. Parker[1]
[1]University of Utah, Salt Lake City, Utah, USA

A computer simulation has been developed to study the effects of movement on the visualization of normal and diseased carotid anatomy. After Fourier transformation of this high resolution model, K-space measurements are predicted using Bloch's equations and specified imaging parameters. Pulsatile motion is based upon human cine-MR images. MRA proton density images were simulated for models with 0% (normal), 13.5%, 62% and 132% vessel wall thickening. The image artifacts mimic those evident in MR Angiograms. Wall thickening is evident in the simulated images of the 62% and 132% models, but is obscured for less severe thickening.

1645. Coronary Artery Plaque Imaging with Limited Resolution: Is It useful?

Jie Zheng[1], Doris Chan[1], Haodong Xu[1], Faith E. Rowold[1], Jinghua Wang[1], Pamela K. Woodard[1], Robert J. Gropler[1], Jeffrey E. Saffitz[1]
[1]Washington University in St. Louis, St. Louis, Missouri, USA

Magnetic resonance imaging technique has shown the great potentials for imaging and characterizing coronary atherosclerotic plaques. However, spatial resolution of MRI in vivo is limited. This project is to seek whether lower image resolution achieved currently is still valuable to provide similar information as high resolution images. 7 plaque specimens were obtained from 6 autopsy cases and T2 images were acquired under different image resolutions. Plaque stenosis and T2 values of calcified/necrotic plaques were found to be similar using different image resolution. The low resolution images seemed to overestimate the area of these plaque components.

1646. MR Imaging of Atherosclerosis Plaque in Coronary and Carotid Endarterectomy Specimens *Ex Vivo*

Rakesh Sharma[1], Ram B. Singh[2], Paul J. Cannon[1], Raj K. Gupta[3]
[1]Columbia University, New York, New York, USA; [2]International College of Cardiology, Moradabad, UP, India; [3]Albert Einstein College of Medicine, New York, New York, USA

A clinical MRI method was developed for characterization, segmentation and ex vivo MRI visualization of atherosclerotic carotid and coronary plaque components to correlate with respective in vivo MRI images and NMR spectra.

1647. Identification of Necrotic Core Area in Fibrous Cap Atheromas by *Ex Vivo* MRI: A Possible Surrogate Measure of Plaque Vulnerability

Breno Pessanha[1], Kimberlee Potter[2], Frank D. Kolodgie[2], Adrew Farb[2], Erik Mont[2], Allen P. Burke[2], Renu Virmani[2]
[1]George Washington University Medical Center-Armed Forces Institute of Pathology, Washington, DC, USA; [2]Armed Forces Institute of Pathology, Washington, DC, USA

Coronary plaque rupture is associated with thin fibrous cap overlying a large necrotic core. We proposed the MR study of the lipid components of atherosclerotic plaque in an attempt to distinguish rupture-prone lesions. Nineteen coronary segments were imaged at 9.4T. Necrotic cores from late fibrous cap atheromas (FCA), a subgroup more likely to be associated with rupture, were identified by ex vivo MRI and distinguished from the more stable lipid pools characteristic of early FCA and PIT, suggesting that necrotic core area identified by MRI could potentially be used as a surrogate measurement of plaque vulnerability.

1648. Coronary Artery Atherosclerosis and Iron: Arterial Imaging and Characterization using 8 Tesla Magnetic Resonance

Subha V. Raman[1], Kelly Tung[1], Robert DePhilip[1], Peter Baker[2], Charles Hitchcock[1], Jay Zweier[1], Alayar Kangarlu[1]
[1]Ohio State University, Columbus, Ohio, USA; [2]Columbus Children's Hospital, Columbus, Ohio, USA

The development of atherosclerosis involves inflammation and iron plays a crucial role in the inflammatory process by catalyzing free radical formation,. Furthermore, histopathologic studies have suggested the presence of iron in atherosclerotic plaque. Previous authors1,2 have demonstrated that magnetic resonance (MR) measurements of T2 and T2* correlate with myocardial iron content. Because the sub-voxel susceptibility effects of iron increase with magnetic field strength, we measured T2* in coronary artery specimens using an 8T system. We also sought to produce high-resolution cross-sectional images and correlate with histopathology.

1649. Comparison of Two MR Contrast Agents for Characterization of Atherosclerotic Plaque

Christopher Brushett[1], Bensheng Qiu[1], Dara Kraitchman[1], Bruce Wasserman[1], Lawrence Hofmann[1], Ergin Atalar[1], Xiaoming Yang[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

We evaluated the utility of two MR contrast agents for characterizing atherosclerotic plaque in a swine model. Signal intensity changes between pre- and post-injection of contrast agents were compared using a 1.5T MR scanner. The targeted vessels were then harvested, imaged ex vivo using a 9.4T MR scanner, and correlated with histology. Within 2-hours after injection, these two agents resulted in a maximum 20% vessel wall enhancement with no ability to discriminate plaque components. Ex vivo MR imaging confirmed the presence of atherosclerotic lesions. These results indicate that longer time frames and higher spatial resolution are needed.

1650. An Examination of Rapid, High-Resolution Imaging Sequences for Endovascular MRI Applications

Claudia M. Hillenbrand[1], Eddy Y. Wong[1], Frank K. Wacker[1], Shaoxiong Zhang[1], Jonathan S. Lewin[1], Jeffrey L. Duerk[1]
[1]University Hospitals of Cleveland/Case Western Reserve University, Cleveland, Ohio, USA

This study seeks to identify fast MRI sequences that provide high contrast, high SNR and high-resolution MR images of vessel walls under in vivo and/or in situ conditions when used in combination with endovascular coils. An opposed solenoid catheter probe was built and introduced in the abdominal and iliac arteries of a pig model. A variety of imaging techniques were analyzed in order to evaluate their feasibility for use in microimaging applications; these included spin echo, turbo spin echo, HASTE, single shot and segmented EPI, and True FISP sequences.

1651. Imaging Mouse Aortic Arch and Great Vessels With 1.5 Tesla Clinical Scanners and Paramagnetic Nanoparticle Blood Pool Agents

Todd A. Williams[1], J Stacy Allen[1], Patrick M. Winter[1], Mary P. Watkins[1], Greg M. Lanza[1], Samuel A. Wicline[1], Shelton D. Caruthers[2]
[1]Washington University at Barnes-Jewish Hospital, Saint Louis, Missouri, USA; [2]Washington University at Barnes-Jewish Hospital, Philips Medical Systems, Saint Louis, Missouri, USA

Genetically engineered mouse models of human disease such as atherosclerotic vascular disease (the number one source of mortality in the Western World) are one of the most cost effective tools for research and development of treatments. If clinical-scale scanners could be used, the opportunities for research might expand tremendously. We evaluated the possibility for imaging the aorta and great vessels of mouse models with a clinical 1.5T MR scanner in concert with use of a blood pool contrast agent. These data indicate promise for imaging vascular disease in mice with scanners and protocols easily applied to human studies.

Myocardial Perfusion and Flow

Hall D Saturday 14:00 - 16:00

1652. Myocardial T_2 BOLD Contrast: Effects of Echo-Spacing Time

Jinghua Wang[1], Faith Rowold[1], Mark Nolte[1], Pamela K Woodard[1], Robert J Gropler[1], Jie Zheng[1]
[1]Washington University, St. Louis, Missouri, USA

Recently, T2 effect of BLOD leads to new interest in functional MRI. However, when using fast spin echo method to mesure T2, the effect of echo-spacing time (τ) was not systematically investigated in hearts. In this study, effect of τ on T2 was clearly demonstrated in the myocardium of both normal volunteers and stenotic dogs. The regional difference of T2 between normal and stenosis areas changes from 5.5% to 10.6% for increasing τ from 7.6 to 13 ms, respectively. Our results provide promising another no-invasive method in studying ischemic heart at rest without recourse to exercise or pharmacological stress.

1653. Susceptibility Sensitive Magnetic Resonance Imaging Detects Human Myocardium Supplied by a Stenotic Coronary Artery

Christian M. Wacker[1], Andreas W. Hartlep[2], Stefan Pfleger[3], Lothar R. Schad[2], Wolfgang R. Bauer[1]
[1]University of Wuerzburg, Germany; [2]DKFZ, Heidelberg, Germany; [3]University of Mannheim, Germany

Objectives – Evaluation of the severity of a coronary artery stenosis is of paramount interest for therapy. A relevant stenosis provokes poststenotic microvascular dilation with capillary recruitment. This autoregulatory response was investigated in the present study by susceptibility sensitive magnetic resonance imaging (MRI) without contrast agents. Background - Functional alterations of the microvascular system may be studied non-invasively and without contrast agent by susceptibility sensitive MRI, which is based on the paramagnetic property of deoxyhemoglobin [1-3]. This effect, also referred to as blood oxygenation level dependent (BOLD) effect, is investigated by T2* measurements.

1654. Effect of Coronary Artery Occlusion and Adenosine Vasodilation to Magnetization Transfer Contrast on the Canine Heart

Christine O. Menias[1], Nikolaos V. Tsekos[1], Dawei Gui[1], Kamil Ugurbil[2]
[1]Washington University, Saint Louis, Missouri, USA; [2]The University of Minnesota, Minneapolis, Minnesota, USA

The effects of coronary artery occlusion and adenosine vasodilation on Magnetization Transfer Contrast (MTC) of the heart are examined in vivo. Dynamic studies demonstrate that MTC signal follows periods of adenosine vasodilation and coronary artery occlusions. Saturation transfer experiments demonstrate that steady state magnetization and T1sat of tissue during saturation correlate with myocardial blood flow measured with radioactive microspheres. The pseudo-first order exchange rate (kfor) and the To1 are found also to correlate with MBF suggesting that the sensitivity of MTC to alterations of perfusion originates from concurrent alterations of myocardial blood flow and blood volume.

1655. Acceleration Techniques Combined with TrueFISP for Rapid First-Pass Myocardial Perfusion Imaging

Qiang Zhang[1], Mark Elliot Crowe[2], Yiu-Cho Chung[1], Orlando Paul Simonetti[1]
[1]Siemens Medical Solutions, Chicago, Illinois, USA; [2]Northwestern University, Chicago, Illinois, USA

Cardiac perfusion studies require 6 – 8 slices every heartbeat, or a scan time of 100msec-120msec per slice. TurboFLASH (TFL), GRE-EPI, and TrueFISP (TRUFI) have all been used for perfusion imaging [1,2,3]. TRUFI has shown improved CNR compared to TFL [4]. However, TRUFI is less efficient than TFL or GRE-EPI. Two techniques were implemented to improve the efficiency of trueFISP: partial-Fourier imaging (PFI), and GRAPPA [5]. GRE-EPI, TRUFI-PFI, and TRUFI-GRAPPA techniques were compared in three volunteers.

1656. Extended Coverage First Pass Perfusion Imaging using Slice Interleaved TSENSE

Peter Kellman[1], J Andrew Derbyshire[1], Kwabena O. Agyeman[1], Elliot R. McVeigh[1], Andrew E. Arai[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Parallel imaging is applied to first pass contrast enhanced cardiac MR to yield greater spatial coverage for a fixed temporal resolution. The method combines rate R=2 acceleration using TSENSE with shot-to-shot interleaving of R=2 slices. The $\sqrt{R}$ SNR loss is largely compensated by the increased flip angle that is used with slice interleaving. In this manner, increased spatial coverage is achieved while maintaining approximately the same signal quality. Single heart beat temporal resolution was accomplished with spatial coverage of 8 slices at heart rates up to 71bpm, 6 slices up to 95bpm, and 4 slices up to 143bpm.

1657. Myocardial First Pass Perfusion: a Comparison Among TrueFISP, TurboFLASH and Segmented EPI

Y Wang[1], K Moin[1], O Akinboboye[1], N Reichek[1]
[1]St. Francis Hospital, SUNY Stony Brook, Roslyn, New York, USA

We studied the TrueFISP first-pass myocardial perfusion technique and directly compared it with the TurboFLASH and Segmented EPI in 11 volunteers to investigate differences in SNR and artifacts at similar in-plane spatial resolution. The results demonstrate that TrueFISP perfusion images exhibit a roughly 50% SNR improvement over TurboFLASH and 180% over Segmented EPI after signal from contrast agent in the myocardium has stabilized.

1658. Accelerated true-FISP Multi-slice First Pass Perfusion Imaging using TSENSE

Peter Kellman[1], Qiang Zhang[2], Elliot R. McVeigh[1], Andrew E. Arai[1], Orlando P. Simonetti[2]
[1]National Institutes of Health, Bethesda, Maryland, USA; [2]Siemens Medical Solutions, Chicago, Illinois, USA

Parallel imaging is applied to first pass contrasted enhanced cardiac MR to yield greater spatial coverage for a fixed temporal resolution. The method combines true-FISP imaging with rate R=2 acceleration using TSENSE. Single heart beat temporal resolution was accomplished with spatial coverage of 6 slices at heart rates up to 80 bpm and 4 slices up to 120 bpm. Increased spatial coverage is demonstrated with consistently good contrast and overall image quality.

1659. First-pass Cardiac Perfusion Using a Novel Projection Reconstruction Imaging Technique

James J. Pilla[1], Lawrence Dougherty[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

The limiting factor in the clinical use of first-pass contrast-enhanced MRI for the detection of myocardial ischemia is the challenge of achieving whole heart coverage in one to two heartbeats. In this study, a projection reconstruction imaging techniques was combined with FGRE to investigate its potential for obtaining first-pass perfusion with whole heart coverage. The signal intensity curves from 40 projection images had similar profiles compared to the 80 projection images while requiring only half the amount of time to acquire. Using this technique for perfusion imaging may make it possible to obtain whole heart coverage.

1660. A Method for Fast T_1 Measurement in the Heart

David M. Higgins[1], John P. Ridgway[1], Aleksandra Radjenovic[1], Mohan Sivananthan[1], Michael A. Smith[2]
[1]Leeds Teaching Hospitals, Leeds, UK; [2]University of Leeds, Leeds, UK

Quantitative, dynamic myocardial perfusion measurements that are based on the alteration of the T1 relaxation time with contrast agent require knowledge of the initial T1 value of the myocardium and its subsequent variation due to the passage of the contrast agent through the myocardium. A method of T1 measurement is presented that is both fast and whose slice locations and data acquisition timing may be made to exactly match those of the clinically used dynamic perfusion pulse sequence. This allows pixel based mapping of T1 values onto first-pass signal intensity data.

1661. A Mathematical Formulation for Fast T_1 Measurement in Cardiac Applications

David M. Higgins[1], John P. Ridgway[1], Aleksandra Radjenovic[1], Mohan Sivananthan[1], Michael A. Smith[2]
[1]Leeds Teaching Hospitals, Leeds, UK; [2]University of Leeds, Leeds, UK

T1 estimation can be used to calibrate the dynamic series of images taken during the first-pass of a myocardial perfusion study. If the timing and geometry of the calibration measurement are identical to the dynamic series, pixel mapping of T1 values to the first-pass image intensity data is possible. This work investigates the feasibility of making a T1 estimate from just two image acquisitions and a mathematical description of the pulse sequence used. Normalized signal values are compared to calculated signal values derived using the mathematical description of the sequence, to yield a corresponding T1. No curve fitting is required.

1662. Combination of Multislice Short-Axis CINE MRI and Colored Microspheres in Determination of Myocardial Perfusion in Experimental Animals

Pal Suranyi[1,2], Pal Kiss[1], Tamas Simor[1,2], Ada Elgavish[1,2], Gabriel A. Elgavish[1,2]
[1]University of Alabama at Birmingham, Birmingham, Alabama, USA; [2]Elgavish Paramagnetics Inc, Birmingham, Alabama, USA

We have developed a new, more accurate method for the determination of regional myocardial perfusion by combining MRI and colored microsphere measurements. In 17 LAD-occluded dogs we carried out cardiac output(CO) measurements using multislice short axis cine MRI(FIESTA) and colored microspheres. Good correspondence was found between microsphere and MRI results($R=0.88$, $p<0.01$). The microsphere-method overestimated MRI by an average of 17.93%. This error is carried on to the calculation of regional perfusion values. We suggest that in an experimental myocardial perfusion assay by microspheres, short axis cine MRI should be used (if available) as a substitute for reference blood sampling.

1663. Quantification of Myocardial Regional Difference in Noncritical Stenotic Dogs

Jinghua Wang[1], Mark Nolte[1], Pamela K Woodard[1], Robert J Gropler[1], Jie Zheng[1]
[1]Washington University, St. Louis, Missouri, USA

The regional difference of stenotic dogs was preformed by first pass perfusion and T2 at rest and stress.. At rest, the regional difference between normal and stenosis area is 2.2% and 5% for perfusion and T2, respectively. At stress, the difference of T2 enlarged with changed time. About 10 minutes after injection of dipyridamole, the different T2 increase maximum value 13%, and then reduced with the increasing time. The difference of perfusion increases to 29.4% at stress. Our results provide a potential, quantitative, and non-invasive method for studying infarcted myocardium without any contrast agent and pharmacological stress.

1664. Is Myocardial Perfusion MRI Reproducible?

Penelope R. Sensky[1], Mark Horsfield[2], Nilesh Samani[1], Graham Cherryman[1]
[1]Glenfield Hospital, Leicester, UK; [2]Leicester Royal Infirmary, Leicester, Leics, UK

Few data are yet published on the reproducibility of quantitative measurements of myocardial perfusion with MRI. The unidirectional transfer coefficient of gadodiamide over the capillary membrane, Ki, has been proposed as a measure of myocardial blood flow [1]. Aims: To evaluate the reproducibility of Ki calculation in normal volunteers between scans on different days and within the same MRI examination.

1665. Variation of the Arterial Input Function in Myocardial Perfusion Measurements: Influence of ROI Size and Position

Andrea Karg[1], Katja Oberholzer[1], Nico Abegunewardene[1], Georg Horstick[1], Nico Hoffmann[1], Karl Friedrich Kreitner[1], Wolfgang Günther Schreiber[1]
[1]Johannes Gutenberg-University, Mainz, Rheinland-Pfalz, Germany

Arterial input functions (AIF) were obtained from ROIs in the LV. 13 different locations and ROI sizes were evaluated in each of the dynamic data sets. Myocardial perfusion was evaluated using the normalized upslope technique [1,2]. Myocardial perfusion reserve (MPR) was calculated by the normalized upslope during Adenosine infusion divided by that during resting conditions. Slopes varied by (14±11)% over all ROIs and patients. If the amount of pixel in the ROI was greater than 150, the variation was only (7.9±4.7)%. MPR variations were (21±16)% over all ROIs. If ROIs were centered and equally positioned, variations were smaller (5.5±3.4)%.

1666. Quantitative Assessment of Myocardial Blood Flow using First-pass Perfusion MR Imaging Analyzed by Patlak Method.

Kakuya Kitagawa[1], Hajime Sakuma[1], Motonori Nagata[1], Nanaka Ishida[1], Kan Takeda[1], Munenobu Motoyasu[1], Takeshi Nakano[1], Yasutaka Ichikawa[1], Takahiro Natsume[2], Noriyasu Yamamoto[2], Hisato Maeda[2]
[1]Mie University School of Medicine, Tsu, Japan; [2]Fujita Health University School of Health Sciences, Toyoake, Japan

Quantitative assessment of myocardial perfusion was performed with a Patlak method in 11 patients. Sufficient number of fitting points can be maintained with Patlak method when images were acquired at reduced temporal resolution(2RR). Perfusion parameter in normal myocardium demonstrated more homogeneous distribution with Patlak method than with maximum slope method. Significant reduction of perfusion parameter was observed in ischemic myocardium in 10 (91%) of 11 patients. In conclusion, quantitative analysis of perfusion MRI using Patlak method can provide more accurate quantification of myocardial blood flow and better detection of ischemia in comparison with maximal upslope method.

1667. Improved Quantification in the High Dose Regime for First-Pass MR Perfusion Imaging

Florian Fidler[1], Peter M. Jakob[1], Axel Haase[1]
[1]University of Würzburg, Würzburg, Germany

A new model for quantitative evaluation of first-pass perfusion experiments is proposed. It calculates contrast agent (CA) concentration with an exponential approximation of the measured signal based on the following input parameters, signal from precontrast images and the underlying tissue T1. This approach improves the quantitative perfusion evaluation in high CA dose first-pass measurements and therefore increases contrast to noise ratio (CNR). The new model was tested in simulation and experiments with encouraging results such as an improved deconvolution, quantification of CA concentrations and the possibility to inject a 3-fold higher CA dose.

1668. The Effect of Noise Reduction on the Quantification of First-Pass Myocardial Perfusion

Marcel Breeuwer[1], Ursula Goette[1]
[1]Philips Medical Systems QV1, Best, Netherlands

Myocardial ischemia can be detected by quantitatively comparing contrast-enhanced first-pass MR perfusion image series acquired at rest and stress. The perfusion reserve index, i.e. the ratio of the maximum upslopes of local myocardial time-intensity profiles at stress and rest, has proven to be a good indicator of ischemia. The noise level in perfusion images is however high due to the relatively short image acquisition time. This paper analyses the effect of noise on the perfusion reserve index and shows that the accuracy with which this index can be determined is significantly increased by applying noise reduction techniques.

1669. MR Perfusion for the Detection of Coronary Artery Disease

Eike Nagel[1], Christoph Klein[1], Ingo Paetsch[1], Sabine Hettwer[1], Bernhard Schnackenburg[2], Eckart Fleck[1]
[1]German Heart Institute, Berlin, Germany; [2]Philips Medical Systems, Hamburg, Germany

We assessed the value of magnetic resonance perfusion imaging for the noninvasive detection of coronary artery disease in 80 patients, referred for a primary diagnostic coronary angiography. Perfusion reserve was calculated from the alteration of the upslope of the first pass of a Gd-DTPA-bolus before and during adenosine vasodilation for 30 cardiac segments. Receiver operated characteristics were performed and the results prospectively applied yielding a sensitivity, specificity and accuracy of 90, 93, and 91 for the detection of coronary artery disease. The determination of MPRI with MR yields a high diagnostic accuracy in patients with suspected coronary artery disease.

1670. Efficacy of Nicorandil Stressed-Perfusion MRI for the Assessment of Transmural Perfusion of Ischemic Heart Diseases.

Yasuyuki Kobayashi[1], Takanori Yasu[1], Osamu Tanaka[1], Katsuhiko Matsuura[1], Kenji Hamada[1], Masakatsu Funakubo[1], Kouichi Adachi[1], Takashi Ino[1], Muneyasu Saitou[1], Naoya Imai[1], Yoshimasa Koyama[1], Yoshio Machida[2], Kenji Yodo[3], Masahiro Kosaka[3]
[1]Jichi Medical School/Omiya Medical Center, Saitama-shi, Saitama, Japan; [2]Toshiba Medical Systems R&D Center, Otawara, Tochigi, Japan; [3]Toshiba Medical Systems, Bunkyo-ku, Tokyo, Japan

The objective is to assess the usefulness of Nicorandil for the safe performance of stressed perfusion MRI using pharmaceuticals. Pharmacological stress studies using Dobutamin and Dipyridamole are accompanied by serious risks, which may cause an episode due to angina pectoris or serious arrhythmia. In our institution, Nicorandil is used for perfusion MRI to avoid serious complications. We consider that the extent of an ischemic region can be assessed by stressed perfusion MRI using Nicorandil. Clinically useful stressed perfusion MRI could be safely carried out by employing Nicorandil in a large number of institutions

1671. Comparison of Myocardial Perfusion with Regional Wall Motion Abnormality in Symptom Limited High Dose Dobutamine-Atropine Stress MRI

Mushabbar A. Syed[1], Patricia Ingkanisorn[1], Kwabena Agyeman[1], Ian Paterson[1], Andrew E. Arai[1]
[1]National Heart, Lung & Blood Institute, Bethesda, Maryland, USA

Assessment of regional wall motion with high dose dobutamine-atropine stress MRI has been shown to have diagnostic and prgnostic value. Addition of myocardial perfusion during high dose dobutamine-atropine stress MRI has been limited due to poor image quality at high heart rates. We compared the diagnostic accuracy of regional wall motion and perfusion abnormalities in fifteen consecutive patients with known or suspected coronary artery disease undergoing symptom limited high dose dobutamine-atropine stress MRI. We found that myocardial perfusion imaging is more sensitive than cine MRI in detecting ischemic coronary territories consistent with multi-vessel disease when compared with coronary angiography.

1672. Are the Clinical Benefits of Transmyocardial Laser Revascularization Really Placebo? Assessment with MRI.

Penelope R. Sensky[1], Manuel Galinanes[1], Nilesh Samani[1], Mahmoud Loubani[1], Joseph Leverment[1], Graham Cherryman[1]
[1]Glenfield Hospital, Leicester, Leics, UK

Transmyocardial laser revascularization (TMR) and thoracic sympathectomy (TS) are accepted therapeutic strategies in patients with severe coronary artery disease unsuitable for conventional surgical revascularization. Both strategies appear to alleviate patient perception of angina. However it is unclear whether any beneficial clinical effects are accompanied by improvement in regional myocardial perfusion. Aims: To compare the changes in patient perception of angina and exercise tolerance following TMR and TS to gain insight into the mechanism underlying the clinical efficacy of TMR.

1673. Does Transmyocardial Laser Revscularization Therapy Cause Myocardial Fibrosis?

Penelope R. Sensky[1], Nilesh Samani[1], Graham Cherryman[1]
[1]Glenfield Hospital, Leicester, Leics, UK

The longterm physiological effects of laser channel creation in human myocardium are unclear. Initial clinical benefit appears evident but this is not accompanied by definitive evidence of improvement of myocardial perfusion. Myocardial fibrosis arising from laser-induced injury that could hinder myocardial perfusion remains a concern. Aims: To compare remote microvascular integrity within myocardial regions undergoing laser treatment with non-lased regions (controls).

1674. The Diagnostic Value of Delayed Enhancement Sequence in Coronary Artery Disease Compared with Catheterized Coronary Angiography

Chen Suihui[1], Gao Yuangui[1], Cai Youquan[1]
[1]PLA Genaral Hospital, Beijing, People's Republic of China

To investigate the diagnostic value of the delayed enhancement sequence in single- and multi-vessel groups of CAD.Catheterized angiogram confirmed stenoses in 54 coronary arteries of 35 cases(18 cases of one-vessel group ,17 of multi-vessel group). Only 2 (11.1%, 2/18) in one-vessel group had high signal intensities within the relevant subendocardial regions. 25(69.4%,25/36) of the multi-vessel group showed abnormalities. The sensitivities have significant difference between these two groups (11.1% vs.69.4%, Fisher¡¯ exact P=0.001). The stenotic arteries in multi-vessel disease group is more likely to show abnormalities on delay enhancement sequence than the those in single-vessel group.

Flow Quantitation

Hall D Sunday 13:30 - 15:30

1675. Evaluation of Partial Fourier Phase Contrast Acquisition in Velocity Measurements

Gilberto Szarf[1], Yoav Dori[1], Aylin Tekes[1], Luciano Amado[1], Shiquan Ren[1], Shenghan Lai[1], Thomas K.F. Foo[2], David Alan Bluemke[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]GE Medical Systems, Baltimore, Maryland, USA

The purpose of this study was to evaluate the efficacy of using partial Fourier phase contrast acquisition clinically. Partial Fourier phase contrast acquisition allows a substantial reduction in scan time without severely compromising accuracy of the flow measurements. However, phase contrast studies are usually characterized by long acquisition times that can be beyond the capability of an average patient to breath-hold. An optimal acquisition strategy is one that is able to reduce the overall acquisition time to be within a reasonable breath-hold period and yet maintain high temporal resolution in the phase-contrast CINE measurements.

1676. Comparison of Real-Time and Ungated Phase-Contrast Imaging for Rapid Mean Flow Measurements

Jong B. Park[1], Juan M. Santos[1], Krishna S. Nayak[1], Dwight G. Nishimura[1]
[1]Stanford University, Stanford, California, USA

We compared real-time spiral phase-contrast (RSPC) with ungated spiral phase-contrast (USPC) for rapid measurement of mean flow rates. RSPC offers high temporal but low spatial resolution; conversely USPC offers high spatial but low temporal resolution. Experimental results and (k, t)-space analysis show that the trade-off will depend mainly on the spatial and temporal distributions of velocities. In general, USPC demonstrates greater consistency than RSPC for measuring mean blood-flow rates.

1677. Reproducibility in Phase Contrast Imaging using SENSE

Per Thunberg[1], Matts Karlsson[2], Lars Wigström[2]
[1]Örebro University Hospital, Örebro, Sweden; [2]Linköping University Hospital, Linköping, Sweden

Parallel imaging using SENSE can reduce scan time considerably, depending on the reduction factor. SENSE has been successfully implemented in a number of different pulse sequences, phase contrast being one of them. Flow measurements using the phase contrast imaging technique often result in relatively long scan times and would therefore benefit considerably from using SENSE. However, a reduction in scan time influences the signal-to-noise ratio in the reconstructed image and therefore also the reproducibility of the induced phase shift. The purpose of this study was to investigate how the reproducibility in phase contrast imaging is influenced when using SENSE.

1678. Velocity Imaging and Spectroscopy of Xenon Gas Flow

Ross W. Mair[1], Ruopeng Wang[2], Matthew S. Rosen[1], David G. Cory[2], Ronald L. Walsworth[1]
[1]Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, USA; [2]Massachusetts Institute of Technology, Cambridge, Massachusetts, USA

With the advent of laser-polarized gases, measurement of gas flow in a variety of continuous and restricted environments is gaining wider interest, especially for diagnosis of lung pathology. We report initial studies of continuous flow laser-polarized xenon gas, demonstrating the feasibility of velocity-sensitive imaging of much higher flows than are found in liquids. Gas velocity imaging is, however, found to be limited to a resolution of about 1 mm/s due to the high diffusivity of gases compared to liquids. We also demonstrate how details of the flow field can be deduced from the echo attenuation plots.

1679. Practical Considerations of Flow Quantification at 3 Tesla

Christof Baltes[1], Sebastian Kozerke[1], Peter Boesiger[1]
[1]University & ETH Zurich, Switzerland

Accurate determination of blood flow remains challenging in small vessels such as the coronary arteries using systems operating at 1.5T due to signal-to-noise ratio (SNR) limitations. With the increasing availability of whole body 3.0T magnets some of the limitations might be addressed. In this work, theoretical considerations are validated with phantom experiments comparing the accuracy of velocity mapping at 1.5T and 3.0T. Results indicate improved accuracy at 3.0T given the intrinsic SNR gain at higher static field strength and reduced velocity offsets from concomitant gradient fields.

1680. *In Vitro* Validation of Phase Contrast Measurements at 3T versus 1.5T

Joachim Lotz[1], Gerd Peter Meyer[1], Ralph Noeske[2], Matthias Gutberlet[3], Roland Felix[3], Michael Galanski[1]
[1]Medical School Hannover, Hannover, Germany; [2]General Electric, Milwaukee, Berlin, Germany; [3]Department Charité, Campus Virchow-Klinikum, Berlin, Germany

In this study phase contrast (PC) flow measurements were compared in a clinical 3.0 T and 1.5 T scanner in vitro. Background phase scatter of PC measurements at 3T is half of that at 1.5 T. Scatter of mean flow is also reduced compared to 1.5T. No difference was found in the estimation of mean flow rates, if optimum imaging parameters were used.

1681. Noninvasive Assessment of Diffuse Atherosclerosis in the Coronary Circulation with MR Flow Quantification in the Coronary Sinus

Yasutaka Ichikawa[1], Hajime Sakuma[2], Kakuya Kitagawa[2], Nanaka Ishida[2], Tadanori Hirano[1], Kan Takeda[2]
[1]Matsusaka Centaral Hospital, Matsusaka, Mie, Japan; [2]Mie University School of Medicine, Tsu, Mie, Japan

Global coronary flow reserve (CFR) in patients with diffuse atherosclerosis was evaluated by quantifying blood flow in the coronary sinus. Twenty subjects including 7 healthy subjects (A), 7 patients with high risks of atherosclerosis who demonstrated no stenosis on coronary angiography (B), and 6 patients with multi-vessel coronary artery disease (C) were studied. The CFR was significantly reduced in Group B(2.07 ± 0.54, $p<0.01$), as well as in Group C(2.15 ± 1.06, $p<0.01$) in comparison with healthy subjects (3.17 ± 0.77). MR flow measurement in the coronary sinus can provide noninvasive assessment of altered coronary flow dynamics in patients with diffuse atherosclerosis.

1682. Calculation of 2D Relative Pressure Maps using MR Acceleration Measurements

Fanny Balleux[1], Odile Jolivet[1], Alain De Cesare[1], Alain Herment[1], Jean-Pierre Tasu[2], Elie Mousseaux[1]
[1]INSERM, Paris, France; [2]CNRS, Orsay, France

A non-invasive method is proposed to determine relative intraventricular blood pressures using the fluid dynamics Navier-Stokes equation associated with input MR total acceleration measurements. Relative pressures are estimated independently of a path of integration by constructing a minimization problem of a quadratic energy function. The algorithm is applied to compute relative pressure maps of left ventricle filling and ejection using 2D acceleration MR measurements. Spatial and temporal evolutions of the pressure differences, both along inflow and outflow paths, display patterns consistent with previous published catheter studies.

1683. Statistical Comparison of Blood Flow Patterns in the Aorta in Patients with CAD and Age-matched Normal Subjects

Michael H. Buonocore[1], Hugo G. Bogren[1]
[1]UC Davis Medical Center, Sacramento, California, USA

Twenty-one patients with coronary artery disease (CAD), 37-86 years old, were studied with 20 age-matched normal subjects. Time-resolved three-component velocity data over the vessel volume was obtained with sequential single-slice 2D cardiac-gated MR velocity-encoded phase-contrast sequences. Compared to age-matched normal subjects, patients with CAD had significantly different blood flow patterns in the ascending aorta, as measured by three quantifiable parameters. The differences diminished with age. This and other results suggest that age-related changes in the aorta have effects on the flow pattern which are similar in quality and severity to those created by CAD and atherosclerosis.

1684. Visualization and Quantification of Pulse Wave Velocity of Aorta by Phase Contrast Cine MRI

Hsi-Yu Yu[1], Hsu-Hsia Peng[1], Chih-Yung Wen[2], Jaw-Lin Wang[1], Wen-Yih Tseng[1]
[1]National Taiwan University, Taipei, Taiwan; [2]Dept. of Mechanical and Automation Engineering, Chang-Hwa, Taiwan

This study proposed a new phase contrast MRI method to map and measure pulse wave velocity (PWV) of the aorta. Phase contrast cine MRI was acquired in a single plane covering the whole course of aorta. Color-coded velocity maps clearly showed the propagation of the wave front of the PWV. From the velocity profiles along the aorta at different time points, PWV was determined by the speed of progression of the wave front. The proposed method has advantages of reliability and convenience. These advantages will enhance the feasibility of clinical application.

1685. Measuring the Dilated Aortic Root: Agreement Between Echocardiography and Cine MRI

Alan H. Stolpen[1], Lizann Bolinger[1], Tim L. Irwin[1], Marcia C. Willing[1], Thomas D. Scholz[1], David J. Skorton[1]
[1]University of Iowa, Iowa City, Iowa, USA

Accurate and reproducible serial measurements are essential for managing patients at high-risk for aortic root dilatation. Echocardiography (ECHO) is the accepted standard for measuring aortic root dimensions, but has limitations. Cine MRI offers a potentially attractive alternative. We used Bland-Altman analysis to evaluate agreement between aortic root measurements obtained from 49 pairs of ECHO and Cine MRI studies. Bias was minimal at the annulus and sinuses, but significantly negative at the sinotubular junction and proximal aorta. Limits of agreement were large at all sites. The results suggest that it may be imprudent to use the two modalities interchangeably.

1686. Quantification of Steady and Pulsatile Flow Through Mitral Regurgitant Orifices with Segmented k-Space MR Phase Velocity Mapping

Haosen Zhang[1], Sandra S. Halliburton[2], Richard D. White[2], George P. Chatzimavroudis[1]
[1]Cleveland State University, Cleveland, Ohio, USA; [2]Cleveland Clinic Foundation, Cleveland, Ohio, USA

It has been shown that mitral regurgitation can be quantified with three-directional (3-DIR) MR phase velocity mapping (MRPVM) using a multi-slice control volume (CV) method. However, conventional MRPVM is clinically impractical for multi-slice 3-DIR acquisitions. The aim of this study was to evaluate the potential of rapid segmented k-space MRPVM for CV measurements. In vitro studies were performed using a left ventricular (LV) model with a variety of mitral regurgitant orifices. Results showed agreement between conventional and segmented MRPVM (errors<15%). Image quality was sufficiently good for reliable analysis. Multi-slice 3-DIR segmented MRPVM demonstrates great potential in quantifying mitral regurgitation.

1687. The Effect of Inflow Boundary Conditions on Combined Patient Specific MR and CFD Analysis of Left Ventricular Flow

Q. Long[1], R. Merrifield[1], P. Kilner[2], XY. Xu[1], D. Firmin[2], GZ. Yang[1]
[1]Imperial College, London, UK; [2]Royal Brompton Hospital, London, UK

The combination of Computational Fluid Dynamics (CFD) and MRI is a promising area of research that provides detailed blood flow patterns which cannot be measured directly by MRI alone. The influence of cardiovascular geometry on the accuracy of the simulation results is well recognised. The purpose of this paper is to address the impact of different boundary conditions on the flow patterns induced, and we propose a novel hybrid method for prescribing effective inflow boundary conditions.

1688. Estimation of Pulse Wave Velocity in Main Pulmonary Artery With Phase Contrast MRI

Hsu-Hsia Peng[1], Hsi-Yu Yu[2], Hua-Shan Liu[1], Hsiao-Wen Chung[1], Wen-Yih Tseng[3]
[1]National Taiwan University, Taipei, Taiwan; [2]National Taiwan University Hospital, Taipei, Taiwan; [3]National Taiwan University Medical College, Taipei, Taiwan

It has been shown that the pulse wave velocity (PWV) in human aorta can be derived from flow maps obtained with phase-contrast MR imaging. Application of the PWV method to the main pulmonary artery (MPA) is more difficult than aorta due to irregular shape of the cross sectional area. In this study, an optimized imaging protocol combined with automatic area measurement method based on gradient vector field computation is proposed for PWV estimation in MPA. Experimental results as compared with manual measurement show that the proposed method yields PWV values consistent with literature values.

1689. Nonenhanced MRDSA for Carotid Arteries using 2D Projection Flow-Refocused half-Fourier FSE and Parallel Imaging

Mitsue Miyazaki[1], Katsumi Nakamura[2], Akiyoshi Yamamoto[2], Nobuyasu Ichinose[1], Satoshi Sugiura[1], Yuka Matsufuji[3]
[1]Toshiba Corp., Otawara, Tochigi, Japan; [2]Tobata Kyouritsu Hospital, Kitakyusyu, Fukuoka, Japan; [3]Toshiba Medical Co., Fukuoka, Japan

A 2D projection nonenhanced MRDSA technique, using a short echo-train-spacing (ETS) half-Fourier FSE with a red-out (RO) flow-refocusing pulse and parallel imaging, is developed for carotid MRA. Fast flow dynamics of the carotid arteries are clearly visualized using a short increment delay between the acquisitions followed by dynamic subtraction. The R wave increment delay between the continuous acquisitions was optimized in carotid MRA. The technique allows us to obtain MRDSA-like images and thus permits direct observation of natural dynamic flow.

1690. Rapid Measurement of Superior Mesenteric Artery Flow with Ungated Spiral Phase-Contrast

Jong B. Park[1], Charles C. Liu[1], Juan M. Santos[1], Graham Sommer[1], Dwight G. Nishimura[1]
[1]Stanford University, Stanford, California, USA

We applied an ungated spiral phase-contrast (USPC) sequence to study superior mesenteric artery (SMA) flow rates before and after meal. USPC enables seven-second breath-hold scans to measure mean SMA flow even in the presence of pulsatility. The short scan time, and consistent SMA flow measurements showing a sharp increase between before- and after-meal states demonstrated the potential use of USPC for the diagnosis of SMA flow abnormalities.

1691. MRI Evaluation of Physiological End Points in the Rabbit Model of Hind Limb Ischemia

Anthony Z. Faranesh[1], John Bacher[2], Marvin Thomas[2], Joni Taylor[2], Diana Lancaster[2], Elliot R. McVeigh[2]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

The rabbit model of hind limb ischemia is a popular model for testing the efficacy of angiogenic therapies. Some of the more commonly used physiologic end points, such as angiographic score, capillary density and transcutaneous oximetry are problematic in that they may not accurately reflect tissue perfusion. It is proposed that magnetic resonance imaging (MRI) can be used to accurately assess physiological parameters such as flow and muscle infarction in the rabbit hind limb ischemia model, and thereby provide relevant regional and global information that can be used to assess the efficacy of angiogenic therapy.

1692. Combined ASL Perfusion Imaging, BOLD Imaging and ^{31}P NMR Spectroscopy of the Leg in a Rat Model of Peripheral Arteriopathy

Giovanni Vidal[1], Eric Giacomini[1], Claire Wary[1], Patrick Juvet[2], Florence Emmanuel[2], Pierre G. Carlier[1]
[1]Institute of Myology, Paris, France; [2]Gencell SA, Vitry sur Seine, France

Peripheral arteriopathy is a major clinical entity. In this disease, gene therapy offers interesting therapeutic perspectives but also has spurred the development of new, totally non-invasive and fully quantitative evaluation tools [1,2]. Using such methodology, the objective of the present work was to investigate the relationship between energy metabolism and perfusion during the recovery phase of exercise and to characterize the natural history of chronic arteriopathy in a rat model

1693. Analysis of Cerebral Flow in Patients with Late Life Depression

Josephine Naish[1], Robert Baldwin[2], Suzanne Jeffries[2], Alastair Burns[3], Alan Jackson[1], Chris Taylor[1]
[1]University of Manchester, Manchester, UK; [2]Manchester Royal Infirmary, Manchester, UK; [3]Withington Hospital, Manchester, UK

There is growing evidence that cerebrovascular disease or risk factors may lead to late-life depression. We have investigated the relationship between response to drug treatment and vascular compliance in elderly patients with depression by analyzing flow patterns in cerebral vessels and aqueductal CSF using phase contrast magnetic resonance imaging. We find evidence for reduced vessel compliance in the more treatment-resistant patients. This lends weight to the hypothesis of a distinct subtype of depression in the elderly which has a cerebrovascular cause and different treatment requirements.

1694. MR Flow Velocity Measurements for Determining Numerical Simulation Boundary Values

David Saloner[1], Liang-Der Jou[2], Alastair Martin[3], Randall Higashida[2], William Young[2]
[1]VAMC/UC San Francisco, San Francisco, California, USA; [2]UC San Francisco, San Francisco, California, USA; [3]Philips Medical Systems, San Francisco, California, USA

Patients with giant fusiform basilar aneurysms were evaluated with MR angiography and MR velocity mapping methods. These data were used as input to a flow simulation study which was used to assess the hemodynamic forces on the aneurysm wall. MR flow analysis was found to be critical for predicting flow patterns and the potential impact of hemodynamics on the aneurysm wall.

Quantitative Techniques in Cardiovascular MR

Hall D Tuesday 13:30 - 15:30

1695. Mapping Cyclic Change of Regional Intramyocardial Blood Volume Using MION Susceptibility Effect

Ed X. Wu[1], Haiying Tang[1], Kelvin K. Wong[2], Taichi Sakaguchi[1]
[1]Columbia University, New York, New York, USA; [2]University of Hong Kong, Hong Kong

An in vivo MRI technique is illustrated to map the cyclic change of regional relative intramyocardial blood volume fraction (rBVF) during the cardiac cycle with high spatial resolution. The method was based on the dominant T2* shortening effect of MION induced magnetic susceptibility perturbation in myocardium. The technique is demonstrated with in vivo mouse hearts on a 9.4T NMR microimager using steady-state pre- and post-contrast cine images. The cyclic rBVF maps in normal mice are presented and discussed

1696. Constant Volume Attribute of the 4 Chamber Heart: 3D Volumetric vs. 2D Planimetric Comparison via MRI

Emily Alexandria Waters[1], Andrew W. Bowman[2], Shelton D. Caruthers[3], Sandor J. Kovacs[2]
[1]Washington University in St. Louis, St. Louis, Missouri, USA; [2]Washington University School of Medicine, Saint Louis, Missouri, USA; [3]Washington University School of Medicine & Philips Medical Systems, Saint Louis, Missouri, USA

Over the course of one cardiac cycle, the healthy heart maintains a constant volume (within 5%). Failure to fall within this range of variation may have important implications for a patient's long-term prognosis. The current mode of analyzing pericardial volume change is labor-intensive and involves measuring pericardial contents on each image in a short-axis cine-stack of MRI images. We propose a two-dimensional alternative based on a single four-chamber slice. The 2D and 3D datasets exhibit a very strong correlation (r=0.97), and a Bland-Altmann analysis shows no bias in the relative error. We conclude that the two methods are statistically indistinguishable.

1697. Automatic In-Plane Rotation for Doubly Oblique Cardiac Imaging

Peter Kellman[1], John Andrew Derbyshire[1], Elliot R. McVeigh[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

A method for automatically calculating the in-plane rotation for doubly oblique slice geometry is proposed. Doubly oblique slice orientation is commonly used in applications such cardiac imaging, and results in an in-plane rotation of the body cross-section. In-plane rotation minimizes wrap artifacts for a given FOV. It is often desirable to adjust the in-plane orientation to ensure a minimum alias free field-of-view (FOV) in the phase-encode direction. This is particularly important for reduced FOV imaging such as UNFOLD or parallel MR methods, SENSE or SMASH.

1698. Quantification of Cardiac Shunts using MRI Snapshot FLASH

Christian M. Wacker[1], Tungte Wang[1], Peter Schanzenbächer[1], Mathias Nahrendorf[1], Wolfgang R. Bauer[1], Axel Haase[1], Peter M. Jakob[1]
[1]University of Wuerzburg, Wuerzburg, Germany

Objectives – Quantification of cardiac shunts is commonly done noninvasive (i.e. echocardiography) or invasive (catheterization) by measuring oxygen saturations in different heart chambers. Beyond this, shunt quantification by phase-contrast MRI-techniques were established for clinical use in recent years. The aim of this pilot study was quantification of cardiac shunts using an oxygen sensitive spin labeling technique. Methods – Imaging experiments were performed on a commercial 1.5-T whole-body MR scanner (Magnetom VISION, Siemens, Erlangen, Germany) with maximum gradient strengths and slew rates of 25 mT/m and 83 T/m/sec, respectively. T1 was assessed using a rapid IR Snapshot FLASH.

1699. Differential Regurgitation in Branch Pulmonary Arteries after Repair of Tetralogy of Fallot: A Phase-Contrast Cine MR Study

Shi Joon Yoo[1], I Seok Kang[1], Andrew N. Redington[1], Leland N. Benson[1], Emanuela R. Valsangiacomo[2], Kevin Roman[1], Christian J. Kellenberger[1], Christopher K. Macgowan[1]
[1]University of Toronto and The Hospital for Sick Children, Toronto, Ontario, Canada; [2]University Children's Hospital, Zurich, Switzerland

Evaluation of pulmonary blood flow with phase-contrast MR revealed differential regurgitation from the branch pulmonary arteries in 18 out of 22 patients who had undergone repair of tetralogy of Fallot. Among these, regurgitation was greater from the left pulmonary artery than from the right in 15 patients. In some patients the regurgitation from the left pulmonary artery accounted for the majority or all of the total pulmonary regurgitation at the main pulmonary artery. This observation mandates consideration of new treatment planning to reduce postoperative pulmonary regurgitation.

1700. Comparison of Computerized Fluid Dynamics and MR Measurements for Wall Shear Stress Estimation *In Vivo*

Sheng Ping Wu[1], Steffen Ringgaard[2], James G. Turner[3], Peter G. Walker[3], Ernst Torben Fründ[1], Sten Oyre[1], Erik Morre Pedersen[1]
[1]Aarhus University Hospital, Skejby Hospital, Aarhus, Denmark; [2]Aarhus University Hospital, Aarhus, Denmark; [3]University of Leeds, Leeds, UK

Wall shear stresses (WSSs) in the carotid artery obtained from computational fluid dynamics (CFD) and three-dimensional paraboloid fitting (3DP) of MRI phase contrast data were compared. High-resolution MR velocity measurements and MR angiography was used as input for the CFD. In the common carotid artery, mean WSS and oscillatory shear index (OSI) obtained from CFD were nearly similar to those obtained with MRI but maximum and minimum WSSs were higher. In the internal carotid artery, all indices were higher for CFD except minimum WSS that was higher for MRI. Future MRI data with less partial volume effects should be obtained.

1701. High-Resolution MRI Phase Velocity Measurements of Detailed Wall Shear Stress Distributions within the Carotid Bifurcation

Sheng Ping Wu[1], Steffen Ringgaard[1], Erik Morre Pedersen[1]
[1]Aarhus University Hospital, Aarhus, Aarhus AMT, Denmark

High-resolution phase contrast velocity mapping with 0.3 mm2 spatial resolution and 21-23 ms heart phase interval was used for assessment of wall shear stresses (WSSs) in the common carotid artery and in the carotid sinus in ten young healthy volunteers. WSS was assessed from the phase maps using the three-dimensional paraboloid method (3DP) in all heart phases. Low WSS throughout the heart cycle was seen in the carotid bulb. The circumferential gradient of WSS was large in systole at the vessel wall next to the carotid bulb.

1702. Combining MRI and CFD for the Analysis of Blood Flow in the Human Ascending Aorta

Armin Leuprecht[1], Sebastian Kozerke[2], Peter Boesiger[2], Karl Perktold[1]
[1]Graz University of Technology, Graz, Austria; [2]University and ETH Zurich, Zurich, Switzerland

A new approach for studying aortic blood flow using computational simulations based on time-varying anatomic models and inflow conditions derived from in-vivo MRI data is presented. The integration of moving slice imaging and dedicated methods for Computational Fluid Dynamics (CFD) including an ALE-modified Navier-Stokes solver for three-dimensional, time-dependent fluid flow enables realistic simulations. The comparison of simulated flow patterns with data measured by three-directional MR velocity mapping indicates the validity of the methods. In a first application, differences of blood flow and wall shear stress distal to a native and a mechanical aortic valve were studied in human subjects.

1703. Quantification of Defect Size in Hyperenhancement MRI Studies with a Polar Map Approach: A Comparison to SPECT

Stephan G. Nekolla[1], Mira Hoernke[1], Tareq Ibrahim[1], Karin Schreiber[1], Hubertus Buelow[1], Jodi Neverve[1], Dirk Wetzel[1], Markus Schwaiger[1]
[1]Technische Universitaet Muenchen, Muenchen, Germany

This study evaluated the influence of various imaging and analysis parameters on quantitative instead of visual assessment of defect size in early post myocardial infarction patient studies. The comparison to the clinical standard myocardial perfusion imaging with SPECT allowed the evaluation of its technical stability and reproducibility which is mandatory for a wider use in cardiac imaging to assess the effects of invasive and non invasive procedures. The study revealed a substantial potential for this task although an overestimation of defect size was identified.

Cardiovascular MR Spectroscopy

Hall D Saturday 14:00 - 16:00

1704. Cardiac Proton Spectroscopy at 3.0T

Michael Schär[1], Sebastian Kozerke[1], Peter Boesiger[1]
[1]University and ETH, Zürich, Switzerland

Proton MR spectroscopy offers a wealth of information about the physiological status of the examined tissue. In cardiac applications one is mainly interested in lipid and creatine metabolism. However, the acquisition of proton spectra in the human heart is challenging due to the cardiac and respiratory motion. Recently, navigator based gating and volume tracking cardiac ^{1}H spectroscopy has been shown at 1.5T. In this work we present feasibility of navigator based motion corrected cardiac proton spectroscopy at 3.0T.

1705. Increased Reliance on Glycogen Metabolism during β_1- Compared with β_2-Adrenergic Receptor Stimulation in the Isolated, Perfused Rat Heart

Patrick McConville[1], Edward Lakatta[1], Richard Spencer[1]
[1]NIH/National Institute on Aging, Baltimore, Maryland, USA

Glycogen, high-energy phosphate concentrations, contractile function and pH were monitored at matched workload induced by β_1- or β_2-AR stimulation in the isolated, perfused rat heart. The β-AR agonists were administered during (i) an exogenous substrate-free (SF) perfusion and (ii) perfusion with glucose (G) as the sole exogenous substrate. Both protocols showed increased glycogenolysis during β_1- than β_2-AR stimulation, directly confirming for the first time that β_1-AR-specific signaling leads to increased glycogen access.

1706. Evolution of Inotropic, Chronotropic and Metabolic Responses to β_1- and β_2-Adrenergic Receptor Stimulation in the Isolated, Perfused Rat Heart

Patrick McConville[1], Edward Lakatta[1], Richard Spencer[1]
[1]NIH/National Institute on Aging, Baltimore, Maryland, USA

The magnitude, dose-dependence, kinetics, and inter-relations of the inotropic, chronotropic and metabolic responses to β_1- and β_2-adrenergic receptor (AR) stimulation in the isolated perfused rat heart were characterized by ^{31}P NMR, left ventricular pressure monitoring and oxygen consumption measurements. Greater modulation of the inotropic response, oxygen consumption and pH were found in β_1- than β_2-AR stimulated hearts. Despite this, high-energy phosphate levels decreased to the same extent in each group. This is evidence for more dynamic regulation of inotropy and metabolism, and a greater energy reserve during β_1- as compared with β_2-AR stimulation.

1707. Potential Study of High Resolution Magnetic Resonance Spectroscopic Imaging of Myocardial Lipid Accumulation with 25% of Standard Acquisition Time

Yun Gao[1], Stanley J. Reeves[2], Robert J. Gropler[1]
[1]Washington University in St. Louis School of Medicine, St. Louis, Missouri, USA; [2]Auburn University, Auburn, Alabama, USA

Magnetic resonance spectroscopic imaging (MRSI) shows promise for clarifying metabolic abnormalities associated with various forms of heart disease. However, current cardiac MRSI methods have difficulty achieving sufficient spatial resolution because time limitation results in truncated k-space data, and, therefore, limits the spatial resolution. We studied the use of sequential forward array selection (SFAS) on myocardial MRSI. SFAS chooses the required number of samples nonuniformly by shifting a selection array to different locations with control of noise amplification. Simulation with a myocardial fat phantom shows that SFAS can reconstruct spectroscopic images with less than 1/4 of k-space data without losing resolution.

1708. Kinetics of Rb^+ Uptake and Distribution in Pig Heart and Tissues *In Vivo*: ^{87}Rb MRS Study

Valery V. Kupriyanov[1], Bo Xiang[1], Jiankang Sun[1], Olga Jilkina[1], Marco L. H. Gruwel[1]
[1]Institute for Biodiagnostics, Winnipeg, Manitoba, Canada

Accumulation of Rb^+ in blood plasma, heart, skeletal muscle, liver, kidney and lungs was monitored during intravenous infusion of RbCl into the open chest pigs *in vivo*. ^{87}Rb MR spectra from cardiac LV wall were acquired, blood and tissue samples were collected. In heart the net rate of Rb^+ uptake was 3.5 times higher than the total body uptake rate. Tissue Rb^+ content was decreasing in the following order: heart>liver~kidney~lungs>>skeletal muscle>blood plasma. Pig hearts *in vivo* can be loaded with Rb^+ to the levels that are readily monitored by ^{87} Rb MRS without producing any side effects.

Peripheral MR Angiography

Hall D Sunday 13:30 - 15:30

1709. Non-Contrast-Enhanced MRDSA of Peripheral Arteries using Continuous Acquisitions of ECG-Triggered 2D half-Fourier FSE within a Cardiac Cycle

Akiyoshi Yamamoto[1], Katsumi Nakamura[1], Mitsue Miyazaki[2], Yuko Shioya[1], Satoshi Kawanami[3], Yuka Matsufuji[4]
[1]Tobata Kyoritsu Hospital, Kitakyushu, Fukuoka, Japan; [2]Toshiba Medical R&D Center, Otawara, Tochigi, Japan; [3]University of Occupational and Environmental Health, Kitakyushu, Fukuoka, Japan; [4]Toshiba Medical Systems Company, Fukuoka, Japan

A new non-contrast-enhanced MRDSA technique is described using ECG-triggered 2D half-Fourier FSE. Signal change during cardiac cycle is clearly visualized using a short R wave increment delay between the acquisitions and by dynamic subtraction. The R wave increment delay between the continuous acquisitions was optimized in peripheral MRA. The technique allows us to obtain MRDSA-like images and thus permits direct observation of natural hemodynamic flow.

1710. Non-Contrast-Enhanced, Flow-Independent, 3D Peripheral Angiography using Steady-State Free Precession at 3T

Jean H. Brittain[1], Ann Shimakawa[1], Graham A. Wright[2], Brian A. Hargreaves[3], Eric Han[1], Jeff A. Stainsby[2], Bob Hu[4]
[1]GE Medical Systems, ASL-West, Menlo Park, California, USA; [2]Sunnybrook & Women's College Health Sciences Center, Toronto, Ontario, Canada; [3]Stanford University, Stanford, California, USA; [4]Palo Alto Medical Foundation, Palo Alto, California, USA

A new method of 3D, non-contrast-enhanced, flow-independent angiography (FIA) using refocused steady-state free precession at 3 T is described. Relaxation time constants are measured at 1.5 T and 3T and imaging parameters are optimized to maximize contrast between arterial blood and surrounding tissues. Changes in blood T2 with field strength and oxygenation result in improvements in predicted arterial-venous contrast at 3 T compared to 1.5 T. High-resolution, high contrast 3D angiograms of the lower leg are presented.

1711. Continuously Moving Table Contrast-Enhanced 3D Magnetic Resonance Angiography: Clinical Feasibility Study in 19 Volunteers

James F. Glockner[1], David G. Kruger[1], Stephen J. Riederer[1], Jerome F. Breen[1], Jason A. Polzin[2], Philip J. Rossman[1]
[1]Mayo Clinic, Rochester, Minnesota, USA; [2]GE Medical Systems, Milwaukee, Wisconsin, USA

Continuously moving table contrast-enhanced 3D MRA is a recently developed technique in which extended field of view data is acquired as the patient moves continuously through the magnet. Results of a clinical feasibility study performed in 19 healthy volunteers are encouraging.

1712. Pitfalls and Artefacts in Performance and Interpretation of Floating Table Contrast-Enhanced Angiography of the Lower Limbs

Paul Napier Malcolm[1], Paul Craven[1], Arpan Shrivastava[1]
[1]United Lincolnshire Hospitals NHS Trust, Boston, Lincolnshire, UK

Contrast-Enhanced MR Angiography of the Lower Limbs is now in widespread use and in some centres is replacing conventional catheter angiography for anatomical imaging in peripheral vascular disease. There has been emphasis in the literature on problems of infusion rate and timing, venous contamination and assessment of stenosis severity. However there are less common pitfalls in planning, executing and imaging these studies. There are also pitfalls in interpretation due to artefacts or arising from review of Subtracted Data or Maximum Intensity Projections. We present a range of these pitfalls and artefacts from our experience of 200 studies.

1713. Evaluation of Arterial Occlusive Diseases in Lower Extremity using Non-Contrast-Enhanced MR Arteriography with ECG-triggered 3D half-Fourier FSE: Initial Experience at 0.5T

Atsushi Ono[1], Mitsue Miyazaki[2], Satoru Takata[1], Mikizou Nakai[3], Atsushi Takeishi[3], Mitsuhito Kuriyama[3], Yukio Kawakami[1], Toshiyuki Taniguchi[4], Osamu Shibutani[5], Nobuaki Watanabe[1], Mitsunori Ikeda[1], K Sanou[1], Yasuyuki Kobashi[1], Yukako Hayashi[1], Takaaki Nagamachi[1], Hayato Fujii[1], Daigo Anami[1]
[1]Okayama Kousei Hospital, Okayama, Japan; [2]Toshiba Corp., Otawara, Japan; [3]Okayama University, Okayama, Japan; [4]Kawasaki University, Okayama, Japan; [5]Mitsubishi Mizushima Hospital, Okayama, Japan

Non-contrast-enhanced MR angiography using fresh blood imaging (FBI), ECG-triggered 3D half-Fourier FSE with a partial flow-refocusing pulse in the read-out (RO) direction, was developed for a 0.5-T clinical system, which allows separation of arteries from veins. The technique was evaluated in healthy volunteers and patients in terms of separation of arteries from veins. Furthermore, the FBI technique was evaluated in patients with arterial occlusive diseases in terms of delineation of lesions and was further compared with the x-ray digital subtraction angiography (DSA). In results, good separation of arteries from veins was obtained in all volunteers and patients even at 0.5T.

fMRI: Methods and Mechanisms

Hall D Monday 13:30 - 15:30

1714. Three-Dimensional Mapping of Local Field Gradient in fMRI

Yiping P. Du[1]
[1]University of Colorado Health Sciences Center, Denver, Colorado, USA

A technique for 3D mapping of the local field gradient (LFG) is presented. This technique allows direct calculation of the LFG from two 3D gradient-echo images acquired with different TEs. The LFG at each of the primary directions can be individually displayed. Because the calculation of the LFG does not use a B0 map, there is no need for phase unwrapping. This technique can be used as an optimization tool for z-shim and diamagnetic passive shim in functional MRI.

1715. Transient Changes of the Apparent Diffusion Coefficient Detected in a Stimulated-Echo Sequence

Ute Goerke[1], *Harald Möller*[1]
[1]MPI for Cognitive Neuroscience, Leipzig, Sachsen, Germany

Changes of the apparent diffusion coefficient were detected with the diffusion weighted primary and stimulated echoes of a three-pulse sequence (α=90) at 3T. The two b values of 250 and 1459 s/mm2 were obtained using different diffusion times for the two echoes. It is expected that the single shot method is more robust against physiological noise and signal variations caused by head movements. Significant changes of the apparent diffusion coefficient were found for three of four subjects in the visual cortex upon presentation of a strong visual stimulus.

1716. Characterisation of Diffusion-Weighted Spin Echo BOLD Signal at 3T.

Laura M. Parkes[1], *Christian M. Kerskens*[1], *David G. Norris*[1]
[1]F.C. Donders Centre for Cognitive Neuroscience, Nijmegen, Gelderland, Netherlands

This work shows the haemodynamic response to simple visual stimulation using three different EPI measurement techniques at 3T: standard gradient echo (GE), spin echo (SE) and diffusion-weighted spin echo (DWSE). We find that not only are the spatial localisations different but the response curves show different temporal characteristics. The DWSE sequence shows a sharper response than the standard GE technique, supporting the hypothesis that this signal comes primarily from the capillary bed. All measurements show similar post stimulus undershoot, suggesting volume changes occur in all compartments of the vascular bed.

1717. Effect of Microscopic Susceptibility on Transverse Relaxation Rate and Comparison to Chemical Exchange Theory

Simona Nikolova[1], *Chris Bowen*[1], *Robart Bartha*[1]
[1]Robarts Research Institute, London, Ontario, Canada

The LASER MRI multi-echo spin-echo pulse sequence has shown promise in detecting tissue changes within the first few minute of ischemia and has been investigated as a novel source of tissue contrast in ischemic injury. The purpose of this study was to investigate the contribution of microscopic susceptibility to LASER signal intensity. ORGASOL, polyamide powders were used to generate different magnetic susceptibility in four phantoms. Transverse relaxation rates R_2 ($1/T_2$) were measured in each phantom as a function of spin echo refocusing time ($2\tau_{cp}$) and agreed with the prediction of the Luz-Meiboom Chemical Exchange theory.

1718. Direct Measurement of Functional Cerebral Hemodynamic Changes in Humans and Their Influence on the BOLD Signal

Andrew Webb[1], *Vladislav Toronov*[1]
[1]University of Illinois, Urbana, Illinois, USA

We have used simultaneously-acquired fMRI and near infrared spectroscopy data to investigate quantitatively functional hemodynamic changes in humans and their influence on the BOLD signal. fMRI signal increases are known to result from both a decrease in deoxyhemoglobin concentration and also an increase in cerebral blood volume. Our data show that the increase in cerebral blood oxygenation during functional activation is mainly due to an increase in the velocity of the regional blood flow, and occurs without significant swelling of the blood vessels.

1719. Simulation of BOLD Phase and Magnitude Changes in a Voxel

Ravi S. Menon[1]
[1]Robarts Research Institute, London, Ontario, Canada

Intensity changes observed during functional activation using gradient-echo EPI are dominated by the intra- and extravascular BOLD changes in non-capillary venous vessels, even at field strengths up to 7 Tesla. This increases the effective point spread function of the fMRI technique in high resolution studies of columnar or lamellar architechture. A recently proposed method removes the intravascular and extravascular BOLD effects by analyzing the phase and magnitude of the voxel timeseries. We use simulations to examine the assumptions behind this method and find that they are valid to a first approximation.

1720. Theory of ^1H_2O T_2 Relaxation in Blood

Dmitriy A. Yablonskiy[1], Alexander L. Sukstanskii[1], Charles S. Springer[2], Joseph JH. Ackerman[1]
[1]Washington University, St. Louis, Missouri, USA; [2]Brookhaven National Laboratory, Upton, New York, USA

Quantification of the BOLD effect requires information on the blood ^1H_2O relaxation dependence on hematocrit (h) and oxygenation level (Y). We propose an analytic theory that describes this relationship for a broad range of blood conditions and external magnetic field strength (B_0) values. The theory takes into account molecular diffusion in the inhomogeneous magnetic field created by an ensemble of magnetized red blood cells (RBCs), the actual RBC shape (biconcave discs), as well as an ensemble orientational distribution. For a spin echo signal (SE), our theoretical predictions are in a good quantitative agreement with experimental data.

1721. High Resolution T_2 Measurement with Slab Selection and Echo Relaxation Imaging During Motor Task

Wen-Ming Luh[1], Rasmus Birn[1], Peter A. Bandettini[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

To achieve high spatial resolution and precise T2 measurement, a spin-echo sequence with slab selection was combined with an EPI readout in the frequency direction and conventional phase stepping in the phase direction. Highly sampled relaxation decay curves and high spatial resolution T2 and T2' maps were obtained with a finger-tapping paradigm. T2 and T2' values increased with spatial resolution. No significant T2 change was observed during motor activation yet a clear M0 change was observed.

1722. T_2* Mapping for TE Optimization in fMRI at Different Field Strength

Michael Erb[1], Uwe Klose[1], Wolfgang Grodd[1]
[1]University Hospital, Tuebingen, Germany

Changes in oxygenated and deoxygenated haemoglobin proportions during brain activation causes susceptibility changes (T2*) and give rise to the so-called BOLD effect. The maximum of BOLD effect can be obtained at echo times corresponding to the mean T2* in each voxel. As the BOLD signal is at the same time field strength dependent it will increase with B0 [1]. We calculated T2* maps at 1.5T and 3T and found a decrease of 20ms between the main peaks in the T2* histograms (65ms/45ms). The amplitudes of BOLD effect at optimised echo times increased by 2.4 in the motor area.

1723. Integration of Shape Tape™ With Experiments Involving Virtual Reality and fMRI

Richard Mraz[1], Fred Tam[1], William McIlroy[2], Richard Staines[3], Sandra Black[1], Konstantine Zakzanis[2], Simon Graham[1]
[1]Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada; [2]University of Toronto, Toronto, Ontario, Canada; [3]York University, Toronto, Ontario, Canada

The purpose of this study was to explore the use of Shape Tape™, a fibre-optic motion-tracking device, to enable subjects to interact intuitively and realistically with virtual environments (VEs) during functional magnetic resonance imaging (fMRI). Experiments were performed to characterize the tape's properties and to illustrate its practical usage. The tape was configured as a virtual stylus, and alternatively as a data glove to investigate brain activations in finger tapping tasks. Results demonstrate the feasibility of the tape for fMRI experiments and its flexible adaptation for a variety of computerized behavioural assessments.

1724. Quantitative fMRI with Graded Visual and Working Memory Paradigms Reveals Subtle Differences in the Increase for Primary and Higher Cognitive Functions

Oliver Speck[1]
[1]University Hospital Freiburg, Freiburg, Germany

Quantitative single-shot multi-echo fMRI was used to assess the brain activation with graded passive visual and active working memory (WM) tasks. In both cases, the passive primary visual stimulation and the active high order brain function, activation strength and extent was highly correlated with the task intensity or difficulty and performance. This demonstrates that apart from possible attentional modulation, quantitative fMRI is able to measure subtle changes in brain activation due to intensity differences in passive or active tasks.

fMRI: Technical Development and Feasibility Assessment

Hall D Tuesday 13:30 - 15:30

1725. Synchronized Functional MRI and Transcranial Magnetic Stimulation (TMS) during Elevated Cortical Excitability

Sven Bestmann[1], Jurgen Baudewig[1], Hartwig R. Siebner[2], John C. Rothwell[2], Jens Frahm[1]
[1]Biomedizinische NMR Forschungs GmbH am Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany; [2]Institute of Neurology, London, UK

Synchronized TMS and fMRI was used to investigate the cortical hemodynamic responses to magnetic stimulation during active contraction of the right first dorsal interosseus (FDI) muscle. Strong activations in primary and secondary motor areas were observed during tonic contraction. This activity was attenuated in left PMd and SMA when repetitive TMS was applied before rather than during contraction. The effect most likely results from changes in corticospinal excitability within the motor cortex. The results show effective modulation of cortically interconnected areas by TMS, presumably mediated by changed cortical excitability rather than altered synaptic efficacy.

1726. Feasibility of fMRI of Ankle Movements and the Role of Visual Biofeedback

Bradley J. MacIntosh[1], Richard Mraz[2], Fred Tam[2], Simon J. Graham[1]
[1]University of Toronto and S&W CHSC, Toronto, Ontario, Canada; [2]S&W CHSC, Toronto, Ontario, Canada

BOLD signal characterization of the primary motor cortex for the lower limb is under-reported compared to analogous investigation of the hand. Such study is important given that lower limb hemiparesis is highly prevalent in stroke patients, and fMRI can potentially assist in elucidating recovery mechanisms or evaluating rehabilitation strategies. For these applications, we have studied healthy subjects to determine a) the feasibility fMRI of ankle movements constrained by visual biofeedback, and b) the relationship between the BOLD signal and the associated motor behaviour.

1727. fMRI of the Cervical Spinal Cord with EPI, FLASH and PRESTO at 1.5T

Fernando A. Barrios[1], Dinora Morales[1], Markus Klarhöfer[2], Chrit TW Moonen[2], Rafael Favila[3], Perla Salgado[3], Rafael Rojas[4]
[1]UNAM-INB, Queretaro, Mexico; [2]UMR 5536 CNRS/UVS Bordeaux 2, Bordeaux, Gironde, France; [3]ABC Medical Center, Mexico, DF, Mexico; [4]LSUHSC Radiology, New Orleans, Louisiana, USA

Spinal fMRI images in control human volunteers were obtained at 1.5T with EPI, PRESTO and FLASH pulse sequences during sensory and motor activation. Functional MR axial images were acquired centered at C6, with GE and Philips instruments. This study was compared with a previous at one 1.5T. After repeating several studies on a small group of volunteers, we can conclude that the EPI and PRESTO sequences are highly sensitive to motion and FLASH may be too slow for good reproducible studies. Functional MR resolution for mapping neural activity of the spine at 1.5T may not be suitable for general studies.

1728. An MRI-Compatible Keyboard Recording System for Functional Investigation of Complex Motor Behaviors

George Andrew James[1], Guojun He[1], Mark A. Eckert[1], Yijun Liu[1]
[1]University of Florida McKnight Brain Institute, Gainesville, Florida, USA

Functional MRI (fMRI) investigations into motor learning and similarly complex sensorimotor or cognitive behaviors are dependent upon an MRI-friendly recording system capable of collecting a variety of behavioral responses. In the course of an fMRI study of motor learning and typing, we have integrated a full-sized keyboard composed of conductive plastic into our response-recording system. Our results have shown that there is no significant difference in the mean fMRI signal intensity whenever the keyboard is absent or present inside an MRI scanner either with a key pressed or not, suggesting a suitable keyboard response system for use in fMRI experiments.

1729. Scanner Noise Induced Saturation of the Hemodynamic Response to Auditory Stimuli

Dave Langers[1], Pim van Dijk[1], Walter Backes[1]
[1]Maastricht University Hospital, Maastricht, Limburg, Netherlands

In this study we investigated the influence of scanner acoustic noise on the amplitude of the hemodynamic response to pure tone auditory stimuli. We found a decrease in response amplitude when brain activation due to scanner noise is additionally present. This decrease appears to be proportional to the time-dependent magnitude of the expected hemodynamic response to the scanner noise. The presence of scanner noise can diminish the amplitude of other auditory responses by a factor two or more. We recommend to use scan-intervals no smaller than 8 s in sparse event-related scan paradigms.

1730. MR Scanner Effects on Auditory Cortex Tonotopy using fMRI

Carrie Jane Tobolski[1], Jos J. Eggermont[1], Richard Frayne[1], Bradley Gordon Goodyear[1]
[1]University of Calgary, Calgary, Alberta, Canada

We show how MR scanner noise effects fMRI measurements of tonotopy, the representation of auditory frequencies within auditory cortex. The number of pixels and amount of activity in auditory cortex in response to tonal frequencies near MR scanner frequencies was reduced compared to the response at other frequencies. The amount of activity decreased with tonal frequency, resulting from upward spread of masking of low frequency high-intensity tonal stimuli or proximity of low-frequency core and belt areas of the auditory cortex. Our results quantitatively demonstrate the effect of scanner noise and high-intensity tonal stimuli on measurements of auditory cortex tonotopy.

1731. Whole Brain Stress Test Using Caffeine: Effects on fMRI and SWI at 3T

E. Mark Haacke[1], Caixia Hu[1], Todd B. Parrish[2], Yingbiao Xu[3]
[1]The MRI Institute for Biomedical Research, Detroit, Michigan, USA; [2]Northwestern University, Chicago, Illinois, USA; [3]Wayne State University, Detroit, Michigan, USA

Purpose: To enhance vessel visibility and BOLD response in fMRI and SWI using caffeine. Methods: SWI and fMRI images were acquired pre and post ingestion of caffeine. Both EPI and SWI were used as the means to collect fMRI data. Results: Whole brain deoxygenation was demonstrated at the micro-vascular level using SWI clearly showing the effects of reduced flow. Both SWI and EPI showed similar regions of activation in a finger tapping experiment with SWI yielding better localization of the vascular response. Discussion: Caffeine increases the CNR in SWI and fMRI and makes it possible to visualize small vessel changes.

1732. Numerical Model of Temperature Changes in Brain During Functional Activation

Christopher Michael Collins[1], Michael Bruce Smith[1], Robert Turner[2]
[1]Penn State College of Medicine, Hershey, Pennsylvania, USA; [2]Institute of Neurology, London, England, UK

A three-dimensional model of temperature in the human head is employed to examine temperature changes during functional activation in brain. It is found that depending on location in brain and corresponding baseline temperature relative to blood temperature, temperature may increase or decrease upon activation and concomitant increase in perfusion, though all calculated changes in temperature remain below 0.1 C.

1733. Olfactory Responses in the Olfactory Bulb, Prefrontal Cortex and the Hypothalamus in Rats Detected by Functional Magnetic Resonance Imaging

Takashi Kondoh[1], Shuori Yamada[2], Seiji Shioda[2], Kunio Torii[1]
[1]Ajinomoto Co., Inc., Kawasaki, Kanagawa, Japan; [2]Showa University, Shinagawa, Tokyo, Japan

Brain activation sites in response to olfactory stimulation were investigated in anesthetized rats by using blood oxygenation-level dependent (BOLD) fMRI. Responses to olfactory stimulations by essential oils were observed most prominently in the olfactory bulb, ventral forebrain (include the lateral olfactory tract, piriform cortex, olfactory tubercle and medial forebrain bundle), medial forebrain (include the anterior cingulate cortex, infralimbic cortex, prelimbic cortex, tenia tecta, lateral septal nucleus, and nucleus of the diagonal band), the lateral hypothalamic area and the mediodorsal thalamic nucleus. These results provided the direct evidence of higher order olfactory structures during olfactory stimulations in rats.

1734. BOLD Responses to Natural Stimuli in the Cat Visual System at 9.4Tesla

Christoph Kayser[1], Mina Kim[2], Kamil Ugurbil[2], Peter Konig[1], Dae-Shik Kim[2]
[1]ETH, Zurich, Switzerland; [2]University of Minnesota, Minneapolis, Minnesota, USA

Visual processing is usually studied using artificial stimuli. Whether these results can be generalized to real world stimuli, however, remains elusive. To address this question, we compare BOLD responses to natural movies, manipulation of these with different higher order statistics and gratings. High resolution MRI was obtained at 9.4T for the whole visual cortex of anaesthetized cats. We find that: activations decrease strongly along the visual hierarchy; stimuli lacking higher order structure elicit smaller responses than the original; activity patterns of gratings differ markedly from activations for natural movies. Overall this agrees with physiological results using the same stimuli.

fMRI: Imaging Techniques

Hall D Saturday 14:00 - 16:00

1735. Reversed EPI Data Acquisition for Improved fMRI in Areas of Large Magnetic Field Susceptibility

Jiachen Zhuo[1], Victor Andrew Stenger[1], Fernando E. Boada[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

We demonstrate the use of a reversed (outside in) echo planar imaging (EPI) k-space trajectory for the reduction of susceptibility artifacts in BOLD fMRI. Our results indicate that the proposed technique has artifact reduction properties similar to those of reversed spiral imaging and that it can be easily implemented in clinical scanners as a minor modification of the conventional EPI technique.

1736. Interactions between Head Motion and Magnetic Susceptibility Artifacts in Functional MRI

Kiran Kumar Pandey[1], Douglas Noll[1], Scott Peltier[2]
[1]University of Michigan, Ann Arbor, Michigan, USA; [2]Emory University, Atlanta, Georgia, USA

Motion artifact is a limiting factor in functional MRI (fMRI) studies. This study examines the influence of acquisition and post-processing measures designed to reduce magnetic susceptibility artifact on the accuracy and completeness of motion correction in fMRI. A motion phantom with an air chamber to induce susceptibility artifact was imaged in different positions with different acquisition parameters (1-shot and 4-shot spiral acquisitions), with and without a susceptibility correction methods (z-shimming), and with and without off-resonance distortion corrections. We found that images acquired with 4-shots, with z-shimming and off-resonance corrections produced more accurate motion estimates and more complete motion corrected images.

1737. Novel Spiral-In/Out Method for Reduced Susceptibility Artifacts in BOLD fMRI

Christine S. Law[1], Gary H. Glover[1]
[1]Stanford University, Stanford, California, USA

Using a two-interleaf trajectory design, an fMRI acquisition technique was developed whereby the first interleaf is acquired during a spiral-in traversal, and the second interleaf is obtained contiguously as a spiral-out traversal during a single RF excitation. Each half of the pulse sequence corresponds to half of the desired FOV, and thus the whole sequence comprises a complete k-space sampling. Precompensation filters were applied in gradient design to correct trajectory errors and hence ensure the actual k-space sampling locations. The method results in reduced susceptibility artifacts in comparison with conventional techniques.

1738. Comparison of Spiral-In/Out and Spiral-Out BOLD fMRI at 1.5T and 3.0T

Moriah E. Thomason[1], Alison R. Preston[1], Kevin N. Ochsner[1], Gary H. Glover[1]
[1]Stanford University, Stanford, California, USA

BOLD fMRI activation experiments were performed with 8 subjects at both 1.5T and 3.0T using a spiral-in/out trajectory. Three tasks were employed to activate medial temporal, inferior frontal and amygdala regions. For each scan, two analyses were performed using the combined spiral-in/out time series and the conventional spiral-out time series. Activation volumes and BOLD contrast were quantified for each region and compared on a subject and group basis across the factors of field strength and trajectory. The in/out trajectory demonstrated superior results at both fields, and 3T in-out acquisitions provided significantly greater activation in regions traditionally compromised by susceptibility dropout.

1739. Reduced Susceptibility Effects in Perfusion FMRI with Single-Shot Spin-Echo EPI Acquisitions at 1.5 T

Jiongjiong Wang[1], Lin Li[1], Anne C. Roc[1], David C. Alsop[2], Kathy Tang[1], Norman S. Bulter[1], Mitchell D. Schnall[1], John A. Detre[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

Continuous arterial spin labeling (CASL) with single-shot spin-echo EPI acquisitions was carried out for fMRI study of motor cortex activation in the presence of exogenously induced susceptibility artifact at 1.5T, and was compared with regular gradient-echo EPI sequence with the same slice thickness, as well as other imaging methods using thin slices and spin-echo acquisitions. The results demonstrated that ASL images, either with or without subtraction of the control, provide a robust alternative to blood oxygenation level dependant (BOLD) methods for activation imaging in regions of high static field inhomogeneity.

1740. Estimation of Effects of Neuronal Magnetic Fields on MRI Signals

Jinhu Xiong[1], Jia-Hong Gao[1], Peter T. Fox[1]
[1]University of Texas Health Science Center, San Antonio, Texas, USA

Direct mapping of neuronal activity using MRI by detecting magnetic transients induced by neural firing has been proposed as a potential strategy for spatio-temporal mapping. We present here a theoretical estimation of MRI signal changes induced by neuronal magnetic field using a current dipole model. The changes can be up to 5%, depending on spatial configurations and density of neurons in a given voxel.

1741. Comparison of "Blipped" and "Spiral-in" EPI Designs in Regard to the Imaging of Electrical Currents

Alexander B. Pinus[1], Feroze B. Mohamed[2], Scott H. Faro[2]
[1]Yale University, New Haven, Connecticut, USA; [2]Drexel University, Philadelphia, Pennsylvania, USA

The effectiveness of signal collection using pulse sequences with spiral gradient waveforms is investigated in regard to detection of small electrical currents by means of the phase imaging. It is shown that an extension of a pulse sequence's effective echo time to the end of the ADC period achieved using "spiral-in" gradient waveforms provides higher sensitivity relative to that attained with a "blipped" version of the EPI pulse sequence, where the effective echo time was positioned in the center of the ADC period. With that, the echo time elongation does not necessitate an increase of the acquisition time.

1742. Correction of Geometric Distortion in fMRI: A Single-Shot Technique Using Multi-Echo Echo-Planar Imaging (EPI)

Nikolaus Weiskopf[1], Uwe Klose[1], Michael Erb[1], Niels Birbaumer[1], Klaus Mathiak[1]
[1]University of Tuebingen, Tuebingen, Germany

Inhomogeneities of the static magnetic field cause geometric distortions in echo-planar imaging (EPI), which is commonly used for functional neuroimaging (fMRI). Usually, distortion correction is based on static field maps, which increases acquisition time and does not account for dynamic changes. We employed single-shot multi-echo EPI with alternating phase encoding (PE) direction. By comparing the echoes showing opposite distortions, displacement fields could be estimated. Application of the inverse displacement yielded an improved match of the echoes and allowed for weighted averages to increase contrast-to-noise ratio. This methodology is of interest for fMRI at higher fields and real-time applications.

1743. High Spatial-Temporal-Resolution fMRI with Odd- and Even-Fourier EPI and Two-Way Hermitian Reconstruction

Nan-kuei Chen[1], Charles R. G. Guttmann[1], Lawrence P. Panych[1]
[1]Brigham and Women's Hospital, Boston, Massachusetts, USA

A novel partial Fourier EPI acquisition and reconstruction strategy is developed for high-resolution functional mapping. This technique combines advantages of single-shot EPI (high temporal resolution) and two-shot segmented EPI (higher spatial accuracy and shorter echo time achievable). In the developed technique, fMRI data are acquired with two alternating and complementary scan paradigms. The ky lines that are not sampled can be accurately calculated with a two-way Hermitian reconstruction. Functional MRI data with high spatial-temporal-resolution and high spatial accuracy can then be obtained by Fourier transformation. Application of the technique to a finger-tapping motor study at 3 Tesla is presented.

1744. Simultaneous Perfusion and BOLD Mesurements Using Single-Shot Interleaved Z-Shim EPI (SSIZS-EPI)

Yihong Yang[1], Hong Gu[1], Hanhua Feng[1], Wang Zhan[1], Su Xu[2], David A. Silbersweig[1], Emily Stern[1]
[1]Weill Medical College of Cornell University, New York, New York, USA; [2]Memorial Sloan-Kettering Cancer Center, New York, New York, USA

A simultaneous perfusion and BOLD imaging method with reduction of susceptibility artifacts was developed for detecting brain activations in the regions with field inhomogeneities. Single-shot interleaved z-shim EPI (SSIZS-EPI) was used to reduce susceptibility artifacts, while preserving rapid imaging acquisition. Perfusion and BOLD signals were measured simultaneously with a neuropsychiatric paradigm which is known to generate brain activations in the meso-temporal lobes. Increased brain activities were observed reliably in the peri-amygdalar regions in both perfusion and BOLD maps.

1745. Validation of Rapid-Presentation Event-Related fMRI in Auditory Cortex

Gregory Tamer, Jr.[1], Tie Qiang Li[2], John L. Ulmer[3], Thomas M. Talavage[1]
[1]Purdue University, West Lafayette, Indiana, USA; [2]Indiana University School of Medicine, Indianapolis, Indiana, USA; [3]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Despite the possible confound scanner noise may produce in auditory cortical activation, it has been found that rapid-presentation event-related (rper) fMRI auditory studies, using an ISI and TR of 3 s while employing a clustered volume acquisition (CVA), result in estimated hemodynamic responses (HDRs) similar to those estimated from long-ISI event-related fMRI runs. In our rper fMRI studies, lateralization was observed in right-versus-left music studies, and expected language responses were observed in words-versus-tones experiments. 1–2% signal changes were observed for the estimated HDRs. Therefore, rper fMRI auditory experiments are plausible and the shortened experiment time required should prove advantageous.

1746. Multi-Region Gradient Compensation using Single-Shot Multi-Echo EPI Increases Apparent T_2^* at 4 Tesla

Stefan Posse[1], Zhou Shen[1]
[1]Wayne State University School of Medicine, Detroit, Michigan, USA

FMRI sensitivity at 4 T using multi-echo EPI (TurboPEPSI) was quantified as a function of data preprocessing (weighted echo averaging versus single echo data) and voxel size. TurboPEPSI data were acquired in 6 subjects at 4 echo times using a 64x64 matrix and at 8 echo times using a 32x32 matrix, while they performed a combined motor and visual block design paradigm. Extent and t-score of activation increased strongly with (a) weighted-average data as compared to single echo data, (b) increasing voxel size. TurboPEPSI is advantageous for detecting weak brain activation using multi-resolution fMRI and for real-time fMRI.

1747. A Simulation on Motion Artifacts in Segmented Spiral Event-Related fMRI

Michael Amann[1], Dieter Kleinböhl[2], Lothar Rudi Schad[1]
[1]DKFZ, Heidelberg, Baden, Germany; [2]Universität Mannheim, Mannheim, Baden, Germany

Segmented spiral MRI offers both high resolution and high signal-to-noise ratio and seems therefore to be suitable for event-related fMRI. The major drawback is that motion results in inconsistent k-space data. To investigate the artifact dependency on the temporal order of spiral interleaves and on the timing of the motion, a simulation was conducted with a "head" phantom with two "activated" areas. Two order of interleaves were evaluated for different types and timing of motion. It was demonstrated that pattern and severity of motion artifacts is sensitive on both interleaf order and motion timing.

1748. Effects of Oxygenation on Blood T_2

A G. Gardener[1], S T. Francis[1], P A. Gowland[1]
[1]University of Nottingham, Nottingham, England, UK

The echo time dependence of blood T2 has been investigated in order to develop a method of determining arterial and venous blood volume changes that occur during neuronal activation. Experimental data acquired at 3T and literature values (1.5 - 4.7 T) have been fitted to three different exchange and diffusion models. No significant difference was found in the fits, and the distribution of fitted parameters suggests that no model successfully simulates the true physical situation. Additional data at a variety of field strengths and echo spacings, and possibly a combined diffusion and exchange model, are required.

1749. Functional MRI with Multi-Echo Segmented EPI and Echo Time Stepping Technique

Nan-kuei Chen[1], Charles R. G. Guttmann[1], Lawrence P. Panych[1]
[1]Brigham and Women's Hospital, Boston, Massachusetts, USA

This abstract shows that high-resolution fMRI with multi-TE can be realized by integrating multi-echo segmented EPI and TE-stepping technique into a block-design functional paradigm. The BOLD contrast-to-noise ratio per unit scan time achieved with the proposed technique is comparable to that obtained with conventional single-TE fMRI, but the proposed method has several advantages that cannot be achieved with previous approaches. First, changes of T2* relaxation time associated with functional activation can be measured. Second, the geometric distortions are reduced in the developed functional imaging technique. Using this technique, an efficient spatial-encoding and TE sampling for functional mapping can be achieved.

1750. Event-Related fMRI with Sub-Second Whole Brain Acquisition using 3D PRESTO-SENSE

Konstantinos Arfanakis[1], Ian Alistair Heaton[1], Baxter P. Rogers[2], Nolan R. Altman[1]
[1]Miami Children's Hospital, Miami, Florida, USA; [2]University of Wisconsin, Madison, Wisconsin, USA

In this study, the principle of echo-shifting with a train of observations (PRESTO) was combined with sensitivity encoding (SENSE) to achieve sub-second temporal resolution in event-related (ER) fMRI with 3D whole brain acquisition. 3D PRESTO-SENSE was applied on normal volunteers that performed two different ER-tasks during the same scan. The whole brain was probed for activation resulting from the performance of the tasks. Additionally, the hemodynamic response in activated regions was estimated with sub-second temporal resolution. Finally, ER-fMRI results obtained with 3D PRESTO-SENSE were compared to those obtained with 2D EPI and 3D EPI-SENSE with reduced brain coverage.

1751. Improving the Sensitivity of Current Imaging with the Circular Mean Value Method

Lin Li[1], Alexander B. Pinus[2], Scott H. Faro[3], John S. Leigh[1], Feroze Mohamed[3]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Yale University, New Haven, Connecticut, USA; [3]Drexel University, Philadelphia, Pennsylvania, USA

Measurement of small electric currents with MR phase imaging is potentially useful for the detection of neuronal electric activities. A circular mean value (CMV) method is applied to improve the SNR of the phase imaging and to raise detection sensitivity of small currents.

1752. Physiological Noise Reduction in fMRI Using Dual Echo EPI

Arjen van der Schaaf[1], Peter van Gelderen[1], Nick Ramsey[1]
[1]UMC, Utrecht, Netherlands; [2]National Institutes of Health, Bethesda, Maryland, USA

The acquisition of an extra EPI echo at short TE in fMRI measurements can be used to eliminate physiological noise from the fMRI-signal. We measured noise properties in dual echo fMRI experiments and assessed a method to reduce physiological noise. The average noise reduction is 5% in white matter and 15% in gray matter. The contrast to noise ratio increases 28% in active areas after noise reduction and 21% more activated voxels are detected. The results are comparable to those of other noise reduction techniques, while the disadvantages of the proposed method are negligible.

1753. Functional MRI Using SSFP Phase Transitions

Karla L. Miller[1], Jongho Lee[1], Brian A. Hargreaves[1], Christopher deCharms[1], John M. Pauly[1]
[1]Stanford University, Stanford, California, USA

Blood Oxygenation Level Dependent (BOLD) imaging is an important method which has some inherent limitations such as low contrast, low resolution and sensitivity to susceptibility. Steady-State Free Precession (SSFP) is an alternate method for functional imaging that does not suffer from many of these issues. This study presents an SSFP method for detecting neural activity based on the high-gain phase transition in the SSFP signal within a particular frequency band. This method has high SNR efficiency, allows high-resolution multishot acquisitions and is robust against susceptibility. Initial visual experiments show strong activations with high contrast-to-noise.

1754. Improved Functional Signal Localization Based on Apparent Diffusion Coefficient Changes Using Flow-Moment-Nulled Intra-Voxel Incoherent Motion Weighted fMRI

Allen W. Song[1], Tianlu Li[1]
[1]Duke University, Durham, North Carolina, USA

Functional brain signal based on the BOLD contrast can arise from vascular compartments of various sizes, some of which may be distant from the neuronal activities. Recent reports indicated that apparent diffusion coefficient (ADC) based contrast could be used to detect functional activities. It was found that this contrast has significant arterial contribution where flow changes were more dominant. In this study, a refined such approach was proposed that incorporated flow-moment-nulling strategy. It was shown that activated region using the new acquisition strategy was a subset of the activated areas from either the conventional ADC or the BOLD activations.

1755. Image-Guided TMS Coil Positioning During Interleaved TMS-fMRI

Stewart Denslow[1], Daryl E. Bohning[1], Mikhail P. Lomarev[1], Qiwen Mu[1], Mark S. George[1]
[1]Medical University of South Carolina, Charleston, South Carolina, USA

We wanted to combine interleaved transcranial magnetic stimulation (TMS) and functional magnetic resonance imaging (fMRI) with neuronavigation based upon individual anatomic images. Positioning a TMS coil using population average locations of cortical anatomy lacks both accuracy and precision for individual subjects. Analysis of cortical response to TMS based upon mapping TMS locations to separately obtained anatomic images cannot demonstrate direct temporal causation. Accordingly, we developed a system, to be used during interleaved TMS-fMRI, for coil positioning so that the coil-field isocenter line is precisely directed at a selected cortical target on an individual subject.

1756. Increased Signal Change and Localization of fMRI Mapping in Humans using T_1/Gd-DTPA Weighted Images

Gil Navon[1], Talma Hendler[2], Moshe Graif[2], Dan Gamliel[2], Pazit Pianka[2], Ida Sivan[2], Michal Sigal[2], Dafna Ben Bashat[2]
[1]Tel Aviv University, Tel Aviv, Israel; [2]Tel Aviv Sourasky Medical Center, Tel Aviv, Israel

fMRI based on BOLD contrast suffers from low fractional signal changes and high sensitivity to susceptibility artifacts. Functional mapping with contrast agents is more specific to small blood vessels and shows a higher percent signal change in animal studies. In this study we compare T_1/Gd-DTPA and BOLD contrasts in mapping motor and language activations in six patients. In all subjects the locations of activation using T_1/Gd-DTPA were similar to those obtained using the BOLD. However, they were more localized and had higher percent signal changes. This method could be beneficial for pre-surgical mapping, especially when EPI cannot be applied.

1757. Correction of Task-induced Motion Artifacts During Speech

Vinai Roopchansingh[1], Andrzej Jesmanowicz[1], James Hyde[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Functional brain scans during speech contain signal artifacts arising from magnetic field changes caused by motion of the anatomical structures involved in speech. These artifacts confound statistical analysis of speech-associated brain function, as they both occur during similar time intervals. This work describes a novel technique for correcting the effects of magnetic field perturbations caused by jaw movements, allowing brain activity from a block paradigm to be measured during a speech task.

1758. DTfMRI: Modeling and Application to Visual and Motor Cortex

Claudia A M Wheeler-Kingshott[1], Ahmed Toosy[1], Olga Ciccarelli[1], Phil Boulby[1], Geoff J M Parker[2], Mark R. Symms[1], Gareth J. Barker[3]
[1]Institute of Neurology, London, UK; [2]University of Manchester, Manchester, UK; [3]Institute of Psychiatry, London, UK

DTfMRI is a technique simultaneously sensitive to functional MRI (fMRI) and diffusion tensor imaging (DTI). Bipolar diffusion gradients are applied between excitation and acquisition during a standard fMRI experiment; their direction/amplitude is changed 7 times through the experiment, at a lower frequency than the functional stimulus so that possible effects on the BOLD response can be filtered out during post-processing. The effect of different models and the sensitivity to stimulation of the visual cortex and the motor cortex were separately tested. On our 1.5T clinical scanner inherently co-registered DT parameter maps and statistical parametric maps were obtained in both studies.

1759. Spatial Spectral Fat Suppression in fMRI

Annie Papadaki[1], Rebecca Quest[1], Donald McRobbie[1]
[1]Charing Cross Hospital, London, UK

Spatial spectral selection based on 90-90 phase modulation was used to reduce chemical shift artefacts in EPI for fMRI. The acquisition time is reduced compared to conventional fat suppression where a train of four hard binomial pulses is applied to the whole coil volume. Images of phantoms and functional data of a healthy volunteer performing a motor paradigm were obtained with the spatial spectral sequence and a conventional EPI sequence. Fat suppression was comparable in both sequences, however a slight decrease in the water signal was observed with the new sequence. Activation maps showed an increase in activation areas.

1760. Single Line Imaging Spectroscopy (SLIMS): Exploring the fMRI Signal

Nikolaus Weiskopf[1], Uwe Klose[1], Niels Birbaumer[1], Klaus Mathiak[1]
[1]University of Tuebingen, Tuebingen, Germany

Neuronal activity influences the signal intensities of gradient recalled echo (T2*-weighted) imaging sequences. However, different models describing the signal changes and the underlying mechanisms such as BOLD (intra-, extravascular) and CBF effects are discussed controversially. Acquisition of the free induction decay (FID) of the NMR signal provides a tool to study these mechanisms. Therefore, a single line imaging spectroscopy (SLIMS) was implemented to record the spatially resolved FID of a bar of voxels. The sequence was successfully employed to measure functional brain activity in a motor task. SLIMS provides a trade-off of high spectral resolution and adequate spatial resolution.

1761. Real-Time Multi-Shot EPI for Whole Brain FMRI

Rongyan Zhang[1], Hanbing Lu[1], Vinai Roopchansingh[1], Andrzej Jesmanowicz[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

A real-time multi-shot EPI method is presented. This method will facilitate high-resolution functional MRI and diffusion tensor imaging. Multi-shot (or segmented) EPI acquisition provides high spatial and temporal resolution without sacrificing signal intensity or k-space coverage. Real-time acquisition and reconstruction enables data quality monitoring, and allows for interactive development of functional paradigms. Combined with real-time motion correction and functional analysis by the AFNI software package, this method provides a means for efficient and accurate functional studies.

1762. The Use of Superresolution Reconstruction Algorithms to Enhance Spatial Resolution in fMRI

Ronald Roel Peeters[1], Pierre Kornprobst[2], Stefan Sunaert[1], Thierry Vieville[2], Olivier Faugeras[2], Paul Van Hecke[1]
[1]University Hospitals KULeuven, Leuven, Belgium; [2]INRIA, Sophia Antipolis, France

The aim of this study is to increase the resolution of fMRI maps without the loss in SNR inherent to scanning at a higher resolution. For this we used a superresolution reconstruction algorithm in combination with an adapted acquisition scheme of shifted MR images in the slice direction. The resulting activation maps calculated from the superresolution datasets demonstrated similar patterns of activation as the high resolution reference datasets. But as a result of the gain in SNR, the statistical significance of activated areas is higher than in the original and the reference datasets.

1763. Influence of Acquisition Parameters Slice Resolution, Number of Slices, and TR, on Motion Correction in fMRI

Xenios Papademetris[1], James S. Duncan[1], R. Todd Constable[1]
[1]Yale University School of Medicine, New Haven, Connecticut, USA

Previous studies have demonstrated that fMRI imaging with reduced TR's can increase the statistical power in the activation maps due to the increased number of samples collected. Motion correction however, performs best when the through-plane resolution is high and there is whole brain coverage necessitating long TR's. This work examines the trade-off between brain coverage, through-plane resolution, TR, statistical power, and efficacy of motion correction for fixed paradigm timing.

1764. Hemodynamics Unrelated to Sounds from Hardware (HUSH): A Completely Silent Event-Related fMRI Technique

Vincent Jerome Schmithorst[1], Scott Kerry Holland[1]
[1]Children's Hospital Medical Center, Cincinnati, Ohio, USA

For the application of functional magnetic resonance imaging (fMRI) to auditory tasks, various approaches have been considered in order to minimize the interference due to the scanner noise. We propose a completely silent event-related design that is highly time-efficient, called HUSH (Hemodynamics Unrelated to Sounds from Hardware) and a technique for post-processing of the data. Results are presented both for simulated data and data from a normal volunteer.

fMRI: Spatial and Temporal Signal Characteristics

Hall D Sunday 13:30 - 15:30

1765. Measurement of R_2* Changes in a Head Phantom Induced by Small Rotations

Elisabeth Castro Caparelli[1], Dardo Tomasi[1], Thomas Ernst[1]
[1]Brookhaven National Laboratory, Upton, New York, USA

The magnetic field distribution and the effective transverse relaxation rate, R2*, in the brain can be altered by head rotations. Changes in R2* due to small rotations were measured in a brain-phantom. For a 1° x-rotation, significant R2* changes (>5 Hz) occurred only close to the surface of the phantom. For a 50 x-rotation, however, more than 30% of all voxels showed pronounced R2* changes.

1766. GRACE - Ghost Reconstructed Alternating Current Estimation: Simulation and Experiment

Hua Yang[1], Greg Cook[1], Martyn Paley[1]
[1]University of Sheffield, Sheffield, Yorkshire, UK

Recent reports suggest the possibility of directly detecting localized neuronal firing events using MRI. A new method of estimating alternating currents using ghost images created when the magnetic field from a fluctuating current modulates the phase of the MR signal between successive phase encode views is described. Fields as low as 10-9T have been detected with frequencies of 0.5Hz to 50Hz from sine and square waves. Ghost reconstructed alternating current estimation (GRACE) may be useful for directly mapping fields, and hence current impulses produced by neuronal firing events when synchronized periodic modulation can be induced e.g. in the optic nerve.

1767. Hypercapnic Normalization of BOLD fMRI Data: Comparison Across Field Strengths and Pulse Sequences

Eric R. Cohen[1], Egill Rostrup[2], Karam Sidaros[2], Torben Lund[2], Olaf B. Paulson[2], Kamil Ugurbil[3], Seong-Gi Kim[4]
[1]SUNY Upstate Medical University, Syracuse, New York, USA; [2]Danish Research Centre for Magnetic Resonance, Hvidovre, Copenhagen, Denmark; [3]Center for Magnetic Resonance Research, Minneapolis, Minnesota, USA; [4]University of Pittsburgh, Pittsburgh, Pennsylvania, USA

The typical BOLD functional activation map can be misleading in terms of activity localization due its inherent resting CBV weighting, which emphasizes large veins. Furthermore, comparison of results obtained under different conditions (e.g., field strengths and pulse sequences) is difficult due to BOLD signal dependence on experimental parameters. To address these problems, we explored the use of hypercapnic normalization of BOLD motor activation data at 1.5, 4, and 7 Tesla, and using GE and SE pulse sequences at 4 Tesla. We found that, in addition to enhancing spatial specificity, hypercapnic normalization allows quantitative comparison of results across experimental conditions.

1768. Distance Measure for Ranking Spatial ICA Components of Functional MRI Data

Rakesh Arya[1], Steve Roys[1], Vince Calhoun[2], Tulay Adali[3], Joel Greenspan[1], Rao Gullapalli[1]
[1]University of Maryland Medical Center, Baltimore, Maryland, USA; [2]Yale University, New Haven, Connecticut, USA; [3]University of Maryland Baltimore County, Baltimore, Maryland, USA

To objectively identify the meaningful independent analysis components obtained from analyzing fMRI data we developed a method based on the skewness, kurtosis, and entropy of each individual component. The sum of squares of these measures provides the distance measure which is indicative of the deviation of these components from gaussianity. Simulations on digital phantoms were performed where the robustness of the distance measure at different SNR was assessed. We have successfully applied this method to separate the relevant components from motor paradigm data. The distance measure was also able to separate the physiological components from the task related components.

1769. The Influence of an fMRI Language Task on Subsequent Resting State Networks.

A.B. Waites[1], A. Stanislavsky[1], D.F. Abbott[1], G.D. Jackson[1]
[1]Brain Research Institute, Melbourne, Australia

Resting state networks were identified by examining regions of correlated signal fluctuation, using 3 seed regions associated with language production: middle frontal gyrus, anterior cingulate and posterior cingulate. Prior to any cognitive task, each network remained distinct, each involving its own system of largely non-overlapping brain regions. In the five minutes following performance of a language production task, however, the anterior cingulate and middle frontal gyrus subnetworks became coincident. This result indicates that resting state networks are influenced by prior cognitive processing, and not an absolute cognitive state associated with rest.

1770. Contrast Agent-Enhanced Functional Magnetic Resonance Imaging at 4.7T and 9.4T

Fuqiang Zhao[1], Ping Wang[2], Noam Harel[2], Tsukasa Nagaoka[3], Seong-Gi Kim[2]
[1]University of Minnesota, Minneapolis, Minnesota, USA; [2]University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [3]Albert Einstein College of Medicine, Bronx, New York, USA

fMRI with dextran-coated monocrystalline iron oxides (MION) as an intravascular contrast agent were performed on both 4.7T and 9.4T magnets to determine the field dependency of stimulation-induced CBV-weighted signal changes. In both fields, the CBV-weighted fMRI change is more sensitive to tissue area than large vessels. As expected, stimulation-induced DR2* after the MION injection at 4.7T is greater than that at 9.4T. However, an addition of MION in blood improves CNR of tissue and reduces CNR of vessels at 9.4T. This suggests that contrast agent-introduced fMRI is still a good choice at 9.4T.

1771. Fourier Analysis of Navigator Echo Information Reveals Differential Nature of Physiologic Fluctuations in fMRI Data

Pallab K. Bhattacharyya[1], Mark J. Lowe[1]
[1]Indiana University School of Medicine, Indianapolis, Indiana, USA

Dynamic, BOLD-weighted MRI data can contain fluctuations stemming from respiratory and cardiac related sources. In 3-dimensional echo-planar imaging (EPI), these physiologic noises propagate along the volume and so we have employed a shot by shot correction using navigator echo. It has been shown that navigator echoes can be very effective in reducing the temporal variance arising primarily from respiratory artifact in 2D EPI. We demonstrate that the navigator echo effectively measures respiratory related fluctuations but cardiac related fluctuations are not adequately represented in the navigator echo data, indicating that the cardiac fluctuations present in dynamic MRI data are not motion-related.

1772. Mechanisms of Apparent Dissociation between BOLD and CBV Changes: Implications for Fractions of Venous and Arterial Vessels

Gaohong Wu[1], Feng Luo[1], Shi-Jiang Li[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Under hypercapnia conditions, some voxels with strong BOLD responses in rat brain have little CBV changes, and vice versa. The present study is to elucidate the mechanisms responsible for such apparent dissociation. Through development of a biophysical model for the BOLD signal and determination of BOLD and CBV changes under hypercapnia, it is suggested that the dissociation between BOLD and CBV changes is dependent on the vascular composition of arterial and venous vessels.

1773. Signal Temporal Instability Correction in fMRI

Yiping P. Du[1], Jason Tregellas[1], Stephen J. Uftring[2]
[1]University of Colorado Health Sciences Center, Denver, Colorado, USA; [2]University of Chicago, Chicago, Illinois, USA

A signal temporal instability correction (STIC) technique is presented to correct the adverse effects of signal instability in fMRI. This technique uses the signal summation of the entire imaging volume, v(n), at each time point, n, to characterize the signal instability. The signal intensity of each pixel at each time point was corrected using v(n). STIC reduced the root-mean-square error by 5% and 17% in two 9 minute phantom scans, respectively, acquired with single-shot EPI. In human fMRI studies, the number activated pixels was increased in a range from 5.9% to 22.7%.

1774. Map-Induced Effects in CBF and Bold Signal Response to Apnea in Anesthetized Rats

Sridhar S. Kannurpatti[1], Bharat B. Biswal[1], Antony G. Hudetz[2]
[1]UMDNJ-New Jersey Medical School, Newark, New Jersey, USA; [2]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

During apnea, BOLD signal increases in humans with no apparent change in MAP, but decreases in anesthetized rats with a drop in MAP. Though apnea-induced hypoxia in anesthetized rats may decrease the BOLD signal, decrease in MAP may also affect the BOLD signal dynamics. Unlike barbiturates, urethane does not influence GABAergic mechanisms involved in the control of cardiovascular functions. We hypothesized that the two anesthetics pentobarbital and urethane would have different effects on the dynamics of MAP induced by apnea. This could be used to separate out the effects of MAP on CBF and hence the BOLD signal.

1775. Timing Accuracy of Perfusion and BOLD Based fMRI Evaluated by Simultaneous Visual and Auditory Stimulation

Ho Ling Liu[1], Ching Mei Feng[2], Jinqi Li[2], Fan Chi Su[1], Jia Hong Gao[2]
[1]Chang Gung Memorial Hospital and Chang Gung University, Kweishan, Taoyuan, Taiwan; [2]University of Texas Health Science Center, San Antonio, Texas, USA

Inaccuracy in the estimation of onset times of neuronal activity was evaluated in perfusion and BOLD based event-related fMRI, using simultaneous auditory and visual stimulation (ideal timing difference < 50 ms). Both auditory and visual onset times in perfusion (2195 ±219 and 2180 ±206) were earlier than that in BOLD responses (2763 ±247 and 2958 ±230 ms). Differences between the two areas ranged from –10 to +110 ms in perfusion, and from 210 to –720 ms in BOLD measurements. Better timing accuracy was found in the perfusion-based fMRI, comparing to that in the BOLD-based fMRI.

1776. Radial Correlation Contrast – A New fMRI Contrast to Map Neuronal Synchronization

Gadi Goelman[1]
[1]Hadassah Hebrew University Hospital, Jerusalem, Israel

An MRI post-processing contrast, ‘Radial Correlation Contrast’ (RCC), is described. Each RCC voxel gives the average communication and its direction with the surroundings volumes. The method identifies dynamic structures based on their temporal fluctuations. While the average communication shows good gray/white matter contrast, its direction identifies dynamic structures. During spontaneous activity, short-range communication identifies cortical layers with excellent agreement to the atlas. Longer-range communication clearly identifies major cerebral structures and has the potential of showing their interaction during specific brain activity. This non-invasive ability to follow neuronal communication at various distances will enable a better understanding of brain function.

1777. Anaesthesia in Pharmacological fMRI - Virtue or Shortcoming?

Basil Künnecke[1], Markus von Kienlin[1]
[1]F. Hoffmann La-Roche Ltd, Basel, Switzerland

Pharmacological activation paradigms for functional MRI (fMRI) are receiving increased interest as a valuable tool for monitoring brain function in animal models of CNS diseases. However, anaesthesia generally required in such animal experiments intrinsically affect brain activity to a mostly unknown degree and may thus confound the results obtained. In the present study, we used 'reverse' pharmacological fMRI (phMRI) to study the specific effects of different common anaes-thetics on the outcome of brain activation in rats upon standardised amphetamine challenges. Large regional as well as temporal differences were detected for the four anaesthetics isoflurane, propofol, alpha-chloralose and ketamine.

1778. Evidence for Nonlinear Dynamical Determinism Related to Functional Connectivity in fMRI Baseline Time Series

Stephen LaConte[1], Shing-Chung Ngan[2], Jianchang Zhuang[1], Keith Heberlein[1], Scott Peltier[1], Xiaoping Hu[1]
[1]Emory University/Georgia Tech, Atlanta, Georgia, USA; [2]University of Washington, Seattle, Washington, USA

We introduce the delta-epsilon method from the field of non-linear dynamics for studying functional connectivity. The method was applied to baseline data in the primary motor area. This method is more robust to noise and finite data sets than traditional measures such as correlation dimension and Lyapunov exponents and may be useful for examining temporal characteristics of fMRI data.

1779. Dynamic Multiple-Component Model Applied to fMRI Data Analysis

Yongxia Zhou[1], Manbir Singh[1], Tae-Seong Kim[1], Witaya Sungkarat[1]
[1]University of Southern California, Los Angeles, California, USA

A multi-componet model representing a mixture of many reference functions was used to fit the time-course of pixels in fMRI. The number of relevant components, the latency of the first component, the time-separation among the components, their relative amplitude and possible interpretation in terms of partial volume contributions of micro and macrovasculature to the time-course data were investigated. Analysis of a reversing checkerboard experiment revealed that there was no improvement in the fiting beyond two components. The results suggest that it may be possible to separate the micro and macro-vasculature fractional contributions to pixels by this approach.

1780. k-Space Based Motion Detection for fMRI

Elisabeth Castro Caparelli[1], Dardo Tomasi[1], Sheeba Arnold[1], Linda Chang[1], Thomas Ernst[1]
[1]Brookhaven National Laboratory, Upton, New York, USA

To monitor subject motion in functional MRI (fMRI) studies, a fast, k-space based algorithm was developed which calculates the weighted average of squared differences between the initial scan and subsequent scans. This weighted average was determined in 50 fMRI time series and was shown to classify brain motion (“acceptable” vs. “excessive”) with an accuracy >90%.

1781. Functional MR Imaging of the Awake Monkey in a Novel Vertical Large-Bore 7 Tesla Setup

Josef Pfeuffer[1], Jon Pauls[1], Mark Augath[1], Thomas Steudel[1], Hellmut Merkle[2], Nikos K. Logothetis[1]
[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany; [2]National Institutes of Health, Bethesda, Maryland, USA

First fMRI results in the awake trained monkey (*Macaca mulatta*) using a novel vertical 7T/60cm MR system are reported. The setup was custom-designed for MR imaging of monkeys in upright position and simultaneous electrophysiological recording. Using fast gradients and optimized RF coils, the benefits of high magnetic field with increased signal and contrast-to-noise ratio are demonstrated in high-resolution anatomical and functional images.

1782. Comparative Study of Several Multivariate fMRI Processing Methods: PCA, Factor Analysis, Infomax, FASTICA, MELODIC

Rakesh Arya[1], Vince Calhoun[2], Steve Roys[1], Tulay Adali[3], Joel Greenspan[1], Rao Gullapalli[1]
[1]University of Maryland Medical Center, Baltimore, Maryland, USA; [2]Yale University, New Haven, Connecticut, USA; [3]University of Maryland Baltimore County, Baltimore, Maryland, USA

Various blind source separation techniques have been used for distinguishing different signal sources from noisy data. Independent component analysis (ICA) algorithms which use higher order statistics to separate signal sources appear to be a promising tool for fMRI data analysis. In this study, we have compared several ICA algorithms and implementations: Infomax, FASTICA, FSL (MELODIC), and also other multivariate methods: Factor analysis and principle component analysis.

1783. Sub Millimeter Analysis of Specificity of SE, GE, and ASE BOLD Responses in the Human Visual Cortex

Essa Yacoub[1], Amir Shmuel[2], Pierre-Francois Van de Moortele[1], Kamil Ugurbil[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA; [2]Max-Planck Institute for Biological Cybernetics, Tuebingen, Germany

Sub-millimeter spatial resolution applications are becoming of increasing interest in fMRI. Several animal and human studies have successfully mapped high resolution functional organizations. However, it is not known which fMRI technique (which depends on field strength), maximizes contrast to noise as well as specificity to capillaries for sub-millimeter functional mapping. In this work we examine this problem by comparing functional maps, at 0.5mm in plane resolution, of gradient echo BOLD, spin echo BOLD, and asymmetric echo BOLD in human visual cortex at 7 Tesla

1784. Optimum Stimulus Timing for Estimating fMRI Response Latencies

Rasmus M. Birn[1], Ziad S. Saad[1], Peter A. Bandettini[1]
[1]National Institute of Mental Health, Bethesda, Maryland, USA

The purpose of this study is to determine, by simulation, the optimum stimulus design for estimating response latencies. The effect of two parameters were studied – the number of stimuli in a fixed amount of time, and the stimulus block duration. For time courses with an inter-stimulus interval that varies in time, the optimum number of stimuli was exactly half of the total number of time points acquired. A longer inter-stimulus interval of 8 seconds was optimal for a time courses with a constant ISI. The optimal stimulus block duration was between 4-6 seconds.

1785. Which BOLD Latency is Most Reflective of Neuronal Timing Modulation?

Marta Maieron[1], Ziad S. Saad[1], Frank Q. Ye[1], Peter A. Bandettini[1]
[1]NIMH, Bethesda, Maryland, USA

In this study, the spatial variability of the hemodynamic latency and latency modulation with task timing modulation is studied. Specifically, we assess on a voxel-wise basis the relationship between intrinsic latency and the degree that the latency reflects modulazion in task timing.

1786. BOLD Signal Response in the Human Sensorimotor Cortex during Hyperventilation

Sridhar S. Kannurpatti[1], Vahan E. Sharoyan[1], Bharat B. Biswal[1]
[1]UMDNJ-New Jersey Medical School, Newark, New Jersey, USA

Baseline cerebral blood flow and oxygenation affect the BOLD signal significantly. Hypocapnia decreases the CBF and hence the BOLD signal. When compared to normocapnia, hypocapnic baseline conditions lead to an enhanced BOLD signal response in humans. However, in some studies, a diminished BOLD signal response during hypocapnia has been reported. In the present study, the effect of hyperventilation on the BOLD signal dynamics in the sensorimotor cortex of humans was investigated. In response to motor task, we observed an increase in the magnitude of the BOLD signal response during hyperventilation when compared to normal ventilation.

1787. Increased BOLD Signal in Conscious Rats during Hypercapnia

Mathew E. Brevard[1], Timothy Q. Duong[1], Jean A. King[1], Craig F. Ferris[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA

Functional MRI studies in animals are often conducted under anesthesia to minimize motion related artifacts that aren't present in human fMRI studies. While awake animal fMRI studies are still uncommon, some BOLD studies in awake animals have indicated greater vascluar respones to evoked activity leading to a more robust change in signal. In this study, hypercapnia also produced a larger and faster increase in BOLD signal in awake animals than in animals under sedation. Awake animals also had increased contrast to noise ratios and differences in the response of subcortical regions to hypercapnia.

1788. Analysis of the S0(t) and R_2*(t) Components of Physiological Noise in an fMRI Study

Gaohong Wu[1], Shi-Jiang Li[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Physiological noise in the fMRI BOLD signal in the brain is mainly composed of two different fluctuations – spin density S0(t) and transverse relaxation rate R2*(t). Previous studies assumed that these two fluctuations were independent. This may not be true, however. In this study, we investigated the two fluctuations with a cross-correlation method. The results demonstrate that a cross correlation between S0(t) and R2*(t) does exist. It is suggested that the negative correlation is located mainly in the CSF region and big vessels, and the positive correlation is in white and gray matter.

1789. Correlation of BOLD and EEG in Conscious Rats: A Seizure Model

Mathew E. Brevard[1], John R. Ives[2], Timothy Q. Duong[1], Craig F. Ferris[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA; [2]University of Western Ontario, London, Ontario, Canada

Functional MRI studies of seizure are routinely conducted in anesthetized animals. Anesthesia, however, has a strong effect on cerebral blood flow and metabolism that might hinder the interplay of different brain structures leading up to, and during seizure. In this study, EEG was used concurrently with BOLD fMRI to study the initiation of seizure in fully conscious rats. BOLD signal had a strong correspondence with EEG activity suggesting a neuronal basis of the BOLD signal. Both BOLD EEG increase had a strong correlation with seizure activity in the rat.

1790. A Quantitative Analysis of the Nonlinearity of the BOLD Response in Different Cortices

David A. Soltysik[1], Kyung K. Peck[1], Kaundinya Gopinath[1], Keith D. White[1], Richard W. Briggs[1]
[1]University of Florida, Gainesville, Florida, USA

We investigated the nonlinearity of the BOLD response due to changes in stimulus duration in three different primary cortices (auditory, motor, and visual). A quantitative analysis was performed on the hemodynamic response function (HRF) that examined the change in maximum percent change in signal (%ΔS), time-to-peak (TTP), full width at half maximum (FWHM), and area under the curve. Our results show that changes in stimulus duration produce linear changes in TTP, FWHM, and area but produce nonlinear changes in %ΔS.

1791. Dependence of BOLD Contrast on the Echo Time in Subcortical-Limbic Regions: An Olfactory fMRI Study

Tony Stöcker[1], Thilo Kellermann[1], Frank Schneider[1], Nadim Jon Shah[2]
[1]Heinrich-Heine-Universität, Düsseldorf, Germany; [2]Forschungszentrum Jülich, Jülich, Germany

We investigate the optimal EPI echo time for the detection of subcortical-limbic BOLD responses due to an olfactory stimulus (fermented yeast), which induces negative emotions. Activated regions showed a strong dependence on the TE measured at five different values (20,30,40,50,60 ms). The results clearly emphasize the importance of TE optimization and are of critical importance in the planning of an upcoming study on schizophrenia with fMRI.

1792. Involuntary Head Motion Increases Susceptibility Artifacts: A Caveat for fMRI in Mapping Brain Functions

Shi-Jiang Li[1], *Zhu Li*[1], *Gaohong Wu*[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

It is well known that involuntary head motion, in addition to cardiac and respiratory motions, can produce artifacts in fMRI studies. It is also known that at air-tissue boundaries, background gradients can cause image distortion and produce signal dropout. We have found that the slow progressive involuntary head motion caused by acute cocaine administration can interact with susceptibility artifacts. When this motion varies over time, the susceptibility artifacts also varies over time, resulting in misinterpreting drug-induced neuronal response in a fMRI study.

1793. Comparison of Low Frequency Noise Characteristics between Diseased and Healthy Brain Regions

K.S. Gopinath[1], *K. Peck*[1], *D. Soltysik*[1], *B. Crosson*[1], *R.W. Briggs*[1]
[1]University of Florida, Gainesville, Florida, USA

Functional magnetic resonance image time-series have been observed to possess non-flat power spectral density (PSD). Patients with lateralized ischemic strokes provide a test-bed for low frequency noise, in that the stroke regions are severely depleted of some of the low frequency noise-producing sources (e.g. neuronal events, blood and CSF flow and respiratory events). We compared the low frequency (below 0.1 Hz) noise characteristics of voxels in the stroke regions and intact regions by means of their cumulative periodogram. Stroke regions seem to exhibit stronger low frequency drifts.

1794. Quantitative Measurement of Oxygen Extraction Fraction at 3T

Richard E. Ansorge[1], *T Adrian Carpenter*[1], *Sally G. Harding*[1], *Ponpiboon Satangput*[1]
[1]University of Cambridge, Cambridge, Cambs, UK

The oxygen extraction fraction (OEF) is an important indicator of brain tissue viability. In the present study a multi-echo gradient and spin echo imaging sequence was used to acquire images from normal volunteers. A theoretical model describing signal dephasing in the presence of deoxyhemoglobin was used to estimate cerebral blood oxygen saturation and cerebral blood volume. Two methods of analysing the data are discussed in this study. It was found that a novel fitting procedure simultaneously fitting for T_2 and dephasing effects gives better estimates of OEF and improved T_2 maps.

1795. Similarities in the Low Frequency Noise Characteristics between the Magnitude and Phase Time-Series

K.S. Gopinath[1], *K. Peck*[1], *D. Soltysik*[1], *B. Crosson*[1], *R.W. Briggs*[1]
[1]University of Florida, Gainesville, Florida, USA

Large low frequency signal drifts are often observed in functional magnetic resonance image time-series. Using the integrated periodogram to characterize the noise power spectrum below 0.1 Hz of both the voxel magnitude signal and voxel phase time-series we discovered strong similarities between the low frequency behavior of phase and magnitude time series of voxels which exhibit large low frequency signal drifts.

1796. Finding Connectivity from Spatio-Temporal Characteristics of fMRI Data Using Exploratory Structural Equation Modeling

Jiancheng Zhuang[1], *Stephen LaConte*[1], *Sheng He*[2], *Xiaoping Hu*[1]
[1]Emory University / Georgia Tech, Atlanta, Georgia, USA; [2]University of Minnesota, Minneapolis, Minnesota, USA

Exploratory Structural Equation Modeling (SEM) analysis of spatio-temporal characteristics in fMRI was applied to derive functional connectivity maps. Possible connections between each brain pixel and selected ROIs were assessed by SEM using various possible network models. The most significant model was identified on the pixel-by-pixel basis to generate a Model Index Map (MIM). Subsequently, the path coefficients for each pixel were calculated for its selected model to generate a Path Parameter Map (PPM). Such maps reflect the overall connectivity and provide valuable information on functional networks in the brain. This approach was applied to experimental data from a shape-from-motion task.

fMRI: Physiological Measurement Applications

Hall D Monday 13:30 - 15:30

1797. An Estimation of Dynamic Cerebral Blood Volume Changes in Event-Related Functional MRI

Fan Chi Su[1], *Jiun Jie Wang*[2], *Tieh Chi Chu*[1], *Ho Ling Liu*[2]
[1]National Tsing Hua University, Hsinchu, Taiwan; [2]Chang Gung Memorial Hospital, Chang Gung University, Kueishan, Taoyuan, Taiwan

Flow nulling gradients, which selectively attenuate the blood signals, were utilized to quantify the cerebral blood volume (CBV) changes in event-related fMRI. CBV changes during brain activation were usually estimated from the cerebral blood flow (CBF) changes using a power law determined in steady-state and may fail in transient-state. In this study, both CBF and CBV changes due to 1-s visual stimuli were dynamically measured in a temporal resolution of 1s. Maximum CBF and CBV changes were 22.5% and 13% respectively. Resultant CBV responses returned to the baseline slower than CBF, which was in good agreement with previous studies.

1798. Classification Study of Long-Term Marijuana Smokers Based on Mean Regional BOLD Response

Piotr Bogorodzki[1], Jadwiga Rogowska[1], Deborah A. Yurgelun-Todd[1]
[1]McLean Hospital/Harvard Medical School, Belmont, Massachusetts, USA

A new classification method was applied to BOLD fMRI data in order to examine whether chronic heavy smokers could be differentiated from normal control subjects after acute drug exposure and after a 28-day washout period. Mean regional response time curves were calculated for activated voxels in selected anatomical regions and the multivariate classification analysis was applied to the measurements obtained from the curves. The differences between groups were calculated using Mahalanobis distance. The results indicate that marijuana-associated BOLD responses are altered as a function of abstinence based on the measurement of BOLD response parameters.

1799. Negative BOLD-Signal Changes are Associated with a Decrease in Perfusion Simultaneously Measured by an UNFAIR-Sequence

Alexander Maximilian Hopt[1], Felix Blankenburg[1], Rüdiger Wenzel[1], Arno Villringer[1]
[1]Charité, Berlin, Germany

Using an UNFAIR sequence (Helpern 1997, Tanabe 1999), we investigated the relationship between changes in cerebral perfusion and BOLD (blood-oxygenation-level-dependent) signal for both, increases and decreases of BOLD contrast For this purpose we employed a motor paradigm which activates the contralateral sensorimotor cortex and "deactivates" the ipsilateral sensorimotor cortex. Our results show a close positive correlation between BOLD and perfusion for positive and negative BOLD-contrast.

1800. Perturbation Corrections of the Steady State Model for the Determination of Dynamic $CMRO_2$ Changes

Seong-Hwan Yee[1], Stephen J. Dodd[1], Jia-Hong Gao[1], Peter T. Fox[1]
[1]University of Texas Health Science Center, San Antonio, Texas, USA

Relative CMRO2 changes can be effectively determined using an existing biophysical model if both BOLD and perfusion weighted fMRI signals are measured after hypercapnia calibration. In deriving this model, a physiological steady state was assumed to avoid complexity, while rendering it hardly applicable to non-steady states. We provide here, a modification to unconstrain the model from this dependence on a steady state. Our technique utilizes an additional calibration factor to account for perturbations of the steady state during dynamic changes. Our results suggest a solution to overcome the intrinsic limitation of the existing model in determining dynamic CMRO2 changes.

1801. Detection at 1.5 Tesla of Sustained Negative BOLD Signal in the Human Visual Cortex during Partial Visual Field Stimulation

Michel Dojat[1], Jan Warnking[1], Christoph Segebarth[1]
[1]INSERM, Grenoble, Isère, France

Sustained negative BOLD responses, in the human visual system, have not been reported at the usual field strengths. Such negative responses are likely due to a decrease of cerebral perfusion in non-stimulated areas adjacent to the activated ones, as a result of reallocation of the cortical blood resources. This reallocation may affect activated areas, thus inducing signal extinction or negative BOLD signal in areas where positive BOLD responses would be anticipated. In combining partial visual field stimulation experiments and retinotopic mapping experiments at 1.5 T, we show that such negative responses may be detected, following reduced visual field stimulation.

1802. Modulation of CBF Responses to Visual Stimulation during the Cold Pressor Test, A fMRI Study

Jihong Wang[1], Rong Zhang[1], Qi Peng[1], Roderick McColl[1], Benjamin Levine[1], Paul Weatherall[1]
[1]University of Texas Southwestern Medical Center, Dallas, Texas, USA

Both sympathetic and parasympathetic nerves innervate the cerebral circulation and blood flow. Conceivably, the autonomic nervous system should serve as an indispensable determinant in the control of the cerebral circulation. However, despite extensive study the importance of autonomic neural control of the CC remains controversial and data in humans are scarce. In order to understand how CBF responses to neuronal activation are modulated by enhanced sympathetic neural activity during the cold pressor test (CPT). The time course CBF responses to visual stimuli were studied using fMRI under CPT. fMRI of visual stimulation were performed on nine healthy volunteers

1803. Brain Regions Involved in Mediating the Baroreflex Following Peripherally-Induced Decreases and Increases in Arterial Pressure

Matt L. Runquist[1], Luke A. Henderson[2], Christopher R. Richard[2], Paul M. Macey[2], Jean-Philippe Galons[1], Ronald M. Harper[2]
[1]University of Arizona, Tucson, Arizona, USA; [2]University of California-Los Angeles, Los Angeles, California, USA

The baroreceptor reflex is concerned with homeostasis of arterial pressure. The aim of this study was to use functional magnetic resonance imaging to determine those regions throughout the entire brain responsible for the mediation of this primitive cardiovascular reflex. In seven isoflurane anesthetized cats, fMRI scans through the entire brain were performed during baroreceptor reflex activation. Significant changes emerged in regions of the medulla as well as in multiple rostral sites including the cerebellar nuclei and cortex, midbrain, insula, hippocampus and hypothalamus. This study reveals the response patterns over the entire brain to a primitive cardiovascular reflex.

_1804_. Functional MRI and Contrast Enhanced CT Studies of Oxygenation Changes in the Livers of Living Alcoholic Rats during Hypoxic, Hyperoxic and Hypercapnic Challenge

Manfred Brauer[1], Lesley M. Foley[1], Melissa J. Yau[1], Paul Picot[2], R. Terry Thompson[2], Jennifer Hadway[3], Sarah Henderson[3], Errol Stewart[3], Ting-Yim Lee[3]
[1]University of Guelph, Guelph, Ontario, Canada; [2]Lawson Health Research Institute, London, Ontario, Canada; [3]John P. Robarts Research Institute, London, Ontario, Canada

Spin-echo fMRI, relatively selective for microvascular oxygenation changes, showed 20% decreases in control rat liver image intensity with hypoxia and >40% increases with hyperoxia. In all cases, alcoholic rats showed little change, indicating microvasular dysfunction. MRI intensities correlated well with pulse oximetry and lactate / pyruvate ratios. Faster gradient-echo fMRI showed that alcoholic livers responded more slowly. Carbogen (95% O2, 5% CO2) almost doubled MRI intensity within 3 min for controls with <10% change for alcoholics. Dynamic contrast enhanced CT also showed much less increase in liver blood flow and volume in alcoholic rats with carbogen.

_1805_. Simulation of Flow Dependent Components in $CMRO_2$ Change Estimated by fMRI

Chang-Wei Wesley Wu[1], Jyh-Horng Chen[1], Ho-Ling Liu[2]
[1]National Taiwan University, Taipei, Taiwan, Taiwan; [2]Chang Gung Memorial Hospital and University, Taipei, Taiwan, Taiwan

Recently the detection of CMRO2 changes during steady-state brain activities has been investigated. In transient state, we found some flow-dependent parameters may cause variations in CMRO2 estimation. We provided an alternative expression of the biophysical model and simulations to observe the relationship between CMRO2 changes and two flow-dependent parameters; p, active vessel fraction and α, coefficient of relationship between CBF and CBV. Results showed that CMRO2 change was slightly increased by $13 \pm 1\%$ when p was from 0 to 1, and CMRO2 change was steeply decreased by $218 \pm 8\%$ when α was from 0 to 1.

_1806_. 0.03 Hz BOLD Signal Fluctuation is a Non-Aliased Physiological Phenomenom - Evidence from Multisampled Imaging.

Vesa Johannes Kiviniemi[1], Jyrki Ruohonen[1], Minna Mäkiranta[1], Juha-Heikki Kantola[1], Osmo Tervonen[1]
[1]Oulu University Hospital, Oulu, Finland

Fast physiological activity including respiration and cardioballistic effects aliase on the low frequency BOLD signal (1). This has caused concerns about the physiological nature of low frequency BOLD fluctuations (1). However, prominent 0.03 Hz fluctuation has been detected in BOLD signal of anesthetized subjects (2). Vasomotor waves at 0.03 Hz have also been detected with faster imaging methods without the risk of aliasing (3). If the very low frequency (VLF) 0.03 Hz fluctuation resulted from aliasing then the position of the frequency would change when sampling rate (i.e. TR) is changed.

_1807_. T_2* Heterogeneity in Cerebral Ischemia: Implications for fMRI Interpretation

Bradley Gordon Goodyear[1], Andrew Michael Demchuk[1], Richard Frayne[1]
[1]University of Calgary, Calgary, Alberta, Canada

The presence of infracted tissue and edema make the interpretation of fMRI data collected from ischemic stroke patients difficult to interpret. T2* values of these tissues differ from normal tissue and BOLD sensitivity is heavily dependent on image echo time relative to T2*. We have calculated T2* maps of ischemic stroke patients to demonstrate that T2* in infracted tissue and near edema is greatly altered and the heterogeneity of T2* is also increased. These results suggest that multi-echo fMRI experiments or direct calculation of T2* maps may be necessary to better elucidate function of neural tissue near these areas.

fMRI: Data Analysis

Hall D Tuesday 13:30 - 15:30

_1808_. An Investigation into Trial Dependencies using Event-Related fMRI

S.F. Cauley[1], G. Tamer Jr.[1], J.L. Ulmer[2], T.M. Talavage[1]
[1]Purdue University, West Lafayette, Indiana, USA; [2]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Building upon previously accepted techniques and models, a new, less rigid statistical model is presented which allows for the analysis of trial dependencies within auditory event-related fMRI experiments. The addition of a trial-dependent proportionality factor to the model prevents underestimation of the hemodynamic response (HDR) that can occur with trial averaging techniques. The coefficients of the model are estimated through a non-linear least squares regression. The model was evaluated using data collected from auditory event-related fMRI experiments. Our analysis strongly suggests that dependencies exist between intra-run trials and that these dependencies can seriously bias the estimation of the HDR.

1809. Efficient Estimation of Hemodynamic Responses with M-Sequences

Giedrius T. Buracas[1], Geoffrey M. Boynton[2]
[1]UCSD Center for fMRI, La Jolla, California, USA; [2]Salk Institute, La Jolla, California, USA

Efficient design of event related fMRI (erfMRI) experiments affords optimal estimation of fMRI responses. The critical parameters determining efficiency of ERfMRI experimental designs are the rate and temporal arrangement of event sequence. We introduce to erfMRI a simple method for generating efficient event sequences based on m-sequences. We show that efficiency of erfMRI experimental designs that employ m-sequences exceeds efficiency of the best randomly generated sequences for a wide range of experiment design parameters. In addition, m-sequences also afford efficient estimation of higher order kernels that can be used for estimation of effects of neuronal adaptation and nonlinear hemodynamics.

1810. Estimation Efficiency and Detection Power in Event-Related fMRI Experiments with Multiple Trial Types

Thomas T. Liu[1], Lawrence R. Frank[2]
[1]University of California, San Diego, La Jolla, California, USA; [2]UCSD and VASDHS, La Jolla, California, USA

We present a theoretical model for the relation between detection power and estimation efficiency for event-related fMRI experiments with multiple trial types. We find that the fundamental trade-off between efficiency and power previously observed for experiments with one trial type is also present in experiments with more than one trial type. As the number of trial types increases, it becomes increasingly difficult to achieve the theoretically achievable performance through a random search of possible designs.

1811. A Bayesian Hemodynamic Drug Response Model for fMRI Analysis

Peter Rae Kufahl[1], Daniel B. Rowe[1], Shi-Jiang Li[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

A Bayesian modeling and multivariate regression technique is described for FMRI analysis of a hemodynamic response to a drug injection, where the neuronal reference function is region-specific. Analysis is shown using data observed in the orbitofrontal cortex of a human brain during a single-dose cocaine infusion experiment.

1812. Using Features of Hemodynamic Response in Fuzzy Cluster Analysis of fMRI

Gholam Ali Hossein-Zadeh[1], Hesam Jahanian[1,2], Hamid Soltanian-Zadeh[1,2,3]
[1]University of Tehran, Tehran, Iran; [2]Institute for Studies in Theoretical Physics and Mathematics, Tehran, Iran; [3]Henry Ford Health System, Detroit, Michigan, USA

Commonly used hemodynamic response functions (HRF) such as gamma or Gaussian ignore the variability of HRF over different brain areas, subjects and sessions. Using three basis functions that model this variability, we derived three features for each fMRI time series. These features along with conventional correlation coefficient provided a feature space. By applying a Fuzzy C-Means clustering (FCM) on this space, activated areas were detected with an increased sensitivity. This method was applied to a finger tapping fMRI data and revealed activation in sub-cortical areas where FCM on cross correlation feature was unable to detect them.

1813. Detecting Clusters in fMRI Data Using the Dendrogram Sharpening Algorithm

Larissa Stanberry[1], Rajesh Ranjan Nandy[1], Dietmar Cordes[1]
[1]University of Washington, Seattle, Washington, USA

Dendrogram sharpening (DSh) makes it easier to identify the modality regions, which are, in essence, areas of activation in the human brain while analyzing fMRI data. The idea of the algorithm is to simply remove data from low density regions in order to obtain a clear representation of the data structure. For this paper, a hierarchical clustering method based on a single linkage algorithm was used to group the data, then the DSh algorithm was applied twice. After cluster cores were identified, the classification algorithm was run on the remained voxels, attempting to assign them to the found clusters.

1814. Structure-Seeking Multilinear Methods for the Analysis of fMRI Data

Anders H. Andersen[1], William S. Rayens[1]
[1]University of Kentucky, Lexington, Kentucky, USA

In comprehensive fMRI studies of brain function, the data structures often contain higher-order ways such as trial, task condition, subject, and group in addition to the intrinsic dimensions of time and space. While multivariate bilinear methods such as PCA have been used successfully for extracting information about spatial and temporal features in data from a single fMRI run, the need to unfold higher-order data sets into bilinear arrays has lead to decompositions that are nonunique and loss of multiway linkages and interactions present in the data. These additional dimensions can be retained in multilinear models that are neurophysiologically meaningful.

1815. A Novel Approach to the Modeling of the Spatial Structure of the Brain using Kriging Methods

Rajesh Ranjan Nandy[1], Dietmar Cordes[1], Yulia Gel[1]
[1]University of Washington, Seattle, Washington, USA

Modeling the spatial dependence among the voxels in the brain have always been a difficult problem in fMRI. Part of the problem is due to the fact that the physical characteristics of the three primary constituents of the brain (gray matter, white matter and CSF) are quite different. Here we adopt a segmentation based approach to isolate gray matter, white matter and CSF. A geostatistical method of kriging is then adopted to model the spatial dependence for the segmented data. This method is highly useful in generating images of higher resolution and new resampled images of brain.

1816. Evaluating fMRI Spatial Extent in Groups with Different CNR

Charles Michelich[1], Scott Huettel[1], Gregory McCarthy[1], James MacFall[1]
[1]Duke-UNC Brain Imaging and Analysis Center, Durham, North Carolina, USA

A method to allow comparison of the spatial extent of fMRI activations between two groups with differing CNR was developed. The method was evaluated in two subjects and was found to successfully recover many of the active voxels across a wide range of CNRs. The error in the estimation of the size of the activation was smaller than the uncorrected case for all but the smallest CNRs. The technique increased the number of false positives and consistently overestimated the activation size while the uncorrected data underestimated the size. Further work is necessary to establish the robustness of the technique.

1817. Comparison of Clustering Methods in fMRI Analysis by Ranking Association Coefficients

Markus Barth[1], Evgenia Dimitriadou[2], Kurt Hornik[2], Ewald Moser[3]
[1]University and General Hospital Vienna, Vienna, Austria; [2]Vienna University of Technology, Vienna, Austria; [3]University of Vienna, Vienna, Austria

The aim of this work was to compare the efficiency and power of several unsupervised data analysis techniques on artificial and hybrid fMRI data sets using two different association coefficients - namely the weighted Jaccard and the correlation coefficient - for performance ranking. By varying several study design parameters (initial number of clusters, contrast-to-noise level, noise characteristics) we found that among all tested clustering algorithms the most stable and best performing ones were neural gas and k-means.

1818. Wavelet Analysis of Clusters to Characterize the Time-Frequency Dependence of the Correlation Coefficient

Dietmar Cordes[1], Rajesh Ranyan Nandy[1]
[1]University of Washington, Seattle, Washington, USA

Brain activity in fMRI during rest or active motor-task periods has been analyzed using a hierarchical clustering method. Time-frequency specific correlations in the motor cortex are computed using the complex Morlet wavelet. Results show that periodic maxima occur with frequencies above 0.05 Hz whereas (more or less) continuous maxima are present for very low frequencies less than 0.05 Hz.

1819. Differences of Activated Area and Hemodynamic Response between Autistic Patients and Normal Subjects Evaluated by fMRI with a Language Task using Independent Component Analysis and t-test

Mayumi Takeuchi[1], Masafumi Harada[1], Hiromu Nishitani[1], Kenji Mori[1]
[1]University of Tokushima, Tokushima, Japan

We performed fMRI on autism and normal subjects with language task and analyzed by both independent component analysis (ICA) and t-test analysis. Autistic patients showed different activated portions compared to the normal subjects by both ICA and t-test, and signal time-courses extracted in autism by ICA were different from that in normal subjects, i.e., the elevation of signal in autism was slower than that in normal subjects. ICA may be a useful method to separate different hemodynamic response which could not be predicted. This study showed that fMRI is useful to evaluate activated area and hemodynamic response on autistic patients.

1820. A Method for Testing Conjuntive and Subtractive Hypotheses on Group fMRI Data Using Independent Component Analysis

Vince D. Calhoun[1], Tulay Adali[2], Godfrey D. Pearlson[1], James J. Pekar[3]
[1]Olin Neuropsychiatry Research Center/Yale University, Hartford, Connecticut, USA; [2]University of Maryland Baltimore County, Baltimore, Maryland, USA; [3]Johns Hopkins, FM Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA

Independent component analysis for fMRI has been extended for use with multiple subjects but a method for group comparisons is needed. We propose a method for performing subtractive and conjunctive comparisons of group ICA data. Our approach compares similar features (either in space or in time) extracted from group data, allowing subtractive and conjunctive tests to be performed on ICA components. We demonstrate its application to a simple set of paradigms designed to stimulate visual cortex, motor cortex, or both.

1821. Error in Estimation of ICA Z-maps from FMRI Data

John D. Carew[1], M. Elizabeth Meyerand[1]
[1]University of Wisconsin--Madison, Madison, Wisconsin, USA

Independent component analysis (ICA) is a method for mapping activation in functional MRI data. We examined the error in Z-map estimation as a function of the number of time points in the analysis. Over the range of our analysis the error is approximately 1/n.

1822. A Novel Nonparametric Estimation of p-Values in fMRI using Resting State Data

Rajesh Ranjan Nandy[1], Dietmar Cordes[1]
[1]University of Washington, Seattle, Washington, USA

Calculating the true distribution of a relevant test statistic under the null hypothesis of no activation has always been a challenging problem in fMRI. Investigators usually make several assumptions and calculate simplified parametric distributions of the test statistic. In fMRI environment, such assumptions are rarely valid, one of the most severe being the assumption of independence of observations at different time points. As a remedy, we suggest a novel nonparametric method of empirically obtaining the distribution using the resting state data. The method is simple with broad applicability and being a nonparametric method, has very few weaknesses.

1823. A Parametric Model-Based Technique for fMRI Data Analysis

Masayuki Kamba[1], Yul-Wang Sung[1], Seiji Ogawa[1]
[1]Hamano Life Science Research Foundation, Tokyo, Japan

We applied a parametric model-based technique to human visual fMRI experiments to determine the validity and feasibility of this technique for fMRI data analysis. Local signal changes were successfully predicted by autoregressive model with two external inputs, a visual stimulation paradigm and a global reference signal. A significant linear relationship was found between static gains based on the parametric modeling and beta coefficients based on general linear model analysis for active pixels in the primary visual cortex. This parametric model-based technique may be feasible for extracting signal changes caused by neuronal activation from measured signals with physiological fluctuations.

1824. Comparative Evaluation of the Performances of Different Quantitative Methods in DCE-MRI using Neural Network and Principal Component Analysis

Xiangyu Yang[1], Guang Jia[1], Klaus T. Baudendistel[1], Hendrik von Tengg-Kobligk[1], Michael V. Knopp[1]
[1]The Ohio State University, Columbus, Ohio, USA

Quantitative parameters are of crucial importance for analyzing time dependent dynamic contrast enhanced MR studies. Artificial neural network (ANN) classifiers and principal component analysis (PCA) technique were used to compare the performances of different quantification approaches derived from parameters obtained from a two compartment pharmacokinetic model. We evaluated 53 ROI's in 20 patients with brain tumors. Except for the area-under-the-curve-ratio classifier, all other classifiers, including the area-under-the-curve, were able to separate tumor from normal tissue, but none could classify the tumors into subcategories.

1825. Dynamic Changes in Neural Network Activation Patterns During Sustained Motor and Cognitive Tasks Observed with fMRI

Jeremy Wellen[1], Lawrence Sweet[2], Karl G. Helmer[1], Ronald A. Cohen[2], Christopher H. Sotak[1], James F. Paskavitz[3]
[1]Worcester Polytechnic Institute, Worcester, Massachusetts, USA; [2]Brown Medical School, Providence, Rhode Island, USA; [3]University of Massachusetts Memorial Healthcare, Worcester, Massachusetts, USA

We present a method to observe the evolution of neural activity during sustained performance of simple hand-flexion and working-memory (WM) tasks. Using blocked stimulus paradigms, ideal waveforms for cross-correlation analysis were created by dividing the stimulus epochs into subsets of TRs. Applying this approach to the motor and WM task paradigms revealed variation in the volumes of activation that arise over the stimulus epoch. We interpret these changes as adaptation of the neural network that coordinates the respective sustained activity. This analysis method may be useful to demonstrate temporal changes of activation patterns in other neural network systems.

1826. Isolating BOLD Correlates of Inter- and Intra- Hemispheric Activation during Visual Processing.

Sara Sullivan[1], Ryan D'Arcy[2], Mark Jarmasz[2], Frank MacMaster[1], Lawrence Ryner[2], Ray Somorjai[2]
[1]National Research Council, Institute for Biodiagnostics (Atlantic), Halifax, Nova Scotia, Canada; [2]National Research Council, Institute for Biodiagnostics, Winnipeg, Manitoba, Canada

We investigated fMRI correlates of visual processing within and between cerebral hemispheres. We exploited the fact that the hemispheres preferentially process certain stimuli, particularly for words and faces. The design selectively delivered stimuli to the ipsilateral or contralateral hemisphere for processing. Exploratory analyses were done using temporal fuzzy clustering to decompose the activation into uncrossed and crossed conditions. When stimuli were delivered to the ipsilateral hemisphere (uncrossed), the extracted time courses contained less noise and the activation was more distributed. When the stimuli were delivered to the contralateral hemisphere, subtle differences associated with interhemispheric transmission were present in perisplenial regions.

1827. Precision of the Delineation of Low-Order Visual Areas by fMRI Retinotopic Mapping

Jan M. Warnking[1], Michel Dojat[2], Anne Guérin-Dugué[3], Chantal Delon[2], Christoph Segebarth[2]
[1]Montreal Neurological Institute, Montreal, Quebec, Canada; [2]INSERM / UJF U438, Grenoble, Isere, France; [3]CLIPS, Grenoble, Isere, France

Delineation of low order visual areas is increasingly used to aid interpretation of results from functional studies concerning the visual system. These methods rely on the processing of structural data to construct an explicit cortical surface model, on three-dimensional retinotopic mapping, on the assignment of functional data to the model, and on surface-based processing of the functional data (1). Errors in the data leading to variability in the final area limits are introduced at each one of these stages. We measured the precision of the delineation of visual areas in a reproducibility study performed on three subjects.

1828. Analytic Error Bounds for 2D and 3D Resampling: Implications for fMRI

Thomas Ernst[1], Eunsil Recksiek[1], Klaus Mueller[2]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]SUNY at Stony Brook, Stony Brook, New York, USA

fMRI time series are commonly corrected for subject motion to improve detection of small BOLD signals. Motion correction involves spatial transformations which only provide approximations to ideal transformations. Thus, it is important to guarantee a maximum error. We derive analytic bounds for 2D and 3D reconstruction errors, which depend on the position of the reconstruction point in a grid cell and the filter size. Consequently, the filter size can be adjusted to achieve a specified error bound ("position-adaptive filter"). Large filter sizes (191^3) may be necessary to achieve the small errors required for fMRI processing (<1%).

1829. Effects of Reference Image Selection for Image Realignment on Functional Activity Detection

Chia-Shang Jason Liu[1], Peter Hurh[2], John Haselgrove[2]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA

Subject motion is a significant confound in an fMRI experiment, one which affects the sensitivity of the activation detected. SPM99 provides a technique to correct for motion, but it is unclear what the limits of displacement from the reference image are. For each subject, functional data was processed by referencing the acquired data to the image which generates the maximum sum of displacements and to one which minimized the sum of absolute displacements and one which minimized the sum of squares of displacements. No significant differences were seen in the metrics depending on which reference image was used.

1830. Integrated Motion and Geometric Distortion Correction in fMRI

Eugene E. Gualtieri[1], Ruben Gur[1], Mark A. Elliott[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

A confounder to fMRI data quality is geometric image distortion. Most high field echo-planar imaging methods incorporate post-processing distortion correction by acquiring a field map of the sample prior to the fMRI measurement. Field mapping methods require that a mask be imposed on the data, since field information is only obtainable from regions with adequate SNR. This masking step can clip the effects of motion, causing inaccurate estimation and correction of motion based changes in the time series of images. In this work we present a method for implementing geometric distortion correction without masking out the effects of subject motion.

1831. Correction of Time-dependent Frequency Offset in BOLD fMRI Caused by System Hardware

Jr-Yuan Chiou[1], Orhan Nalcioglu[1]
[1]University of California, Irvine, California, USA

We report on EPI distortion caused by a time-dependent frequency offset that was observed during fMRI studies done to study the effect of anesthesia. This time-dependent frequency offset was caused from system hardware error. The phantom images acquired with 200 frames shows the "movement" along the phase-encoding direction during this study. A correction scheme was developed and used for the comparison of the fMRI results from both un-corrected and corrected images.

1832. Evaluating Functional Neuroimaging Results: A Comparison of ROC Methods and Data-Driven Performance Metrics

Marnie E. Shaw[1], Anthony B. Waites[2], Stephen C. Strother[3]
[1]Brain Sciences Institute and Brain Research Institute, Melbourne, Victoria, Australia; [2]Brain Research Institute, Melbourne, Victoria, Australia; [3]VA Medical Center and University of Minnesota, Minneapolis, Minnesota, USA

We investigated the evaluation of functional neuroimaging results. Two evaluation methods were tested and compared; (i) ROC methods and (ii) data-driven performance metrics. The evaluation methods were compared on the basis of their application to a simulated data set, smoothed with four different spatial filters. Results demonstrated that both methods provided a similar evaluation of the results. For example, spatial smoothing with a 8mm filter generated optimal results according to both evaluation methods. These results suggest that the performance metrics may be a useful alternative to ROC methods, particularly as they can be used on any data, simulated or real.

1833. Test-Retest Reliability Improvements of fMRI Data Through Physiological Filtering

Steven R. Roys[1], Rakesh Arya[2], Rao Gullapalli[1]
[1]University of Maryland Medical Center, Baltimore, Maryland, USA; [2]University of Maryland Baltimore County, Baltimore, Maryland, USA

Signal variations induced by physiological motion can corrupt information obtained during an fMRI session. We have applied a frequency-based digital filtering technique to suppress physiological noise associated with cardiac and respiratory signals and to increase sensitivity and reliability in detecting function. The fundamental cardiac and respiratory frequencies were determined from digitized physiological data and filtered from the functional data. The reliability of this technique was assessed on a single subject performing a motor paradigm seven times over two weeks. While significant reliability improvements were realized by removing respiratory components, filtering both cardiac and respiratory components yielded the best results.

1834. Development of Smart Phantom for Characterizing fMRI Informatics Tools

Qun Zhao[1], George Duensing[1], Jeffery Fitzsimmons[2]
[1]MRI Devices Co., Gainesville, Florida, USA; [2]University of Florida, Gainesville, Florida, USA

Qualitative analyses of various fMRI informatics tools have been done using computer-simulated functional activation signals. However, these data are usually simply overlapped on top of anatomic images, they cannot reflect the real MR imaging process, e.g. the MR spin characteristics and noise from MR power system, pre-amplifier, transmit/receive, and digitization error. A remote-controlled “Smart Phantom” was developed to produce simulated data that can be acquired with any MR system. The data represent various BOLD models, contrast-to-noise ratio, and signal intensities. The data can be used to provide a standard for quantitative characterization, comparison, and validation of various fMRI informatics tools.

1835. Quality Control of fMRI Data in a Multi-Center Study

Tony Stöcker[1], Nadim Jon Shah[2], Frank Schneider[1]
[1]Heinrich-Heine-Universität, Düsseldorf, Germany; [2]Forschungszentrum Jülich, Jülich, Germany

Standard procedures to achieve quality control (QC) of fMRI data are especially important if data are collected at multiple sites within a single study. Phantom measurements were used to check scanner hardware performance for the properties of the noise in EPI data. In vivo data were efficiently checked for artifacts within the standard fMRI post-processing procedure. Standardized and routinely performed QC is essential for extensive data amounts as collected in multi-center studies.

1836. Automatic Segmentation of a Rat Brain Atlas via a Multiple-Material, Marching-Cube Strategy

Praveen P. Kulkarni[1], John M. Sullivan[1], Hamid R. Ghadyani[1], Wei Huang[1], Ziji Wu[2], Jean A. King[3]
[1]Worcester Polytechnic Institute, Worcester, Massachusetts, USA; [2]Dartmouth College, Hanover, New Hampshire, USA; [3]University of Massachusetts Medical School, Worcester, Massachusetts, USA

Segmentation of a MRI dataset requires identification of different region of interests. Existing 2D atlases are seldom complete for volume segmentation. Although many of these atlases are prepared electronically, the drawings are not numerically robust. This paper presents an automatic conversion of graphics atlases to segmented 3D geometry atlases. The system begins with DXF files of individual 2D atlas drawings. Numerous integrity diagnostics are performed to eliminate artistic flaws. Numerically intact and labeled closed loops are formed. A multiple-material marching-cube routine creates the entire 3D volume maintaining tissue delineations with fidelity.

1837. Analyzing Brain Function *In-Vivo* using both fMRI and White Matter Fiber Tracking

Frank Hoogenraad[1], Mark Stoesz[1], Ronald Holthuizen[1], Paul Downing[2], Anne-Sophie Glantenay[1], Arianne van Muiswinkel[1]
[1]Philips Medical Systems, Best, Brabant, Netherlands; [2]University of Wales, Bangor, Wales, UK

In this study a feasibility study of combining the data from fMRI and fibertracking was performed. These experiments set out to localize both fMRI function and white matter connections between detected areas to improve the understanding of brain organization. It was shown that tracts can be obtained from the spinal cord all the way up to the cortices at the site of activation, ranging over a length of more than 21 cm in the Z-direction. It also appeared that the number of possible distinguishable fiber bundles (including multiple fibers) was quite large, thus creating a complex picture of brain connectivity.

1838. Enhanced fMRI Analysis by using ERP Information

Silvina G. Horovitz[1], Bruno Rossion[2], Pawel Skudlarski[1], John C. Gore[3]
[1]Yale University, New Haven, Connecticut, USA; [2]University of Louvain, Louvain-la-Neuve, Belgium; [3]Vanderbilt University, Nashville, Tennessee, USA

ERP recordings were used to find fMRI sources of activation using a parametric experiment. Method: Pictures of faces and cars contaminated with different level of noise were presented. The characteristic N170 response decreased in magnitude as the noise increased. These data were used to find fMRI activations by correlation of the fMRI maps with ERP values. Results: Correlation between fMRI data and N170 amplitude for faces was significant ($p<0.0001$) in fusiform gyrus and superior temporal sulcus. Conclusion: fMRI activations followed electrical activity responses. ERP may be used to find sources of activation in fMRI data.

1839. Fully Real-time Analysis System for Functional MRI Time Series

Epifanio Jr Tila Bagarinao[1], Kayako Matsuo[1], Toshiharu Nakai[1]
[1]National Institute of Advanced Industrial Science and Technology Kansai Center, Ikeda City, Osaka, Japan

A system for the real time analysis of functional magnetic resonance imaging (fMRI) time series is described. The system exploits the advantages of parallel computing using PC clusters, coupled with an efficient general linear model (GLM) estimation algorithm, to overcome several issues constraining the analysis of the whole-brain fMRI data in real time. With this, a significant reduction in computation time was achieved. In particular, image preprocessing including realignment and smoothing took only 0.525 s while statistics computation for only 0.055 s for each 64 x 64 x 30 image volume. A complete fully real-time operation is thus achieved.

1840. The Effects of Eye and Stimulus on the Voxel-wise Repeatability of Visual Cortex fMRI

Antonio Algaze[1], Cynthia Roberts[2], Martina Pavlicova[2], James W. Ibinson[2], Petra Schmalbrock[2]
[1]The Ohio State University & University of Puerto Rico, Columbus, Ohio, San Juan, Puerto Rico, USA; [2]The Ohio State University, Columbus, Ohio, USA

A limited number of studies have addressed the repeatability of visual cortex activation maps. Most of these were restricted to the repeatability of binocular stimulation under a flashing LED stimulus. This study investigates the voxel-wise repeatability of FMRI activation maps elicited by monocular and binocular stimulation with two types of stimuli. Repeatability was assessed using a group analysis method based on a mixed-effects ANOVA model. Visual cortex activation was found to be repeatable, regardless of the stimulus type or eye stimulated

Pharmacologic fMRI: Animal Model Applications

Hall D Saturday 14:00 - 16:00

1841. GABAergic Regulation of Heroin Effect by Nipecotic Acid Detected by fMRI

Guofan Xu[1], Gaohong Wu[1], Feng Luo[1], Hanbing Lu[1], Shi-Jiang Li[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

To study the mechanisms of how GABAergic regulation is involved in heroin's effects, nipecotic acid (NPA), a GABA reuptake inhibitor, was employed to perturb GABAergic systems. Systemic administration of NPA significantly($P< 0.05$) produced positive and negative BOLD signals in cortical and subcortical regions. With pretreatment of NPA, systemic heroin administration produced significantly fewer BOLD responses than without NPA pretreatment. Our results suggest that GABAergic regulation mediates heroin effects. We demonstrated that fMRI BOLD methods could be extended to study molecular events between neuropharmacological drugs and transporters of neurotransmitter at a systems level with high spatial and temporal resolution.

1842. Intra-Subject Detrending in Small-Animal Pharmacological MRI

Andrew Sheridan Lowe[1], Gareth J. Barker[1], Matthew D. Ireland[1], Mohammed Shoaib[1], John S. Beech[2], Steve C. R. Williams[1]
[1]Institute of Psychiatry, London, UK; [2]University of Cambridge, Cambridge, UK

A cubic spline algorithm is reported for normalising temporal changes in signal intensity at the voxel and global levels, in addtion to an innovative input function derived from intra-subject region of interest (ROI). All exhibit marked increases in sensitivity to activation paradigms. Use of a ROI input function in conjunction with the cubic spline algorithm will be of significant utility for pharmacological MRI which may invalidate standard normalisation procedures due to widespread changes in neuronal activity.

1843. Corticothalamic Activation during Experimental Absence Seizures: A Functional MRI Assessment

Jeffrey R. Tenney[1], Jean A. King[1], Timothy Q. Duong[1], Craig F. Ferris[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA

BOLD fMRI was used to identify areas of brain activation during absence seizures in an awake animal model. The cortico-thalamic circuitry, critical for spike-wave discharge formation in absence seizure, showed robust BOLD signal changes after gamma-butyrolactone administration, consistent with EEG recordings in the same animals. These results corroborate previous findings from lesion and electrophysiological experiments and show the technical feasibility of non-invasively imaging absence seizures in fully conscious rodents with minimal motion artifact.

1844. Acute Effects of Corticosterone on BOLD Signal: A Pharmacological fMRI Study in Rats at 7 Tesla.

Mirjam I. Schubert[1], Susanne Droste[1], Raffael Kalisch[1], Florian Holsboer[1], Johannes M.H.M. Reul[1], Dorothee P. Auer[1]
[1]Max Planck Institute of Psychiatry, Munich, Germany

Thirteen adrenalectomized rats were examined by phMRI at 7 Tesla in order to map local changes in BOLD signal after an acute stress challenge with corticosterone (CORT, n=7) compared to vehicle injection (CON, n=6). Regional time courses of CORT versus CON showed a relative increase (1.0-1.2%) in BOLD signal in medial prefrontal cortex/anterior cingulate (mPFC/ACC). Averaged time courses of volume of interests identified post hoc in SPM map confirmed a positive response difference of CORT/CON in orbitofrontal cortex, caudate-putamen and mPFC/ACC. Acute rises of CORT appear to regionally increase BOLD signal being in line with stress-related activation of prefrontal circuits.

fMRI: Animal Model Applications

Hall D Sunday 13:30 - 15:30

1845. MR Compatibility of Silicon Recording and Stimulation Electrode Systems

Francisco M. Martinez[1], Douglas C. Noll[1], David J. Anderson[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

Magnetic Resonance compatibility of biomedical implants and devices represents a challenge for designers and potential risks for users. This work addresses this problem and presents the first MR compatible multichannel silicon microelectrode system, used for recording and electrical stimulation in the Central Nervous System of animal subjects. A standard chronic assembly was tested on a 2 Tesla magnet to detect areas of concern and modified to minimize or eliminate susceptibility artifacts, tissue damage, and electrode displacement, maintaining good image quality and safety to the animals. The final design is fully MR compatible and has been successfully tested on guinea pigs.

1846. CBV and BOLD Responses to Direct Cortical Stimulation in the Rat

Vivienne Catherine Austin[1], Andrew M. Blamire[1], Peter Styles[1], Paul M. Matthews[1], Nicola R. Sibson[1]
[1]University of Oxford, Oxford, UK

An iron oxide contrast agent was used to investigate the CBV contribution to the disparate BOLD responses observed during direct cortical stimulation of the rat brain. BOLD and CBV responses were observed in the stimulated and contralateral motor cortices, secondary somatosensory cortices, and ipsilateral striatum. In all of the activated regions, the CBV response had a similar temporal profile to the BOLD response, but faster onset. Ipsilateral activated regions displayed a prolonged response, whilst contralateral cortical activated regions displayed a shorter response and subsequent negative undershoot. In addition, a negative change in CBV was observed in the contralateral striatum.

1847. Adenosine Regulates the BOLD Signal in Rat Brain during Forepaw Stimulation

Feng Luo[1], Gaohong Wu[1], Shi-Jiang Li[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

To study the causal mechanism between the BOLD signal and forepaw stimulation-induced neural activity in rat brain, theophylline, an adenosine receptor blocker was employed. An inter- and intra-subject experimental design was employed to compare the effects of treatment before, during and after theophylline administration on the BOLD signal. Significantly fewer activated voxels were found after theophylline infusion, demonstrating for the first time that adenosine regulates BOLD contrast as a neural-vascular mediator and suggesting a causal relationship between neuronal activation and the BOLD signal.

1848. Neurophysiologic Events Associated with Sensory Stimulation and Hypercapnia: Implications for BOLD Calibration

Fahmeed Hyder[1], Ikuhiro Kida[1], Hubert Trübel[1], Richard Kennan[2], Douglas Rothman[1]
[1]Yale University, New Haven, Connecticut, USA; [2]Albert Einstein College of Medicine, Bronx, New York, USA

Changes in CMRO2 may be calculated from BOLD provided changes in CBV and CBF are independently measured. Commonly hypercapnia is used to calibrate the CBV-CBF relationship to calculate changes in CMRO2 from BOLD-CBF measurements during functional activation. For this calibration the assumptions are that the CBF-CBV relationship is the same in both perturbations and changes in CMRO2 (i.e., neuronal activity) with CO2 are negligible. We measured the CBF-CBV relationship (by MRI) and neuronal spiking frequency (by extracellular recordings) in anesthetized rat brain for both perturbations. Our results suggest that both the CBF-CBV relationship and neuronal activity are modified with hypercapnia.

1849. Frequency dependent Activation of the Somatosensory Cortex of the Rat as Discerned with Functional MRI

Nadja Van Camp[1], Marleen Verhoye[1], Antonia Volny-Luraghi[2], Erik De Schutter[2], Annemie Van der Linden[1]
[1]University of Antwerp, Ruca, Antwerp, Belgium; [2]University of Antwerp, UIA, Antwerp, Belgium

7-9Hz are important frequencies of whisking twitches of the rat, which occur during voluntary immobility and attentiveness. Electrophysiological studies demonstrated that somatosensory stimulation at these frequencies resulted in a cyclic response pattern, which wasn't observed at 1-5Hz or >9Hz. Preliminary electrophysiological studies also suggested a better correlated local field potential (LFP) response at these frequencies. We investigated this frequency-dependent activity in cerebral cortex with functional MRI based on the BOLD signal and demonstrated that the BOLD response of the <7-8Hz> group was significant higher than the BOLD response of the <1–5Hz> and <10–12 Hz> group (p=0.0351).

1850. BOLD Response under Graded Stimulus Frequency in a Rat Whisker Barrel Stimulation Model

Hanbing Lu[1], Feng Luo[1], Guofan Xu[1], Thomas Prieto[1], Shi-Jiang Li[1], James S. Hyde[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

BOLD response under graded stimulus frequency is characterized. Our data demonstrate that BOLD response increases with whisker stimulation frequency up to 12 Hz, and tends to plateau at higher frequencies. Comparing with previous local cerebral blood flow (LCBF) measurements using Laser Doppler Flowmetry and neuronal activity measurements with single unit (SU) recording, our data suggest that BOLD response strongly depends on LCBF. As LCBF plateaus, BOLD response plateaus, despite increased neuronal firing spikes.

1851. Visual System Activation in the Rat as Studied with BOLD fMRI

Anthony G. Hudetz[1], Feng Luo[1], Thomas E. Prieto[1], James D. Wood[1], Li Shi-Jiang[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Monocular flash stimuli repeated at 10 Hz were used to produce visual cortical and collicular neuronal activation in 0.2 % halothane-anesthetized, immobilized, artificially ventilated Sprague-Dawley rats. Significant, positive BOLD signal changes and intracortical oscillatory field potential responses in separate animals were recorded from contralateral monocular primary visual cortex and bilateral binocular and extrastriate cortex, demonstrating the feasibility to study visual system function with fMRI in the albino rat.

1852. Functional MRI Reveals the Flicker Diffusion Frequency Threshold of the Superior Colliculus in the Rat.

Nadja Van Camp[1], Marleen Verhoye[1], Chris I. De Zeeuw[2], Annemie Van der Linden[1]
[1]University of Antwerp, Ruca, Antwerp, Belgium; [2]Erasmus University, Rotterdam, South-Holland, Netherlands

We investigated the effect of different frequencies of light stimulation on the activity of different brain regions involved with visual perception in the rat using fMRI. The superior colliculus (SC) was the only structure whose activity seemed to be frequency sensitive: peak responses occurred at 8, 10 and 12Hz, while above 20Hz, the BOLD activity decreased. This confirms the characteristics of scintillation detector neurons present in the SC and looks as if for the rat a light stimulation frequency above 20 Hz represents the threshold above which the difference between scattering and continuous light cannot be discerned anymore (flicker diffusion).

1853. A Fiber Optic-Based Detector for Behavioral Eyeblink Measurement in a MRI Environment

Limin Li[1], Michael J. Miller[2], Alice M. Wyrwicz[1]
[1]ENH Research Institute, Evanston, Illinois, USA; [2]Northwestern University, Evanston, Illinois, USA

We previously described a reliable system to control the timing of multiple stimuli and to detect behavioral responses in fMRI studies of learning in animals. Here we report a modification to the system. The modified system uses a fiber-optic cable to avoid the interference often associated with the application of pulsed gradients during MR imaging, especially EPI. Comparison of the original and modified detection setups is demonstrated with behavioral measurements on awake, behaving rabbits in a MRI environment.

1854. Functional Forepaw Plasticity after Thoracic Contusion Injury of the Rat Spinal Cord

Petra Schweinhardt[1], Christoph Hofstetter[1], Tomas Klason[2], Sven Mansson[3], Lars Olson[1], Christian Spenger[1]
[1]Karolinska Institutet, Stockholm, Sweden; [2]Karolinska Hospital, Stockholm, Sweden; [3]University Hospital, Malmö, Sweden

We used fMRI and behavioral tests (BBB, gridway and hotplate) to explore functional and structural plasticity of sensory pathways following contusion injury of the rat spinal cord. Rats were tested 1, 4 or 16 weeks after weight drop injury. FMRI revealed larger and bilateral cerebral activation following electric forepaw stimulation after chronic injury and regain of somatosensory activation following hindlimb stimulation after mild injury. Comparison of fMRI and behavioral tests suggest a discrepancy between an earlier and more complete motor and a later and less complete sensory recovery.

1855. Functional, Perfusion and Diffusion MRI of Stroke

Qiang Shen[1], Xiangjun Meng[1], Marc Fisher[1], Timothy Q. Duong[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA

fMRI was used to evaluate the BOLD and CBF responses to hypercapnic challenge immediately (0.5 to 3 hours) and up to 24 hours following focal cerebral ischemia. Combined quantitative diffusion and perfusion imaging were used to delineate salvageable and non-salvageable tissues. BOLD and CBF responses were evaluated in different brain regions delineated based on differences in diffusion and perfusion mismatch. These results were correlated with TTC histological staining.

Animal fMRI: From Anesthesia to Awake Animals

Hall D Monday 13:30 - 15:30

1856. MAP Reversibly Modulates Resting State fMRI-Low Frequency Fluctuations in Anesthetized Rats

Sridhar S. Kannurpatti[1], Bharat B. Biswal[1], Antony G. Hudetz[2]
[1]UMDNJ-New Jersey Medical School, Newark, New Jersey, USA; [2]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

The resting state MR-BOLD signal was measured in anesthetized rats under normal and exanguinated conditions, which drops MAP markedly and increases blood flow oscillations. The presence of low-frequency physiological fluctuations under various conditions were analyzed from the Fourier Transform of the MR-signal after filtering the high frequency components to remove respiration and cardiac frequencies. Decrease in MAP led to an increase in power at 0.01 Hz and 0.125 Hz respectively. The dependence of the resting state low frequency BOLD signal fluctuations on MAP suggest that they could be directly linked to blood flow oscillations observed in anesthetized rats.

1857. Observation of the Changes in the Fronto Parietal Cortex, Preoptic Area and Amygdala using Functional MRI during Sleep in Conscious Animals.

Manjula Khubchandani[1], H. N Mallick[1], V. Mohan Kumar[1], N. R Jagannathan[1]
[1]All India Institute of Medical Sciences, New Delhi, Delhi, India

We report the functional MR images obtained from conscious rats during sleep- wakefulness (S-W) using the simultaneous electrophysiological and functional MRI (fMRI). Blood flow changes in the preoptic area (POA), fronto parietal cortex (FrPaM) and amygdala region of the rats were observed during sleep. Physiologically, POA is known to play a significant role in the regulation of sleep while as amygdala is well known for its predominant role in emotions. Fronto parietal cortex which is deactivated during sleep regulates all the motor activities. These results establish the relationship between hemodynamics (fMRI) and the neuronal activity (EEG).

1858. Hypoxia in Awake and Anesthetized Animals: A CBF and BOLD fMRI Study

Ross W. Sullivan[1], Qiang Shen[1], Kenneth Sicard[1], Craig F. Ferris[1], Jean A. King[1], Timothy Q. Duong[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA

Anesthetics could have a profound effect on cerebrovascular coupling. We hypothesized that anesthesia perturbs the autonomic responses that would result in marked differences in the fMRI responses to transient hypoxia between anesthetized and awake animals. CBF and BOLD fMRI responses, blood pressure, heart rate, respiration rate and blood gases were evaluated under graded hypoxia in the same animals under both awake and anesthetized conditions.

1859. Subcortical fMRI Activations in Awake Animals

Timothy Q. Duong[1], Qiang Shen[1], Jeffery R. Tenney[1], Mathew E. Brevard[1], Jean A. King[1], Craig F. Ferris[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA

fMRI studies in awake and behaving animals could offer many unique advantages. We demonstrated herein that BOLD fMRI responses under awake conditions are reasonably robust by using three well-established stimulation models, namely: global stimulation via seizure induction, and focal stimulation using forepaw stimulation and olfactory stimulus. Larger BOLD percent changes were observed under awake conditions compared to the anesthetized conditions. Most importantly, activations were observed in additional brain structures (predominantly in the subcortical regions and higher order functions) that were not detected in the anesthetized preparations.

1860. Functional Magnetic Resonance Imaging of Brain Activity Following Cocaine Administration in Fully Conscious Rats

Jeffrey R. Tenney[1], Marcelo Febo[2], Annabell C. Segarra[2], Jean A. King[1], Timothy Q. Duong[1], Craig F. Ferris[1]
[1]University of Massachusetts Medical School, Worcester, Massachusetts, USA; [2]University of Puerto Rico Medical School, San Juan, Puerto Rico

BOLD fMRI was used to identify areas of brain activation following cocaine administration in an awake animal model. The structures comprising the reward circuit, thought to be responsible for the euphoric and addictive properties of cocaine, showed robust BOLD signal changes. Both chronic administration of cocaine and cocaine administered to castrated animals were found to result in decreased levels of activation. These results validate the use of BOLD fMRI as a tool for studying drugs of abuse.

1861. Characterization of D_2 Antagonist Sulpiride Effects on Cerebral Hemodynamics in a Conscious Rabbit with fMRI

Huiming Zhang[1], Tongyou Ji[1], R. Leslie[2], P. D. Hockings[2], D. Templeton[2], Alice M. Wyrwicz[3]
[1]ENH Research Institute, Evanston, Illinois, USA; [2]GlaxoSmithKline, The Frythe, Welwyn, UK; [3]ENH Research Institute, Northwestern University, Evanston, Illinois, USA

The substituted benzamide sulpiride is used to treat negative symptoms of schizophrenia at low doses, and florid positive symptoms at high doses. We examined the spatial distribution of sulpiride-induced BOLD changes in conscious rabbit brain using fMRI.

Neuroscience Investigation with fMRI

Hall D Tuesday 13:30 - 15:30

1862. Effects of D-Amphetamine on fMRI Brain Activation During a Simple Motor Task

Deidre J. Devier[1], Andrew R. Mayer[1], Daniel Sheltraw[2], Jo Ann Harnar[1], Glenn D. Graham[1]
[1]University of New Mexcio, Albuquerque, New Mexico, USA; [2]Albuquerque VA Healthcare System, Albuquerque, New Mexico, USA

Pharmacologic fMRI can be used to investigate the use of medications on the BOLD response. Images were analyzed from 6 right handed normal subjects who performed a simple motor task before and after receiving 10 mg of d-amphetamine (AMPH). Repeated measures 2X2 ANOVA of laterality (right, left primary motor cortex) and time (pre, post drug) found an interaction leading to a significant increase in BOLD activation in the left motor cortex following AMPH. These results suggest that AMPH may interact with highly practiced movements increasing BOLD signal in the dominant hemisphere.

1863. De-Activation of Ipsilateral Motor Regions during a Reaching Task.

Peter Brotchie[1], Michael Lee[2], Anthony Waites[2], David Abbott[2], Graeme Jackson[2]
[1]BSI, Melbourne, Australia; [2]BRI, Melbourne, Victoria, Australia

Transcranial magnetic stimulation, PET and functional MRI studies demonstrate a reduction in activation of ipsilateral motor cortex with hand movements. This effect was thought to be transcallosally mediated at the level of primary motor cortex. We have shown a similar reduction of BOLD signal in ipsilateral motor region with a delayed reaching task. However, our data suggests that the de-activation lies within pre-motor cortex rather than primary motor cortex with the de-activation occurring only during the planning phase of the movement, not during the execution of the movement.

1864. An fMRI Study of Hand Representation in Left and Right Handed Subjects

Arshad Zaman[1], Marta Garcia Finana[2], Wendy Moody[3], Neil Roberts[1]
[1]University of Liverpool, Liverpool, Mersyside, UK; [2]University of Cantabria, Santander, Spain; [3]Liverpool John Moore University, Liverpool, Mersyside, UK

The purpose of this study was to use fMRI to investigate the neural correlates of handedness. We investigated the relationship, in both right and left handed subjects, between hand skill, and hand preference, and the cortical representation of the digits of the hand. We measured the distance between the peak of the activated cluster for the respective digits for each hand to test our hypothesis that in each handedness group digit separation would be greater for the dominant compared to the non-dominant hand. Furthermore, we investigated (with both cohorts) the possible interaction between language lateralization, hand representation and handedness.

1865. Computation of Coupling Direction between Motor Cortex and Cerebellum in fMRI

Angela R. Laird[1], Baxter P. Rogers[1], M. Elizabeth Meyerand[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

Much progress has been made in understanding the connections between brain regions using fMRI; however, many of these studies have been unable to characterize the relevant causal relationships. Here we propose a novel method of determining the direction of coupling between the motor cortex and cerebellum using an algorithm taken from the theory of dynamics of interacting, nonlinear oscillators. This method is based on the idea that the underlying relationship between two systems may be investigated by determining whether the predictability of a signal from one system is improved by the knowledge of a signal from another system.

1866. Imaging Secondary Hyperalgesia. An fMRI Study using the Heat/Capsaicin Sensitization Model

Laura Zambreanu[1], Richard G. Wise[1], Jonathan Brooks[1], Irene Tracey[1]
[1]Oxford University, Oxford, UK

Secondary hyperalgesia is a manifestation of plastic changes in pain processing, characterized by lowered pain thresholds and increased pain to suprathreshold stimuli, occurring in undamaged tissue surrounding an injury. We used the combined action of heat and capsaicin to produce secondary hyperalgesia in healthy volunteers and used fMRI to image the brain's responses to von Frey filament stimulation of the skin before and after heat and capsaicin treatment. Stimulation of the secondary hyperalgesia region produced robust activation in all major areas of the pain matrix although to a lesser extent than that produced by stimulation of the primary hyperalgesia area.

1867. Excitatory and Inhibitory Process Observed by fMRI and SEP in Rat Somatosensory Cortex

Tsukasa Nagaoka[1], Richard P. Kennan[1], Chaiyapoj Netsiri[1], Nikolai I. Avdievich[1], Hoby P. Hetherington[1], Seiji Ogawa[1]
[1]Albert Einstein College of Medicine, Bronx, New York, USA

To date fMRI has been primarily interpreted in terms of neural activation by excitatory inputs. Neural systems are clearly controlled by both excitatory and inhibitory input, and it can be defined all neuronal process involves both inputs. Nevertheless, the mechanism of this interaction has not been clarified yet. The objective of this report is to clarify this mechanism of inhibitory and excitatory interactions by using fMRI and SEP in rat somatosensory cortex. Cross-hemispheric inhibition was consistently observed at 20-140msec in inter stimulus interval at low current, while an excitatory reaction was detected at 167-400msec only in 1.5mA in current.

1868. Long - Lasting Cerebral Cortex Activation Changes Involved in Motor Learning

Dusan Suput[1], Mihael Rogac[1]
[1]School of Medicine, Ljubljana, Slovenia

Premotor area and supplemetary motor area are cortical regions involved in movement planning, and associative parietal lobe cortex in the sensory - motor integration. Previous fMRI studies have described changes of the BOLD signal pattern in the contralateral primary sensory and motor cortex during a motor skill learning. PET studies showed different signal changes, depending on the paradigms used. In the present fMRI study of motor skill learning a reorganization pattern of cerebral cortex activation was observed in the learned finger-tapping task involving each hand. Repeating the measurements after a year revealed that the described changes are persistent.

1869. Neuron Activity Indicated by fMRI in Sensory Motor Cortex Induced by Specific Acupoint Stimulation

Geng Li[1], Raymond TF Cheung[1], Q Y. Ma[1], Edward S. Yang[1]
[1]The University of Hong Kong, Hong Kong

fMRI is one of the most widely used approaches in the localization of cerebral cortex in patients with brain lesions. We used sensory motor-implicated acupoint stimulation as an external stimulus to induce neuron activations indicated by fMRI in specific brain cortex for the basic and inter mediate sense modalities in 39 health subjects. Signal increases were found in BA 4, 6 or BA 2, 3 and 4 during lower or upper limb sensory motor-implicated acupoint stimulation, respectively. Results suggest that stimulation of sensory motor-implicated acupoint maybe useful for localizing the sensory-motor-cortex in patients with brain lesions for preoperative planning.

1870. Location of SI and SII Activation in Dental Vibration using fMRI

Sarah Gutteridge[1], Mats Trullson[2], Susan Francis[1], Staffan Norsell[2], Nicola Phillips[3], Richard Bowtell[1], Francis McGlone[3]
[1]Magnetic Resonance Centre, Nottingham, UK; [2]Karolinska Institute, Karolinska, Huddinge, Sweden; [3]Unilever Institute, Wirral, UK

In this study, fMRI was used to investigate the sensory (SI and SII) brain areas that are involved in the perception of tooth vibration. A vibrotactile stimulus was applied to the upper incisor and those brain areas activated by tooth vibration were localised. The ipsi- and contralateral location of this brain activity was then compared to that of areas activated by stimulation of the digit tip of the hand.

1871. Hemispheric Asymmetry in Supplementary Motor Area Connectivity

Baxter P. Rogers[1], M Elizabeth Meyerand[1]
[1]University of Wisconsin-Madison, Madison, Wisconsin, USA

We studied the effective connectivity of supplementary motor area to motor cortex during a visually-cued button press experiment performed separately with both hands. We observed a task-related increase in the influence of contralateral SMA on contralateral MC for both hands. Also, ipsilateral SMA appeared to play a role in movement of the non-dominant hand, suggesting that right and left SMA do not play symmetrical roles.

1872. The Neural Systems Involved in Motor Timing Display Context Dependence: An fMRI Study

Kelly Jantzen[1], Fred L. Steinberg[2], Scott Kelso[1]
[1]Florida Atlantic University, Boca Raton, Florida, USA; [2]University MRI, Boca Raton, Florida, USA

A variant of the standard continuation paradigm was used to investigate context dependence in the neural substrates of timing. Pacing was established by moving in-phase (usual procedure) or antiphase (syncopation) with an auditory metronome. Functional MRI was measured from subjects using four conditions: Synchronized-Pacing, Synchronized-Continuation, Syncopated-Pacing and Syncopated-Continuation. Results showed that, although performance was similar, the brain areas activated during continuation differed dramatically from each other and depended directly the nature of the pacing phase. We show that the neural mechanisms underlying timing are highly flexible, reflecting the context in which the timing is established.

1873. The Frequency Dependence of BOLD fMRI Response Induced in Human Primary Visual Cortex is Influenced by Different Photic Patterns

Kenichi Kashikura[1], Tetsuo Sato[1], Hiroshi Toyoda[1], Sadahiko Nishizawa[1], Yasuhisa Fujibayashi[1], Yoshiharu Yonekura[1]
[1]Fukui Medical University, Yoshida-gun, Fukui-ken, Japan

The frequency dependence of fMRI response in human V1 was investigated by varying the presentation rate of photic stimuli. The magnitude of the BOLD response induced by three different photic patterns (two checkerboard sizes and a flickering stimulus) reversing at frequencies of 1, 3.9, 7.8, and 15.5 Hz was measured. The results showed the flickering stimulus produced a peak at 8 Hz while the responses of the reversing checkerboard patterns were approximately constant across all frequencies. These results suggest that the (temporal) frequency dependence of the BOLD response of human V1 may be influenced by the spatial frequency photic stimulus.

1874. Visual Area V5 (MT) Activation by Moving and Non-Moving Pattern Stimulation

Yul-Wang Sung[1], Masayuki Kamba[1], Seiji Ogawa[1]
[1]Hamano Life Science Research Foundation, Tokyo, Japan

We posed a question that which part of functional system activity fMRI signal represents. We examined fMRI activation at V1 and MT by transient stimulation with moving, stationary and flickering vertical bar patterns at high and low illumination contrast. Stationary pattern and moving patterns, both had equivalent illumination in light quantity and spatial distribution, produced very similar activation intensity at MT as well as in V1area. Repeating the pattern twice with 200 msec interval, refractory response was observed in both cases. The major contribution to fMRI signal could be the processing of the input regardless of its type.

1875. An fMRI Study of Attentional Selection between a Visual Cue and an Auditory Cue

Toshiharu Nakai[1], Chikako N. Kato[2], Keiichiro Toma[3], Kayako Matsuo[1]
[1]National Institute of Advanced Industrial Science and Technology, Ikeda, Osaka, Japan; [2]Toyohashi Sozo College, Toyohashi, Aichi, Japan; [3]Institute of Biomedical Research and Innovation, Kobe, Hyogo, Japan

The interaction between an auditory and a visual cue in motor execution was investigated using fMRI. When the auditory and visual cues were un-synchronized, the brain activation related to working memory and auditory rehearsal was increased to select auditory pacing, and the activation indicating motor selection was increased to select visual pacing. With synchronization of the auditory and visual cues, the demand for the bilateral superior temporal gyri was less than that with only auditory pacing. These findings may indicate predominance of the visual cue over the auditory cue and different mechanisms between these two modalities.

1876. The Effect of Practice in Visual Attention Processing: A Functional MRI Study at 4 Tesla

Dardo Tomasi[1], Thomas Ernst[1], Sheeba Arnold[1], Elisabeth Castro Caparelli[1], Linda Chang[1]
[1]Brookhaven National Laboratory, Upton, New York, USA

Brief practice for a visual attention task induced a clear change from activation to deactivation in the frontal cortex. This finding suggests that some neural processes associated with novel (controlled) task processing are not needed in more automated task processing.

1877. Amitriptyline Reduces Symptoms of IBS, Intestinal Pain Sensitivity and Brain Activation during Rectal Pain

Howard Mertz[1], David R. Pickens[1], Shiva Gautam[1], Victoria L. Morgan[1]
[1]Vanderbilt University, Nashville, Tennessee, USA

Irritable bowel syndrome (IBS) is a disorder of intestinal hypersensitivity exacerbated by stress. Tricyclic antidepressants (TCAs) may act in the CNS to reduce pain sensitivity and symptoms. 19 women with IBS took TCA (amitriptyline) and placebo for one month. Rectal sensitivity and brain activation by distension (BOLD fMRI) were recorded during stress and relaxing music. Ami reduced symptoms and rectal sensitivity during stress. Ami reduced brain activation in 2.3% of total voxels during stress (vs. 0.9% with music, p=0.01), notably in the anterior cingulate, hippocampus, posterior parietal and thalamus. CNS directed therapies are likely to be useful in IBS.

1878. Contrasting Activation of Brain Systems by Complex Designed Fragrances

Jianli Wang[1], Paul J. Eslinger[1], Rahman Ansari[2], Anne Richardson[2], John Behan[2], Michael B. Smith[1], Qing X. Yang[1]
[1]Pennsylvania State University, Hershey, Pennsylvania, USA; [2]Quest International Fragrances Co., Mount Olive, New Jersey, USA

The brain responses to fragrances designed as perfumes with high personal appeal were studied with seven young right-handed healthy subjects using olfactory fMRI on a 3T system. Activations with the two fragrances were located mainly in the same brain structures. The fragrance designed to invoke invigorating emotion was associated with stronger and wider activation in structures linked to olfaction, emotion, memory, imagery, attention and action-oriented processing. In contrast, the fragrance design to invoke relaxing attribute produced significantly milder activation.

1879. Functional MRI Study of Normal Aging Effects on Human Olfaction

Jianli Wang[1], Paul J. Eslinger[1], Michael B. Smith[1], Qing X. Yang[1]
[1]Pennsylvania State University, Hershey, Pennsylvania, USA

Aging effect on olfactory central nervous system was studied with fMRI on eleven young and eight aged right-handed normal subjects. In the aged group, the activation of main olfactory structures significantly reduced, especially in the right primary olfactory cortex and amygdala region. Correlations between the smell identification test score and fMRI activation map as well as age and fMRI activation map were presented.

1880. The BOLD Signal Amplitude is Larger for Aperiodic Stimuli than Periodic Stimuli for Fast Presentation Rates

Laura M. Parkes[1], Christian M. Kerskens[1], David G. Norris[1]
[1]F.C. Donders Centre for Cognitive Neuroscience, Nijmegen, Gelderland, Netherlands

This work shows that the amplitude of the BOLD response in the visual cortex is higher for aperiodic stimuli compared to periodic stimuli for frequencies above 8Hz. This suggests that the metabolic energy demand of the neurons during a jittered, aperiodic stimulus is higher. It has been shown [1] that periodic flashes of light shone into the eye can cause entrainment of cortical neurons with bursts of activity precisely locked to the driving frequency of the stimulus. Difference in neuronal entrainment between the periodic and aperiodic stimuli could account for the differences we see in the BOLD amplitude.

Clinical Applications of fMRI

Hall D Saturday 14:00 - 16:00

1881. A Functional MRI Study of Cortical Activations Associated with Object-Manipulation and Recognition in Patients with MS

Maria Assunta Rocca[1], Domenico Maria Mezzapesa[1], Andrea Falini[2], Bruno Colombo[1], Paolo Rossi[1], Giuseppe Scotti[2], Giancarlo Comi[1], Massimo Filippi[1]
[1]Scientific Institute and University H San Raffaele, Milan, Italy; [2]Scientific Institute and University Ospedale San Raffaele, Milan, Italy

The aim of this study was to verify the hypothesis that patients with MS, during the performance of a simple motor task, recruit brain regions that are usually activated in healthy subjects during the execution of more complex tasks. Compared to healthy volunteers, MS patients showed an increased activation of several regions, mainly located in the frontal and parietal lobes during the performance of the simple motor task. These regions were activated in healthy volunteers during the execution of the complex task, thus providing additional evidence in favour of our initial hypothesis.

1882. Identifying Hemodynamic Timing Differences in the Motor System of Stroke Patients and Normal Volunteers using Event-Related fMRI

Jennifer Newton[1], Alan Sunderland[1], Steven Butterworth[1], Andrew Peters[1], Kyung Kun Peck[1], Penny Gowland[1]
[1]University of Nottingham, Nottingham, UK

The aim of this study was to locate significant activations in the primary motor area of each hemisphere and assess variations in timing of the hemodynamic response in stroke patients and healthy controls. A voxelwise procedure was used to optimise the temporal parameters determining the model of the motor-evoked hemodynamic response. Fitted responses peaked earlier in the contralateral primary motor area than in the ipsilateral region in control subjects. The same pattern was seen in patients when moving the unaffected arm, but the relative timing was reversed in some patients during movement of the affected arm.

1883. Does Presurgical BOLD fMRI make the Neurosurgeons Too Bold?

Asta K. Haberg[1], Kjell Arne Kvistad[2], Geirmund Unsgard[2], Olav Haraldseth[1]
[1]Norwegian University of Science and Technology (NTNU), Trondheim, Norway; [2]St. Olavs Hospital, Trondheim, Norway

Preoperative BOLD fMRI can be used to delineate the topographic relationship between an intracerebral tumor and functional cortex. The clinical feasibility of BOLD fMRI mapping of functional cortex was investigated in 27 consecutive cases of intrahemispheric gliomas prior to neurosurgery. Identification of the functional cortex was successful in 84% of the cases, and the neurosurgeon used the information actively in 76% of these cases. The major cause of unsuccessful BOLD signal acquisition was EPI defects due to previous craniotomies, followed by motion artifacts. The postoperative outcome was not significantly different between the groups where fMRI data were used and not.

1884. Decompressive Craniectomy after Massive Ischemic Stroke: An Assessment of Recovery using Functional MRI

Jianli Wang[1], Qing X. Yang[1], Timothy J. Mosher[1], Arnold Cheung[1], Christopher Telaghani[1], Raymond K. Reichwein[1], Kevin M. Cockroft[1], Michael B. Smith[1]
[1]Penn State University College of Medicine, Hershey, Pennsylvania, USA

Functional MRI was used to evaluate extent and location of focal recovery in three patients undergoing decompressive craniectomy for hemispheric infarct. Peri-infarct activation was seen, but no activation appeared within the area of infarction as defined by the initial DWI lesion. It suggests that the infarcted hemisphere may provide some functional recovery, however, since no activation was noted within the initial infarct, image guided resection may be a viable alternative to decompressive craniectomy.

1885. An fMRI Study of Functional Reorganization of the Cerebral Cortex after Resection of Gliomas of the Central Region.

Massimo Caulo[1], Antonio Ferretti[1], Cosimo Del Gratta[1], Cesare Colosimo[1], Armando Tartaro[1], Lorenzo Bonomo[1], Gian Luca Romani[2]
[1]University of Chieti, Chieti, Italy; [2]National Institute for the Physics of Matter, L'Aquila, Italy

Acute and late functional reorganization of the cerebral cortex after resection of rolandic tumors has been documented by intraoperative direct electrical cortical stimulation. This study aims to demonstrate, using fMRI, the functional redistribution of the cerebral cortex after the resection of gliomas of the central region.

1886. Brain Activity Associated with Upper Limb Motor Tasks in Young Children with Cerebral Palsy:- A Serial fMRI Feasability Study

Roslyn N. Boyd[1], Timothy Bach[2], Meg E. Morris[2], Ari Syngeniotis[3], David F. Abbott[3], H Kerr Graham[1], Graeme D. Jackson[3]
[1]Murdoch Children's Research Institute, Melbourne, Victoria, Australia; [2]La Trobe University, Melbourne, Victoria, Australia; [3]Brain Research Institute, Melbourne, Victoria, Australia

This study examines the short term reproducibility of brain activation associated with upper limb motor tasks using functional Magnetic Resonance Imaging in young children with cerebral palsy. We undertook three studies over a 12 week period in children with congenital hemiplegia aged 5 to 15 years as part of a training study. Good reproducibility was demonstrated for a finger tapping and a wrist extension task in the unaffected arm over 3 weeks and 12 weeks. Serial fMRI is practicable and reproducible in children as young as five years. This provides baseline data for long term and intervention studies.

1887. A Structural and Functional MRI Study of Patients with Secondary Progressive Multiple Sclerosis.

Cinzia Gavazzi[1], Maria Assunta Rocca[1], Domenico Maria Mezzapesa[1], Andrea Falini[2], Bruno Colombo[1], Giancarlo Comi[1], Giuseppe Scotti[2], Massimo Filippi[1]
[1]Scientific Institute and University H San Raffaele, Milan, Italy; [2]Scientific Institute and University Ospedale San Raffaele, Milan, Italy

In this study, we used fMRI to assess the extent of movement-associated cortical activations in patients with secondary progressive multiple sclerosis (SPMS) and correlated them with the extent of subcortical structural pathology. When compared to controls, SPMS patients showed an increased activation of several regions of a widespread sensorimotor network during the performance of different simple motor tasks. The correlation found between the activity of these regions and diffusion tensor MR imaging metrics of tissue damage suggests an adaptive role of these changes in limiting the clinical consequences of MS pathology.

1888. The Role of Spinal Cord Damage on Brain Plasticity: A Structural and Functional MRI Study of Patients with a Single Episode of Remitting Myelitis of Possible Demyelinating Origin

Maria Assunta Rocca[1], Domenico Maria Mezzapesa[1], Andrea Falini[2], Angelo Ghezzi[3], Vittorio Martinelli[1], Giuseppe Scotti[2], Giancarlo Comi[1], Massimo Filippi[1]
[1]Scientific Institute and University H San Raffaele, Milan, Italy; [2]Scientific Institute and University Ospedale San Raffaele, Milan, Italy; [3]Ospedale di Gallarate, Gallarate, Italy

Using fMRI, we compared the movement-associated brain pattern of cortical activations between patients with a previous remitting episode of myelitis of possible demyelinating origin and healthy volunteers and evaluated the correlations between the extent of brain activations and the extent of cervical cord damage. Compared to controls, patients with myelitis showed larger activation of several sensorimotor areas located in the ipsilateral hemisphere. The activity of these regions was strongly correlated with the extent of cervical cord injury. This suggests that cervical cord damage can elicit adaptive cortical changes that could limit the clinical consequences of cord pathology.

1889. A Functional MRI Study to Assess the Influence of Pyramidal Tract Damage and Clinical Impairment on Cortical Activation in MS Patients

Antonio Gallo[1], Maria Assunta Rocca[1], Andrea Falini[2], Vittorio Martinelli[1], Bruno Colombo[1], Gioacchino Tedeschi[3], Angelo Ghezzi[4], Giancarlo Comi[1], Massimo Filippi[1]
[1]Scientific Institute and University H San Raffaele, Milan, Italy; [2]Scientific Institute and University Ospedale San Raffaele, Milan, Italy; [3]II University of Naples, Naples, Italy; [4]Ospedale di Gallarate, Gallarate, Italy

Cortical functional changes have been demonstrated in patients with MS. The aim of this study was to assess, using fMRI in 76 MS patients, whether the patterns of cortical brain activation, during a simple motor task with the dominant hand, are related to the presence of lesions located along the pyramidal tracts and the clinical impairment. Our data suggest that the presence of lesions mainly influence the activation of the ipsi-lateral SMC, while clinical impairment seems to modulate both ipsi- and contra-lateral SMC. Finally, specific patterns of cortical reorganisation related either to injury or to clinical impairment were not identified.

1890. Hippocampal BOLD Response during Eye Movements in Schizophrenia at 1.5T

Jody Tanabe[1], Jason Tregellas[1], David Miller[1], Randal Ross[1], Ann Olincy[1], Robert Freedman[1]
[1]University of Colorado, Denver, Colorado, USA

Synopsis: Smooth pursuit eye movement is abnormal in schizophrenics and their first degree relatives, suggesting that this deficit may be a vulnerability marker for the disease. Reduced hippocampal inhibition has been implicated in the pathology of schizophrenia. This study found greater brain activation in the posterior hippocampi of schizophrenics compared to controls. The results are consistent with a hypothesis of hippocampal disinhibition as a significant pathophysiological abnormality in schizophrenia.

fMRI of Cognitive and Visual Processes

Hall D Sunday 13:30 - 15:30

1891. Visual Mechanisms and Cortical Areas Detecting Features for Structuring Visual Images

Michela Tosetti[1], Andrea Perna[2], Domenico Montanaro[3], Laura Biagi[1], Maria Concetta Morrone[4]
[1]IRCCS Stella Maris, Pisa, Italy; [2]Scuola Normale Superiore, Pisa, Italy; [3]H S.Chiara, Pisa, Italy; [4]Universita' Vita-Salute S. Raffaele, Milano, Italy

We have studied visual neural responses that may be instrumental in scene segmentation. We measured the BOLD activity to stimuli that were perceptually very different, but had identical local energy profiles, differing only in phase; and also to those with quite different local energy profiles, but with matched average energy. The results show that primary visual cortex BOLD responses are independent of phase, but depend on the local energy profile. A higher associative area discriminates between the two sets of stimuli and may determine the perceptual appearance.

1892. Difference in Motor Planning for the Use of a Pen or a Finger - Functional Magnetic Resonance Imaging during Copying Gestures

Kayako Matsuo[1], Keiichiro Toma[2], Kenichi Oishi[3], Thuy Ha Duy Dinh[3], Chikako Kato[4], Gary H. Glover[5], Toshiharu Nakai[1]
[1]National Institute of Advanced Industrial Science and Technology, Ikeda, Osaka, Japan; [2]Institute of Biomedical Research and Innovation, Kobe, Hyogo, Japan; [3]Kyoto University, Kyoto, Japan; [4]Toyohashi Sozo College, Toyohashi, Aichi, Japan; [5]Stanford University, Stanford, California, USA

Brain activation between two types of copying gestures, one with using a pen and the other with an index finger, was compared using fMRI at 3.0 tesla. Two types of materials were prepared: Japanese ideographic characters (Kanji) and nonsense figures. While no substantial differences were found between pen and finger during the copying of Kanji, nonsense figures copied by a finger activated the bilateral parietal areas more intensively than those copied by using a pen. The results may indicate that the copying with a finger increases attention to somesthetic and proprioceptive information, specifically when the movements are novel.

1893. Motor Decisions at 1.5 T and 3.0 T: An Intraindividual Comparative fMRI Study

Klaus Hoenig[1], Jochen Textor[1], Jürgen Gieseke[2], Christiane Kuhl[1], Hans Harald Schild[1], Lukas Scheef[1]
[1]University of Bonn, Bonn, Nordrhein-Westfalen, Germany; [2]Philips Medical Systems, Hamburg, Germany

Motor decision tasks of varying cognitive complexity were intraindividually compared at 1.5T and 3.0T to examine whether functional MRI will benefit from the higher magnetic field strength not only quantitatively but also qualitatively. Whereas functional activation in primary motor, posterior parietal and superior frontal cortex was commonly found at both field strengths, it was only possible at 3.0T to additionally detect activation in the SMA and the left premotor cortex. Being able to detect higher cognitive subprocesses involved in premotor planning and response preparation provides strong impetus for the use of higher main magnetic fields (especially 3.0T) in fMRI.

1894. An fMRI Study of Neural Basis for Representational Momentum

HengYi Rao[1], ShuHui Han[2], Yi Jiang[2], YanPing Xue[3], Yong Cui[3], Hua Gu[3], LiHua Mao[2]
[1]Peking University and Chinese Academy of Sciences, Beijing, People's Republic of China; [2]Peking University, Beijing, People's Republic of China; [3]Beijing Chaoyang Hospital, Beijing, People's Republic of China

Neural basis of representational momentum (RM) was investigated by fMRI while ten subjects performed a standard rotation representational momentum task. The identical stimuli were presented in two orders that either or not implying a consistent rotation direction. RM task activated the left Lobulus parietallis inferior (LPi), the posterior Gyrus cinguli (GC), the left Gyrus frontalis inferior (GFi) and the right Gyri orbitales (GO). The results suggested a cortical network engaged in representational momentum.

1895. Are There Gender Specific Neural Substrates of Route Learning from Different Perspectives?

Richard James Blanch[1], David Brennan[1], Barrie Condon[1], Celestine Santosh[1], Donald Hadley[1]
[1]Institute of Neurological Sciences, Glasgow, Scotland, UK

There are demonstrated sex differences for performance in route learning. Route information can be represented in different perspectives – the survey perspective, used in maps, and the route perspective, used in everyday life. We used fMRI to examine sex differences for route learning from these two perspectives. We found no sex differences in areas of activation. Route learning from the route and survey perspectives activated many of the same brain areas such as the parahippocampus, precuneus, posterior cingulate gyrus and middle frontal gyrus. Paired comparisons showed lateral temporal activation in the survey perspective, not present in the route perspective.

1896. Selective Attention Load Interfered By Working Memory

Loukas G. Astrakas[1], Maria K. Zarifi[2], Martin H. Teicher[3], A Aria Tzika[1]
[1]Massachussets General Hospital, Boston, Massachusetts, USA; [2]Agia Sophia Children's Hospital, Athens, Attiki, Greece; [3]McLean Hospital, Harvard Medical School, Belmont, Massachusetts, USA

Since the auditory-attention component and the motor component during a simple auditory-motor paradigm have non-overlapping spectra in the frequency domain a frequency analysis method was used to separate auditory-attention from motor function. Statistical parametric maps (F-maps) corresponding to the attention and motor function were obtained. We suggested that, greater attention load produces significantly enhanced activation in a distributed network that serves attention interfered with by working memory.

fMRI of Cognitive Deficits

Hall D Monday 13:30 - 15:30

1897. Functional Cerebral Indicators of Relapse in First-Episode Schizophrenia Patients

F Schneider[1], D Braus[2], I Frommann[3], U Habel[1], N Kathmann[4], B Kaufmann[5], M Klein[1], E Meisenzahl[4], B Müller[6], M J. Müller[5], S Ruhrmann[7], R Schlösser[8], N J. Shah[9], A Schmitt[2], S Smesny[8], I Tendolkar[7], R Thienel[6], M Wagner[3], W Gaebel[1], H Sauer[8], F A. Henn[2]
[1]University of Duesseldorf, Duesseldorf, Germany; [2]Central Institute of Mental Health, Mannheim, Germany; [3]University of Bonn, Bonn, Germany; [4]University of Munich, Munich, Germany; [5]University of Mainz, Mainz, Germany; [6]University of Essen, Essen, Germany; [7]University of Cologne, Cologne, Germany; [8]University of Jena, Jena, Germany; [9]Research Center Juelich, Juelich, Germany

In an ongoing multi-center fMRI study, first-episode schizophrenia patients and healthy controls perform a modified version of the Continuous Performance Test and center specific paradigms addressing cognitive and emotional functions. Preliminary results indicate a dysfunctional neural network despite matched behavioral performance in patients and controls. Affected regions comprise parts of the frontal, parietal and cingular cortex and are more prominent with increasing task demands. Reassessments of patients show that psychopathological improvements are paralleled by reduced cerebral dysfunctions. Hence, dysfunctional activation patterns of first-episode schizophrenia patients may be used as regressors for predicting symptomatological changes during the illness course.

1898. Brain Activity Changes Pre and Post Concussion as Revealed by fMRI

Kelly Jantzen[1], Fred L. Steinberg[2], Scott Kelso[1]
[1]Florida Atlantic University, Boca Raton, Florida, USA; [2]University MRI, Boca Raton, Florida, USA

Functional MRI was used to assess the neurophysiological consequences of concussion in football players. BOLD activity was recorded while players performed a battery of tasks prior to the season, following concussion and at the end of the season. This novel prospective approach revealed within subject post-concussion increases in the amplitude of neural activity. Such increases suggest that following concussion greater resources were required to accomplish the same task. These effects were not observed when comparing across sessions of non-concussed players, thus stressing the importance of incorporating baseline measures for the detection and assessment of concussion using fMRI.

1899. Differential Brain Activation in Nonverbal Learning Disabled Teenagers: Words vs. Touch

Betty Tuller[1], K. J. Jantzen[1], F. Steinberg[2], J.A.S. Kelso[1]
[1]Florida Atlantic University, Boca Raton, Florida, USA; [2]University MRI and FAU, Boca Raton, Florida, USA

We examined the ability of nonverbal learning disabled (NLD) teenagers and age- and sex-matched controls to perform a sequence of finger to thumb oppositions bimanually, 1) with tactile instruction and 2) with verbal instruction (using a standard FMR block design). Results showed that only NLD subjects activated Broca's area with verbal, but not tactile, instruction. NLD subjects also showed increased activation in bilateral sensorimotor cortices, SMA, and superior parietal lobules when instruction was tactile rather than verbal. This pattern may reflect the increased difficulty NLD subjects have when verbal mediation is not an obvious strategy.

1900. Functional Neural Abnormalities during Sustained and Selective Attention: Possible Endophenotypes for Schizophrenia?

Francesca Mapua Filbey[1], Tamara Russell[1], Christopher Andrew[1], Robin G. Morris[1], Robin M. Murray[1]
[1]Institute of Psychiatry, London, UK

Aim: To determine whether the genetic risk for schizophrenia (SZ) is associated with the dysfunctional neuroanatomy that underlies attention impairment in individuals with SZ. Methods: Six patients (PT), six obligate carriers (OC) (i.e., phenotypically healthy relatives of patients who are members of kindreds multiply affected by SZ, and who appear to be transmitting liability) and six normal controls (NC) were selected based on their ability to perform the task of attention. All subjects (Ss) were Caucasian and right-handed. Ss performed a modified version of the Divided Attention Task (DIVA) (Necka, 1996) called the Dual Attention Task (DAT).

1901. Cognitive Effects of Nicotine in Humans: an fMRI Study

Veena Kumari[1], Jeffrey Gray[1], Dominic ffytche[1], Martina Mitterschiffthaler[1], Mrigen Das[1], Elizabeth Zachariah[1], Goparlen Vythelingum[1], Steve Williams[1], Andy Simmons[1], Tonmoy Sharma[2]
[1]Institute of Psychiatry, London, UK; [2]Clinical Neuroscience Research Centre, Dartford, Kent, UK

The cognitive effects of nicotine are well established. This study used fMRI and an ‘n-back’ working memory task to investigate the neural correlates of the effects of nicotine in healthy male non-smokers and found that nicotine enhanced activity in a number of brain regions, mainly the anterior cingulate, superior frontal gyrus, and parietal lobe (all within the working memory network), parahippocampal gyrus, cerebellum and medial occipital lobe. The effects on nicotine on working memory arise via its effects on on-line task monitoring and visual and spatial attention systems.

1902. Effects of Chronic XTC Use on Frontal Brain Function in Humans

Gerry Jager[1], Jeske Damoiseaux[1], Thelma Schilt[2], Maartje de Win[2], Wim van den Brink[2], Rene Kahn[1], Nick Ramsey[1]
[1]Rudolf Magnus Institute of Neuroscience, Utrecht, Netherlands; [2]University of Amsterdam, Amsterdam, Netherlands

Evidence is accumulating that ecstasy may have neurotoxic effects on serotonergic and dopaminergic systems in the brain. In this fMRI study we examine function of the working memory network in humans with a history of extensive use of ecstasy. In ecstasy users, activity in frontal regions was reduced, whereas performance was normal, suggesting reorganization of the network. Moreover, reduction of activity following practice of the task, an indirect measure of processing capacity, was less pronounced than in controls. These findings suggest that ecstasy may cause a change in organization and dynamics of the working memory network.

1903. Comparative fMRI Study of Braille Reading on Subjects of Congenital and Late Blinds

Xuesong Wang[1], Guangyao Wu[1], Li Wei[1], Junmo Sun[2], Liyun Li[1], Maili Liu[1], Chaohui Ye[1]
[1]Chinese Academy of Sciences, Wuhan, Hubei, People's Republic of China; [2]Zhongnan Hospital, Wuhan University, Wuhan, Hubei, People's Republic of China

Functional magnetic resonance was used to study the activation of occipital lobes during Chinese Braille reading on the congenital and late blinds and sighted subjects. The BOLD enhancements were observed in the occipital visual cortex on the blind, but not on the normal subjects. The BOLD signal intensities were significantly higher on the congenital blind than that on the late blind. The results revealed that occipital lobes are participated in the processing of tactile discrimination of Braille. In addition, these findings suggested that the visual experience may suppress this function.

fMRI of Language and Cognition

Hall D Tuesday 13:30 - 15:30

1904. Comparison of fMRI and MEG Language Localization Tasks

Sylvester Chuang[1], Elizabeth W. Pang[1], William J. Logan[1], Hiroshi Otsubo[1], Ayako Ochi[1], Nathanial Chuang[2], Stephanie Holowka[1], Amrita Hunjan[1], Rohit Sharma[1], O. Carter Snead,III[1]
[1]The Hospital for Sick Children, Toronto, Ontario, Canada; [2]Scrips Clinic, La Jolla, California, USA

In the paediatric epilepsy population where anomalous cortical organization is more common, presurgical planning involving the localization of cortical language areas is critical. We compared language localization using functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG) in 6 children as part of their presurgical work-up. Three of 6 cases showed discordant results between fMRI and MEG; all 3 of these had temporal lobe disease. These findings suggest that temporal lobe disease may cause some shifting of language function into the non-dominant hemisphere, and fMRI and MEG are tapping different aspects of the language function.

1905. Influence of Stimulus Pacing on Language Lateralization and Localization with fMRI using a Semantic Decision Task: Preliminary Results

Ann Tieleman[1], Karel Deblaere[1], Pieter Vandemaele[1], Eric Achten[1]
[1]Ghent University Hospital, Ghent, Belgium

We examined the influence of stimulus pacing on the determination of global and regional hemispheric language lateralization and localization using a semantic decision task in healthy subjects. The same experiment was performed in a self-paced and a fixed-paced manner. Individual and group statistical results were analysed. Lateralization indices were calculated for the the cerebral regions as a whole, and 3 regions of interest. The self-paced experiment resulted in more consistent and reliable lateralization indices, and more consitent activation of the medial temporal lobe.

1906. Mapping The Functional Anatomy of Spelling Using fMRI

Morgan Willson[1], Alan Wilman[1], Angela Chamberland[1], Lauren Figueredo[1], Trudy Kwong[1], Connie Varnhagen[1]
[1]University of Alberta, Edmonton, Alberta, Canada

Previous functional imaging studies into the functional anatomy of spelling have not been entirely consistent with respect to orthographic, phonological and visual processes. Difficulty arises because these components may not be entirely independent. Experimental tasks designed to examine a particular element may include other components due to the overlap in cognitive operations involved in these processes. The goal of our study is to examine the brain regions involved in phonological, orthographic, and visual processes related to spelling using functional magnetic resonance imaging by employing three separate tasks to evaluate each component separately.

1907. Correlation between Sub-second Reaction Time and Event-related BOLD Response in a Language Task

Ho Ling Liu[1], Wan Ting Liao[2], Yung Liang Wan[1], Yau Yau Wai[1], Tieh Chi Chu[2]
[1]Chang Gung Memorial Hospital and Chang Gung University, Kweishan, Taoyuan, Taiwan; [2]National Tsing Hua University, Hsinchu, Taiwan

A lexical decision task with different word frequencies was employed to examine the correlation between the reaction time (RT) and the temporal parameters in event-related BOLD responses. RTs for high-, low-frequency and pseudo- characters were measured during fMRI (417±9 ms, 631±22 ms and 658±15 ms, respectively). For high-frequency characters, RTs were significantly shorter than that for low-frequency and pseudo- characters (p_0.0005). In the left inferior frontal areas, the FWHM of the fMRI responses was significantly correlated with RT (p_0.001), which corresponded to areas activated during the whole processing.

1908. Age-Related Differences in Brain Activity Patterns and the Relation with Performance during Word Processing

Danielle J. Tisserand[1], Anthony R. McIntosh[1], Freddy M. van der Veen[2], Jelle Jolles[2]
[1]Rotman Research Institute of Baycrest Centre, Toronto, Ontario, Canada; [2]Brain and Behaviour Institute, Maastricht, Netherlands

Aging is associated with a reduction in information processing capacity, possibly resulting from changes in brain function. The neural correlates of age-related cognitive changes, however, are still largely unknown. We measured brain activity patterns using fMRI in 12 young and 11 old adults during word processing. The main difference between the groups was that young participants had higher prefrontal activity during strategic word processing than old subjects. Furthermore, frontal activity was associated with faster responses in young adults and with slower responses in old adults, suggesting that the young participants used these frontal brain regions more efficiently.

1909. A Meta-Analysis of fMRI Studies of Verbal Fluency: Segregation of Activation within Inferior Frontal Gyrus in Healthy Individuals

Sergi Costafreda[1], Cynthia H. Y. Fu[2], Lucy Lee[3], Brian Everitt[2], Michael J. Brammer[2], Anthony S. David[2]
[1]Hospital de Terrassa, Barcelona, Catalonia, Spain; [2]Institute of Psychiatry, King's College, London, UK; [3]Wellcome Department of Imaging Neuroscience, London, UK

There has been increasing interest in developing methods for meta-analyses of neuroimaging data. We used Bootstrap analysis to examine whether published functional neuroimaging studies using different versions of a verbal fluency task produced consistent activations within the region of the left inferior frontal gyrus (LIFG). A systematic literature search (1990-2002) was performed. This yielded 14 fMRI papers (total n=127 subjects) of healthy individuals with a phonological letter fluency task or a semantic category fluency task, reporting 20 peak activations in LIFG. Our results suggest that semantic fluency may show a more inferior activation in the z-axis relative to phonological fluency.

1910. Functional MRI of Language Processing: Differences between Two Language Tasks

Graeme D. Jackson[1], Anthony B. Waites[1], Alexandra Stanislavsky[1], Ari Syngeniotis[1], Regula S. Briellmann[1], Michael M. Saling[1], David F. Abbott[1]
[1]Brain Research Institute, Heidelberg West, Victoria, Australia

fMRI activation using two different language paradigms (orthographic lexical retrieval: OLR, and noun verb generation: NVG) was compared in 30 healthy subjects. Analysis was performed with SPM99 (Wellcome Department of Cognitive Neurology, London) and iBrain® (Brain Research Institute, Melbourne). Activation in classical language areas, and an index of lateralized hemispheric activity (LI) did not differ significantly between the tasks. OLR, however, was associated with increased activation in the left angular gyrus. This may reflect the increased complexity of lexical search in the OLR task.

1911. Neurolinguistic Response to Semi-Syllabic Scripts in Tri-Linguals using Functional MRI

Uma Sreekumar[1], Senthil S. Kumaran[2], Subash Khushu[1], Rajendra P. Tripathi[1]
[1]Institute of Nuclear Medicine and Allied Sciences, Timarpur, Delhi, India; [2]David Geffen School of Medicine at UCLA, Los Angeles, California, USA

Functional MRI studies were carried out in six tri-lingual subjects in block paradigms for visual inputs (words vs 1 and sentences vs 1) using LED goggles in a 1.5T whole body MR system. The post-processing was carried out using SPM99. Activation was seen in the posterior, inferior frontal cortex, pareitotemporal cortex, angular and supramarginal gyrus, other than prefrontal and occipital lobes. Increasing levels of complexity in the language pattern (from spoken language to mother tongue to rarely used language) demonstrated increased activation in the Broca's area (BA 44/45), prefrontal cortex and cerebellum.

1912. Pre and Post fMRI of an Aphasia Therapy: Shifts in Hemodynamic Time to Peak during Overt Language Task

Kyung K. Peck[1], A. Bacon. Moore[1], B. Crosson[1], C. Milsted[2], M. Gaiefsky[1], K. Gopinath[1], D. Soltysik[1], R. W. Briggs[1]
[1]University of Florida, Gainesville, Florida, USA; [2]College of Medicine, Gainesville, Florida, USA

An event-related word generation task was performed by aphasic patients studied by fMRI before and after rehabilitative intervention targeting language production. Temporal synchrony of ROIs including SMA, Broca's area, and motor cortex was investigated using time to peak analysis. Results showed that time to peak obtained after post-therapy becomes shorter, reflecting faster response in the region. This indicates that rehabilitation increased the speed of word finding processes and that the time to peak analysis may be sensitive to detect this functional change.

1913. Assessment of Language Function using Functional Magnetic Resonance Imaging in Patients with Brain Tumors: The Dominancy of Supplementary Motor Area May Not Reflect Hemispheric Language Dominancy

Hiroshi Karibe[1], Toshihiro Kumabe[1], Reizo Shirane[1], Takashi Yoshimoto[1]
[1]Tohoku University Graduate School of Medicine, Sendai, Miyagi, Japan

Preservation of brain function is important for surgical treatment of brain tumors locating near eloquent areas. Preoperative topographic mapping of brain function is required to achieve it. Supplementary motor area (SMA), which locates in superior frontal gyrus, constitutes a complex functional system for initiation and control of speech expression. It has been proposed that failure of speech promotion is usually resulting from injury of SMA in dominant but not non-dominant hemisphere. However, SMA injury in non-dominant hemisphere may also cause a failure of speech promotion in some cases. These results suggest that the dominancy of SMA may not

1914. Comparison of Cerebral Regions in Encoding and Retrieval of Native Language under the Conceptual and Perceptual Processing: fMRI

Heoung Keun Kang[1], Hyung Joong Kim[1], Gwang Woo Jeong[1], Jeong Jin Seo[1], Sung Jong Eun[1], Yong Yeon Jeong[1], Tae Woong Chung[1], Tae Jin Park[2]
[1]Chonnam National University Medical School, GwangJu, Republic of Korea; [2]Chonnam National University, GwangJu, Republic of Korea

In this study, the cerebral centers for encoding and retrieval tasks of Korean words under the conceptual and perceptual processing were evaluated by using fMRI. Our findings confirm that the encoding and retrieval tasks are dissociated by different mechanism based on neuro-anatomy, and the quantitative results depend on the levels with conceptual and perceptual processing of the words. Also, lateralization indices of cerebral hemisphere depend on the tasks as well.

1915. **Reduction in Cortical Activation Associated with Decreased Visibility of a Visual Target**

Jie Huang[1], Ming Xiang[1], Yue Cao[1]
[1]Michigan State University, East Lansing, Michigan, USA

A stimulus immediately preceding or following a target stimulus can affect the perception of the target, known as a visual masking effect. A visual masking protocol suitable for an fMRI study was developed and cortical activation during visual masking was investigated by fMRI. It was found that visual cortical activity was associated with the observed psychophysical visual masking effect.

1916. **Numerical magnitude assessment in dyscalculic and control individuals: an event-related PRESTO fMRI study**

Istvan Akos Morocz[1], David Manor[2], Avi Karni[3], Zvia Breznitz[3], Peter van Gelderen[4], Michael von Aster[5], Tammar Kushnir[2], Yacov Itzchak[2], Varda Gross-Tsur[6], Ruth Shalev[6]
[1]Weizmann Institute of Science, Rehovot, Israel; [2]Sheba Medical Center, Israel; [3]University of Haifa, Haifa, Israel; [4]National Institutes of Health, Bethesda, Maryland, USA; [5]University Hospital of Zurich, Zurich, Switzerland; [6]Shaare Zedek Medical Center, Jerusalem, Israel

We report the results of an fMRI study using the PRESTO sequence in an event-related design to study the differences in brain activation between dyscalculic and normal subjects. Our results show that the left parietal lobe (intraparietal sulcus) is not activated in subjects with developmental dyscalculia (DC) and suggest that dyscalculics may be deficient in looking up language-coded multiplication tables.

1917. **Cerebrocortical Regions Associated with Implicit and Explicit Memory Retrieval Under the Conceptual Processing: fMRI**

Heoung Keun Kang[1], Gwang Woo Jeong[1], Hyung Joong Kim[1], Sung Jong Eun[1], Jeong Jin Seo[1], Yong Yeon Jeong[1], Tae Woong Chung[1], Tae Jin Park[2]
[1]Chonnam National University Medical School, GwangJu, Republic of Korea; [2]Chonnam National University, GwangJu, Republic of Korea

The brain centers associated with implicit and explicit memory retrievals under the conceptual processing were assessed by fMRI. Compared with implicit retrieval, explicit tasks provided greater activities over the brain regions by 12.7%. The most distinct brain activity in explicit retrieval was shown in the temporal and parietal lobes, giving 82.8% and 50.2% higher activities, respectively. On the contrary, the frontal lobe gave greater activities by 22.8% during the implicit retrieval.

1918. **Money Activates Reward Circuits in Cocaine Addiction: A Functional MRI Study at 4 T**

Rita Z. Goldstein[1], Steve A. Berry[2], Andreana C. Leskovjan[1], Elizabeth C. Caparelli[1], Dardo Tomasi[1], Linda Chang[1], Frank Telang[1], Nora D. Volkow[1], Nancy K. Squires[2], Thomas Ernst[1]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]SUNY at Stony Brook, Stony Brook, New York, USA

In this fMRI study we examined modulation of the brain circuits underlying salience attribution by drug addiction. Subjects were 5 cocaine addicts and 7 healthy volunteers scanned while performing a Go/No-Go task under three levels of feedback for correct performance: no money (0 cent), low money (1 cent) and high money (45 cents). While there were no significant differences in brain activity between the high and low monetary conditions for either study group, the corticolimbic reward circuit (including the cingulate gyrus and basal ganglia) was activated by money in the cocaine group only, consistent with increased subjective value of money.

fMRI: Emotion, Age, Disease

Hall D Saturday 14:00 - 16:00

1919. **Cortical and Subcortical Activations during Affective Facial Processing Predict Treatment Response in Unipolar Depression**

Cynthia H.Y. Fu[1], Jieun Kim[1], Mick J. Brammer[1], Steve C.R. Williams[1], Anthony J. Cleare[1], Emilio M. Pich[2], Nicholas D. Walsh[1], Chris M. Andrew[1], John Suckling[3], Martina Mitterschiffthaler[1], Ed T. Bullmore[3]
[1]Institute of Psychiatry, London, UK; [2]GlaxoSmithKline SpA, Verona, Italy; [3]University of Cambridge, Cambridge, UK

Discerning regions which are predictive of subsequent treatment response has a particular clinical significance in depression as the effectiveness of antidepressant therapy is not evident for several weeks. Increased resting metabolism in the anterior cingulate cortex (ACC) has been noted in depressed patients who subsequently respond to treatment. We sought to investigate neural predictors of treatment response with fMRI scans during an implicit affective facial recognition task. As expected, we had found that treatment responders showed increased ACC activity at baseline. We sought to examine additional cortical and subcortical regions which were predictive of treatment response.

1920. fMRI Study of Truth & Deception using Classical Control Question Technique.

Feroze B. Mohamed[1], Nathan J. Gordon[2], Alexander B. Pinus[3], Harris Ahmed[1], Mike Williams[1], Joseph I. Tracy[4], Scott H. Faro[1]
[1]Drexel University, Philadelphia, Pennsylvania, USA; [2]Academy of Scientific Investigative Training, Philadelphia, Pennsylvania, USA; [3]Yale University, New Haven, Connecticut, USA; [4]Thomas Jefferson University, Philadelphia, Pennsylvania, USA

The purpose of this study was to investigate the regions of brain activation during truth-telling or deception by functional MRI using blood oxygenation level dependent (BOLD) contrast while simultaneously recording the physiological signals using a standard polygraph machine and Control Question Technique (CQT) inside the MRI scanner.

1921. Activation of Limbic System by Visually Evoked Sexual Arousal in Human Brain: 3Tesla fMRI

Sung Jong Eun[1], Gwang Woo Jeong[1], Hyung Joong Kim[1], Jin Myoung Lee[2], Heoung Keun Kang[1]
[1]Chonnam National University Medical School, GwangJu, Republic of Korea; [2]Chonnam National University Hospital, Kwang Ju, Republic of Korea

In this study, we compared brain centers in the limbic system associated with visual sexual arousal between male and female by using a high field 3 Tesla functional MRI. The dominant brain areas in male over female are shown in the pCIN, HTH, THAL, CIN, MID, aCIN, AMY and HIP by 13.7%, 12.5%, 8.6%, 1.3%, 1.8%, 1.9%, 2.2% and 2.3%, while the following areas are dominant in female over male: SEP, PHIP and INS by 5.9%, 0.9% and 2.3%.

1922. Emotion Discrimination Training Alters Functional Frontal Correlates in Schizophrenia Patients: An fMRI Treatment Study

Frank Schneider[1], Ute Habel[1], Nadim Jon Shah[2], N Fromann[1], Katrin Koch[1], Martina Klein[1], Thilo Kellermann[1], J Brinkmeyer[1], M Streit[1], Tony Stöcker[1], K Zilles[2], W Wölwer[1]
[1]Heinrich-Heine-Universität, Düsseldorf, Germany; [2]Forschungszentrum Jülich, Jülich, Germany

Facing the emotional impairments of schizophrenia patients, cerebral correlates of facial affect recognition were compared in this ongoing study before and following a standardized emotion discrimination training in schizophrenia patients. Therapeutic effects were demonstrated in emotion behavior and specifically in neurobehavioral correlates: The frontal hypoactivation found during emotion discrimination was reduced following training and the brain activation approached that of controls. A control group of patients without behavior therapy similarly failed to display comparable changes. Hence, fMRI is applicable in demonstrating the efficacy of behavioral intervention programs in neurofunctional correlates of emotional functions.

1923. Differences in the BOLD Response in Visual Cortex of Men and Women

Thomas Loenneker[1], Ernst Martin[1], Andrea Straessle[1], Franck Girard[2], Valentine Leslie Marcar[3]
[1]University Children's Hospital, Zurich, Switzerland; [2]GE Medical Systems Europe, Buc, France; [3]University of Zurich, Zurich, Switzerland

A number of functional MR studies have reported considerable differences in the way men and women process tasks presented to them. Reading is more strongly left lateralized in men than in women while spatial tasks are more strongly right lateralized in men than women. Language comprehension is left lateralized in both sexes. A recent study has shown that the fMRI response of women varied forty fold within their menstrual cycle. Differences in the fMRI response to a visual stimulation has also been reported. We augmented functional MR data from a previous study and analyzed them for differences in gender.

1924. Developmental Aspects of the BOLD Response in Visual Cortex of Infants and Children

Thomas Loenneker[1], Valentine Leslie Marcar[2], Andrea Straessle[1], Uwe Schwarz[1], Ernst Martin[1]
[1]University Children's Hospital, Zurich, Switzerland; [2]University of Zurich, Zurich, Switzerland

The human visual system is composed of a number different functionally distinct cortical area that interact in a complex manner to generate our perception of the environment. Work involving animals has led the way in unraveling the make-up of the primate visual system and revealed that normal development of the visual system is based on an interactive process. Behavioral studies in children have revealed different stages in the functional development of vision. We performed fMRI on 21 children and compared the BOLD response in visual cortex of children aged younger than 48 months against children older than 48 months.

1925. Age-Dependent Decreases in Brain Activation During Visual Attention

Linda Chang[1], Sheeba Arnold[1], Elisabeth C. Caparelli[2], Dardo Tomasi[1], Thomas Ernst[1]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]Brookhaven National Laboratory, Upton, New York, USA

This study evaluated whether age-related BOLD signal changes occur with tasks that require visual attention. 20 healthy subjects were studied in a 4 Tesla scanner while performing a set of visual attention tasks with 3-levels of difficulty. Age-dependent decreases in BOLD signal were observed primarily in right lateral frontal region, posterior parietal cortex and in cingulate gyrus. Men and older subjects have less activation than women or younger subjects in the parietal cortex. Decreased activation may be due to age-related gray matter loss and larger sulci in the parietal cortex of older subjects, especially in men.

1926. Age-Related Differences in Human Cerebral Vasoreactivity Assessed by Functional MRI

Vahan E. Sharoyan[1], Sridhar S. Kannurpatti[1], Bharat B. Biswal[1]
[1]UMDNJ-NJ Medical School, Newark, New Jersey, USA

Recently, a number of studies using functional MRI have shown substantial differences in activation patterns of older (>50 years of age) and younger (21-40 years of age) subjects. The altered hemodynamic response, which would affect the BOLD signal, may be among the factors contributing to the age-related changes in cognitive function. In this study, we examined the characteristics of the cerebrovascular reactivity changes with age using a breath-hold stimulus.

1927. Multi-modal Brain Surgery Planning

Arthur Peter Wunderlich[1], Veit Braun[2], Alexandra Albrecht[2], Hans-Jürgen Brambs[3]
[1]University Clinic Ulm, Ulm, Baden-Württemberg, Germany; [2]Neurosurgery, Günzburg, Bayern, Germany; [3]Diagnostic Radiology, Ulm, Baden-Württemberg, Germany

In order to resect brain tumors without affecting function, we investigated 20 brain tumor patients with high-resolution MRI, fMRI and DTI. Beside motor areas, we detected areas of language and working memory with fMRI. Furthermore, DTI gave information about nerve fibre bundles. This information was overlaid on the anatomical images. For procedure planning, information was available about the distance of the tumor to tissue of interest, either performing critical functions (motor, speech) or bearing nerve bundles (corpus callosum, pyramidal tract). With this improved planning, surgery is easier than without fMRI and DTI. Patients recover faster and show less deficits.

1928. Neural Correlates of Tactile Prepulse Inhibition: A Functional MRI Study in Normal and Schizophrenic Subjects

Veena Kumari[1], Jeffrey Gray[1], Mark Geyer[2], Dominic ffytche[1], William Soni[1], Martina Mitterschiffthaler[1], Goparlen Vythelingum[1], Andy Simmons[1], Steve Williams[1], Tonmoy Sharma[3]
[1]Institute of Psychiatry, London, UK; [2]University of California, California, USA; [3]Clinical Neuroscience Research Centre, Dartford, Kent, UK

Prepulse inhibition (PPI) of the startle reflex refers to the ability of a weak prestimulus to inhibit the response to a closely following strong sensory stimulus, the pulse. This study applied a whole-brain fMRI approach to elucidate the roles of both cortical and sub-cortical structures in PPI. The findings demonstrated involvement of the striatum, hippocampus, thalamus, and frontal and parietal cortical regions in PPI in healthy subjects but not in patients. Dysfunctions in any of these regions may underlie observations of reduced PPI in schizophrenia.

1929. 3T Functional MRI Study by Acupuncture Stimulation

Sinsoo Jeun[1], Seungschik Yoo[2], Seikown Kang[3], Gisoon Choi[4], Sangdong Park[4], Eunchul Lim[4], Sungtaek Chung[5], Hyoungkoo Lee[1], Taesuk Suh[1], Boyoung Choe[1]
[1]Catholic University of Korea, Seoul, Republic of Korea; [2]Brigham and Womens Hospital, Boston, Massachusetts, USA; [3]Yonsei University, Seoul, Republic of Korea; [4]Dong-Seo Hospital of Oriental Medicine, Seoul, Republic of Korea; [5]Medinus Co., Yongin, Kyunggi-do, Republic of Korea

To investigate whether or not acupuncture of GB34 produces a significant response of the modulation of somatomotor areas by fMRI.Using 3T MRI scanner,fMRI of the whole brain was performed in 12 normal healthy subjects during two stimulation paradigms; acupuncture manipulation on GB34 and sham points.Group analysis from seven individuals showed that bilateral sensorimotor areas showed stimulation related BOLD signal contrast of approximately 6% whereas very few areas were activated when sham stimulation is given.The study shows that acupuncture stimulation in GB34 modulates the cortical activities of the somatomotor area in human.

1930. Integration of Functional MRI into a Commercial Image-Guided Surgical System

James Stefansic[1], Victoria Morgan[1], Karl Sillay[1], Mark Gorelik[1], Gilbert Humbert[1], Reid Thompson[1]
[1]Vanderbilt University, Nashville, Tennessee, USA

Functional MRI (fMRI) is emerging as an adjunct method to direct cortical stimulation for localization of eloquent cortical regions. Currently, a procedure for using fMRI information for surgical guidance efficiently and accurately has not been developed. We demonstrate a technique to integrate the functional MRI activation maps of a patient into a commercial image-guided surgical system. This development will allow for improved localization of presurgically defined functional regions during surgery, as well as more direct comparisons between fMRI and intraoperative mapping.

1931. Treatment Effect of Levodopa in Amblyopia Evaluated by Functional MRI

Ju Chuan Huang[1], Chao I. Yang[2], Meng Ling Yang[2], Yung Liang Wan[2], Jui Fang Tsai[2], Yau Yau Wai[1], Ho Ling Liu[1]
[1]Chang Gung Memorial Hospital and Chang Gung University, Kweishan, Taoyuan, Taiwan; [2]Chang Gung Memorial Hospital, Kweishan, Taoyuan, Taiwan

Functional MRI (fMRI) was applied to amblyopes with monocular amblyopia before and after levodopa treatment. FMR images were acquired in two runs with visual stimulation delivered through the sound and the amblyopic eyes, respectively. The experiment was performed before and after subject's oral administration of levodopa/carbidopa (0.5/0.12mg/kg). Our study demonstrated that the volume ratio between the amblyopic and sound eye stimulation significantly increased after the treatment. This finding supports the previous studies of levodopa effect on amblyopia at the visual cortical level, and suggests that fMRI can be a useful tool in assessing changes of visual cortical activity after levodopa.

Animal Models of Brain Perfusion, Stroke, and other Brain Diseases

Hall D Monday 13:30 - 15:30

1932. Monitoring Angiogenesis in Normal Brain using Steady-State Quantification of ΔR_2 (SSTAR2) with Mion Infusion

Marcie A. Roche[1], Jeff F. Dunn[1], Malek Makki[1], Michelle Abajian[1], Charles P. Daghlian[1], Roger Springett[1], Jennifer Merlis[1], Shi Y. Lu[2]
[1]Dartmouth Medical School, Hanover, New Hampshire, USA; [2]V.A. Hospital, White River Junction, Vermont, USA

We have developed an MR imaging method (Steady-STAte quantification of ΔR2 in tissue and blood with infusion of the stable contrast agent MION—$SSTAR_2$) in order to measure cerebral blood volume as a marker of angiogenesis. Angiogenesis is an important variable in conditions such as tumor growth and treatment, cardiac and cerebral ischemia, and chronic hypoxia. In this study, we apply our imaging method to a “natural” model of cerebral angiogenesis-- that of chronic hypoxia exposure--to demonstrate that we can detect increases in cerebral blood volume over time in individual animals.

1933. Characterisation of Vascular Territories using ASL Measurements of Arterial Transit Time

Mark Francis Lythgoe[1], David L. Thomas[1], Louise van der Weerd[1], Rebeccah Slater[1], David G. Gadian[1]
[1]University College London, London, UK

Reproducibility is a prerequisite of any animal model in the investigation of drug efficacy. During the past 20 years many studies have suggested improvements to the commonly used middle cerebral artery occlusion rat model. Inter-animal variability is, in part, due to the variation in vascular supply. In this study we demonstrate the use of arterial transit times measured with ASL to distinguish vascular territories in the control and occluded rat brain. Thus, this technique may provide a method to group animals of similar vascular distributions together and thereby increase reproducibly in drug trials.

1934. Endothelin-1-Mediated Decrease in Cerebral Blood Volume Induces Changes in Apparent Diffusion Coefficient, T_1 and Magnetisation Transfer Ratio of Tissue Water in Rat Brain

Nicola Sibson[1], John Lowe[1], Peter Styles[1], Andrew Blamire[1], Daniel Anthony[2]
[1]University of Oxford, Oxford, UK; [2]University of Southampton, Southampton, UK

Recent findings suggest that the vasoconstrictor endothelin-1 may contribute to the broad spectrum of neuropathologies associated with expression of the pro-inflammatory cytokine TNF-α. MRI was used to investigate the effects of endothelin-1 on the ADC, T_1, T_2 and MTR of tissue water and BBB integrity. Following intracerebral endothelin-1 injection, a marked reduction in CBV was accompanied by a rapid decrease in ADC, a rapid increase in T_1, and a gradual decrease in MTR. This model of endothelin-1-induced cytotoxic oedema enables investigation of the relationship between CBV, CBF and tissue viability, in the absence of BBB breakdown and leukocyte recruitment.

1935. Quantitative Perfusion Mapping in Mice using FAIR and CASL

Louise van der Weerd[1], David L. Thomas[2], Romina Aron Badin[1], Mark Lythgoe[1], David S. Latchman[1], Roger J. Ordidge[2], David G. Gadian[1]
[1]Institute of Child Health, London, UK; [2]University College London, London, UK

We present the first quantitative cerebral perfusion data obtained for mice using FAIR and CASL. Measurements of the ASL signal using both techniques were made over a range of delay times to allow estimation of both CBF and arterial transit times by fitting the data to the appropriate theoretical models. Calculated CBF values are similar for CASL and FAIR (~135 ml/100g/min), and correspond well with autoradiography data from literature. However, the arterial transit times are significantly longer in CASL than expected, which has implications for CBF quantification at single delay times.

1936. Can Diffusion/Perfusion Mismatch be Protected after Reperfusion in Experimental Focal Ischemia?

Yuki Mori[1], Toshihiko Ebisu[1], Kiyotaka Katsuta[2], Akihiko Fujikawa[2], Ichio Aoki[1], Masaki Fukunaga[1], Masahiro Umeda[1], Shoji Naruse[3], Chuzo Tanaka[1]
[1]Meiji University of Oriental Medicine, Hiyoshi-cho, Kyoto, Japan; [2]Fujisawa Pharmaceutical Co., Ltd., Osaka, Japan; [3]Kyoto Prefectural University of Medicine, Kyoto, Japan

The goal of this study was to determine the pathological outcome of DWI/PWI match and mismatch areas after reperfusion in experimantal focal ischemia prospectively. Six male Wistar rats were subjected to transient MCA occlusion. Initial DWI, PWI, and T2WI were obtained at 0.5 h after MCA occlusion. Recirculation was performed at 1 h after occlusion. Our findings suggest DWI/PWI mismatch with mild to moderate reduction of rCBF may be an indicator of ischemic penumbra, which is potentially salvageable ischemic brain tissue.

1937. Magnetic Resonance Imaging of Hypoxic-ischemic Changes in Cerebral White Matter of Neonatal Brain: Comparison With Gray Matter

Shuzhen Meng[1], Min Qiao[1], Boguslaw Tomanek[1], Mili Gupta[1], Ursula Tuor[1]
[1]Institute for Biodiagnostics (West), NRC, Calgary, Alberta, Canada

We investigated in neonatal rat brain the acute hypoxic-ischemic (HI) changes occuring in gray and white matter measured within MR images and their corresponding histological sections. HI produced a ADC decrease and T2 increase in both white and gray matter during HI. One hour after HI, ADC recovered but T2 increase remained in both white and gray matter. T2 increased further at 24 hrs post HI. Histological assessment (eg. axonal injury indicated by APP immunostaining) identified earlier damage in white matter than in gray matter. T2 imaging detects well acute hypoxic-ischemic changes in this model of rather severe neonatal encephalopathy.

1938. Neuroprotective Effects of Kadsurenone on Transient Focal Ischemia in Rat Brain Observed by *In Vivo* MRI/MRS

Xuesong Wang[1], Hao Lei[1], Chaohui Ye[1], Maili Liu[1]
[1]Chinese Academy of Sciences, Wuhan, Hubei, People's Republic of China

Diffusion weighted imaging (DWI), T2 weighted imaging, and localized 1H MRS were used to investigate the neuroprotective effects of Kadsurenone, which is a specific PAF receptor antagonist extracted from Chinese herb Caulis Piperis Futokadsurae, in a rat model of transient middle cerebral artery occlusion (MCAO). The results show that Kadsurenone can decrease cerebral lesion volume, as measured by DWI and T2 weighted imaging, after ischemia/reperfusion. Localized 1H MRS showed that Kadsurenone can decrease cerebral lactate concentration at 1 hr after reperfusion. The results suggest that Kadsurenone is neuroprotective in the rat model of transient focal ischemia.

1939. Oxygen-17 Uptake in Mouse Cerebral Ischemia

Robert DeLaPaz[1], Pradeep Gupte[2], Sander Connolly[1], Ed Wu[1], Truman Brown[1]
[1]Columbia University, New York, New York, USA; [2]Rockland Technimed, Ltd., Airmont, New York, USA

Molecular oxygen-17, bound to an intravascular perfluorocarbon (PFC) carrier molecule, was used to assess the oxidative metabolic rate in cerebral ischemic tissue. Because metabolism of the molecular oxygen-17 to oxygen-17 water results in T2 acceleration, signal reduction on T2W SE images was used as an indicator of relative tissue oxygen metabolism. Different rates of signal decline were seen in regions of cerebral ischemia in contrast to stable signal in normal brain.

1940. STAT-1 Activation Following Cerebral Ischaemia in the Rat

Daniel Alexander West[1], Lauren M. Valentim[1], Mark F. Lythgoe[1], A Stephanou[1], Edward Proctor[1], Louise Van Der Weerd[1], Roger J. Ordidge[1], David S. Latchman[1], David G. Gadian[1]
[1]University College London, London, UK

STAT-1 is one of a family of proteins called Signal Transducers and Activators of Transcription (STATs), and recent studies have shown its involvement in the induction of programmed cell death in cardiac myocytes. In this study we demonstrate that STAT-1 is also activated during focal cerebral ischaemia, with a pattern of activation reflecting tissue status as defined by MR diffusion and perfusion measurements. Activation was greatest in tissue subjected to severe ischaemia and reperfusion.

1941. BOLD Responses during Hemorrhagic Hypotension and Heart Arrest in Rat

Hao Lei[1], Run-Xia Tian[2], Xiao-Hong Zhu[2], Wei Chen[2]
[1]The Chinese Academy of Science, Wuhan, Hubei, People's Republic of China; [2]University of Minnesota, Minneapolis, Minnesota, USA

Localized proton MRS was used to observe blood oxygenation level dependent (BOLD) responses of cerebral water and metabolites to graded hemorrhagic hypotension and heart arrest in d rats. BOLD-related signal intensity of water decreased linearly as the mean arterial blood pressure (MABP) dropped between 45-80 mmHg (i.e., within autoregulation). The magnitude of such decrease was small. Larger BOLD responses were observed when MABP dropped beyond the autoregulation range. An unspecific B0 field shift was detected during systematic hypotension by hemorrhaging, probably caused by global changes in susceptibility inside the magnet bore.

1942. Characterization of a Novel Chronic Photothrombotic Ring Stroke Model in Rats by Magnetic Resonance Imaging, Biochemical Imaging and Histology

Thomas Hilger[1], James Allen Blunk[1], Mathias Hoehn[1], Per Wester[2]
[1]Max-Planck-Institute for Neurological Research, Cologne, Germany; [2]University of Umea, Umeå, Sweden

A novel photothrombotic ring stroke model in the rat was characterized by magnetic resonance imaging (MRI), biochemical imaging, and histology. The reproducible lesion comprised the primarily damaged ring ("ring-lesion"), which degenerated into necrosis at 14 days after lesion induction, and the ring-encircled interior "region-at-risk" showing spontaneous recovery after 3 days, as documented by reperfusion, ADC and T2 relaxation time normalization. Therefore, a considerable part of cells was salvaged in the region-at-risk, as reflected by partially maintained brain metabolism. Furthermore, this first noninvasive study on the ring stroke model demonstrates individual outcome prognosis by early MR tissue signature.

1943. $T_{1\rho}$ and Carr-Purcell T_2 Relaxation in a Rat Brain Model of Transient Ischaemia at 4.7T.

Martin Kavec[1], Mikko Kettunen[1], Olli Gröhn[2], Michael Garwood[3], Risto Kauppinen[3]
[1]University of Kuopio, Kuopio, Finland; [2]University of Minnesota, Minneapolis, Minnesota, USA; [3]University of Manchester, Manchester, UK

On-resonance T_1 in the rotating frame ($T_{1\rho}$) is a very sensitive MRI index of acute cerebral ischaemia. Here Carr-Purcell T_2 (CP-T_2) both with short and long τ_{CP} was measured in parallel with $T_{1\rho}$. In ischaemic rat brain $T_{1\rho}$ prolonged during evolution of irreversible ischaemia. In the same tissue, long-τ_{CP} CP-T_2 showed shortening by ~2 ms, whereas short-τ_{CP} CP-T_2 was unchanged. Thus, both $T_{1\rho}$ and short-τ_{CP} CP-T_2 are insensitive to negative BOLD effect. Interestingly, short-τ_{CP} CP-T_2 prolonged by 10 minutes postischaemia similar to $T_{1\rho}$ indicating that it may be an MRI marker for irreversible cerebral ischaemia.

1944. Is There an ADC Threshold for Depolarisation? An MCMC Analysis

M D. King[1], M J. Crowder[2], D J. Hand[2], N G. Harris[3], S R. Williams[4], T P. Obrenovitch[5], D G. Gadian[1]
[1]Institute of Child Health, London, UK; [2]Imperial College, London, UK; [3]University of Cambridge, Cambridge, UK; [4]University of Manchester, Manchester, UK; [5]University of Bradford, Bradford, UK

Markov chain Monte Carlo (MCMC) simulation was used in an analysis of the cerebral ADC and DC potential responses to focal ischæmia in the rat. A Bayesian non-linear random effects model was adopted, and the resulting posterior distribution used to explore the temporal relationship between the ADC and DC transitions with a focus on a possible ADC triggering of the DC response. The analysis failed to provide evidence for a well defined and consistent ADC trigger threshold across all animals.

1945. Melatonin Reduces Ischemia-Induced Edema in MCA Occlusion Rats

Takashi Kondoh[1], Hisayuki Uneyama[1], Hitoo Nishino[2], Kunio Torii[1]
[1]Ajinomoto Co., Inc., Kawasaki, Kanagawa, Japan; [2]Nagoya City University Medical School, Nagoya, Aichi, Japan

Effectiveness of melatonin, a metabolite of tryptophan released from pineal gland, on reduction of ischemia-induced cerebral edema formation was investigated in rats. T_2-weighted spin-echo images were acquired 1 day after the middle cerebral artery occlusion/reperfusion surgery. Melatonin reduced the total edema volume by 40.8% compared to saline-treated control. The protective effect was more clearly observed in the cerebral cortex than in the striatum. The present study clearly demonstrated the protective effect of melatonin on ischemia-induced edema formation, especially in the cerebral cortex. Melatonin may highly be useful to prevent cortical dysfunctions such as motor, sensory, memory, and psychological impairments.

1946. Characterization of Brain Deformation and Strain Field in a Rodent Model of Brain Injury Using MRI Tagging

Philip V. Bayly[1], Sheng Kwei Song[1], Junjie Chen[1], Wei Liu[1], Gretchen Meyer[1], Guy M. Genin[1], Xin Yu[1]
[1]Washington University, St. Louis, Missouri, USA

The goal of this study was to measure the strain field in the intact brain during mild closed-head trauma. Tagged MR images were acquired during repeated application of force to the head of a euthanized rat pup. Strain fields were estimated from deformed tag lines via the harmonic phase (HARP) approach proposed by Osman et al. (2000). Strain fields show compression under the indentation site and high shear strains near its edges. This method will be used in future to characterize brain injury in live rats; the pattern of neuronal degeneration is expected to depend fundamentally on strain.

1947. Use of Diffusion Weighted Imaging to Understand the Observed Neuroprotective Effect of 2-trans,trans-farnesylthiosalycilic acid, FTS, in a Rat Model of Cerebral Brain Injury.

Daniele Marciano[1], Esther Shohami[2], Yoel Kloog[3], Gadi Goelman[4]
[1]Israel Institute of Biological Research, Ness-Ziona, Israel; [2]The Hebrew University School of Pharmacy, Jerusalem, Israel; [3]Tel-Aviv University, Tel-Aviv, Israel; [4]Hadassah Hebrew University Hospital, Jerusalem, Israel

The neuroprotective potency of FTS (a Ras inhibitor) in a rat model of cerebral brain injury was tested. It was already shown that, one week post-CBI, the neuronal severity scores of the FTS treated rats were better than control. FTS rescued NMDAR and decreased the lesion size (histological results). In this study, we obtained ADCs by acquiring DWI of the brain. FTS has a stronger effect in slices close to the injury site and in the contralateral versus the ipsilateral hemisphere. While untreated animals show 18% decrease in ADC in the cortex, FTS restores it to slightly above pre-CDI level.

1948. Multi-Parameter MRI for Analysis of the Pathophysiology of Vasogenic Edema in a Cold Injury Induced Brain Trauma Model

Jeff F. Dunn[1], Barney E. Dwyer[2], Shi Y. Lu[2], Malek Makki[1], Clifford J. Eskey[1]
[1]Dartmouth Medical School, Hanover, New Hampshire, USA; [2]V.A. Hospital, White River Junction, Vermont, USA

We are using MRI to investigate the pathophysiology of cerebral edema development in cold injury induced brain trauma (CIBT). CIBT is a classic small-animal model of vasogenic (open blood-brain barrier; BBB) cerebral edema [1]. In clinical practice, T2-weighted images are used to depict the evolution cerebral edema. Gadolinium (Gd)-enhanced T1-weighted images are useful for depicting blood-brain barrier integrity. The apparent diffusion coefficient (ADC) is useful for detecting the presence of cellular (or cytotoxic) edema. These MRI methods were used to investigate the evolution of tissue damage, BBB disruption, and edema formation in CIBT.

1949. Imaging Inflammation in Experimental Autoimmune Encephalomyelitis: Methods for Improved Detection of Susceptibility Induced Contrast by Iron Labeled Cells

Paula Foster-Gareau[1], Mathilde S. A Deloire[2], Klaus G. Petry[2], Vincent Dousset[2]
[1]Robarts Research Institute, London, Ontario, Canada; [2]University Victor Segalen, Bordeaux, France

Experimental autoimmune encephalomyelitis, an animal model of multiple sclerosis, was used for studies of cellular imaging in neuroinflammation. Superparamagnetic iron oxide particles were administered to rats i.v. during the course of the disease and imaging methods for detecting the presence of iron in cells were examined. Standard in vivo 1.5T imaging was compared with high- resolution microimaging of specimens ex vivo at1.5 and 9.4T.

1950. Assessment by MRI of Brain Infiltration by Peripheral Blood Macrophages in Anti-VLA-4 Antibody Treatment of Experimental Autoimmune Encephalomyelitis

Vincent Dousset[1], Mathilde Deloire[1], Tarik Touil[1], Bruno Brochet[1], Jean-Marie Caille[1], Klaus Petry[1]
[1]Neurobiologie des Affections de la myeline, Bordeaux, France

The treatment of an experimental allergic encephalomyelitis (EAE) with anti-VLA-4 antibody was monitored by the development of clinical signs and the consequences for both rupture of the blood brain barrier (BBB) and macrophage migration into the brain using MRI with gadolinium and USPIO. We show that although in almost all animals clinical EAE is suppressed by the anti-VLA-4 antibody treatment these animals present ongoing macrophage infiltration into the CNS parenchyma shedding some new light on the role of macrophage brain infiltration in an EAE disease process with relevance for the understanding and therapy of MS.

1951. Spatial Comparison of Different Inflammation Related MRI Readouts in Acute and Chronic Relapsing EAE

Martin Rausch[1], Diana Baumann[1], Peter Hiestand[1], Catherine Cannet[1], Markus Rudin[1]
[1]Novartis Institute for Biomedical Research, Basel, Basel-Stadt, Switzerland

Experimental autoimmune encephalomyelitis (EAE) is a commonly used animal model, which mimics in several aspects human multiple sclerosis (MS) and can be used to design or validate new strategies for treatment of this disease. EAE is based on the immunization of rodents by administration of myelin antigens, or myelin reactive CD4+ cells leading to activation of T-cells against the host's myelin. Conventional MRI allows analysis of some important aspects of the disease: Transient or permanent breakdown of the blood brain barrier (BBB) can be visualized by contrast enhanced MRI.

1952. Differentiation of Axonal and Myelin Injury using Directional Diffusivities

Shu-Wei Sun[1], Wonkyu Ju[1], Lin Zhao[1], Anne H. Cross[1], Jeffrey J. Neil[1], Arthur H. Neufeld[1], Sheng-Kwei Song[1]
[1]Washington University School of Medicine, St. Louis, Missouri, USA

We propose that changes in radial and axial diffusivities reflect myelin and axonal injury, respectively, in white matter disorders. To validate this hypothesis, we examined DTI parameters of optic nerve in mice following Wallerian degeneration induced by retinal ischemia. The preliminary finding supports our hypothesis that axonal injury causes reduced $\lambda_{\|}$ and demyelination results in increased radial diffusivity.

1953. Different Injury Patterns of Gray and White Matter Detected using DTI

Joong Hee Kim[1], Jeffrey J. Neil[1], Chung Y. Hsu[1], Sheng-Kwei Song[1]
[1]Washington University, St. Louis, Missouri, USA

During days 0 - 1of stroke, relative anisotropy (RA) decreased in cortex but was unchanged in the external capsule (EC). Ultimately, RA declined to ~30% below control in both tissues. Diffusivity parameters in cortex were ~30% lower than control in days 0 - 1. They increased to levels well above control after 7 days. EC diffusivity parameters showed a different pattern. After diffusivities decreased to ~20% below control levels during days 0 - 1, by day 3 onward the axial diffusivity recovered to and remained at control level and the radial diffusivity increased to and remained at 40% above control.

MR Spectroscopy of the Brain: Animal Models

Hall D Tuesday 13:30 - 15:30

1954. Absolute Quantification of Brain Metabolites in a Mouse Model of Huntington's Disease

Alan Bainbridge[1], Rupert A. Page[2], Daniel A. West[3], Ern B. Cady[1], Andrew N. Priest[1], John S. Thornton[3], Gillian P. Bates[4], Ben Woodman[4], Roger J. Ordidge[3], Charles A. Davie[2]
[1]University College Hospital London, London, UK; [2]Royal Free Hospital, London, UK; [3]University College London, London, UK; [4]Guy's Hospital, London, UK

Analysis of magnetic resonance spectroscopy spectra using peak-area ratios is unsatisfactory because of the uncertain stability of the concentration of the reference metabolite (e.g. creatine (Cr)) and possible relaxation changes. Absolute quantification of metabolite concentrations avoids these problems. Previous studies of a transgenic mouse model (R6/2) of Huntington's disease have identified the N-acetylaspartate (Naa)/Cr and Choline (Cho)/Cr ratios as surrogate markers for disease progression. These results demonstrate that [Naa] decreases and [Cho] increases with age supporting their use as more rigorous markers of disease progression.

1955. Measurement of NAA by ^{1}H MR Spectroscopy in Huntington's and Parkinson's Disease and Correlation with Histology

Monique Mazzuca[1], Nagalingam Rajakumar[2], Robert Bartha[1]
[1]Robarts Research Institute, London, Ontario, Canada; [2]University of Western Ontario, London, Ontario, Canada

In-vivo short echo-time 1H MR spectroscopy has demonstrated decreased N-acetylaspartate (NAA) levels in many neurodegenerative conditions (1). However, it is not clear whether the NAA decrease is associated with the degeneration of cell bodies/dendrites or axon terminals. Metabolite levels including NAA were measured from the left and right striatum in a rat model of cell body degeneration (Huntington's disease), axonal degeneration (Parkinson's disease), and in controls using LASER localized 4.0 Tesla 1H spectroscopy. Decreased NAA was associated with loss of neuronal cell bodies, but not axon terminals in these models.

1956. Proton Magnetic Resonance Spectroscopy in an Animal Model of Parkinson's Disease: Effect of L-DOPA or Pramipexole Treatment.

Marina Delfino[1], Gustavo Murer[2], Claudia Trenkwalder[3], Oscar Gershanik[1], Dorothee Auer[4]
[1]Inst. de Investigaciones Farmacologicas (ININFA-CONICET), Buenos Aires, Argentina; [2]Univ. de Buenos Aires, Buenos Aires, Argentina; [3]Universität Göttingen, Göttingen, Germany; [4]Max Plank Institut für Psychiatrie, München, Germany

The unilateral mesencephalic hydroxydopamine (6-OHDA) lesion model is a well characterized animal model of Parkinson's disease (PD). Previously we have shown that striatal NAA was reduced ipsilaterally. In a cross-over intervention design 6-hydroxydopamine (6-OHDA) lesioned rats were studied with 1H-MRS at 7T before and after 4 weeks of L-DOPA or Pramipexole treatment. We confirmed ipsilateral striatal reduction of NAA/Cr with a further decline in both treatment groups. There was a trend for NAA/Cr in the contralateral motor cortex to decrease in the Pramipexole group. Thus, mesencephalic dopaminergic cell loss, is associated with denervation-induced NAA reduction, not reversible by parkinsonian pharmacotherapy.

1957. MRS Reveals New Resonances in Extracts of Sandhoff Mouse Brain

John P. Lowe[1], Daniel J. Stuckey[1], Fazli R. Awan[1], Jules L. Griffin[2], Mylvaganam Jeyakumar[1], Fran Platt[1], Andrew M. Blamire[1], Peter Styles[1], Nicola R. Sibson[1]
[1]University of Oxford, Oxford, UK; [2]University of Cambridge, Cambridge, UK

Sandhoff disease, one of several related glycolipid lysosomal storage disorders, results from the build up of N-acetyl-containing glycolipids, particularly in the lysosomes of neurons, causing severe neuropathology. In vitro and solid state MRS of Sandhoff and wild type mouse brain revealed significant differences: Sandhoff mice exhibited new resonances, probably due to derivatives of the stored glycolipids, and a decrease in aspartate. Solid state spectra showed a gradual increase of the same new resonances with disease progression. These findings suggest that MRS may provide a useful, non-invasive means of monitoring progression and treatment of such diseases.

1958. Sequential Metabolic Changes in Hydrocephalic Neonatal Rat Brain by *In Vivo* ^{1}H Magnetic Resonance Spectroscopy

Young Shin Ra[1], Yong Soo Kim[1], Keun Ho Lim[2], Hee Jin Cho[1], Jung Hee Lee[2]
[1]Asan Medical Center, University of Ulsan College of Medicine, Korea, Republic of Seoul; [2]Asan Institute for Life Sciences, Seoul, Republic of Korea

Children with hydrocephalus often show residual neurological deficits despite successful treatment. Hydrocephalic neonatal rats were investigated for the sequential changes of the cerebral metabolites in the time course of 9 wks after induction of hydrocephalus. Pathologic process of hydrocephalus in the neonatal period was verified along with 1H-MRS. Localized in vivo 1H MR spectra were acquired at 1, 2, 3, 5, and 9 wks after surgery. Neuronal damage of hydrocephalus seem to depend on the location of neuronal structure and duration of hydrocephalus. The elevated [NAA/Cho], [Cho/Cr] ratio may represent metabolic change by axonal damage during progressive ventricular dilatation.

1959. Methamphetamine and AIDS: *Ex Vivo* ^{1}HMRS in a Feline Model

Christine C. Cloak[1], Linda Chang[1], Thomas Ernst[1], Thomas Phillips[2], S Huitron-Resendiz[3], M Sanchez-Alavez[3], V Hampton[2], Steven Henriksen[3]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]Vaccine Research Institute of San Diego, San Diego, California, USA; [3]The Scripps Research Institute, La Jolla, California, USA

We evaluated possible interactive effects of psychostimulant drugs and HIV on the brain in a feline model. Four groups of cats were studied, control, FIV positive, methamphetamine (MA) exposed, and FIV positive plus MA exposed. Frontal gray matter, frontal white matter, and caudate brain extracts were studied with 1HMRS. In the frontal white matter, FIV-infected cats showed decreases in creatine and choline, while MA-treated cats had elevated GABA. The decreased glutamate in FIV cats normalized with MA exposure. This study shows the feasibility of using the FIV model and 1HMRS to further study HIV and drug abuse.

1960. Quantitative Proton MRS Detects Different Cerebral Metabolic Responses of Mouse Strains to Global Ischemia

Oliver Natt[1], Attila Schwarcz[2], Takashi Watanabe[1], Susann Boretius[1], Jens Frahm[1], Thomas Michaelis[1]
[1]Biomedizinische NMR Forschung GmbH am Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany; [2]University of Pecs, Pecs, Hungary

Localized proton MRS was performed to quantify cerebral metabolite concentrations in vivo and post mortem after irreversible global ischemia in C57BL/6J, BALB/c, and NMRI mice. In vivo, C57BL/6J mice show higher concentrations of N-acetylaspartate (tNAA), (phospho)-creatine (tCr), choline-containing compounds (Cho), lactate (Lac), and glucose (Glc) relative to BALB/c mice and higher concentration of Glc relative to NMRI mice. Decreases of tNAA, tCr and Cho after global ischemia were only observed in C57BL/6J. The results suggest that the higher vulnerability to brain ischemia in C57BL/6J might be associated with intrinsic metabolic/cellular properties.

1961. *In Vivo* $T_{1\rho}$ Spectroscopy of Brain Metabolites in Normoxic and Ischaemic Rat

Mikko I. Kettunen[1], Olli H.J. Gröhn[1], Risto A. Kauppinen[2]
[1]University of Kuopio, Kuopio, Finland; [2]University of Manchester, Manchester, UK

$T_{1\rho}$ of brain metabolites (N-acetylaspartate, creatine and lactate) were measured in normoxic and ischaemic rat brain at 4.7T and results were compared with water $T_{1\rho}$. In normoxia, $T_{1\rho}$ at spin-lock field of 0.5 G were 570±29ms, 437±25ms and 79±1ms for NAA, Cr and water, respectively. Unlike water, no significant differences in metabolite $T_{1\rho}$ were observed between 0.5G and 1.0G. Following cardiac arrest, $T_{1\rho}$ of NAA dropped by 30%, that of Cr did not change, whereas water $T_{1\rho}$ increased by 5%. $T_{1\rho}$ of lactate was 325±23ms. These results indicate differential behaviour of metabolite and water $T_{1\rho}$ relaxation in cerebral ischaemia.

1962. Prediction of Viability of Neurocysticercosis with Proton Magnetic Resonance Spectroscopy and its Correlation with Histopathology

Sanjeev Chawla[1], Rakesh K Gupta[1], Nuzhat Husain[2], Rajesh Kumar[1], Monika Garg[1], Sunil Kumar[1]
[1]Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [2]Chhatrapati Shahu Ji Maharaja Medical University, Lucknow, Uttar Pradesh, India

Neurocysticercosis (NCC) is the most frequent parasitic disease of central nervous system. Fluid of cysticercus cysts (n= 12) from swine brains was subjected to PMRS. Histopathology of cyst wall was done and was categorized into two groups based on cellular characteristics and amount of musculature. Creatine was present in grade I cysts, while in grade II cysts, it was absent. Grade I cysts showed no or minimal inflammation and large musculature. Direct correlation (r=0.80) was observed between concentration of creatine and amount of musculature for grade I cysts. We conclude creatine may be a marker for viability of NCC.

1963. Effects of Low-Dose Chronic Exposure to Persian Gulf War Chemicals and Stress on Rat Brainstem Function and Energy Metabolism

Nicholas V. Reo[1], Ina Bicknell[1], Lawrence Prochaska[1], Andrew Neuforth[1], Sehul Shah[1], Lois Shroyer[1], David Moyer[1]
[1]Wright State University, Dayton, Ohio, USA

During the Persian Gulf War (GW) US troops were exposed to DEET, pyridostigmine bromide (PB), and low levels of sarin nerve gas. Combined with stress, such exposures may be a contributing cause to GW Illness. Using a 4-wk chronic exposure in rats we measured auditory brainstem response (ABR) evoked potentials, and brain metabolism by 1H and 31P NMR in vivo. NMR of brainstem extracts and biochemical assays of brainstem mitochondrial energy metabolism were also conducted. To date, ABR shows an effect on brainstem function at 24 h post PB+stress; NMR indicates that DEET+PB+stress causes a decrease in brainstem taurine.

1964. Proton-MRS of Transient Cerebral Hypoxia in a Chicken Embryo Model of Fetal Growth Restriction

John S. Thornton[1], James C. Dixon[1], Andrew N. Priest[1], Alan Bainbridge[1], Ernest B. Cady[1], Charles H. Rodek[1], Donald M. Peebles[1], Roger J. Ordidge[1]
[1]University College London, London, UK

The brains of growth-restricted and normally-incubated chicken embryos were studied in ovo 2 days prior to hatching using 1H-MRS. Growth-restricted embryos demonstrated decreased baseline cerebral N-acetylaspartate/creatine and inositol/creatine, and increased b-hydroxybutyrate/creatine compared with controls. During acute hypoxia, growth-restricted embryos exhibited an attenuated increase in lactate/creatine compared with the normally developed group. Differences in the baseline metabolite ratios may reflect impaired micro-structural development. The study demonstrated differences in the metabolic response to hypoxic stress in the growth restricted compared with the normally incubated group.

1965. Evidence that GAD65 Mediates a Major Fraction of GABA Synthesis During Seizures

Anant B. Patel[1], Golam MI Chowdhury[1], Robin A. de Graaf[1], Douglas L. Rothman[1], Bei Wang[1], Kevin L. Behar[1]
[1]Yale University School of Medicine, New Haven, Connecticut, USA

In this study we tested the hypothesis that GAD65 mediates activity-dependent GABA synthesis. Net GABA synthesis was measured following acute GABA-transaminase inhibition using spatially localized 1H NMR spectroscopy before and after bicuculline-induced seizures in normal controls and in animals pre-treated with vigabatrin to reduced GAD67 protein. Seizures led to significant increases in GABA synthesis rates in controls (246%) and in rats with GAD67 reduction (411%). Together with our previous results on the relative activities of the two isoforms under baseline conditions and after vigabatrin-treatment, the present results suggest that the activity-dependent increase in GABA synthesis is mediated by GAD65.

1966. Effects of Myo-Inositol Treatment on Plasmalogen Levels and Biosynthesis in Rat Brain

Beth Kuczynski[1], Nicholas V. Reo[1]
[1]Wright State University, Dayton, Ohio, USA

NMR in conjunction with 13C labeling was used to examine the effects of myo-Insitol (myo-Ins) administration on the phospholipid profile and plasmalogen content in rat brain. Several protocols were investigated. Acute myo-Ins + 13C-ethanolamine (13C-Etn) increased the biosynthesis of Etn phospholipids and produced the greatest elevation in brain myo-Ins and plasmalogen content. These data suggest that brain myo-Ins content is correlated with biosynthesis of Etn plasmalogen. This protocol may provide a unique means to investigate the role of brain plasmalogen in vivo.

1967. Glucose and Glial-Neuronal Metabolism in α-chloralose Anesthetized Rats Measured by *In Vivo* ^{13}C NMR Spectroscopy

Pierre Gilles Henry[1], Sarah Crawford[1], Gulin Oz[1], Kamil Ugurbil[1], Rolf Gruetter[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Carbon-13 labeling time courses for glutamate C4, C3, C2, glutamine C4, C3, C2 and aspartate C3, C2 were measured simultaneously in the rat brain during 7 hours of [1,6-$^{13}C_2$]glucose infusion under α-chloralose anesthesia. The isotopic enrichment of glutamate and glutamine at isotopic steady-state varied depending on carbon position, consistent with substantial pyruvate carboxylase activity and glutamine dilution. Labeling time courses were fitted by a metabolic model to derive quantitative metabolic fluxes, indicating a low rate of neurotransmission, high rate of anaplerosis and an important regulatory role for the malate-aspartate shuttle in the brain.

1968. *In Vivo* ^{13}C MRS Recording of Glucose Uptake and Neurotransmitter Metabolism in Mouse Brain

KlaasJan Renema[1], Dennis Klomp[1], Giulio Gambarota[1], Frank Oerlemans[1], Bé Wieringa[1], Arend Heerschap[1]
[1]UMC Nijmegen, Nijmegen, Netherlands

In vivo ^{13}C MRS is a valuable tool to study brain energy metabolism and neurotransmitter recycling. Although this is more difficult in mice compared to rats due to a smaller brain size, the present study shows glucose uptake and neurotransmitter formation with high temporal resolution in the in vivo mouse brain. Our procedures open up the possibility for in-depth study of energy metabolism and neurotransmitter cycling in knockout and transgenic mouse models.

1969. Absolute Quantification of GABA/Glutamine and Glutamate/Glutamine Cycle Fluxes in the Rat Cerebral Cortex: An *In Vivo* ^{13}C NMR Study

Anant B. Patel[1], Robin A. de Graaf[1], Graeme F. Mason[1], Douglas L. Rothman[1], Bei Wang[1], Robert G. Shulman[1], Kevin L. Behar[1]
[1]Yale University School of Medicine, New Haven, Connecticut, USA

The objective of this study was to measure the absolute values of the GABA/Gln and Glu/Gln cycle fluxes. We have used 13C NMR spectroscopy together with infusion of labeled glucose and acetate to determine the metabolic flux under mild halothane and isoelectric pentobarbital anesthesia. The GABA/Gln cycle was highly active accounting for 22% of total neurotransmitter cycling. Isoelectricity eliminated neurotransmitter cycling and resulted in a 6 and 9 fold reduction of glucose oxidation in both glutamatergic and GABAergic neurons, respectively indicating that in both cell types the primary energetic costs are associated with activity.

1970. Physiological Coupling between Glutamatergic Transmission and Glucose Oxidation Over the Entire Range of Brain Activity

Anant B. Patel[1], Robin A. de Graaf[1], Graeme F. Mason[1], Tomoyuki Kanamatsu[1], Douglas L. Rothman[1], Robert G. Shulman[1], Kevin L. Behar[1]
[1]Yale University School of Medicine, New Haven, Connecticut, USA

In this study we investigated the relationship between Glu/Gln neurotransmitter cycling and glucose oxidation fluxes during seizures to test whether these fluxes are coupled over the full range of neuronal activity in rat cerebral cortex. POCE NMR spectroscopy was used with [1,6-$^{13}C_2$]glucose infusion to determine $V_{cycle(Glu/Gln)}$ and $CMR_{glc(ox)N}$. During seizures, $V_{cycle(Glu/Gln)}$ (255%) and $CMR_{glc(ox)N}$ (252%) increased equally compared to controls. The proportional increase in neurotransmitter cycling flux and glucose oxidation suggests that the coupling is physiologically intrinsic over the entire range of neuronal activity and contradicts the proposal that glycolysis provides the majority of energy for neuronal activity during stimulation.

1971. Proton MR Spectroscopy at 7 Tesla in the Macaque Monkey

Josef Pfeuffer[1], Christoph Juchem[1], Hellmut Merkle[2], Nikos K. Logothetis[1]
[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany; [2]National Institutes of Health, Bethesda, Maryland, USA

First MR spectroscopy results in the anaesthetized and the awake trained monkey (*Macaca mulatta*) are reported using a novel vertical bore 7T/60cm MR system. The setup was custom-designed for MR imaging and spectroscopy of monkeys in upright position and simultaneous electrophysiological recording. Using fast gradients and custom RF coils, the benefits of high magnetic field with increased spectral resolution are demonstrated.

1972. Localized ^{7}Li MR Spectroscopy: Correlation of *In Vivo* Brain and Serum Concentrations in the Rat

Richard A. Komoroski[1], John M. Pearce[1]
[1]University of Arkansas for Medical Sciences, Little Rock, Arkansas, USA

The brain concentration of lithium (Li) in treated rats was measured by in vivo ^{7}Li PRESS localized MRS and compared to the corresponding serum concentration at two treatment times. The brain and serum Li concentrations were highly correlated with each other, more so than found previously for humans. The brain and serum Li concentrations also correlated with dose. The brain/serum Li ratios for rats were comparable to previous values found for humans. In some cases the ratios deviated substantially from the mean, suggesting that serum Li is not always a reliable indicator of brain Li.

1973. Diffusion Spectrum Imaging Reveals Disorganized Cytoarchitecture in the Hippocampus of Pilocarpine-induced Epileptic Rats

Wen-Yih Isaac Tseng[1], Chih-Chuan Chen[2], Ching-Po Lin[3], Horng-Huei Liou[2], Jyh-Horng Chen[3], Li-Wei Kuo[3], Van J. Wedeen[4]
[1]National Taiwan University College of Medicine, Taipei, Taiwan; [2]National Taiwan University Hospital, Taipei, Taiwan; [3]National Taiwan University, Taipei, Taiwan; [4]MGH Martinos Center for Biomedical Imaging, Harvard Medical School, Charlestown, Massachusetts, USA

The recently developed diffusion spectrum imaging (DSI) technique was used in the study of a rat model of chronic epilepsy. In our study, DSI shows that it is able to provide a sensitive non-invasive method to detect microstructure changes of epileptic foci. It is shown that DSI seems to be a promising tool to provide (1) more accurate localization of epileptic focus and (2) follow-up study for preventive and anti-epileptic therapy. With the help of appropriate single index value and mapping, DSI could also help neurologist in prognosis prediction and decision making of pharmacological/ non-pharmacological treatment of epilepsy.

MR Imaging of the Brain: Animal Models

Hall D Saturday 14:00 - 16:00

1974. Regional Brain Atrophy Revealed by Increased CSF Volume in APP/PS1 Mouse Models of Alzheimer's Disease

Marc Dhenain[1], Benoît Delatour[2], Marie Noëlle Castel-Barthe[3], Hans Paul Juretschke[4], Andreas Volk[1]
[1]U350 INSERM - Curie Institute, Orsay, France; [2]NAMC - CNRS UMR 8620, Orsay, France; [3]Aventis Pharma, Vitry Sur Seine, France; [4]Aventis Pharma Deutschland GmbH, Frankfurt, Germany

Cerebral atrophy was studied in 24 months old APP/PS1 mouse model of Alzheimer's disease and in control age-matched PS1 animals. It was evaluated from 3D RARE images by measuring CSF volume in various peri-encephalic areas and in the ventricles. Results from MRI were compared to histological measurements of brain atrophy and amyloid load. Histological exams revealed a reduction of the total brain volume or weight in APP/PS1. This was not associated to an increase of total CSF volume detected by MRI. Regional MRI studies highlighted an atrophy of the pons and a dilation of the mamillary fossa in APP/PS1 mice.

1975. T_1 and T_2 Characterization in Mouse Brain during Hyperoxia at 9.4 Tesla

Hidemasa Uematsu[1], Masaya Takahashi[2], Hiroto Hatabu[2], Qiukan Chen[3], Chih-Liang Chin[4], Suzanne L. Wehrli[3], Felix W. Wehrli[1], Toshio Asakura[3]
[1]University of Pennsylvania Medical Center, Philadelphia, Pennsylvania, USA; [2]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA; [3]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA; [4]University of Pennsylvania, Philadelphia, Pennsylvania, USA

The aim of this study was to investigate changes in the T1 and T2 values on MR imaging of the brain of mice that were exposed to either 100% oxygen (n=8) or carbogen (95% oxygen and 5% carbon dioxide) (n=8). T1 shortening and T2 elongation in hyperoxia-exposed brains were demonstrated in both challenges. The T1 reduction was interpreted as resulting from intermolecular dipole-dipole relaxation, whereas the T2 prolongation was the result of an increase in the amount of oxyhemoglobin that caused a reduction in the cellular gradients that ordinarily govern water transverse relaxation (BOLD effect).

1976. MRI Approaches for Detection of Prion Diseases

Cheuk Ying Tang[1], Marcin Sadowski[2], Gilbert Aguinaldo[1], Richard Carp[3], Youssef Zaim Wadghiri[2], Daniel H Turnbull[2], Thomas Wisniewski[2]
[1]Mt. Sinai School of Medicine, New York, New York, USA; [2]New York University, New York, New York, USA; [3]New York Institute Basic Research for Developmental Disabilities, Staten Island, New York, USA

Focally increased MRI T2 signal intensity in the cerebral cortex and in subcortical gray matter has been reported in some individuals with autopsy confirmed prion diseases. We sought 1) to analyze the pathological mechanism producing increased T2 signal using a mouse model and 2) to develop ligands to increase the specificity and sensitivity of MRI as a diagnostic tool for prion diseases.

1977. Animal Models of Cirrhosis: A Relaxometry Study on the Rat Brain

Vít Herynek[1], Pavel Trunecka[1], Jana Havlícková[1], Daniel Jirák[1], Martin Burian[1], Hynek Mergentál[1], Karel Filip[1], Milan Hájek[1]
[1]Institute for Clinical and Experimental Medicine, Prague, Czech Republic

In search for changes in the brain due to hepatic encephalopathy we studied three animal models: toxic cirrhosis, cirrhosis induced by biliary duct ligation, and a model with portocaval anastomosis. Contrary to the results obtained in humans, the decrease of relaxation times was observed only in the toxic group in the putamen. No correlation of the relaxation times to the manganese concentration was found in any of the models. In the toxic cirrhosis model, the relaxation times in the putamen correlated to the ammonia concentration in the serum. The animal models do not correspond fully to the findings on humans.

1978. Longitudinal Monitoring of Structural Changes and Development of Lesions in the Aging Canine Brain

Min-Ying Su[1], Changqing Chen[1], Jun Wang[1], Jr-Yuan Chiou[1], Hon Yu[1], Elizabeth Head[1], Bruce Muggenburg[2], Carl Cotman[1], Orhan Nalcioglu[1]
[1]UC, Irvine, California, USA; [2]LRRI, Albuquerque, New Mexico, USA

We have been following a group of cognitively well characterized old dogs as a model of human aging since 1999. Yearly MRI examination was performed to measure the structural and vascular changes in the brain. Two types of interventions: antioxidant diet and environmental enrichment, were studied. Cognitive performance of these dogs were also assessed longitudinally. As in humans, ventricular enlargement was the most prominent feature. Lesions were developed when dogs became older. Combination of antioxidant diet and environmental enrichment preserved the cognitive ability, but had no significant effect on changes in the brain structures.

1979. Functional Reorganisation of Sensory Maps Following Status Epilepticus in Neonatal Age: A Volumetric MRI and Multimodal Electrophysiology Study

Jaak Nairismägi[1], Asla Pitkänen[1], Mikko Iivari Kettunen[1], Markku Penttonen[1], Risto Antero Kauppinen[2], Hana Kubova[3]
[1]A. I. Virtanen Institute, Kuopio, Finland; [2]University of Manchester, Manchester, UK; [3]Academy of Sciences of the Czech Republic, Prague, Czech Republic

The study was designed to investigate changes of electrophysiological activity in the cortex and functional reorganisation following recovery from status epilepticus (STE) at immature age. We found shortened evoked potential latencies in forelimb area in epileptic animals relative to controls. No abnormalities in visual evoked potentials were detected. MRI shows intact brain cortex with no atrophy, yet reduced volumes of hippocampi, thalamus and amygdala. It is concluded that abnormal properties of electrophysiology in cortex may be caused by modified signals from brain structures such as those above.

Cerebral Fine Structures: Mice and Birds

Hall D Monday 13:30 - 15:30

1980. In Vivo Diffusion Tensor Imaging of the Transgenic Mouse Brain at 7 Tesla

Sang-Pil Lee[1], Maria-Fatima Falangola[1], Victor Dyakin[1], Babak Ardekani[1], Ralph Nixon[1], Joseph A. Helpern[1]
[1]Nathan Kline Institute, Orangeburg, New York, USA

The application of an in vivo DTI technique to small animals such as transgenic mice has been a great challenge due to its technical difficulties: short apparent transverse relaxation time by increased magnetic field inhomogeneites and motion artifacts due to long data acquisition time. In this study, we demonstrate the feasibility of the in vivo DTI in the PS-APP mouse brain, a model of Alzheimer's disease. The development and optimization of an in vivo DTI technique were achieved with significantly reduced acquisition time of ~17 min and improved spatial resolution of ~150 µm at 7 Tesla.

1981. Temporal Characterization of Wild-type and Bcl-X Conditional Knock-out Mice Phenotypes Using Three Dimensional Diffusion Tensor Micro-Imaging

Jiangyang Zhang[1], Yingbei Bei Chen[1], J. Marie Hardwick[1], Susumu Mori[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Three dimensional high resolution diffusion tensor and T2-weighted images were acquired from brain samples of wild-type and neuronal specific Bcl-X conditional knock-out mice at several developmental stages, to examine the effect of gene knock-out on brain structures and progression of damages over development. Knock-out mice started to show defect in cortex, hippocampus and associated white matter tracts at P0. The defects became more severe in P7 and adulthood. We quantitatively analyzed our data to study the defects. Our results also demonstrated that diffusion tensor imaging was a useful tool to macroscopically characterize phenotype.

1982. Optimized Contrast for Neurohistology in the Mouse Brain Using Magnetic Resonance Microscopy

Anjum Anwar Ali[1], Aki Laakso[1], G. Allan Johnson[1]
[1]Duke University, Durham, North Carolina, USA

The analysis of neuroanatomical structures in the mouse brain is becoming increasingly important with the advent of animal models of neurodegenerative diseases like Alzheimer's and Parkinson's. Volumetric measures and 3D shape analysis are critical metrics for quantitative neuromorphology. We present an optimized multispectral T1, T2, proton density, and diffusion weighted image acquisition protocol for clearest differentiation of critical neuroanatomical structures in the mouse brain and discuss strategies for future automated segmentation of structures, which will ultimately aid in the morphological phenotyping of different animal models.

1983. Diffusion and Extracellular Space Volume Fraction in the Brain of Mice Lacking Tenascin-R or HNK1 Sulfotransferase

Ivan Vorisek[1], Tatiana Antonova[2], Tomas Mazel[3], Milan Hajek[4], Eva Sykova[1]
[1]Institute of Experimental Medicine ASCR, Prague, Czech Republic; [2]Charles University, 2nd Medical Faculty, Prague, Czech Republic; [3]Center for Cell Therapy and Tissue Repair, Prague, Czech Republic; [4]Institute for Clinical and Experimental Medicine, Prague, Czech Republic

We investigated the apparent diffusion coefficient (ADC) of water (ADC_W) and the extracellular space (ECS) diffusion parameters in the cerebral cortex of two strains of knockout mice with altered extracellular matrix (ECM) using diffusion-weighted MRI and the real-time iontophoretic tetramethylammonium (TMA) method. Both TN-R- (tenascin-restrictin) and HNK-1 (human natural killer) sulfotransferase-deficient mice had a decreased ECS volume and an increased ADC of TMA compared to controls. ECM-deficient mice also showed a decreased ADC_W. The composition of the ECM, which changes in many pathological states, influences extrasynaptic transmission and the diffusion of substances in brain tissue.

1984. 3D MRI of Mouse Brain after Systemic Application of Chromium: Comparison with Manganese

Takashi Watanabe[1], Oliver Natt[1], Susann Boretius[1], Jens Frahm[1], Thomas Michaelis[1]
[1]Biomedizinische NMR Forschungs GmbH, Göttingen, Germany

This study describes effects of systemically applied chromium (Cr(III), Cr(VI)) on soft-tissue contrast enhancement in high-resolution 3D gradient-echo MRI of mouse brain. T1-weighted MRI reveals signal enhancement of vessels, regions without blood-brain barrier, and cerebellar cortex 24 hours after the subcutaneous administration of Cr(VI) but not of Cr(III). The results suggest that Cr(VI) may become a useful contrast agent for phenotyping mutant mice.

1985. High Resolution Manganese Enhanced MRI (MEMRI) of Mouse Brain at 11.7T: Manganese Dose Dependent T_1 Values in Various Regions of Brain

Jung Hee Lee[1], Afonso C. Silva[1], Alan P. Koretsky[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Mn2+ as a MRI contrast agent has been increasingly used to mark excitable cells, to trace neuronal connections and to enhance the brain. The exact knowledge of the selective uptake and distribution of Mn2+ throughout the brain has not yet been fully established. In addition, the degree of hyper-enhancement in relation to the dose of Mn2+ administered has not been fully assessed. The purpose of this study was to evaluate the relationship between the dose of Mn2+ administered systemically and both contrast enhancement and T1 values in MEMRI in various regions of the mouse brain.

1986. Parametric MR Mapping of Axonal Tranport in the Olfactory System of Living Rat Brains

Donna Cross[1], Yoshimi Anzai[1], Bart Keogh[1], Kenneth Maravilla[1], Eric Shankland[1], Satoshi Minoshima[1]
[1]University of Washington, Seattle, Washington, USA

Axonal transport, an essential process for neuronal homeostasis, was measured in living rodent brains using manganese (MnCl2) and tracer kinetic analysis. Following intranasal injection of MnCl2, multiple T1-weighted MR image sets were obtained in 6 rats. After image coregistration and pixel normalization, parametric maps of bulk axonal transport rates were calculated based on a dispersion model. The maps demonstrated progressive transport of MnCl2 to higher olfactory cortices with the estimated bulk axonal transport rate of 2.6±0.6 mm / hour in the olfactory tract. This technique will permit investigations of axonal transport in living brains under various experimental conditions.

1987. *In-Vivo* Dynamic ME MRI of Canary Brain Reveals How Different Neuron Types Respond Differentially to Song Stimulation

Ilse Tindemans[1], Marleen Verhoye[1], Jacques Balthazart[2], Annemie Van der Linden[1]
[1]University of Antwerp, Antwerp, Belgium; [2]University of Liège, Liège, Belgium

Dynamic Manganese Enhanced (DME) MRI of the canary brain after Manganese injection into the High Vocal Center (HVC) revealed that hearing conspecific songs (CS) influences the way manganese is taken up and transported from HVC to RA and Area X, and that CS differentially affects these two classes of HVC neurons. These results demonstrate that DME MRI can be used to assess the functional state of specific neurons in the song system in a manner reminiscent of functional MRI but with higher anatomical resolution.

MR Spectroscopy of Human Brain: Methods

Hall D Tuesday 13:30 - 15:30

1988. High Resolution Phased-Array 3D MR Spectroscopic Imaging at 3 Tesla

Duan Xu[1], Radhika Srinivasan[1], Napapon Sailasuta[2], Ralph Hurd[2], Susan Moyher Noworolski[1], Pratik Murkherjee[1], Sarah J. Nelson[1], Daniel B. Vigneron[1]
[1]University of California at San Francisco, San Francisco, California, USA; [2]GE Medical Systems, Menlo Park, California, USA

The goal of this study was to apply 3T phased-array coil technology and optimized 3D MR spectroscopic imaging techniques to obtain very high resolution spectra of the human cerebral cortex. Using a GE 3T scanner with body coil excitation and a Nova Medical bitemporal phased-array coil, we obtained very high sensitivity over specific cortical regions in the temporal, parietal, frontal and occipital lobes with up to 10 fold higher than at 1.5T with a standard head coil. This permitted the acquisition of 3DMRSI data with a spatial resolution as fine as 0.125cm3 in a 17min acquisition.

1989. Measurement of ^{1}H Metabolite Relaxation Times in Human Brain at 3.0 Tesla and Determination of Regional Variations in T_2 Values

Frank Träber[1], Wolfgang Block[1], Rolf Lamerichs[2], Jürgen Gieseke[2], Hans Schild[1]
[1]University of Bonn, Bonn, Germany; [2]Philips Medical Systems, Best, Netherlands

With the increasing demand for clinically used high-field MR systems operating at magnetic inductions of 3 T or even beyond, the measurement of proton relaxation times at these field strengths has gained great importance. Accurate values of 1H metabolite T1 and T2 times are required for reliable and reproducible determination of absolute metabolite concentrations by MRS techniques. Pioneering in-vivo MRS relaxometry studies in human brain [1-4] have already stated a steady decrease of metabolite T2 when increasing the magnetic field from the 1.5 T standard to 3 and 4 T .

1990. Is Physiological Motion Important in MRS of the Brain at 3T: Frame-to-Frame PRESS Acquisitions

Rachel Katz-Brull[1], Robert E. Lenkinski[1]
[1]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

Brain motion has been suggested to lead to a significant reduction in the SNR of brain MRS at 1.5T. The purpose of this work was to quantify the magnitude of this effect at 3T. Various brain regions in 9 healthy volunteers were investigated with PRESS 1H-MRS. Frequency shifts of up to 4 Hz were observed. However, individual frame-to-frame phase correction and frequency registration did not change the overall intensity or the width of the signals of brain metabolites. We conclude that PRESS proton spectroscopy at 3T is not succeptible to physiological motion of the brain.

1991. Feasibility of Proton Chemical Shift Imaging with a Stereotactic Headframe

Hyun-Man Baik[1], Bo-Young Choe[2], Sung-Taek Chung[1], Jeong-Seok Kim[2], Hyoung-Koo Lee[2], Tae-Suk Suh[2]
[1]Medinus MR Center & Catholic Medical MR Center, Yongin-Si, Kyounggi-Do, Republic of Korea; [2]Catholic Medical MR Center, Seoul, Republic of Korea

To prove feasibility of proton chemical shift imaging (1H CSI) during stereotactic procedure, authors performed 1H CSI in combination with a stereotactic headframe and selected targets according to local metabolic information, evaluated the pathologic results. The final pathologic results obtained were concordant with the local metabolic information from 1H CSI. We believe that 1H CSI-directed stereotatic biopsy has the potential to significantly improve the accuracy of stereotactic biopsy targeting.

1992. Whole Brain ^{31}P RINEPT in a Depressed Patient Undergoing ECT

Gabriele Ende[1], Wolfgang Weber-Fahr[1], Alexander Sartorius[1], Florian Lederbogen[1], Fritz A. Henn[1]
[1]Central Institute of Mental Health, Mannheim, Germany

We used a whole brain ^{31}P RINEPT sequence to monitor metabolite changes in a depressed patient induced by ECT. Spectra were acquired pre and post a course of electroconvulsive therapy (ECT) and were compared to spectra acquired in five healthy controls. The observation of an increasing ratio of glycerphosphorylcholine to phosphomonoesthers following ECT is in accordance with a previously reported increase of the hippocampal 1H choline signal in depressed patients undergoing ECT. Our RINEPT spectra show that resolution and specificity of in vivo brain ^{31}P MRS at 1.5 T can be greatly enhanced by means of polarization transfer methods.

MR Spectroscopy of Human Brain: Gray Matter

Hall D Saturday 14:00 - 16:00

1993. Can MR Spectroscopy of Extra-Axial Intracranial Tumors Differentiate Meningiomas from Non-Meningiomas?

Recai Aktay[1], Mehmet Sahin Ugurel[1], Scott D. Rand[1], Robert Prost[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Aim of the study was to determine an MR spectroscopy feature which may help discriminating meningiomas from non-meningiomatous extra-axial tumors. Qualitative and quantitative retrospective analysis of MRS data from a 0.5T scanner was undertaken on 48 patients, who had imaging features of extra-axial tumors and final histopathological results. 8 normal subjects' data was also included for comparisons. Both visual qualitative evaluation and metabolite-to-water peak amplitude ratio based quantitative evaluation on 9 metabolites revealed that high glutamine-glutamate peak may favor the diagnosis of meningioma over non-meningioma.

1994. Cortical ^{1}H-MRS in Huntington's Disease Does Not Confirm Lactate Increase But Shows Elevated Glucose

Ralf Reilmann[1], Philipp Sämann[1], Thomas Merl[1], Andreas Bender[2], Thomas Klopstock[2], Dorothee P. Auer[1]
[1]Max-Planck-Institute of Psychiatry, Munich, Bavaria, Germany; [2]Ludwig Maximilians University, Munich, Bavaria, Germany

Alteration of oxidative energy metabolism has been suggested to cause the neurodegeneration observed in Huntington's disease (HD). Using 1H-MRS increased lactate has previously been reported in the occipital cortex in HD presenting further evidence for an energy deficit. The current study investigated metabolites potentially involved in oxidative metabolism or neuroexcitotoxicity in patients with HD (n=20) compared to controls using single-voxel 1H-MRS. In our sample no change of lactacte was found, however, increased glucose concentrations ($p<0,05$) were seen in the parieto-occipital cortex in HD. Implications of these findings for a possible defect of energy metabolism in HD are discussed.

1995. Quantitative Proton MRS in Lhermitte-Duclos Disease

Gunther Helms[1], Dan Greitz[1], Olof Flodmark[1]
[1]Karolinska Hospital, Stockholm, Sweden

The study comprises five patients with Lhermitte-Duclos disease (dysplastic gangliocytoma), an extremely rare malformation in the cerebellum featuring a progessive hypertrophy of the granular neurons and an excessive myelination of their axons in the molecular layer. Absolute quantification of short TE STEAM MR spectra including correction for increased CSF subvolumes revealed a highly specific decrease in cholines and myo-inositol, while there were little changes of creatine and N-acetyl-aspartate levels. Lactate was seen in three patients.

1996. Proton Magnetic Resonance Spectroscopy of the Primary Motor Cortex in Hemiparetic Patients due to Deep Intracerebral Hematoma

Hyun-Man Baik[1], Bo-Young Choe[2], Sung-Taek Chung[1], Jeong-Seok Kim[2], Hyoung-Koo Lee[2], Tae-Suk Suh[2]
[1]Medinus MR Center & Catholic Medical MR Center, Yongin-Si, Kyounggi-Do, Republic of Korea; [2]Catholic Medical MR Center, Seoul, Republic of Korea

To determine the motor cortex dysfunction in hemiparetic patients due to deep intracerebral hematoma, authors performed proton magnetic resonance spectroscopy (1H MRS) for the evaluation of biochemical changes in the cortex on affected hemisphere according to axonal injury at the level of internal capsule. We found that NAA/Cr and NAA/Cho ratios were significantly decreased in the motor cortex of the hemiparesis patients compared with control subjects. 1H MRS examinations of the motor cortex might help to differentiate distinct clinical entities of hemiparesis and to monitor pharmacological effects in therapeutic trials, providing a quantitative biological marker for motor neuron dysfunction.

1997. Quantitation of GABA in Human Brain Using MEGA-PRESS Editing and LCM Analysis

Marzena Wylezinska[1], Paul Matthews[1], Peter Jezzard[1]
[1]University of Oxford, Oxford, Oxfordshire, UK

We describe a protocol that allows the Linear Combination Model (LCM) routine to be applied to the analysis of GABA edited spectra. The editing sequence is based on the MEGA-PRESS editing method, and has been adjusted to use the formate peak as an internal chemical shift reference in order to generate model spectra. Our results show an in vivo GABA to Cr ratio of 0.19 (±0.04) and a GABA concentration of 1.52 mmol/kg (±0.32), that are in agreement with values published elsewhere.

1998. *In Vivo* Evidence of Cortical Neuronal Injury in Secondary Progressive Multiple Sclerosis

Salvatore DiMaio[1], Sridar Narayanan[1], Nicola De Stefano[1], Jacqueline Chen[1], Yves Lapierre[1], Douglas L. Arnold[1]
[1]Montreal Neurological Institute, Montreal, Quebec, Canada

There has recently been increased appreciation for the potential importance of gray matter pathology in MS. We measured the extent and timing of cortical grey matter (cGM) injury in MS. MRI/MRS data were obtained from 27 MS patients (15 RR + 2 SP) and 21 healthy controls. NAA/Cr was significantly lower in the cGM of the SP group relative both to controls, (-14.3%, P = 0.002) and RR patients (-12.6% (P = 0.014). Normalized cGM thickness within the spectroscopic region studied was significantly lower in both RR and SP patients compared to controls (P < 0.003).

1999. Potential MRS Markers of Preclinical Alzheimer Disease in Patients with Mild Cognitive Impairment

Sophie Chantal[1], Martin Labelle[2], Claude M.J. Braun[3], Rémi W. Bouchard[1], Yvon Boulanger[2]
[1]Hôpital de l'Enfant-Jésus du CHA de Québec, Quebec, Québec, Canada; [2]Hôpital Saint-Luc du CHUM, Montreal, Québec, Canada; [3]UQÀM, Montreal, Québec, Canada

1H MRS has been used to study metabolic changes in the brain of patients with mild cognitive impairment (MCI), a potential intermediate state between normal aging and Alzheimer disease (AD). MR spectra were recorded in the medial temporal lobes (MTLs), parietotemporal cortices (PTCs) and prefrontal cortices (PFCs) of 14 patients with MCI and compared to matched groups of patients with AD and control subjects. Results indicate that NAA and Cho reductions in the left MTL characterize both patients with AD and MCI but that mI increases in all regions are specific to patients with AD.

2000. Prefrontal PCr/Cr Levels Indicate Reduced Energy Demand in Schizophrenic Brains

Yong Ke[1], Joseph Coyle[1], Norah Simpson[1], Staci Gruber[1], Isabelle Rosso[1], Perry F. Renshaw[1], Deborah Yurgelun-Todd[1]
[1]McLean Hospital, Harvard Medical School, Belmont, Massachusetts, USA

Abnormal brain metabolism measured by MRS has been reported in schizophrenic patients. Measurements of PCr and Cr concentration provide a direct assessment of metabolism, however, they have similar resonance frequencies in the proton spectrum making it difficult to estimate their chemical concentrations. As they have substantially different T2 relaxation rates, their contributions can be estimated by fitting the T2 relaxation curve to a biexponential T2 relaxation mode. Using this method, concentrations and T2 values of PCr and Cr were measured in a frontal region in schizophrenics and controls. Patients demonstrated significantly higher PCr, indicating reduced energy demands in this region.

2001. Alzheimer's Disease Diagnosis Requires STEAM: An Evaluation of Sequences

Cathleen Mateo Enriquez[1], Alexander Peter Lin[2], Kamini V. Patel[1], Brian David Ross[2]
[1]Rudi Schulte Research Institute, Pasadena, California, USA; [2]Huntington Medical Research Institutes, Pasadena, California, USA

This study determines differences between PRESS and STEAM acquisitions in vivo and their effect on the accuracy of diagnosis of Alzheimer's Disease (AD) with MRS. PRESS and STEAM in the posterior cingulate gyrus were acquired in fifteen subjects, blinded to neuropsychological results. NAA reductions are more significant in STEAM. PRESS acquisitions have underlying contributions to the baseline resulting in artificial increases in NAA and mI measurements confirmed by T2 assays and multiecho acquisitions. STEAM is less susceptible to these contributions. Choice of sequence affects diagnosis; STEAM must be added or retained to support the diagnosis of AD with MRS.

2002. Feasibility of Quantitative Proton MRSI in the Anterior Mesial Temporal Lobe

Atilla Arslanoglu[1], Peter B. Barker[1], Alena Horska[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Using quantitative proton MRSI, we evaluated changes in Cho, Cr, and NAA concentrations across the longitudinal axis of the mesial temporal lobe (MTL) (allocortex) and performed a comparison with metabolite concentration in neocortex in healthy brain. In the MTL, average Cho concentration decreased in the anterior-posterior direction while NAA and Cr concentrations did not vary significantly. Cho concentration in the allocortex (3.7±1.1 mM) was higher than in the neocortex (2.2±0.8 mM, p<0.05), perhaps reflecting differences in cellular composition. The effect of susceptibility artifacts on feasibility of MRSI in the anterior MTL is evaluated.

2003. Proton MR Spectroscopy in Restless Legs Syndrome: Evidence for Abnormal Thalamic Metabolism

Alena Horska[1], Richard P. Allen[1], Peter B. Barker[1], Christopher J. Earley[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

Single voxel proton MR spectroscopy (MRS) was performed in the thalamus and putamen of 32 patients with Restless Legs Syndrome (RLS) and in 13 age and gender matched control subjects. A reduced level of creatine (Cr) was found in patients compared to controls (p<0.03) in the thalamus; all other metabolites were normal. No metabolic abnormalities were found in the putamen. The degree of Cr reduction also correlated significantly with CSF tetrahydrobiopterin levels (p=0.03). This study provides evidence that abnormal thalamic metabolism plays a role in the pathology of RLS.

2004. Altered Glutamate/Glutamine Levels within the Left Dorsolateral Prefrontal Cortex in Acute Mania – Impact of Tissue Segmentation and Related Corrections

Bettina Pfleiderer[1], Nikolaus Michael[2], Michael Gösling[1], Volker Arolt[2], Walter Heindel[1]
[1]Department of Clinical Radiology, Münster, Germany; [2]Department of Psychiatry, Münster, Germany

Here, the effect of various correction steps on ^{1}H MRS data of the left dosolateral prefrontal cortex (DLPFC) in a small sample of 8 acute manic patients and age matched controls is demonstrated. Clinical studies with small sample size and an inhomogenous age distribution may in particularly be hampered by variations in voxel composition (percentage: CSF (partial volume), gray and white matter) and differences in coil loading [1]. This is insofar problematic, since there may exist significant differences in tissue composition between controls and patients. This is particularly true for patients with psychiatric diseases such as affective disorder.

Human Brain MR Imaging and Spectroscopy of Psychiatric Disorders

Hall D Monday 13:30 - 15:30

2005. Evidence of a Relationship Between Cognitive Impairment and Membrane Phospholipid Metabolism in Chronic Schizophrenia Subjects: An *In Vivo* Multi-Voxel ^{31}P Spectroscopy Study

Jeffrey A. Stanley[1], Gerald Goldstein[2], Matcheri S. Keshavan[3], Kanagasabai Panchalingam[1], Richard J. McClure[4], Jay W. Pettegrew[1]
[1]University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania, USA; [2]VA Pittsburgh Healthcare System, Pittsburgh, Pennsylvania, USA; [3]Western Psychiatric Institute and Clinic, Pittsburgh, Pennsylvania, USA; [4]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA

In vivo ^{31}P spectroscopy was used to determine if there are any associations between cognitive impairment and membrane phospholipid (MPL) metabolites in chronic schizophrenia subjects (CSCH). Based on a battery of cognitive scores, an average impairment score was determined for each subject. Preliminary results show decreasing MPL precursor levels in the right prefrontal, basal ganglia and superior temporal regions and decreasing utilization of high-energy phosphate in the right prefrontal and occipital regions with increasing cognitive impairment. These CSCH findings demonstrate the inner relationship between MPL and high-energy phosphate metabolism and cognitive function and suggest metabolite alterations underlie the clinical findings.

2006. Regional Specificity of NAA - IQ Relationships in Schizophrenia and Normal Brain

Rex E. Jung[1], Laura M. Rowland[1], Ron A. Yeo[1], Ranee A. Barrow[1], Helen Petropoulos[2], John Lauriello[1], Juan R. Bustillo[1], William M. Brooks[2]
[1]University of New Mexico, Albuquerque, New Mexico, USA; [2]MIND Imaging Center, Albuquerque, New Mexico, USA

N-acetylaspartate has been related to intellectual functioning in both disease and normal human brain. Cognitive decline (i.e., dementia praecox) is a characteristic symptom of schizophrenia; thus we hypothesized a relationship between NAA and IQ reflecting both metabolic and behavioral decline. NAA was correlated with IQ in both control ($n = 14$, $r = .72$, $p < .01$) and patient groups ($n = 14$, $r = .53$, $p < .05$), and the relationship was specific to occipito-parietal white matter. Our current findings highlight the importance of white matter interconnections to cognitive functioning in both disease and health.

2007. ^{1}H MRSI and Single Photon Emission Computed Tomography (SPECT) Study of Baseline Striatal Dopamine Hyperfunction in Schizophrenia

Lawrence S. Kegeles[1], Anissa Abi-Dargham[1], Dikoma C. Shungu[1], Xiangling Mao[1], Arindam Rano Chatterjee[1], Jack M. Gorman[1], Marc Laruelle[1]
[1]Columbia University, New York, New York, USA

The dopamine hypothesis of schizophrenia holds that the positive symptoms of the illness are related to excess dopamine function. 1H MRSI and [123I]IBZM SPECT were used to investigate the relationship between regional cortical deficits in neuronal functional integrity and baseline striatal dopamine hyperfunction in schizophrenia. Low NAA/Cr in several forebrain regions was found to correlate with abnormally elevated striatal dopamine activity. These findings suggest that cortical dysregulation of subcortical dopamine function may play a role in schizophrenia.

2008. *In Vivo* ^{1}H Spectroscopy Evidence of Age and Comorbidity Effects in First-Episode, Never-Medicated Schizophrenia Subjects

Jeffrey A. Stanley[1], Sarah D. Sahni[2], Debra M. Montrose[2], John A. Sweeney[3], Jay W. Pettegrew[1], Matcheri S. Keshavan[2]
[1]University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania, USA; [2]Western Psychiatric Institute and Clinic, Pittsburgh, Pennsylvania, USA; [3]University of Illinois at Chicago, Chicago, Illinois, USA

In this study, the effects of age and comorbidity was investigated in first-episode, never-medicated schizophrenia (FESCH) subjects by quantifying ^{1}H metabolites in the left dorsolateral prefrontal cortex (DLPFC) using a single-voxel short TE ^{1}H spectroscopy technique. In FESCH subjects with a comorbid personality disorder (PD) showed decreased N-acetylaspartate (NAA) and increased glycerolphosphocholine plus phosphorylcholine (GPC+PC) suggesting an underdevelopment of neuronal processes and synapses. In contrast, the NAA and GPC+PC significantly correlated with age in FESCH without a comorbit PD, which resulted in a greater alteration in the younger subjects and may suggest a greater vulnerability during this period of neurodevelopment.

2009. Adolescents at High Risk for Schizophrenia Studied by ^{1}H MRS.

Christopher Hanstock[1], Peter Allen[1], Agitha Valiakalayil[1], Lori Paulson[1], Philip Tibbo[1]
[1]University of Alberta, Edmonton, Alberta, Canada

Children of individuals with schizophrenia have a higher risk (10-15%) of developing this disorder, compared to a 1% risk in the general population. 1H MRS in chronic and first episode schizophrenia has shown decreased N-acetylaspartate (NAA) in the frontal cortex, and the temporal lobe, and this is thought to represent neurodegeneration. However, it is currently not known if these abnormalities are present before the onset of symptoms. This study is designed to determine if the brain metabolite changes noted in chronic and first episode schizophrenics are observed in asymptomatic adolescents.

2010. Relaxation Effects in Quantitative MRS Studies of Schizophrenia

David P. Olson[1], Fuyuki Hirashima[1], Deborah A. Yurgelun-Todd[1], Perry F. Renshaw[1]
[1]McLean Hospital / Harvard Medical School, Belmont, Massachusetts, USA

Quantitative proton (1H) and phosphorus (31P) magnetic resonance spectroscopy (MRS) has been utilized in a large number of studies comparing metabolite concentrations in the brains of individuals with schizophrenia with healthy control subjects. The published findings are inconsistent. One possible explanation is that metabolite relaxation times in the frontal and temporal lobes of schizophrenic subjects may be altered, introducing a systematic bias in quantitative measurements. Our review/analysis of the published literature indicates an MRS acquisition parameter dependence for metabolite concentration measurements consistent with the possibility of altered relaxation times in schizophrenic subjects.

2011. Medial Temporal Lobe Changes in First Episode Psychosis Measured by ^{1}H MRS at 3T

R Mark Wellard[1], Stephen J. Wood[2], Gregor E. Berger[3], Patrick D. McGorry[3], Graeme D. Jackson[1], Christos Pantelis[2]
[1]Brain Research Institute, Melbourne, Victoria, Australia; [2]Sunshine Hospital, Melbourne, Victoria, Australia; [3]Mental Health Service for Kids and Youth, Melbourne, Victoria, Australia

This proton MRS study examined the metabolite profile associated with first episode psychosis in a group consisting of both early medicated and drug naïve patients. Single voxel proton MR spectra were acquired from each temporal lobe and analysed with LCModel. NAA was not different from controls but creatine and myoinositol were elevated. The results are consistent with increased metabolic activity involving glial (progenitor) cells with no or limited change in neuronal cell function or density.

2012. Fronto-Temporal Connectivity and Violence in Schizophrenia: A ^{1}H-MRS Study

Roland Jones[1], Andy Simmons[1], Nigel Tunstall[1], Eileen Daly[1], Maria Isaac[1], Declan Murphy[1]
[1]Institute of Psychiatry, London, UK

This abstract describes a single voxel 1H MRS study of frontal temporal connectivity and violence in schizophrenia. Three groups of subjects were investigated – schizophrenics with a history of violence, schizophrenics with no history of violence and normal controls. The results support the hypothesis that (1) people with schizophrenia have significant differences in correlated development of the hippocampus and prefrontal regions and (2) amongst people with schizophrenia, regional differences in neuronal density, membrane turnover and metabolism are associated with increased levels of interpersonal violence.

2013. 31-Phosphorus Magnetic Resonance Spectroscopy of Cerebral Metabolism in Patients with Anorexia Nervosa

Reinhard Rzanny[1], Jürgen R. Reichenbach[1], Daniela Freesmeyer[2], Hans J. Mentzel[1], Stefan OR Pfleiderer[1], Uwe J. Gerhard[2], Berhard Blanz[2], Werner A. Kaiser[1]
[1]Institute of Diagnostic and Interventional Radiology, Friedrich-Schiller-University, Jena, Germany; [2]Clinic of Child and Adolescent Psychiatry, Friedrich-Schiller-University, Jena, Germany

31P-MRS of patients with anorexia nervosa was performed to detect possible changes in the cerebral energy and membrane metabolism. 10 female patients (age range: 12-20 y; mean BMI: 14.8±1.6 kg/m2) and 10 healthy female controls were examined with a whole-body scanner (1.5 T). A group comparison indicated no changes of PCr or NTP, but a decrease of PDE in the patient group. The results do not support the hypothesis of a deficiency of high energy phosphates and katabolic conditions of metabolism. The correlation of PDE with the BMI rather indicates reduced contributions of mobile phospholipids to the PDE signal.

2014. A ^{1}H MRSI Study in Adult Generalized Anxiety Disorder: Effects of Early Abuse on Neuronal Integrity

Xiangling Mao[1], Sanjay Mathew[1], Jose Martinez[1], Jack Gorman[1], Jeremy Coplan[1], Dikoma C. Shungu[1]
[1]Columbia University, New York, New York, USA

1H MRSI has been used to investigate cerebral metabolism in 15 generalized anxiety disorder GAD patients and in 15 sex- and age-matched control subjects. Measures of NAA/Cr in right dorsolateral prefrontal cortex (DLPFC) were increased in GAD compared control subjects. This is in contrast to post-traumatic stress disorder (PTSD) and other mood disorders in which decreased NAA/Cr ratios were found.

2015. Clinical Application of Proton MR Spectroscopy for Detecting Thalamic Abnormalities in Schizophrenic Patients

Hirotsugu Kado[1], Masao Omori[1], Hirohiko Kimura[1], Tetsuhito Murata[1], Eku Shimosegawa[2], Yuji Wada[1], Harumi Itoh[1]
[1]Fukui Medical University, Fukui, Japan; [2]Research Institute for Brain and Blood Vessels, Akita, Akita, Japan

Numerous investigations suggest that thalamic abnormalities may underlie symptom formation in schizophrenia. In the present study, in vivo 1H-MR spectra of the thalamus was investigated in 20 schizophrenic patients and 16 age-matched control subjects to assess the utility of MR spectroscopy in detecting thalamic abnormalities. Patients had significantly lower NAA/Cr and Cho/Cr ratios in the thalamus compared to control subjects, while no significant difference was found in the frontal lobes. We suggest that these findings reflect thalamic dysfunction and diminution of white matter tracts adjacent to the thalamus in schizophrenia.

2016. High Resolution MRI Neuromorphometric Assessment of the Hippocampal Subiculum in Mood Disorders

Allison C. Wymore[1], Suzanne Wood[1], Earle Bain[1], Har Tan[1], Sean Marrett[1], Joseph Price[2], Lalith Talagala[3], Alan Koretsky[3], Husseini Manji[1], Dennis Charney[1], Wayne C. Drevets[1]
[1]National Institute of Mental Health, Bethesda, Maryland, USA; [2]Washington University, St. Louis, Missouri, USA; [3]National Institute of Neurological Disorders and Stroke, Bethesda, Maryland, USA

Neuromorphometric MRI studies have reported reductions in hippocampal volume in mood disorders. However, differences relative to control samples have been subtle, and were not confirmed by most replication attempts. Two post mortem studies of bipolar disorder (BD) found abnormal reductions of synaptic proteins in the subiculum and of the spine density on pyramidal cell apical dendrites in the subiculum and CA1, which did not extend to other hippocampal subregions. The current study utilized high resolution MRI to investigate whether the subiculum can be reliably segmented in MRI images.

2017. A Morphometric Study of Autism

Gordon D. Waiter[1], Justin HG Williams[1], Andrew Whiten[2], David I. Perrett[2], Alison D. Murray[1], Emma J. Hepburn[1], Anne Gilchrist[3]
[1]University of Aberdeen, Aberdeen, UK; [2]University of St Andrews, St Andrews, UK; [3]Cornhill Hospital, Aberdeen, UK

Autism is a complex developmental disability that typically appears during the first three years of life. We report structural MRI data on 16 high-functioning individuals with autistic spectrum disorder. A voxel by voxel analysis of the brain identified grey matter differences relative to 16 age- and IQ- matched controls. Increased grey matter volume in the ASD subjects was found in the cerebellum, superior frontal gyrus and the middle temporal gyrus with decreased volume in the inferior parietal lobule and the inferior and middle frontal gyri.

2018. Normal Cerebral Asymmetry in Early Onset Schizophrenia

Michael Hadjulis[1], Sophia Frangou[1], Andrew Simmons[1]
[1]Institute of Psychiatry, London, UK

As aberrant neurodevelopment may relevant to early onset schizophrenia (EOS; age of onset < 17th birthday) we examined brain lateralisation in adolescent schizophrenics (n=40) and matched healthy controls (n=40). The volumes of the occipitoparietal, sensorimotor, premotor, prefrontal, and temporal regions were measured bilaterally from MR images using stereological methods. Asymmetry indices were calculated for each region and a composite asymmetry index (torque) was computed as the sum of the five index scores. As there were no group differences in any asymmetry measure examined the onset of EOS may not be associated with abnormal hemispheric laterality.

2019. Multi-Spectral Imaging of the Interface between Gray Matter and White Matter Shows Abnormality in Schizophrenia

James Donald Christensen[1], David L. Garver[1]
[1]University of Louisville, Louisville, Kentucky, USA

Precise localization of the interface between gray matter and white matter was achieved using a new method of multi-spectral MRI post-processing. A probabilistic neural network classifier computed tissue fractions for gray matter and white matter in each voxel. The spatial gradients of these tissue fractions were computed and their vector product yielded a highly selective spatial filter for the gray matter – white matter interface. Compared to normal controls, schizophrenic patients had a broader, more diffuse tissue interface characterized by a larger volume of mixed tissues and a lower tissue fraction gradient.

2020. Altered Asymmetry in Affected But Not Unaffected Family Members With Schizophrenia Revealed by Automatic Image Analysis Method

Roozbeh Rezaie[1], Clare E. Mackay[2], Thomas R. Barrick[3], Lynn E. DeLisi[4], Tim J. Crow[2], Neil Roberts[1]
[1]University of Liverpool, Liverpool, Merseyside, UK; [2]University of Oxford, Oxford, Oxfordshire, UK; [3]St. George's Hospital Medical School, University of London, London, UK; [4]New York University, New York, New York, USA

To test the hypothesis that schizophrenia is caused by genetically determined alterations in cerebral asymmetry, a reflection based automated image analysis technique was applied to investigate regional grey and white matter asymmetries in patients with schizophrenia, unaffected relatives and healthy controls. No differences in asymmetry were observed between unaffected relatives and either patients or controls. Significant differences in asymmetry between patients and unrelated controls were found in the posterior cingulate (leftward in controls, close to symmetry in patients) and medial frontal gyrus (controls more rightwardly asymmetric than patients). We therefore provide support for phenotypic alterations of asymmetry in schizophrenia.

Epilepsy

Hall D Tuesday 13:30 - 15:30

2021. Texture Analysis in Mesial Temporal Lobe Epilepsy

Neda Bernasconi[1], Samson B. Antel[1], Andrea Bernasconi[1]
[1]Montreal Neurological Institute and McConnell Brain Imaging Centre, Montreal, Quebec, Canada

We used texture analysis to assess structural integrity of mesial temporal structures (hippocampus, amygdala and entorhinal cortex) in patients with medically intractable temporal lobe epilepsy (TLE). Compared to normal controls, TLE patients were found to have mostly bilateral abnormalities, particularly in the entorhinal cortex. Textural abnormalities were present regardless of atrophy. Texture analysis allows the characterization of differences in patterns of gray-level intensity that are unrecognizable by visual observation and volumetric analysis.

2022. Executive Dysfunction in Temporal Lobe Epilepsy: Evidence of Prefrontal Atrophy using Voxel Based Morphometry

Simon Sean Keller[1], Udo Wieshmann[2], Gus Baker[2], Christine Denby[1], Neil Roberts[1]
[1]University of Liverpool, Liverpool, Merseyside, UK; [2]Walton Centre for Neurology and Neurosurgery, Liverpool, Merseyside, UK

We used voxel-based morphometry (VBM) on three-dimensional Magnetic Resonance (MR) images to investigate grey matter volumetric correlates of executive dysfunction (ED) in patients with temporal lobe epilepsy (TLE). Patients with TLE and ED had reduced grey matter volume in bilateral medial prefrontal cortex (PFC), orbitofrontal cortex and right temporal neocortex compared to age-matched TLE patients without ED, and controls. These results suggest that PFC atrophy may be an underlying cause of ED in patients with TLE.

2023. Quantitative Assessement of Temporopolar Cortex and White Matter in Temporal Lobe Epilepsy using Volumetric MRI and Texture Analysis

Neda Bernasconi[1], Samson B. Antel[1], Tejas Sankar[1], Andrea Bernasconi[1]
[1]Montreal Neurological Institute and McConnell Brain Imaging Centre, Montreal, Quebec, Canada

Signal intensity abnormalities have been described in the anterior temporal pole. The temporopolar cortex constitutes the rostralmost portion of the temporal pole. As part of limbic network, this cortex is heavily interconnected to mesial temporal lobe structures. We assessed quantitatively the temporopolar cortex and white matter using volumetric MRI and texture analysis in patients with medically intractable temporal lobe epilepsy. We found structural changes in the temporopolar cortex and white matter characterized by a combination of atrophy and signal changes. Pathological changes of temporopolar cortex and white matter could contribute to signal abnormalities observed in the temporal pole.

2024. MRI Evidence for Progressive Structural Damage in Temporal Lobe Epilepsy

Neda Bernasconi[1], Andrea Bernasconi[1], Jun Natsume[1], Samson B. Antel[1], Zografos Caramanos[1], Frederick Andermann[1], Douglas L. Arnold[1]
[1]Montreal Neurological Institute and McConnell Brain Imaging Centre, Montreal, Quebec, Canada

To determine whether mesial structural damage in temporal lobe epilepsy (TLE) is progressive, we assessed the relationship between MRI volumetric measurements of the hippocampus, amygdala and entorhinal cortex, and duration of epilepsy in 82 patients. The negative correlation we found between mesial temporal volumes and duration of epilepsy indicates that progressive damage occurs in TLE. Regression analysis showed that at the time of the onset of recurrent seizures, volumes of the entorhinal cortex and hippocampus are abnormally low ipsilateral to the focus, suggesting that both these structures play a pivotal role in the pathogenesis of intractable TLE.

2025. *In-Vivo* Proton MRS of the Hippocampus in Unilateral Temporal Lobe Epilepsy

Todd K. Stevens[1], Warren T. Blume[1], Donald H. Lee[1], R Bartha[2]
[1]The University of Western Ontario, London, Ontario, Canada; [2]Robarts Research Institue, London, Ontario, Canada

Glutamate and glutamine are important excitatory neurotransmitters that have been linked to epileptic activity. Using a combination of short echo time proton magnetic resonance spectroscopy (1H MRS), macromolecule subtraction, water suppression, lineshape correction and spectral fitting techniques, glutamate and glutamine along with 17 other metabolites were quantified in 3 MRI negative temporal lobe epilepsy (TLE) patients. Results showed a bilateral decrease in N-acetyl-asparate in one patient and decreased creatine and myo-inositol in all 3 patients with respect to a control group, while preliminary observations of glutamate and glutamine levels were inconclusive.

2026. Identification of the Epileptogenic Focus in Neocortical Epilepsy (NE) with Proton Multislice Magnetic Resonance Spectroscopic Imaging (MRSI)

Susanne G. Mueller[1], Kenneth D. Laxer[2], Jerome A. Barakos[2], Nathan Cashdollar[1], Derek L. Flenniken[1], Peter Vermathen[1], Gerald B. Matson[1], Michael W. Weiner[1]
[1]VAMC, San Francisco, California, USA; [2]California Pacific Medical Center, San Francisco, California, USA

Background: The aim of this study was to evaluate the usefulness of MRSI for the identification of the epileptogenic focus in NE. Methods: MRSI in combination with tissue segmentation was performed on 21 NE and 19 controls. In controls, NAA/Cr and NAA/Cho of all voxels of a given lobe was expressed as a function of white matter content and thresholds for pathological values determined by calculating the 95% prediction intervals for NAA/Cr and NAA/Cho. Results: MRSI correctly identified the lobe containing the epileptogenic focus in 62% of the NE patients. Conclusion: MRSI helps to define the epileptogenic focus in NE.

2027. Combined Triggered EEG-fMRI and ^{1}H Spectroscopy in the Localization of Extratemporal Epileptic Activity.

Ivan Zimine[1], Francois Lazeyras[1], Mohamed L. Seghier[1], Goran Lantz[1], Margitta Seeck[1]
[1]University Hospital of Geneva, Geneva, Switzerland

We combined EEG triggered fMRI and 1H spectroscopy to improve the localization and characterization of epileptic foci in patients with non-lesional extratemporal epilepsy. In 5 patients, EEG-fMRI revealed discrete activated areas, which served as a guide to place 1H-MRS voxel. Spectroscopy data, thus obtained, showed a marked reduction of NAA/Cho ratio ipsilateral to the epileptic focus in all patients. Our results suggest that the combination of EEG-fMRI and 1H-MRS might bring new insight into extratemporal epileptic foci characterization.

2028. Serial Quantitative Atlas-based MRI Volumetry to Assess Progressive Neocortical Damage in Epilepsy

Rebecca SN Liu[1], Louis Lemieux[1], Alexander Hammers[1], Gail S. Bell[1], Sanjay M. Sisodiya[1], Simon D. Shorvon[1], Josemir WAS Sander[1], John S. Duncan[1]
[1]Institute of Neurology, London, UK

We investigated the pattern of generalized and focal neocortical atrophy that develops in patients with epilepsy. Patients and controls were scanned 3.5 years apart. Image subtraction was used to identify neocortical change that was quantified by automatic segmentation and a regional brain atlas. New focal or generalized neocortical volume losses were identified in 54% of patients with chronic epilepsy, 39% of newly diagnosed patients and 24% of controls. The increased risk of cerebral atrophy in epilepsy was not related to a history of documented seizures. Cerebral atrophy may therefore be widespread and remote from the epileptic focus.

2029. Perfusion and Diffusion Weighted Brain Imaging of the Neonate Presenting with Seizures

Mary Ann Rutherford[1], David J. Larkman[2], Serena J. Counsell[1], Joanna Allsop[1], Olga Kapellou[2], Michael Harrison[2], Joseph V. Hajnal[2], Sabine Heiland[3]
[1]Medical Research Council, London, England, UK; [2]Imperial College, London, England, UK; [3]Neurorafiologie Universitatsklinikum, Heidelberg, Germany

Neonatal diffusion and perfusion weighted imaging examinations have not been reported in the literature. We have imaged nineteen infants presenting with neonatal seizures. Infants with global injury did not always show marked reduction in apparent diffusion coefficient ADC values in tissue that subsequently broke down. This was true for both basal ganglia and white matter. In apparently normal neonatal white matter it was difficult to detect perfusion with this method. In infants with global damage perfusion was markedly increase within white matter that subsequently infarcted despite relatively normal ADC values. Further serial studies in the neonate are needed.

2030. T_2 Relaxometry of Temporal Lobe White Matter in Temporal Lobe Epilepsy

Tiffany N. Townsend[1], Neda Bernasconi[1], Frederick Andermann[1], Bruce G. Pike[1], Andrea Bernasconi[1]
[1]Montreal Neurological Institute, McGill University, Montreal, Quebec, Canada

We assessed temporal lobe white matter signal changes using T2 relaxometry in 56 patients with pharmacologically intractable temporal lobe epilepsy (TLE). Compared to a group of 30 healthy controls, TLE patients showed bilateral T2-signal increase in the temporal lobe WM (WM-T2). There was no difference in mean WM-T2 between patients with hiuppocampal atrophy and those with normal hippocampal volume. Yet, we found a positive correlation between WM-T2 and T2 relaxation times in the hippocampus. This finding suggests dissociation between the pathophysiology underlying WM-T2 changes and that underlying hippocampal atrophy in TLE.

Traumatic Brain Injury

Hall D Saturday 14:00 - 16:00

2031. Assessment of Tissue Damage with Magnetization Transfer Ratio and T_2 Quantitation in Traumatic Brain Injury

Rakesh K Gupta[1], Rajesh Kumar[1], Sajja Rao[2], Sanjeev Chawla[1], Mazhar Husain[3], Sunil Pradhan[1], RamKishore Rathore[2]
[1]SGPGIMS, Lucknow, India, Lucknow, Uttar Pradesh, India; [2]Indian Institute of Technology, Kanpur, Uttar Pradesh, India; [3]King George's Medical College, Lucknow, Uttar Pradesh, India

We have tested hypothesis whether normal appearing adjacent gray and white matter regions on T2 and magnetization transfer (MT) image shows any abnormality on quantitative imaging in patients with traumatic brain injury (TBI). Fifty-one patients with TBI and 10 normal subjects were included. There were significant differences in T2 and MT ratio values of T2 and MT normal appearing gray matter region adjacent to image abnormality compared to normal gray matter region ($p< 0.05$). We conclude that quantitative T2 and MT ratio values provide additional abnormality in patients with TBI that is not discernable on T2 and MT imaging.

2032. Metabolite Changes Identified by Serial Proton Magnetic Resonance Spectroscopy Can Differentiate Long-Term Neurologic Outcome in Traumatic Brain Injury.

Barbara Ann Holshouser[1], Karen Angela Tong[1], Austin Colohan[1], Lori Shutter[1]
[1]Loma Linda University Medical Center, Loma Linda, California, USA

1H-MRS was used serially to measure brain metabolite changes in subjects with severe traumatic brain injury. The initial study was taken at 7± 4 days after injury using quantitative single voxel (STEAM;TR/TE=3000/20 ms) and MR spectroscopic imaging (PRESS; TR/TE=3000/144 ms) and repeated at 7.5± 2.6 months after injury. In subjects with poor neurologic outcomes at follow-up: SVS showed initial elevation of glutamate/glutamine and choline which normalized at follow-up. N-acetylaspartate (NAA) decreased and myo-inositol increased significantly at follow-up in parietal white matter. Mean NAA/Creatine from MRSI decreased significantly at follow-up only in subjects with poor neurologic outcomes.

2033. Application of Volumetric Proton MRSI to Mild Traumatic Brain Injury

Varanavasi Govindaraju[1], Grant Gauger[2], Geoffrey Manley[2], Andreas Ebel[1], Andrew Maudsley[1]
[1]University of Miami, Miami, Florida, USA; [2]University of California, San Francisco, California, USA

Cellular level injury is recognized to occur in a significant number of patients following mild traumatic brain injury (MTBI). Such injury is poorly understood, though it may be responsible for many neuropsychological dysfunctions and long-term disability seen in MTBI patients. A volumetric proton MR spectroscopic imaging (MRSI) method was used in this study to map metabolite distributions over the entire human brain in order to allow comparison of metabolite ratios of MTBI patients with controls. Statistically significant changes ($p<0.05$) in metabolite ratios relative to controls were found in some, but not all, brain regions.

2034. Increased Apparent Diffusion Coefficient in Normal Appearing White Matter Following Traumatic Brain Injury in Humans

Pablo Goetz[1], Andrew Blamire[1], Bheeshma Rajagopalan[1], Tom Cadoux-Hudson[2], Peter Styles[1]
[1]MRC Biochemical and Clinical Magnetic Resonance Spectroscopy Unit, Oxford, UK; [2]Radcliffe Infirmary, Oxford, UK

Traumatic Brain Injury (TBI) patients with persistent neurobehavioural deficits often display normal conventional imaging. 1H-spectroscopy shows metabolic abnormalities in normal appearing white matter (NAWM). Previous experimental DWI studies show inconsistent ADC-change patterns. To unveil relaxation abnormalities below the visual threshold and to further characterize diffusion changes, we measured absolute T1, T2 and ADC. The patient group showed an increase in ADC of the NAWM, which was significant in the centrum semiovale (6.49±42 x10-4mm2s-1, mean±SD; controls 6.19±30; p=0.007), with no significant changes in absolute T1 or T2 relaxation times compared to controls. Microstructural changes may be an underlying mechanism.

2035. Correlation of Hemorrhagic Shearing Injury Demonstrated on Susceptibility Weighted Imaging (SWI) with Glasgow Coma Scale in the Initial Assessment of Traumatic Brain Injury.

Karen Angela Tong[1], Lori Shutter[1], Barbara Ann Holshouser[1], Austin Colohan[1], Stephen Ashwal[1]
[1]Loma Linda University Medical Center, Loma Linda, California, USA

The diagnosis of diffuse axonal injury (DAI) is often difficult to confirm on conventional imaging but has significantly improved with a high resolution 3D susceptibility weighted imaging (SWI) technique that dramatically increases detection of small parenchymal hemorrhages suggestive of shearing injury. This study compares the extent of hemorrhage demonstrated by this method to initial GCS scores in 37 patients. A significant inverse correlation between hemorrhage extent and GCS is definitively shown. There is also a significant difference between mean values in dichotomized GCS groups. These findings suggest that SWI can improve diagnosis of DAI.

2036. Correlation of Whole Brain Apparent Diffusion Coefficient with Glasgow Coma Score among Traumatic Brain Injury Patients

Rao P. Gullapalli[1], Steven R. Roys[1], Prasad A. Murthy[1], Karthikeyan Shanmuganathan[1], Stuart Mirvis[1]
[1]University of Maryland Medical System, Baltimore, Maryland, USA

Quantitative whole-brain MR diffusion histograms in patients admitted with traumatic brain injury were evaluated and compared to those obtained from normal control subjects. Patients with normal MR imaging findings but low Glasgow coma score (GCS) showed an increased apparent diffusion coefficient (ADC). In addition, patients with lesions confined to the cortex that had minimal abnormal MR imaging findings but low GCS score showed significantly increased whole brain ADC's compared to similar group of patients with normal GCS score. A strong correlation between the ADC values and the GCS scores of the different groups was found.

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
Neurodegeneration: From Mouse to Man

Room 701B Sunday 13:30 - 15:30 Chairs: Laurel O. Sillerud and Steve C.R. Williams

13:30 **2037. Quantitative T_2 Evidence for Selective Hippocampal Involvement in a Transgenic Mouse Model of AD**

Maria-Fatima Falangola[1], Victor Dyakin[1], Sang-Pil Lee[1], Adam Bogart[1], Kristina Estok[1], Karen Duff[1], Ralph Nixon[1], Joseph A. Helpern[1]
[1]Nathan Kline Institute, Orangeburg, New York, USA

We have investigated regional differences and distribution of brain water T2 relaxation times in three transgenic mouse lines recapitulating features of Alzheimer's Disease (AD), at two different ages. This analysis demonstrated a shift to shorter T2 values in the cortex and hippocampus of amyloid forming (PS-APP) mice compared with non-transgenic (NTG) littermate controls. In addition, singly transgenic PS mice, which have modestly elevated levels of soluble amyloid-ß peptide (Aß), but not amyloid deposits, demonstrated reduced T2 values only in the hippocampus, a finding that may suggest selective vulnerability for this region even in the absence of Aß deposition.

13:40 **2038. Age-Related White Matter Changes in Alzheimer Disease Mice Detected using DTI**

Joong Hee Kim[1], Shiow-Jiuan Lin[1], Robert P. Brendza[1], David M. Holtzman[1], Sheng-Kwei Song[1]
[1]Washington University, St. Louis, Missouri, USA

In this study, we have utilized PDAPP mice, a mouse model that develops age-dependent Ab deposition and neuritic plaque formation, combined with DTI to examine the white matter in mice prior to and following the development of AD-like pathology. Importantly, while PDAPP mice develop significant neuritic dystrophy coincident with amyloid deposition, they do not develop cerebrovascular disease, gray or white matter infarcts, or appreciable neuronal loss. Thus, the findings of current study may potentially shed lights on white matter pathology in AD mice without complication of vascular components.

13:50 **2039. *In Vivo* $T_{1\rho}$-weighted MRI of Amyloid Transgenic Mouse Model of Alzheimer's Disease**

Arijitt Borthakur[1], Kunihiro Uryu[1], Sharon B. Shively[1], Harish Poptani[1], Matthew Corbo[1], Sridhar R. Charagundla[1], John Q. Trojanowski[1], Virginia M.-Y. Lee[1], Ravinder Reddy[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Early in its disease progression, Alzheimer's disease (AD) is characterized by the formation of amyloid (i.e. senile) plaques, which are extra-cellular deposits of insoluble amyloid-β peptide. Currently, there is a dearth of *in vivo* imaging techniques for the early detection of AD plaques. In previous studies, $T_{1\rho}$-weighted (or spin-lock) MRI has shown some promise in generating tissue contrast based on variations in protein content. Here, we demonstrate the feasibility of $T_{1\rho}$-weighted MRI in generating selective contrast in Aβ plaques in the brains of transgenic mouse models of the AD amyloidosis (Tg2575) *in vivo*.

14:00 **2040. Detection of Basal Activity Level using Physiological MRI Noise –Application for Parkinson's Disease**

Galit Pelled[1], Hagai Bergman[2], Tamir Ben-Hur[1], Gadi Goelman[1]
[1]Hadassah Hebrew University Hospital, Jerusalem, Israel; [2]Hadassah Medical School, The Hebrew University, Jerusalem, Israel

Previous imaging studies in human Parkinson's disease (PD) patients and PD rats are inconsistent, regarding sensorimotor cortex activity. We introduce a unique method based on BOLD temporal fluctuations for measuring spontaneous activity level, and have detected the sensorimotor cortex and striatum in the 6-OHDA PD rat model. Since fMRI is a relative measurement, high BOLD signal can be observed when basal activity level is lower then normal. Reduced basal activity was found in the sensorimotor cortex and the striatum in the PD rats compare to sham-operated rats. These results agree with the classical basal ganglia-cortex model and previous autoradiography studies.

14:10 *2041*. Age-Dependent Arterial Cerebrovascular Abnormalities in a Mouse Model of Alzheimer's Disease Revealed by High Resolution Magnetic Resonance Angiography (MRA) and by Corrosion Casts

Nicolau Beckmann[1], Alexandra Schuler[2], Thomas Mueggler[1], Eric P. Meyer[2], Matthias Staufenbiel[1], Thomas Krucker[3]
[1]Novartis Institute for Biomedical Research, Basel, Switzerland; [2]University of Zurich, Zurich, Switzerland; [3]The Scripps Research Institute, La Jolla, California, USA

Age-dependent flow disturbances were seen in vivo in large arteries of the circle of Willis in APP23 transgenic mice, a model of Alzheimer's disease (AD). In 6-month-old mice, no flow abnormalities were discernible. However, at the age of 11 months, flow voids were present in carotid arteries. Severe flow perturbations were seen additionally in other arteries of 20-month-old APP23 mice. Cast technology revealed that, at sites where flow voids had been detected in vivo, vessel elimination and/or deformation had taken place. Our results support the idea that cerebral microcirculatory abnormalities evolving progressively could contribute to events leading to AD pathogenesis.

14:20 *2042*. CBV and CBF Measurements using GE_EPI Bolus Tracking in Different Mice Models Related to ALS Pathology

Greetje Vanhoutte[1], Erik Storkebaum[2], Peter Carmeliet[2], Annemie Van der Linden[1]
[1]University of Antwerp, Antwerpen, Belgium; [2]Katholic University of Leuven, Leuven, Vlaams-Brabant, Belgium

In some neurodegenerative diseases it is questioned whether perfusion deficits are the cause or the result of the neurodegeneration processes. We studied cerebral perfusion (CBF and CBV) using bolus tracking, in four different genotype (VEGF/SOD) mice models for motor neurodegeneration, reminiscent of Amyotrophic Lateral Sclerosis (ALS). We demonstrated that the co-excistence of 2 mutations, in VEGF and SOD, resulting in a more severe phenotype, displayed a reduced CBF, but an unaffected CBV, suggesting abnormalities in the cerebral hemodynamic response of these mice.

14:30 *2043*. A Quantitative MRI Study of Lesion Progression in Experimental Autoimmune Encephalomyelitis in the Common Marmoset Model for MS

Erwin Blezer[1], Herbert Brok[2], Bert 't Hart[2], Klaas Nicolay[3]
[1]Medical Center Utrecht, Utrecht, Netherlands; [2]Biomedical Primate Research Center, Rijswijk, Netherlands; [3]Eindhoven University of Technology, Eindhoven, Netherlands

Quantitative MRI was used to monitor lesion progression in a model of multiple sclerosis, the experimental autoimmune encephalomyelitis model in the marmoset. Most white matter lesions increased in size during the progression of EAE. Furthermore lesions showed a persistent increase in relaxation times, a reduction in MTR values and an increase in leakage of the blood brain barrier compared to WM/NAWM. As these values showed no signs of normalization with time we conclude that most lesions in this model have a persistent inflammatory activity.

14:40 *2044*. Regional Atrophy in Mouse Lemur, a Lissencephalic Primate

Marc Dhenain[1], Evelyne Chenu[1], Calvin K. Hisley[2], Fabienne Aujard[3], Andreas Volk[1]
[1]U350 INSERM - Curie Institute, Orsay, France; [2]University of Maryland Medical System, Baltimore, Maryland, USA; [3]CNRS UMR 8571, Brunoy, France

Age-related regional cerebral atrophy was evaluated in 12 mouse lemurs aged from 1.9 to 10.9 years. They are small lissencephalic primates, model of cerebral aging. MR images (3D IR-RARE, isotropic resolution = 234µm) were segmented with an automatic method and the CSF volume was estimated in various ventricular areas and in 11 regions of the peri-encephalic space that were carefully selected on the basis of cytoarchitectonic areas and of anatomical landmarks. Dilation of the mamillary fossa was an early event in the aging process. A severe atrophy of occipital and temporo-parietal cortices was detected in the oldest animals.

14:50 *2045*. Mapping Dopaminergic Function in Normal and MPTP Treated Monkeys with Pharmacological MRI and PET

Bruce G. Jenkins[1], R. Sanchez Pernaute[2], Y. Iris Chen[1], C. Owen[1], O. Issacson[2], B. R. Rosen[1], A. L. Brownell[1]
[1]MGH-NMR Center, Charlestown, Massachusetts, USA; [2]Udall Parkinson's Disease Research Center of Excellence, Belmont, Massachusetts, USA

Amphetamine induces a large release in dopamine. This release is depdendent upon an intact dopamine system. Loss of dopamine neurons is the cause of Parkinson's disease (PD). In this work we investigate how the hemodynamic changes evoked by D-amphetamine in normal and parkinsonian monkeys can be mapped using pharmacologic MRI (phMRI) and PET to validate the degree of dopaminergic denervation after treatment with the toxin MPTP.

15:00 *2046*. A Whole Brain MR Spectroscopy Study from Patients with Alzheimer's Disease and Mild Cognitive Impairment

Andrea Falini[1], Marco Bozzali[1], Massimo Filippi[1], Guglielmo Pero[1], Anna Gambini[1], Giuseppe Magnani[1], Massimo Franceschi[1], Giancarlo Comi[1], Giuseppe Scotti[1]
[1]Ospedale San Raffaele, Milan, Italy

We studied 25 patients with clinically probable Alzheimer's disease (AD), 11 with mild cognitive impairment (MCI) and 16 sex- and age-matched controls, using a non-localized proton magnetic resonance spectroscopy to quantify the N-acetylaspartate in the whole brain (WBNAA), Compared to controls, AD patients showed significantly lower brain volumes (BV) and WBNAA concentrations while MCI patients had a significant reduction of WBNAA concentration without significant differences of BV. This suggest that axonal loss/dysfunction occurs at a early stage in AD. The magnitude of the reduction of WBNAA in MCI might be a strong predicting factor of subsequent clinical evolution to AD.

15:10 *2047*. H-1 MRS in Differential Diagnosis of Common Dementia Syndromes

Kejal Kantarci[1], Ronald C. Petersen[1], Bradley F. Boeve[1], David S. Knopman[1], Glenn E. Smith[1], Robert J. Ivnik[1], Eric G. Tangalos[1], Clifford R. Jack, Jr.[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Our objective was to determine whether 1H MR spectroscopy (MRS) findings can differentiate the more common dementia syndromes: Alzheimer's disease (AD), vascular dementia (VaD), Lewy body dementia (LBD), and frontotemporal dementia (FTD). N-acetylaspartate/creatine (NAA/Cr) ratio was decreased in all dementia syndromes except LBD. Myoinositol (MI)/Cr ratio was elevated in all neurodegenerative dementias but not in VaD. Normal NAA /Cr levels in demented patients may be useful in distinguishing patients with LBD from those with other dementia syndromes, and elevated MI /Cr levels may be useful for distinguishing patients with neurodegenerative dementias from those with VaD.

15:20 *2048*. MRS and MRI Insights into the Diagnosis of the Heredo-degenerative Ataxias

Martin Viau[1], Christian Arseneau[1], Céline Bard[1], Suzanne Fontaine[1], Luc Marchand[1], Jean Léveillé[1], Yvan Boulanger[1]
[1]CHUM, Montréal, Québec, Canada

A wide variety of autosomal transmitted ataxias exists and their ultimate characterization requires genetic testing. As the choice of the appropriate genetic test is difficult, information from other clinical methods is essential to define a probable type of ataxia. In this study, MRS and MRI data from five brain regions were used to identify markers of different types of ataxias. Results indicate that different atrophy and metabolite patterns can be observed for different types of ataxias and should be useful for a differential characterization of the disease.

MR Spectroscopy of Human Brain: White Matter

Hall D Monday 13:30 - 15:30

2049. Reduction in Brain NAA Levels and Elevation in Cerebral Atrophy Are Associated with Cognitive Decline in Multiple Sclerosis: A ^{1}H MRS and Volumetric MRI Study

Alina Tudorica[1], Christopher Christodoulou[1], Lihong Li[1], Xiang Li[1], Patricia Melville[1], William Scherl[1], Patricia Roche[1], Zhengrong Liang[1], Lauren Krupp[1], Wei Huang[1]
[1]State University of New York, Stony Brook, New York, USA

The goal was to assess the relationships between brain metabolite levels, cerebral atrophy, and cognitive functions in patients with multiple sclerosis (MS). 1H MRS, volumetric MRI and neuropsychological testing were performed on 38 MS patients. In the posterior periventricular regions, ratios of NAA/Cr and NAA/Cho were positively correlated with cognition, but inversely associated with central cerebral atrophy. These correlations were stronger in the right hemisphere than the left. Central cerebral atrophy was inversely related to cognition. The findings suggest that axonal damage or injury occurs along with progression of atrophy and decline in cognition in MS.

2050. Apolipoprotein E Isoforms Correlate with NAA to Creatine Ratio in Patients Following Traumatic Brain Injury: A Proton Magnetic Resonance Spectroscopy Study

Matthew R. Garnett[1], Andrew M. Blamire[1], Robin G. Corkill[1], Thomas AD Cadoux-Hudson[1], Bheeshma Rajagopalan[1], Peter Styles[1]
[1]University of Oxford, Oxford, UK

Following traumatic brain injury (TBI), patients with the ε4 allele of apolipoprotein E have worse outcome than patients without the ε4 allele. We obtained proton MRS from 17 TBI patients and 20 control subjects. Controls (n=6) with ε4 had normal spectra. Patients with the ε4 allele (n=6) had a significantly lower N-acetyl-aspartate to creatine (NAA/Cr) ratio compared to patients without this allele. This finding was independent of severity or outcome from injury. The reduction in NAA, a marker for neuronal stability, which occurred after injury, may explain the poorer outcome following TBI.

2051. Diffuse Cerebral Choline and Creatine Elevation as Indicators of Relapsing Remitting Multiple Sclerosis Activity

Matilde Inglese[1], Belinda SY Li[1], Henry Rusinek[1], James S. Babb[1], Robert I. Grossman[1], Oded Gonen[1]
[1]New York University, New York, New York, USA

Introduction: Diffuse Multiple Sclerosis disease activity leading to neuronal/axonal damage persists even during the clinically stable phase. Although not visible on conventional MRI, this ongoing activity involves the normal-appearing white matter (NAWM) (1,2) and plays an important role in the evolution of the disease from its initial relapsing-remitting (RR) form to its final secondary progressive stage. To quantify its metabolic characteristics we compared the absolute levels of N-acetylaspartate , Creatine and Choline in the NAWM, between Relapsing-Remitting (RR) MS patients and controls. Methods: Absolute metabolites' concentrations were obtained with 3D-1HMRS, in a 480 cm3 VOI, centered about the corpus callosum

Human Brain MR Imaging and Spectroscopy of Dementias and Degenerative Syndromes

Hall D Tuesday 13:30 - 15:30

2052. Is it Possible to Differentiate Brain Abscesses from Neurocysticercosis by Proton MR Spectroscopy?

Sanjeev Chawla[1], Rakesh K Gupta[1], Monika Garg[1], Mazhar Husain[2], Nuzhat Husain[2], Kashinath Prasad[1]
[1]Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [2]Chhatrapati Shahu Ji Maharaja Medical University, Lucknow, Uttar Pradesh, India

Brain abscesses and neurocysticercosis (NCC) occasionally may offer diagnostic problems due to their nonspecific appearance on MRI. In present study, ex vivo proton MR spectroscopy (PMRS) data of 40 samples of pus from brain abscess patients and 13 samples of cysticercus cyst from swine brain was retrospectively analyzed. Cysticercus fluid has given creatine, choline, and glucose signals in addition to the resonances seen in brain abscesses. We conclude that it is possible to differentiate brain abscesses from NCC on ex vivo study and this information will help in their characterization on in vivo PMRS.

2053. MR Spectroscopy Suggests Neuro-Axonal Dysfunction in Patients with Coeliac Disease

Marco Bozzali[1], Anna Gambini[1], Massimo Filippi[1], Angelo Ghezzi[2], Giancarlo Comi[1], Giuseppe Scotti[1], Andrea Falini[1]
[1]Ospedale San Raffaele, Milan, Italy; [2]Ospedale di Gallarate, Gallarate, Italy

We studied 7 adult patients with coeliac disease (CD) and 4 age-matched normal subjects with single voxel MR-Spectroscopy (MRS) located on T2-hyperintense white matter (WM) lesions of patients and in normal appearing white matter (NAWM), and with a non-localized MRS able to quantify the whole brain concentration of N-Acetilaspartate (WBNAA). The aims of the study were to give insight in cerebral involvement of CD patients and to verify the damage extension.We observed a significant reduction of WBNAA, brain volume, NAA/Creatine in pathological and NAWM of patients, suggesting neuronal dysfunction or loss extended beyond WM lesions to NAWM.

2054. Brain Metabolism Measurement on a MELAS Patient Using 2-T Highly Sensitive ^{13}C-MRS System

Kazuya Okamoto[1], Hidehiro Watanabe[1], Masaaki Umeda[1], Masanori Oda[2], Tomoyuki Kanamatsu[2], Yasuzo Tsukada[2], Taisuke Otsuki[3]
[1]Toshiba Co., Otawara, Tochigi, Japan; [2]Soka University, Hachioji, Tokyo, Japan; [3]National Center of Neurology and Psychiatry, Kodaira, Tokyo, Japan

We report a MELAS patient study on glucose metabolism measurement in brain following oral administration of [1-^{13}C] glucose with 2-T ^{13}C-MRS system, which is equipped with a multislice ^{1}H-^{13}C HSQC sequence and so on. Data acquisition was performed from 30 minute after oral administration to 60 minutes. Compared with the concentration of [4-^{13}C] glutamate and [3-^{13}C] lactate on healthy volunteers, [4-^{13}C] glutamate level is lower and [3-^{13}C] lactate is higher on the MELAS patient. Lactate level in blood was in the range of a normal value. This suggests that the anaerobic pathway is activated in the MELAS patient brain.

2055. Proton MR Spectroscopic Changes in Parkinson's Disease

Hyun-Man Baik[1], Bo-Young Choe[2], Sung-Taek Chung[1], Jeong-Seok Kim[2], Hyoung-Koo Lee[2], Tae-Suk Suh[2]
[1]Medinus MR Center & Catholic Medical MR Center, Yongin-Si, Kyounggi-Do, Republic of Korea; [2]Catholic Medical MR Center, Seoul, Republic of Korea

To investigate whether there are significant changes in regional brain metabolism in patients with Parkinson's disease after thalamotomy using proton magnetic resonance spectroscopy (1H MRS). NAA/Cho ratios showed generally low levels in thalamus in Parkinson's disease patients with clinical improvement following thalamotomy. Our results suggest that NAA/Cho ratio may be a valuable criterion for evaluation of Parkinson's disease patients with the clinical improvement following surgery. 1H MRS may be a useful utility for the aid in better understanding the pathophysiologic process in Parkinson's disease patients on the basis of the variation of NAA/Cho ratio.

2056. Brain Metabolite Changes in Young Hyperlipidemic Patients Studied by *In Vivo* ^{1}H MRS

Virendra Kumar[1], Sanjeev Sinha[1], Anoop Misra[1], Randeep Guleria[1], R M. Pandey[1], Deepak kumar[1], R Singhania[1], N R. Jagannathan[1]
[1]All India Institute of Medical Sciences, New Delhi, Delhi, India

In vivo ^{1}H magnetic resonance spectroscopy (MRS) was carried out to investigate physiological and anatomical abnormalities of brain in young hyperlipidemic patients. Statistically no significant change in NAA/Cr ratio was observed in the parieto-temporal and occipital regions of hyperlipidemic patients compared to normal healthy subjects (controls). However, Cho/Cr, ratio was higher in these patients. Since Cho is associated with myelination, it may be concluded that myelination in these hyperlipidemic patients are affected.

2057. Metabolite Features of Chronic Fatigue Syndrome (CFS) Investigated by Multislice ^{1}H MRSI

Dikoma C. Shungu[1], Xiangling Mao[1], Susan Levine[2], P Cheney[3]
[1]Columbia University, New York, New York, USA; [2]Infectious Disease Specialist, New York, New York, USA; [3]The Cheney Clinic, Asheville, North Carolina, USA

This study reports the ^{1}H MR spectral characteristics associated with chronic fatigue syndrome. Thirty-one subjects diagnosed with the disorder were investigated. Fifteen of 31 exhibited abnormal MRSI spectra , whereas 16 of 31 showed no significant metabolic abnormalities: Twelve of 31 patients showed increased levels of ventricular lactate, and (b) 9 of 31 patients showed increased tCho/tCr and decreased NAA/tCr ratios in the thalamic/basal ganglia area, with 6 subjects in the preceding two groups exhibiting both types of features. These results suggest that CFS might be associated with mitochondrial energy metabolism dysfunction, as well as with neuronal damage or degeneration.

2058. Short Echo ^{1}H MRS at 4T of Motor Pathways in Human Brain

Lana G. Kaiser[1], Norbert Schuff[1], Nathan Cashdollar[2], Michael W. Weiner[1]
[1]University of California, San Francisco, California, USA; [2]DVA Medical Center, San Francisco, California, USA

4 T short echo 1H MRS was performed to determine effects of age and gender on metabolite ratios, including glutamate of motor neurons in mesial (MC) and lateral motor cortex (MCL) and corona radiata (CR) regions. In CR, Naa/Cr and Glu/Cr decreased with increasing age. In MC by contrast, only Glu/Cr decreased with increasing age. Glu/Cr of MC was higher than of CR. In contrast, both Naa/Cr and Cho/Cr of MC were lower than of CR. Sex differences were not significant. In conclusion, age and regional differences must be considered in analyzing MRS data from motor neuron regions.

2059. Brain Metabolism and Cerebrovascular Reserve Capacity: A Correlative Study with Proton MR Spectroscopy and Acetazolamide Test

Chang-Shin Lee[1], Fu-Nien Wang[2], Chao-Ying Wang[2], Cheng-Yu Chen[1]
[1]Tri-Service General Hospital, Taipei, Taiwan; [2]National Taiwan University, Taipei, Taiwan

Patients with carotid and/or cerebrovascular disease often have hemodynamic impairment of blood supply to the brain with reduced cerebrovascular reserve capacity. A previous MRS study in such patients has shown no evidence of reduced NAA in regions ipsilateral to a carotid stenosis or occlusion (1). This result may partially attribute to location of MRS voxal in areas without reduced perfusion reserve. We hypothesis that it is possible to detect increased abnormal metabolism if MRS voxel can be placed in areas with reduced cerebrovascular reserve. Perfusion measurements may allow the assessment of cerebral perfusion reserve by challenge such patients wi

2060. Whole-Brain N-Acetylaspartate Level Versus Cognitive Performance in HIV Infection

Matilde Inglese[1], Sohil H. Patel[1], Guila Glosser[2], Dennis L. Kolson[2], Robert I. Grossman[1], Oded Gonen[1]
[1]New York University, New York, New York, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

AIDS dementia complex (ADC) is a late stage HIV associated, syndrome characterized by progressive cognitive impairment and brain atrophy and afflicts 15-20% of patients (1). The diffuse extent of the disease in the central-nervous-system (CNS) was recently demonstrated by the correlation between the neuropsychological deficits in HIV-infected patients and the lower percentage of brain parenchymal volume (PBV), a global indicator of atrophy (2). The aims of this study were: i) to assess the total metabolic load of the disease, through the whole-brain NAA (WBNAA) concentration, which examines ›90% of this organ, which is especially well suited for diffuse CNS pathologies;

2061. Frontal Lobe CSI Abnormalities in Obstructive Sleep Apnea

Regula Sofia Briellmann[1], Fergal O'Donoghue[2], R Mark Wellard[1], Tony Waites[1], Peter Rochford[2], Robert Pierce[2], Graeme D. Jackson[1]
[1]Brain Research Institute, Heidelberg West, Victoria, Australia; [2]Institute for Breathing and Sleep, Heidelberg, Victoria, Australia

Obstructive sleep apnea (OSA) is characterized by repetitive hypoxemia and sleep fragmentation and results in impaired neurocognitive function and cerebrovascular disease. Whereas these characteristics are well studied, it is not well established whether there are abnormalities in the structure or metabolism of the brain associated with this disease.

2062. Age-Related Changes in the Midbrain Detected by Long-Echo Proton Magnetic Resonance Spectroscopy

Angel Moreno-Torres[1], Juan Deus[2], Alex Iranzo[3], Carles Soriano[1], Jesus Pujol[1]
[1]Centre Diagnòstic Pedralbes, Barcelona, Spain; [2]Hospital de Mataro, Mataro, Barcelona, Spain; [3]Hospital Clínic i Provincial de Barcelona, Barcelona, Spain

Midbrain tegmentum of fifty-seven normal volunteers aged from 23 to 79 years was studied by 1H-MRS (PRESS; TR/TE 1600/135 msec) and NAA/Cr, Cho/Cr, and metabolite/water ratios were calculated. The most significant finding was the decrease of NAA/water, Cho/water and Cr/water ratios with increasing age in the elderly group (>50 yr) while stable with age in the young group (<50 yr). These findings may reflect the neuronal loss and/or metabolic dysfunction associated with normal age-related involutive changes in the midbrain tegmentum.

2063. Relationship between Gray Matter and IQ: An MR Study with Optimized Voxel Based Morphometry

Qi Yong Gong[1], Vanessa Sluming[1], Thomas Barrick[1], Simon Keller[1], Enis Cezayirli[1], Andrew Mays[1], Neil Roberts[1]
[1]The University of Liverpool, Liverpool, England, UK

Optimized voxel-based morphometry was used to investigate the relationship between amount of gray matter and fluid intelligence. High-resolution T_1-weighted 3D volume MR images from 65 subjects under age 60 were analysed. Culture Fair scores were obtained as a measure of fluid intelligence. Voxel-by-voxel regression analysis was performed taking total brain grey matter as a confound and raw Culture Fair score as a covariate of interest. Gray matter volume (modulated data) and concentration (unmodulated data) in frontal lobe were significantly correlated with Culture Fair Score, supporting the hypothesis that general intelligence and prefrontal cortex are associated.

2064. Hahn, CPMG, and Combined Analysis of T_2 Relaxation in the Alzheimer's Hippocampus Using a Mixed Effects Model

Chastity Diane Shaffer Whitaker[1], Douglas W. Scharre[1], David Q. Beversdorf[1], Martina Pavlicova[1], Abhik Ray Chaudhury[1], Roger A. Dashner[1], Mark A. Smith[2], George Perry[2], Donald W. Chakeres[1], Petra Schmalbrock[1]
[1]The Ohio State University, Columbus, Ohio, USA; [2]Case Western Reserve University, Cleveland, Ohio, USA

Alzheimer's disease is presently diagnosed by observation of clinical symptoms and postmortem pathological assessment for amyloid plaques and neurofibrillary tangles. Histology and MR studies have indicated that there are accumulations of iron near extracellular plaques. Using high field MR we are especially sensitive to the susceptibility effects of subvoxel iron particles. Using a mixed effects statistical model to fit Hahn and CP spin echoes simultaneously, we examined susceptibility effects due to iron for different regions within the hippocampus of Alzheimer's brain compared to normal controls, as well as for white matter regions.

2065. A Diffusion Tensor Imaging Study of HIV-Dementia

Ann Ragin[1], Pippa Storey[2], Alejandro Chavez[1], Bruce Cohen[1], Leon Epstein[1], Robert R. Edelman[2]
[1]Northwestern University, Chicago, Illinois, USA; [2]Evanston Northwestern Healthcare, Evanston, Illinois, USA

Diffusion Tensor Imaging (DTI) can be used to derive quantitative in vivo measurements of region-specific and diffuse brain alterations. In this investigation, whole brain measures based on DTI, including fractional anisotropy (FA) and the Apparent Diffusion Coefficient (ADC), are compared in advanced HIV and control subjects. This study evaluates relationships between summary measures of whole brain involvement based on DTI and markers of disease progression (CD4 counts and viral load in plasma) and severity of dementia in the HIV subjects. The results support the utility of in vivo DTI for studying the effects of HIV induced pathology.

2066. The Severity of White Matter Lesions is Associated with Decreased Total Cerebral Blood Flow

Bob Bisschops[1], Yolanda van der Graaf[1], Willem Mali[1], Jereon van der Grond[1]
[1]University Medical Center, Utrecht, Netherlands

We investigated in 248 patients whether decreased blood flow to the brain brain is a riskfactor for the presence and severity of white matter lesions (WMLs). The MRI protocol consisted of a T2-w FLAIR and a 2D phase-contrast flow measurement of the internal carotid arteries and the basilar artery. The adjusted odds ratio for the presence of WMLs was 3.1 (95%CI 1.3-7.4) and for large WMLs was 3.3 (95%CI 1.2-8.7) in patients with low compared with high blood flow. We found that total blood flow to the brain is an independent riskfactor for the presence and severity of WMLs.

2067. Is There Any Leukoaraiosis in the Corpus Callosum? Analysis with Three Orthogonal Thin FLAIR Images.

Akira Yamamoto[1], Yukio Miki[1], Hidekazu Tomimoto[1], Mitsunori Kanagaki[1], Takahiro Takahashi[1], Yasutaka Fushimi[1], Junya Konishi[2], Tabassum Laz Haque[1], Junji Konishi[1]
[1]Graduate School of Medicine, Kyoto University, Kyoto, Japan; [2]Graduate School of Medicine, Kobe University, Kobe, Hyogo, Japan

Leukoaraiosis refers to incidental diffuse T2-weighted hyperintensity in white matter mostly found in aged populations. Many patients with leukoaraiosis develop progressive cognitive impairment. The most popular hypothesis of disease pathogenesis of leukoaraiosis is that acute disruption of blood supply in one perforating artery territory results in lacunar infarction, while a more chronic and widespread reduction in perfusion pressure causes leukoaraiosis. The corpus callosum exhibits several unusual anatomic features compared with the central white matter. Infarctions of the corpus callosum are not common and are attributed to a rich blood suppl

2068. Use of FLAIR Imaging in Diagnosing Amyotropic Lateral Sclerosis

Lijuan Zhang[1], Robert D. Zimmerman[1], Michael Lin[1], Michael Rubin[1], M Flint Beal[1], Aziz M. Ulug[1]
[1]Weill Medical College of Cornell University, New York, New York, USA

Amyotrophic Lateral Sclerosis is a progressive motor neuron disease involving upper and lower motor neurons. The diagnosis is established on clinical, laboratory and neuroimaging evidences. Patients usually die within 3-5 years of diagnosis. Early diagnosis of this disease may help to slow the disease progression by early start of therapeutic intervention. We investigated the overall diagnostic ability of MR FLAIR imaging in clinically verified ALS by scoring the signal abnormalities in FLAIR images of 18 ALS patients and 18 volunteers.

2069. High b Value Enhances Lesion-to-Normal Contrast for White Matter Degeneration in Alzheimer's Disease

Takashi Yoshiura[1], Futoshi Mihara[1], Atsuo Tanaka[1], Yasuo Kuwabara[1], Hiroshi Honda[1]
[1]Kyushu University, Fukuoka, Japan

We studied the effect of high b value on lesion-to-normal contrast of white matter degeneration in Alzheimer's disease (AD). Six AD patients and six healthy subjects were imaged at b values of 1000, 2000 and 4000 s/mm2, and normalized mean diffusivity (MD) in the parietal white matter was obtained for each b value. In the AD patients, the normalized MD at b = 4000 s/mm2 was significantly higher than that at 1000 and 2000 s/mm2, respectively. In the healthy subjects, there was no b value-related change. We concluded that high b value improves the lesion-to-normal contrast of white matter degeneration.

2070. Efficacy of the Diffusion Tensor MR Imaging in Alzheimer's Disease and Vascular Dementia

Shuji Sugihara[1], Toshibumi Kinoshita[1], Eiji Matsusue[1], Toshihide Ogawa[1]
[1]Faculty of Medicine, Tottori University, Yonago, Tottori, Japan

Diffusion weighted MR imaging was performed in control subjects, patients with Alzheimer's disease (AD), and patients with vascular dementia (VD). Fractional anisotropy (FA) was calculated in the genu and splenium of the corpus callosum, and anterior and posterior white matter. FA value of the posterior white matter in patients with AD was significantly lower than that of controls. FA value in the patients with VD was significantly lower than that of the AD and controls in any regions. The FA may be useful in the differentiation diagnosis of VD from AD.

2071. Abnormal White Matter Organization in Huntington's Disease Evaluated with Diffusion Tensor MRI

Jin-Suh Kim[1], Richard Kanaan[2], Walter Kaufmann[3], Christopher Ross[3], Vince Calhoun[1], Dongrong Xu[4], Dinggnag Shen[4], Christos Davatzikos[4], Godfrey Pearlson[1]
[1]Olin Neuropsychiatry Research Center, Hartford, Connecticut, USA; [2]Institute of Psychiatry, London, UK; [3]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; [4]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Six presymptomatic subjects with Huntington's disease and six normal controls were examined with diffusion tensor magnetic resonance imaging. The fractional anisotropy (FA) images were normalized using a nonlinear elastic registration method. The group difference of FA was compared using a voxel-wise nonparametric statistics and a regions of interest analysis. In a whole brain voxel-by-voxel comparison, reduced FA values were observed in the thalamic nuclei, frontal and occipital forceps, splenium of corpus callosum and centrum semiovale, bilaterally. In region specific analysis, the right limbic area of HD group, which contains ventral putamen and thalamus, showed statistically meaningful FA reduction.

2072. Assessment of Amyotrophic Lateral Sclerosis by using MR Imaging and Diffusion Tensor Imaging

Lin Ma[1], Dejun Li[1], Hong Yin[1], Dingguo Shen[1], Youquan Cai[1], Wei Sun[2]
[1]PLA General Hospital, Beijing, People's Republic of China; [2]GE(China)Co.,Ltd-Medical Systems, Beijing, People's Republic of China

Amyotrophic lateral sclerosis is a progressive neurodegenerative disease with both upper and lower motor neuron involvement. The clinical assessment of the upper motor neuron involvement is crucial in the diagnosis of ALS, and various MR techniques have been used for this purpose. Diffusion tensor imaging, with the capacity of demonstrating the magnitude and orientation of the white matter anisotropic diffusion, has also been used in the assessment of the corticospinal tract involvement in patients with ALS. However, the previous techniques use a low b value and limited number of diffusion sensitive gradient directions and need long examination time.

Human Brain MR Imaging of White Matter: Tumors

Hall D Saturday 14:00 - 16:00

2073. Spatial Distribution of Apparent Diffusion Coefficient in Cerebral Gliomas: Possible Pathological Implications as Suggested by Correlated rCBV and Chemical Shift Imaging

Wen-Chau Wu[1], Cheng-Yu Chen[2], Ming-Chong Chou[1], Hsiao-Wen Chung[1]
[1]National Taiwan University, Taipei, Taiwan; [2]Tri-Service General Hospital, Taipei, Taiwan

To evaluate the role of ADC in imaging interpretation of cerebral gliomas activity, rCBV was resorted to define malignant foci and tumor penumbra. Thirteen patients with histologically proven gliomas were included. Results showed statistically low rADC in malignant area. Further, the inverse correlation between rADC and rCho reconfirms the ability of ADC to indirectly detect the degree of cellularity. Our study manifests the practicability of rCBV-based tumor depiction. ADC helps pinpoint the malignant foci of active cell proliferation and serves as a simple and complementary parameter to determine the viability of gliomas.

2074. Effect of Radiation on Normal Appearing Contra-lateral White Matter Assessed by Serial T_2 and MT Quantification in Glioblastoma Multiforme

D Rajasekar[1], Rakesh K Gupta[1], Rajesh Kumar[1], SB Rao[2], Sanjeev Chawla[1], NR Datta[1]
[1]Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [2]Indian Institute of Technology, Kanpur, Uttar Pradesh, India

The radiation-induced changes to the contralateral NAWM in five patients with GBM were evaluated using quantitative T2 and MTR imaging. After registration of pre and post radiotherapy images, T2 and MTR maps were generated. The ROIs were set at the contralateral NAWM and the average values at the same location were computed and analyzed. The reduction of mean MTR values was consistent in majority of the patients. Two patients who had second post radiotherapy study showed reversal of MTR values. The quantitative MT imaging is more sensitive in detecting early delayed radiation induced changes in the contralateral NAWM.

2075. Diffusion Tensor Imaging Shows Potential to Differentiate Infiltrating from Non-Infiltrating Tumors

Mette R. Wiegell[1], John W. Henson[2], David S. Tuch[1], A. Gregory Sorensen[1]
[1]Martinos Center for Biomedical Imaging, Charlestown, Massachusetts, USA; [2]MGH Brain Tumor Center, Boston, Massachusetts, USA

The development of an MR method capable of differentiating infiltrating from non-infiltrating tumors would have significant implications for treatment planning. Based on a retrospective diffusion tensor imaging study of 17 patients, we found that the principal eigenvalue of the diffusion tensor is significantly reduced within edematous white matter surrounding glioblastoma multiforme (GBM) as compared to metastases (MET). Interestingly, the fractional anisotropy of the diffusion tensor was not significantly different for the two tumor types. The observation of lower diffusion eigenvalues in GBM relative to METs suggest that DTI may provide a long sought-after method for identifying tumor infiltration non-invasively.

2076. Quantitative Analysis of Diffusion Tensor Eigenvectors of White Matter Infiltration by Tumors and edema

Yu-Chien Wu[1], Aaron S. Field[2], Benham Badie[2], Andrew L. Alexander[1]
[1]W.M. Keck Laboratory Functional Brain Imaging & Behavior, Madison, Wisconsin, USA; [2]University of Wisconsin Medical School, Madison, Wisconsin, USA

The impact of brain pathology on the organization of white matter is starting to be elucidated using DT-MRI. In particular, brain neoplasms can either deflect or infiltrate tract trajectories. DT-MRI provides unique directional information about white matter tract organization, however, the eigenvector properties of brain pathology has not been studied quantitatively. In this study, a set of quantitative measures of eigenvector organization were used to investigate the impact of tumors and edema that appear to infiltrate the corona radiata in four subjects. The results were compared with measurements obtained in the unaffected contralateral corona radata.

2077. Comparison of the Contrasting Behaviour of Gadobenate Dimeglumine (Gd-BOPTA) and Gadoteric Acid (Gd-DOTA) in CNS Tumours

Emmanuel Gérardin[1], Xavier Barreau[2], Jean Marie Caillé[1], J. Thiebot[2], Klaus-Peter Lodemann[3], C. Brenot[4], Francoise Guezenoc[4], R. Samoyeau[4]
[1]Hôpital Charles Nicolle, Rouen, France; [2]C.H.U. Pellegrin, Bordeaux, France; [3]Bracco-Byk Gulden, Konstanz, Germany; [4]Laboratoires Byk France, Le-Mée-sur-Seine, France

An intra-individual, crossover study was conducted in 23 patients to compare 0.1 mmol/kg doses of Gd-BOPTA and Gd-DOTA for contrast-enhanced MRI of brain tumors. Evaluation was performed in terms of subjective and objective enhancement parameters. Assessment of global contrast enhancement (primary criterion) revealed superiority for Gd-BOPTA in 18/23 patients, equivalence in 4/23 patients and superiority for Gd-DOTA in 1/23 patients ($p<0.0001$). Similar superiority for Gd-BOPTA was noted for evaluations of lesion delineation, CNS-to-lesion contrast, tumor vascularization and information upon internal lesion morphology and structure. The weak protein-interacting capability of Gd-BOPTA offers advantages for MRI of brain tumors.

2078. Relation of Regional White Matter Volume and Attentional Functioning in Survivors of Malignant Pediatric Brain Tumors

John Otis Glass[1], Raymond K. Mulhern[1], Holly A. White[1], Gina M. Wilkinson[1], Wilburn E. Reddick[1]
[1]St. Jude Children's Research Hospital, Memphis, Tennessee, USA

Treatment of children with central nervous system (CNS) prophylaxis for cancer commonly results in potentially debilitating neurological and neuropsychological problems. As part of the standard treatment regimen, these patients are followed with both MR imaging and neuropsychological testing batteries. Segmentation and classification of the MR images was performed to calculate normal appearing white matter volumes by anatomical region for comparison to attention measures. The MR volumetry was significantly correlated with the attentional measures for the right prefrontal white matter region only ($R^2 = 0.317$, $p < 0.005$), the region accepted as performing executive functions such as attention.

2079. Is Increased Relaxivity Beneficial for Contrast-Enhanced MR Imaging of Brain Tumors: Blinded Intraindividual Comparison of Gd-BOPTA and Gd-DOTA

Cesare Colosimo[1], Michael Knopp[2], Xavier Barreau[3], Emmanuel Gérardin[4], Miles A. Kirchin[5], Francoise Guezenoc[6], Klaus-Peter Lodemann[7]
[1]University of Chieti, Chieti, Italy; [2]Ohio State University, Columbus, Ohio, USA; [3]C.H.U. Pellegrin, Bordeaux, France; [4]Hôpital Charles Nicolle, Rouen, France; [5]Bracco Imaging SpA, Milan, Italy; [6]Laboratoires Byk France, Le-Mée-sur-Seine, France; [7]Bracco-Byk Gulden, Konstanz, Germany

The in vivo T1 relaxivity of Gd-BOPTA (9.7 mM-1s-1) is approximately twice that of Gd-DOTA (4.3 mM-1s-1) due to weak and transient interaction of the former with serum albumin. To determine whether this high relaxivity is advantageous for brain tumor imaging, 0.1 mmol/kg doses of these two agents were compared intra-individually in crossover fashion in 19 patients with suspected glioma or metastases. Images were evaluated by two blinded readers in terms of qualitative and quantitative enhancement parameters. For all evaluations Gd-BOPTA was significantly superior to Gd-DOTA. Gd-BOPTA may be beneficial for the detection of small or poorly-enhancing lesions.

2080. Fusion of MRI and SPECT Images in Detection of Brain Tumors.

Piotr Grzelak[1], Magdalena Górska-Chrz'stek[1], Witold Gajewicz[1], Jacek Kuœmierek[1], B Góraj[1]
[1]Medical University, Lodz, Poland

In our study we visualized the fused display of the most active metabolically brain tissue as seen on SPECT together with the post gadolinium-DTPA in order to delineate brain tumors. We used H1-MRS to verify the metabolic content of the area. In 10 patients with diagnosis of the tumor we superimposed the brain SPECT images and MRI brain scans. Areas of the highest accumulation of the 131J-alfa-metylo-tyrozine combined with post-gadolinium-DTPA evaluated regions were then subject to 1H-MRS. Fusion of images enables to visualize the areas most indicating of brain tumor. The technique can be very useful to plan therapy.

Human Brain MR Imaging of White Matter: Multiple Sclerosis

Hall D Monday 13:30 - 15:30

2081. A 36-Month Longitudinal Study on the Evaluation of Interferon Beta Effect on Contrast Enhancing Lesions and Black Holes Duration in Multiple Sclerosis

Bagnato Francesca[1], Neal Jeffries[1], Joan Ohayon[1], Nancy Richert[1], Roger Stone[1], Henry McFarland[1], Joseph Frank[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Interferon beta (IFNβ) reduces the number of contrast enhancing lesions (CELs) and T1 hypointense lesions (i.e. black holes [BHs]), over time in multiple sclerosis (MS). We analyzed the effect of the drug in shortening the duration on both those lesions. Ten MS patients were imaged monthly for 18 months prior to and after IFNβ treatment. No difference was observed in the duration of CELs and BHs for lesions developing during the baseline or treatment phases.

2082. Differences in Gray Matter T_1 Relaxation Measures between Primary Progressive and Other Multiple Sclerosis Clinical Subgroups

Radhika Srinivasan[1], Sarah Nelson[1], Xiaojuan Li[1], Daniel Pelletier[1]
[1]University of California, San Francisco, California, USA

Multiple Sclerosis is mostly known to be a disease of the white matter but recent studies have indicated that normal appearing gray matter is also affected. Magnetic Resonance relaxation measures are sensitive to tissue changes caused by disease progression. We show that there is a statistically significant difference in the gray matter peak T1 relaxation intensities between the Primary Progressive group relative to Relapsing Remitting and Secondary Progressive patient groups. We also investigate if efficient lesion segmentation can be achieved by exploiting the statistical properties of lesions relative to normal appearing tissue.

2083. T_1 Relaxation Time in Multiple Sclerosis: Relapsing Remitting vs Secondary Progressive Form.

Fabrizio Fasano[1], Gisela Hagberg[1], Carlo Caltagirone[1], Alessandro Castriota-Scanderbeg[1]
[1]Fondazione Santa Lucia, Rome, Italy

We measured T1 relaxation times in lesions and normal appearing white matter (NAWM) in patients with relapsing remitting (RR) and secondary progressive (SP) multiple sclerosis (MS). By use of T1-maps, we obtained in each patient T1 frequency histogram, and mean T1 values in lesions, in NAWM proximal (NAWMp) to the lesions, and in NAWM remote (NAWMr) from the lesions. Furthermore, fractional NAWM and cerebrospinal fluid (CSF) volumes were recorded. Mean T1 values of lesions, NAWMp, and fractional volumes were significantly different between the two MS groups. These data suggest that T1 mapping is suitable for monitoring MS disease progression.

2084. Dynamic Contrast Enhancing Perfusion MR Imaging of Cerebral Blood Volume in Multiple Sclerosis Lesions: Comparison of Absolute and Relative Measurements

Yulin Ge[1], Meng Law[1], Glyn Johnson[1], Lois J. Mannon[1], Joseph Herbert[1], Robert I. Grossman[1]
[1]New York University School of Medicine, New York, New York, USA

To better understand lesion perfusion characteristics in multiple sclerosis (MS) using dynamic contrast enhancing perfusion MR imaging (pMRI), we compared two methods of pMRI by measuring absolute cerebral blood volume (aCBV) using arterial input function and relative CBV (rCBV) using contralateral normal appearing white matter (NAWM) reference in MS patients. pMRI showed there is a significant decreased aCBV, rather than rCBV, in both enhancing and non-enhancing lesions compared to periventricular NAWM. This may suggest the relative measurement of pMRI is not an appropriate technique to measure perfusion abnormalities in lesions that have only small changes of CBV in a disease.

2085. DTI Fiber Tracking Analysis of White Matter Lesions in Multiple Sclerosis

Roland G. Henry[1], Jeffrey I. Berman[1], Daniel Pelletier[1]
[1]University of California San Francisco, San Francisco, California, USA

In this work we use diffusion tensor imaging fiber tracking to serially quantify changes in specific white matter tracts encompassing multiple sclerosis lesions. This approach enables the study of the effects on lesions on white matter near and distal to the lesions and may elucidate the role of Wallerian degeneration in the white matter pathology of multiple sclerosis patients. Futhermore, this approach may better predict regions that are a “penumbra” to the lesion and those that go on to chronic degeneration.

2086. Spinal Cord MTR Histograms in Multiple Sclerosis Using a 3D Gradient Echo Acquisition

Simon Hickman[1], Andreas Hadjiprocopis[1], Olivier Coulon[2], David H. Miller[1], Gareth J. Barker[3]
[1]Institute of Neurology, University College London, London, UK; [2]CNRS, Ecole Superiure d'Ingenieurs de Luminy, Marseille, France; [3]Institute of Psychiatry, London, UK

An evaluation of a new magnetization transfer (MT) sequence and segmentation method to produce MT histograms of the cervical spinal cord in a pilot study of controls and multiple sclerosis patients is presented. Subjects' cervical spinal cord were imaged with a) *volume-acquired inversion-prepared fast spoiled gradient echo* sequence and b) *3D gradient echo MT* sequence and segmented using the active surface technique. MT histograms were produced from the segmentations. The method was sensitive enough to detect differences in mean MT ratio and peak location between patients and controls. The spinal cord volumes obtained from the two sequences were associated.

2087. Evaluation of Diffusion Tensor Imaging Derived Disease Markers for Multiple Sclerosis: EDSS and the MSFC

Dorothee P. Auer[1], Mirjam I. Schubert[1], Michaela Gottschalk[2], Benno Puetz[1], Frank Weber[2]
[1]Max Planck Institute of Psychiatry, Munich, Germany

Diffusion tensor studies are known to be sensitive to the pathobiology of MS. To evaluate possible surrogate markers, we studied global histogram-derived metrics from mean diffusivity (D) and FA maps in MS patients and controls and tested for correlations with the Expanded Disability Status Scale and the MS Functional Composite score. We confirmed abnormal DT characteristics in MS and found interrelations with both scores, the strongest correlations were between variance and asymmetry of D and MSFC global and PASAT z-scores. Thus, global diffusivity histograms reflect the burden of disease and global CNS functioning may provide useful MS surrogate markers.

2088. Investigation of Early Relapsing-Remitting Multiple Sclerosis using Diffusion MR Histograms

Waqar Rashid[1], Andreas Hadjiprocopis[1], Colette Griffin[1], Declan Chard[1], Gerard Davies[1], Daniel Altmann[1], Gareth Barker[1], David Miller[1]
[1]UCL, London, UK

Diffusion tensor magnetic resonance imaging is a promising tool in investigating multiple sclerosis (MS). Using a new automated segmentation algorithm which effectively removes cerebrospinal fluid from the whole brain, 16 patients with early relapsing-remitting MS and 17 controls were evaluated with mean diffusivity (MD) and fractional anisotropy (FA) histograms. A significant decrease is reported in mean FA ($p=0.014$) and increased FA peak height is also noted ($p=0.002$). No changes are seen in the MD comparisons. This suggests FA may be more sensitive as a parameter in very early MS compared to MD.

Pediatric Brain MR Imaging

Hall D Tuesday 13:30 - 15:30

2089. Combination of Event-Related Functional MRI and Diffusion Tensor Imaging in Perinatal Stroke.

Mohamed L. Seghier[1], Slava Zimine[1], François Lazeyras[1], Stephan Maier[2], Petra S. Huppi[3]
[1]University Hospital of Geneva, Geneva, Switzerland; [2]Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA; [3]Children's Hospital of Geneva, Geneva, Switzerland

We used combined Event-Related functional MRI with Diffusion Tensor Imaging to explore the structure-function relationship after unilateral perinatal stroke in a three months old infant. With visual stimuli, ER-fMRI maps showed negative activation in the anterior primary visual cortex of the intact hemisphere only. DTI confirmed the absence of optic radiation in the damaged hemisphere. The functional activation on the intact hemisphere corroborated clearly with the track obtained with DTI. In addition, ER-fMRI allowed to define the shape of the hemodynamic response function which was characterised by a negative BOLD response, different from the known adult BOLD response.

2090. Diffusion Tensor MR Imaging in the Evaluation of Wallerian Degeneration in Pediatric Strokes: Work-in-Progress

Pek-Lan Khong[1], Lin-Jiang Zhou[1], Virginia CN Wong[1], Brian HY Chung[1], Clara GC Ooi[1], Cao Guang[2], Fu-Luk Chan[1]
[1]Queen Mary Hospital, The University of Hong Kong, Hong Kong, Hong Kong; [2]GE Medical Systems China, People's Republic of China

We use DTI to detect and quantify Wallerian degeneration (WD) in pediatric MCA strokes. Fractional anisotropy (FA) and mean diffusivity (MD)of the infarction, ipsilateral internal capsule (PLIC) and cerebral peduncle (CP) were measured in nine children and compared to the matched contralateral side. WD was characterized by statistically significant differences in FA, but not MD, of the ipsilateral PLIC and CP compared to normal side. FA was reduced in all children, whilst corresponding hyperintense signals on T2W were seen in five children. DTI is more sensitive than conventional MRI and can be used to detect and quantify WD.

2091. The Sensitivity of Changes of Apparent Diffusion Coefficient of Cerebral Water to Outcome at 1 Year in Neonates with Suspected Hypoxic-Ischaemic Encephalopathy

Alan Bainbridge[1], Shanthi Shanmugalingam[2], Quyen Nguygen[2], John S. Thornton[2], Andrew N. Priest[1], Roger J. Ordidge[2], John S. Wyatt[2]
[1]University College Hospital London, London, UK; [2]University College London, London, UK

The sensitivity of ADC measurements in different regions of the brain to outcome at 1 year following suspected hypoxic-ischaemic encephalopathy (HIE) is examined. 15 term infants with suspected HIE were studied along with 6 healthy controls. Subjects were grouped according to their outcome at 1 year as assessed by neurodevelopmental testing. Regions of interest were defined within the deep grey matter and parietal, occipital and frontal white matter. White matter ADC is more sensitive to 1 year outcome than deep grey matter ADC at a median scan time of 4 days of age.

2092. ADC-Histogram Analysis of Cerebral Hemorrhagic-Ischemic Infarcts of the Neonate

Jan Buijs[1], Carola van Pul[2], O S. Derksen[1], F G. Roos[1]
[1]Maxima Medisch Centrum, Veldhoven, Netherlands; [2]University of Technology Eindhoven, Eindhoven, Netherlands

Apparent Diffusion Coefficient (ADC) characteristics, mean ADC and histogram analysis, were studied in 17 neonates with hemorrhagic-ischemic cerebral infarcts due to perinatal hypoxic-ischemia or infections. All infarcts had a significant lower ADC compared to the contra-lateral normal tissue. ADC in ischemic infarcts was not significant lower than in hemorrhagic infarcts. Thus, an influence of blood on mean ADC was not demonstrated in these subacute infarcts. However, a difference in ADC distribution between hemorrhagic and ischemic infarcts was detected. Hemorrhagic infarcts had a more wide spread distribution of the ADC.

2093. Differentiating Therapy-Induced Leukoencephalopathy from Unmyelinated White Matter in Children Treated for Acute Lymphoblastic Leukemia (ALL)

Wilburn E. Reddick[1], John O. Glass[1], Ching-Hon Pui[1]
[1]St. Jude Children's Research Hospital, Memphis, Tennessee, USA

Reliably detecting subtle therapy-induced leukoencephalopathy in very young patients is challenging due to its nearly identical MR properties and location with unmyelinated white matter. T1, T2, PD, and FLAIR imaging sets were acquired for 44 children near start for treatment for ALL. The ICBM atlas and corresponding apriori maps were spatially normalized to each patient and resliced using SPM99 software. Combined imaging sets were segmented with a neural network and differences between regions of white matter hyperintensities and normal appearing genu were calculated. Analysis of the difference distributions revealed two distinct groups resulting in a threshold applied on subsequent examinations.

2094. Region-Specific Maturation of the Cerebral Cortex in Premature Newborns Demonstrated with High-Resolution DiffusionTensor Imaging

Pratik Mukherjee[1], Kanwar Gill[1], Srivathsa Veeraraghavan[1], Roland G. Henry[1], Steven P. Miller[1], Daniel B. Vigneron[1], A. James Barkovich[1]
[1]University of California San Francisco, San Francisco, California, USA

Diffusion tensor imaging (DTI) is sensitive to the microstructural changes of cerebral cortical development. In this DTI study, employing higher spatial resolution than has been previously achieved in premature newborns, we provide the first in vivo evidence of regional differences in the maturation of human cerebral cortex. We find the earliest maturational loss of diffusion anisotropy in the peri-rolandic cortex, with the slowest development in anterior frontal and anterior temporal cortex. This temporal sequence of preterm cortical maturation presages the later pattern of subcortical white matter myelination seen on conventional MRI during the first 2 years of postnatal life.

2095. Quantitative MRI Follow-up of Brain T_1 Abnormalities in Patients with Sickle Cell Disease

Brian David Benneyworth[1], R. Grant Steen[1]
[1]St. Jude Children's Research Hospital, Memphis, Tennessee, USA

Patients with sickle cell disease (SCD) show longitudinal changes in gray matter T_1 that are strikingly different from the pattern seen in healthy age-similar control children. These changes imply that the pattern of brain development in SCD patients is different than in healthy controls.

2096. A Pilot Study of the Developing Neonatal Brain Using Magnetic Resonance Images and Deformation-based Morphometry

James P. Boardman[1], Daniel Rueckert[1], Olga Kapellou[1], Serena Counsell[1], Joanna Allsop[1], Jo Hajnal[1], Anthony David Edwards[1]
[1]Imperial College, London, UK

To apply deformation-based morphometry to MR images of the developing brain. A non-rigid algorithm was used to register images from 44 prematurely born infants at term corrected age, and 7 full-term control infants, to an anatomical reference space. Changes in the Jacobian of the resulting deformation field were used to quantify regional differences in tissue volume. The technique enabled accurate mapping of anatomical structures in atlas images, and showed a volume increase of the lateral ventricles among the infants who had been born prematurely. The technique has utility in studying brain injury associated with pre-term birth.

2097. Utility of 2D Time-of-Flight MR Venography in Cerebral Sinovenous Thrombosis in Neonates

Manohar Shroff[1], Ashish Atre[2], Susan Blaser[1], Suzanne Laughlin[1], Anna Illner[1], Nathaniel Chuang[1], Gabrielle DeVeber[1]
[1]Hospital for Sick Children, Toronto, Ontario, Canada; [2]Ruby Hall Clinic, Pune, Maharashtra, India

The purpose of this study is to evaluate time-of-flight MR venography (MRV) as used routinely in a clinical setting in the diagnosis and follow up of neonatal CSVT, and to compare it with CT venography. It is hypothesised that several known limitations of MRV (e.g artifacts due in-plane flow saturation, slow flow or flow turbulence) would be exaggerated in neonates due to anatomic differences unique to this age.

2098. Interrelation between Cognitive Abilities and Regional Gray Matter Volume in Childhood

Marko Wilke[1], Jin-Hun Sohn[1], Anna M. Weber Byars[1], Scott K. Holland[1]
[1]Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA

A number of MRI studies now have shown a strong correlation between overall brain gray matter (GM) volume and cognitive abilities, both in adults and in children. We have recently addressed this issue in a large sample of healthy children, using statistical parametrical mapping software (SPM99; Wellcome Department, University College London, UK). We found that this correlation only develops as a function of age and is not present in younger children. We also found first indications for a differing effect of age on gray matter volume in regions associated or not associated with the overall level of cognitive abilities.

2099. Diffusion Tensor Images in Malignant Phenylketonuria

Steven Shinn-Forng Peng[1], Wen-Yih Isaac Tseng[2], Yin-Hsiu Chien[1], Wuh-Liang Hwu[1], Hon-Man Liu[1]
[1]National Taiwan University Hospital, Taipei, Taiwan; [2]National Taiwan University, Taipei, Taiwan

Severe, progressive neurologic deficits remain to be the problems for patients with malignant phenylketonuria (PKU) due to a deficiency of tetrahydrobiopterin (BH4) even with early diagnosis and treatment with supplement of BH4 and neurotransmitter precursors. This study analyzed diffusion tensor images of six patients suffering from BH4 deficiency in a Taiwanese population identified by neonatal screening. Our findings indicated that diffusion trace ADC or fractional anisotropy maps are potential tools for demonstrating brain changes of malignant PKU.

2100. Cerebral Volumetrics and Corpus Callosum Correlations in Autism

Inbal Boger-Megiddo[1], Dennis W.W. Shaw[1], Seth D. Friedman[1], Bobbi Sparks[1], Kenneth R. Maravilla[1], Alan A. Artru[1], Jay N. Giedd[2], Geri Dawson[1], Steve R. Dager[1]
[1]University of Washington School of Medicine, Seattle, Washington, USA; [2]National Institute of Mental Health, Bethesda, Maryland, USA

Larger total brain volumes (TBV) in 44 autism spectrum disorder children, compared to 12 developmentally delayed (DD) and 20 typically developing control children, was distributed between frontal lobes and the remainder of the brain. Compared to typically developing, autistic corpus callosum measrements were similar, but smaller when corrected for TBV. DD callosums were smaller than others. Comparable absolute callosal measurements raises question that the apparently diffusely increased autistic brain volume may to be due to non neruonal elements.

2101. Proton Spectroscopy ([1]HMRS), Perfusion (ASL-PI) and Diffusion (DWI and DTI) in Tuberous Sclerosis Complex

Michela Tosetti[1], Laura Biagi[1], Arturo Abbruzzese[2], Domenico Montanaro[2], Anna Maria Valleriani[2], Roberta Battini[1], MariaCristina Bianchi[2]
[1]IRCCS Stella Maris, Pisa, Italy; [2]H S. Chiara, Pisa, Italy

Brain abnormalities of Tuberous Sclerosis Complex (TSC) have been investigated by means proton spectroscopy (1HMRS), perfusion (ASL-PI) and diffusion (DWI and DTI) in combination with MRI, with the purpose of evaluating possible additional understanding of “in vivo” physiopathology of TSC. 1HMRS has demonstrated to be of use in the characterization of the lesions. ASL-PI revealed a marked depression of CBF of cortical tuberous and in the epileptic patients isolated hyperperfusion cortical areas, perhaps related to epileptic foci. Of little use turned out DWI and DTI, since each type of TS dysplasias demonstrated similar diffusion patterns.

2102. Optimization of 3-D MP-RAGE for Neonatal Brain Imaging at 3.0 Tesla

Lori Anne Williams[1], Neil Gelman[1], Timothy J. DeVito[1], Paul A. Picot[1], R. Terry Thompson[1]
[1]Lawson Health Research Institute, University of Western Ontario, London, Ontario, Canada

Using the known T1 values for neonatal brain tissue at 3.0T, contrast between white matter and gray matter has been simulated for the 3-D magnetization-prepared rapid gradient-echo (MP-RAGE) sequence. Phantom studies show that theoretical contrast is in close agreement with experimental contrast. *In vivo* studies show that high quality 3-D images can be obtained in 6.5 minutes. This is the first report of contrast optimization for the MP-RAGE sequence in neonatal brain imaging as well as the first report of *in vivo* 3-D MRI brain imaging in neonates at 3.0T.

2103. Post-Natal Taurine and its Relationship to the Development of Brain Structure and Function

E B. Isaacs[1], D G. Gadian[1], B Wharton[1], A Lucas[1]
[1]Institute of Child Health, London, UK

This study, undertaken on adolescents who had participated in large-scale neonatal nutrition trials, explores the hypothesis that dietary taurine intake during the post-natal period could significantly influence subsequent brain development. Voxel-based morphometric analyses of structural MRI scans of 22 adolescents showed significant relationships between early plasma taurine status and local grey and white matter densities in the region of the intraparietal sulcus. Neurospychological tests showed significant relationships between early plasma taurine status and numeracy skills. Together, these findings suggest that taurine influences the development of parietal areas and hence those functions that depend on these regions, including numeracy skills.

2104. MRI of Anisotropic Diffusion: Study of Pediatric Brain Maturation and Development

Saïd Boujraf[1], Robert Luypaert[2], Wael Shabana[2], Henri Eisendrath[2], Michel Osteaux[2]
[1]Institut für Neuroradiologie, Zürich, Switzerland; [2]AZ-VUB, Brussels, Belgium

The maturation of white and gray matter can be expected to reflect changes in diffusion tensor (DT) and derived quantities. We study changes occurring in diffusion behavior of healthy developing brain of full term newborn and infant we use diffusion quantities as sensitive and consistent marker of tissue differences (type and age categories). The rotationally invariant quantities are found to be superior to rotationally variant ones. The anisotropy indices correlate between the white matter maturation and the evolution of the diffusion anisotropy. Gray matter tissues did not exhibit any age dependence.

2105. Correlations Between White Matter Structure and Reading Performance in Children Measured by Diffusion Tensor Imaging

Gayle K. Deutsch[1], Robert F. Dougherty[1], Roland Bammer[1], Wai Ting Siok[1], John D.E. Gabrieli[1], Brian Wandell[1]
[1]Stanford University, Stanford, California, USA

We measured the relationship between white matter integrity (assessed by diffusion tensor imaging, DTI) and reading ability in thirteen children with and without reading problems. Fractional anisotropy (FA), a measure of white matter microstructure, was significantly different between the two groups of children in a region within the white matter of the left temporo-parietal lobe that had been previously identified in adult poor readers. FA in this region was also correlated with reading ability ($r = .68$). These observations suggest that white matter integrity in this left temporo-parietal region is important for the development of skilled reading.

2106. DTI Tractography Analysis of Congenital Hemiplegia

Jeffrey I. Berman[1], Orit A. Glenn[1], Patrick Chang[1], Steven P. Miller[1], Anthony J. Barkovich[1], Daniel B. Vigneron[1], Roland G. Henry[1]
[1]UC San Francisco, San Francisco, California, USA

We have investigated the hypothesis that congenital hemiplegia can be assessed by diffusion tensor imaging (DTI) and tractography of the corticospinal tract (CST). DTI fiber tracking was used to delineate the CST in 5 subjects with congenital hemiplegia and 5 age matched controls. We previously reported significant asymmetry of the CST in patients with congenital hemiplegia. In comparison with aged-matched normal controls we now report decreased relative anisotropy (RA) in the CST, decreased primary eigenvalues, and increased minor eigenvalues on the affected side.

Pediatric Brain MR Spectroscopy

Hall D Saturday 14:00 - 16:00

2107. Multi-Slice Echo Planar MR Spectroscopic Imaging (EPSI) in Premature Infants at Term-Equivalent Age.

Maria Jose Miranda[1], Line C. Sørensen[2], A Peter Born[1], Anne Mette Leffers[1], Birgit Peitersen[2], Lars G. Hanson[1]
[1]Copenhagen University Hospital, Hvidovre, Hvidovre, Copenhagen, Denmark; [2]Hvidovre Hospital, Hvidovre, Copenhagen, Denmark

The aim of this study was to explore the feasibility of performing multi-slice echo-planar spectroscopic imaging (EPSI) in premature infants. The study of metabolic changes in premature infants would contribute to the understanding of the pathogenesis of immature brain damage. EPSI provides a rapid method of acquiring spectroscopic information from the whole brain and allows the retrospective selection of spectroscopic volumes. In this study, we demonstrate that whilst lactate levels were complicated by lipid suppression, shimming and motion, measurements of choline, creatine and N-acetylaspartate could be acquired reliably.

2108. *In Vivo* ^{1}H MRS Observation of Brain Succinate in a Subject With Cerebritis and Gram Positive Sepsis

Dah Jyuu Wang[1], Robert A. Zimmerman[1]
[1]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA

Proton brain MRS studies was conducted on a 2-year old diagnosed with cerebral palsy, developmental delay, cerebritis and gram positive sepsis. 2D CSI 1H MRS study on a T2 hyperintense region in the left posterior frontal and parietal regions indicated significantly elevated levels of lactate, slightly elevated choline and decreased NAA. In addition, a large singlet peak was observed at 2.40 ppm in the spectra from the lesion. This appears to be that of the succinate, judging from its chemical shift and line shape. This metabolite was previously reported in in vitro and in vivo studies of brain abscess.

2109. A Preliminary ^{1}H MRS Study of HIV-1 Infected Children: Correlation with Neuropsychological Test

Lidia Gabis[1], Patricia Roche[1], Sharon Nachman[1], Wei Huang[1]
[1]State University of New York, Stony Brook, New York, USA

The goal was to correlate clinical and neuropsychological findings with 1H MRS measures in HIV-1 vertically infected children receiving HAART therapy and to determine the value of MRS in monitoring CNS disease. Eight children with stable HIV were examined. Proton MR spectra were acquired from subcortical white matter and basal ganglia. The metabolic changes were compared to results of IQ tests. Lower NAA/Cr and Higher Cho/Cr were found to significantly correlate with lower verbal IQ.

2110. Brain NAA Reduction is a Sensitive Marker of Perinatal Hypoxic-Ischaemic Encephalopathy Damage. An *In Vivo* ^{1}H-MRS Study

Caterina Tonon[1], Raffaele Lodi[1], Nounou Annamaria Sorci[1], Gina Ancora[1], Guido Cocchi[1], Valeria Clementi[1], Fabrizio Sandri[1], Paolo Ambrosetto[1], Gian Paolo Salvioli[1], Bruno Barbiroli[1]
[1]University of Bologna, Bologna, Italy

The assessment of perinatal hypoxic-ischaemic encephalopathy (HIE) is critical in determining outcome. Nineteen HIE infants with a median day of life 8.1 (10 with normal MRI) were studied with 1H-MRS. One third showed NAA/Cr below the normal range in the cortex and 58% in the deep grey matter. NAA/Cr in both localisation showed a negative correlation with the Sarnat encephalopathy grade ($p<0.001$) and a positive correlation with the Apgar score at 10 min ($p<0.001$). 1H-MRS of the deep grey matter is a sensitive investigation for the early assessment of brain injury in HIE and may have implication for therapeutic intervention.

Diffusion Analysis: Physiological and Hardware Effects

Hall D Sunday 13:30 - 15:30

2111. Effects of Applied Electric Currents on Diffusion Tensor MRI

Kikuo Yamaguchi[1], Masaki Sekino[1], Norio Iriguchi[2], Shoogo Ueno[1]
[1]University of Tokyo, Hongo, Bunkyo-ku, Tokyo, Japan; [2]University of Kumamoto, Kurokami, Kumamoto, Japan

In this paper, we report that the apparent diffusion coefficient (ADC) of rat brain tissue increased by applied external electric currents. A diffusion MR image of a rat brain with applied vertical or horizontal electric currents was obtained. A subtraction MD map was obtained to quantitatively evaluate the effect of the electric currents on ADC. The experimental results show that the MD in the corpus callosum with vertical electric currents of 10 mA increased by 40 %. Based on this phenomenon, the current density distribution was evaluated from a subtraction MD map using diffusion tensor MRI techniques.

2112. Thermal and Physiological Noise Contributions to Apparent Diffusion Coefficient Measurements in the Human Brain.

Harris Wang[1], Steven Warach[2], Lawrence L. Latour[2]
[1]Massachusetts Institute of Technology, Cambridge, Massachusetts, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

Noise in diffusion weighted imaging (DWI) is propagated during the calculation of the apparent diffusion coefficient (ADC), resulting in dispersion in the ADC. We studied the "intrascan" variance of the ADC in a phantom and human brain and contrast it to that predicted by an analytical model of random noise. In the phantom, we found that the variance in the ADC was well accounted for by random noise alone, while in the brain physiological noise further reduced the precision. The approach will prove useful in qualifying ADC measurements in stroke patients and evaluating methods to improve it.

2113. Origins of Signal Differences in 'Perfusion-Corrected' ADC Maps

Emilie C. Bryant[1], Liz Moore[1], Stefan A. Reinsberg[1], Andrzej Stanislaw Konrad Dzik-Jurasz[1], Martin O. Leach[1]
[1]Royal Marsden NHS Trust and Institute of Cancer Research, Sutton, UK

Vascular flow can contribute to apparent diffusion coefficient values. Perfusion-related changes may mask true diffusion effects, thereby confounding differentiation between normal and abnormal tissue. To separate diffusion from perfusion effects, diffusion sensitivity (b) values greater than 500s/mm2 are required. We compared ADC maps created using b values 500 and 1000s/mm2 with those derived from b values of 0, 500 and 1000s/mm2. Differences between '3-point' and '2-point' maps are compared with co-registered relative blood volume maps to confirm the origin of the effects accounted for. Results indicate that the origin of difference is largely perfusion related.

2114. The Effect of the Concomitant Magnetic Field in Diffusion Weighted Imaging

Chunlei Liu[1], Roland Bammer[1], Michael E. Moseley[1]
[1]Stanford University, Stanford, California, USA

Concomitant magnetic field with non-linear spatial dependence arises where linear gradients are applied in order to satisfy the Maxwell's equation. It has been demonstrated that this field can have non-negligible effects on phase-sensitive imaging techniques such as phase contrast MRI. In this study, the effect of the concomitant field on diffusion weighted imaging was explored. Although spatial averaging over one voxel will not normally cause signal attenuation in the presence of concomitant field, spin's random movement will affect the signal intensity. Nevertheless, simulation shows that the signal attenuation due to concomitant field is negligible in diffusion experiments.

2115. Theoretical Expression and Monte Carlo Simulation of Diffusion under Nonlinear Field Gradients

Zhong Chen[1], Congbo Cai[1], Shuhui Cai[1], Jianhui Zhong[2]
[1]Xiamen University, Xiamen, Fujian, People's Republic of China; [2]University of Rochester, Rochester, New York, USA

A propagator method was used to calculate diffusion attenuation of the NMR signal under general nonlinear field gradients. Theoretical expressions of the attenuation factor were obtained for the free and restricted diffusion between two plates under parabolic field as examples. The result of Monte Carlo simulation was compared to the theorical prediction. The results show that the theoretical method is appropriate for the free diffusion, as well as the restricted diffusion under the short gradient pulse approximation.

2116. On Correction of Eddy Current Induced Distortions in Diffusion Weighted Echo Planar Images with a Calibration on a Reference Phantom

Kamil A. Il'yasov[1], Peter Zhilkin[2]
[1]University Medical Center of Freiburg, Freiburg, Germany; [2]National Research Council, Winnipeg, Manitoba, Canada

In this work correction of eddy current induced distortions in DW EPI images with a calibration on a reference phantom has been systematically investigated. Such approach was implemented on four different clinical MR scanners and was successfully applied for DTI examinations on more than 300 patients. It was found, that calibration is very stable in time and depend linear from the gradient amplitudes. Such approach can be used on any MR scanner for an automatic correction of distortions. It is insensitive to anisotropy related signal variations and can be used at very high b-values without loss of accuracy.

2117. Evaluation of Interscanner Variability of ADC Data Acquisition in Stroke Centers in Germany

Chuh-Hyoun Lie[1], Jochen G. Hirsch[1], Thomas Kucinski[2], Jan Junge-Huelsing[3], Mario Siebler[4], Clemens Fitzek[5], Stefan Boor[6], Sabine Heiland[7], Joachim Roether[2], Arno Villringer[3], Achim Gass[1]
[1]University Hospital Mannheim, University of Heidelberg, Mannheim, Germany; [2]University Hospital Hamburg-Eppendorf, Hamburg, Germany; [3]University Hospital Charite Berlin, Berlin, Germany; [4]University Hospital Duesseldorf, Duesseldorf, Germany; [5]University Hospital Jena, Jena, Germany; [6]University Hospital Mainz, Mainz, Germany; [7]University Hospital Heidelberg, University of Heidelberg, Heidelberg, Germany

CDTI includes some oversimplification in regard to the complexity of white matter as the largest eigenvalue and its associated eigenvector focus on a single dominant fibre direction. Common colour-coding schemes neglect additional information that can be gained from the second largest eigenvalue and its eigenvector. Geometrical anisotropy indices are helpful to differentiate high anisotropy regions, that are dominated by a single fibre direction or have input from at least one other large fibre component as can be demonstrated on planar anisotropy index maps. This "background" information is helpful for a more accurate concept of fibre architecture when interpreting CDTI images.

Diffusion Tensor Imaging: Acquisition Methods

Hall D Monday 13:30 - 15:30

2118. When is a DT-MRI Sampling Scheme Truly Isotropic?

Derek K. Jones[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

Necessary conditions for optimal DT-MRI sampling schemes are that the gradient orientations are uniformly distributed and that the precision of the measurement of the diffusion tensor be independent of its orientation. We show that a simplifying assumption that has previously been made in the study of DT-MRI sampling schemes has important consequences in the design of rotationally invariant sampling schemes.

2119. Optimal Design of DT-MRI Experiments Using a New Tensor-variate Gaussian Distribution

Peter J. Basser[1], Sinisa Pajevic[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

We propose that a necessary condition for an optimally designed DT-MRI experiment is that a new normal distribution for the estimated diffusion tensor, p(D) ≈ exp(- 1/2 D:A:D), be characterized by an isotropic 4th-order precision tensor, A. This requirement ensures that statistical properties of D (and quantities derived from it) are all rotationally invariant. We propose a measure of anisotropy of A, which can be used to assess the degree of rotational invariance of any DT-MRI experimental design. We apply this measure to evaluate various DT-MRI experimental designs.

2120. Mapping Orientation Distribution Function with Spherical Encoding

Ching-Po Lin[1], Wen-Yih Isaac Tseng[2], Li-Wei Kuo[1], Van J. Wedeen[3], Jyh-Horng Chen[1]
[1]National Taiwan University, Taipei, Taiwan; [2]National Taiwan University College of Medicine, Taipei, Taiwan; [3]MGH Martinos Center for Biomedical Imaging, Harvard Medical School, Charlestown, Massachusetts, USA

DSI reflects the distribution of fiber orientations by mapping of 3D probability density function and its spherical projection of proton diffusion by q-space diffusion MRI. However, DSI scanning currently requires 515 diffusion-encoding directions, it is very time consuming. Here we developed a spherical encoding method to obtain the spherical projection directly. We found that the salient orientation of fibers can be extracted from summation of the product of diffusion echo signal and an angle function. This method saves at least 50% of scanning time than that needed in DSI and has an accuracy of -1.33 ± 6.79^{o} in defining crossing fibers.

2121. The Effect of Pulsed Gradient Rotational Angle on Diffusion Diffractions: Implication to Fiber Orientations

Liat Avram[1], Yaniv Assaf[2], Yoram Cohen[1]
[1]Tel-Aviv University, Tel-Aviv, Israel; [2]Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel

Under certain conditions, the signal decay in diffusion experiments may provid structional information on the tissues. We studied the effect of the rotational angle of the pulsed gradients on the q-space mean displacements and on the diffraction patterns in 20 µm cylinders as a model of neuronal fibers. We found that the rotation angle had a dramatic effect on the mean displacements and on the diffraction pattern. Diffractions were observed only when the diffusion was measured perpendicular to the long axis of the cylinders. This may be important for the interpretation of high b-values diffusion experiments of the human brain.

2122. Diffusion Anisotropy in Subcortical White Matter and Cortical Gray Matter : Role of CSF-Suppressed Diffusion Tensor Imaging

Yusuf A. Bhagat[1], *Christian Beaulieu*[1]
[1]University of Alberta, Edmonton, Alberta, Canada

Although the diffusion anisotropy of the major white tracts and the deep gray matter in the adult human brain are well known, little quantitative data has been reported in the peripheral gray and white matter, both of which may have anisotropy values affected by partial volume contamination with cerebrospinal fluid. Quantitative measures of anisotropy in the subcortical white matter and cortical gray matter of five normal volunteers (age 21-25) demonstrate a 5-14% increase in fractional anisotropy obtained with CSF-suppressed FLAIR-DTI relative to standard DTI.

2123. Diffusion Tensor Imaging, Using Oscillating Gradients to Probe Short Diffusion Times, in the Human Brain.

Timothy Peter Hosey[1], *Sally Georgia Harding*[1], *Hadrian A L Green*[1], *Richard E. Ansorge*[1], *Thomas Adrian Carpenter*[1]
[1]University of Cambridge, Cambridge, Cambridgeshire, UK

An oscillating gradient spin echo (OGSE) sequence has been used to measure the diffusion tensor in the human brain using shorter diffusion times than obtainable using a standard pulsed gradient spin echo (PGSE) sequence. This has allowed measurement of diffusion properties over a length scale of approximately 8.2 µm. It has been found that the fractional anisotropy is lower, and the apparent diffusion coefficient is higher when measured at these shorter length scales. Probing shorter diffusion time scales will enable a better understanding of the underlying mechanism controlling diffusion in the brain.

2124. PROPELLER Diffusion Tensor Tomography with Rotated Gradient Direction for Efficient DT Imaging

Arvidas Cheryauka[1], *James Lee*[1], *Michele Defrise*[2], *Grant Gullberg*[3]
[1]University of Utah, Salt Lake City, Utah, USA; [2]Free University, Brussels, Belgium; [3]Lawrence Berkeley National Laboratory, Berkeley, California, USA

MRI diffusion imaging is effective in measuring diffusion tensor in brain, cardiac, liver, and spinal lesion imaging. It offers significant potential for studying fiber structure of tissues. Diffusion tensor tomography MRI (DTT MRI) method is based on reconstructing tensor field from projections. We have examined the potential of novel data acquisition scheme, PROPELLER (Periodically Rotated Overlapping ParallEL Lines with Enhanced Reconstruction), for its imaging capability and sufficiency for diffusion tensor imaging. PROPELLER DTT MRI shows the significant potential to reduce a number of weighted measurements, avoid ambiguity in reconstructing diffusion tensor parameters, increase SNR and decrease influence of signal distortions.

2125. Diffusion Tensor Imaging of the Human Cervical Spinal Cord Using PROPELLER

Yijing Wu[1], *Aaron S. Field*[1], *Andrew L. Alexander*[1]
[1]University of Wisconsin, Madison, Wisconsin, USA

A periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) fast spin-echo (FSE) pulse sequence has been used for diffusion tensor (DT) MR imaging of the human cervical spinal cord. Maps of apparent diffusion coefficient (ADC), fractional anisotropy (FA), and major eigenvector orientation were obtained from three normal volunteers. Our preliminary results show improved spatial fidelity relative to echo-planar (EPI) DTI. PROPELLER DTI may help to provide critical information about the integrity of axonal fibers and their myelin sheaths in neurological diseases affecting the spinal cord.

2126. Split-Blade PROPELLER DWI

James G. Pipe[1]
[1]Barrow Neurological Institute, Phoenix, Arizona, USA

The non-CPMG condition of diffusion-weighted FSE previously made PROPELLER DWI possible only with a transmit-receive coil. Modifications were made to PROPELLER data collection that allow imaging with any receive coil.

2127. SAR Reduction for PROPELLER DWI at 3T

James G. Pipe[1], *Eric T. Han*[2], *Reed F. Busse*[2]
[1]Barrow Neurological Institute, Phoenix, Arizona, USA; [2]GE Medical Systems, Menlo Park, California, USA

PROPELLER DWI is a multi-shot FSE sequence that can create high-resolution images without warping. By adding variable-rate gradient rf pulses to the turboprop variant of PROPELLER, SAR limits for routine imaging at 3T were removed.

2128. High Angular Resolution DTI of the Pyramidal Tracks using Sense Technique

Paola Scifo[1], Franck Lethimonnier[2], Yann Cointepas[2], Nicolas Molko[2], Denis Le Bihan[2]
[1]IRCCS H San Raffaele, Milan, Italy; [2]Service Hospitalier Frédéric Joliot, CEA, Orsay, France

A parallel imaging technique (ASSET/Sense) was implemented on a high angular resolution DTI-EPI pulse sequence to evaluate its potential towards improvement of image quality in regions prone to severe susceptibility artefacts. The evaluation of the technique was performed in the posterior cerebral fossa, which is often difficult to study with diffusion MRI (because of susceptibility-induced artefacts) although it represents an important anatomical landmark for surgical planning. The combination of the SENSE technique with high angular resolution DTI allows to obtain less distorted diffusion tensor maps with a higher SNR.

2129. Reduction of Motion Artifacts in Segmented EPI with Velocity Compensation Diffusion Gradients, for Application to Neonatal Imaging at 3.0T

J. D. Winter[1], N. Gelman[1], P. A. Picot[1], D. S. Lee[2], Y. Bureau[1], R. T. Thompson[1]
[1]Lawson Health Research Institute, Dept. of Medical Biophysics, University of Western Ontario, London, Ontario, Canada; [2]St. Joseph's Health Care, London, Ontario, Canada

Diffusion MR images were acquired for 5 healthy adults and 1 neonate with a novel diffusion weighted (DW) segmented EPI sequence with velocity compensation (VC) diffusion gradients and navigator echo correction. Adult imaging results demonstrate the efficacy of motion suppression for the VC-DW sequence compared to conventional DW segmented EPI. VC gradients require a long TE resulting in considerable SNR losses in the adult brain. However in the neonatal brain, with long T2 values, losses in SNR are less as shown by estimates provided here. Therefore the VC-DW sequence is appropriate for neonatal brain imaging.

2130. Assessment of the Quality of Diffusion Tensor Data for Fibre-Tracking: A Comparison between 1.5 and 3.0 T

Rita G. Nunes[1], Peter Jezzard[1], Stuart Clare[1]
[1]University of Oxford, Oxford, UK

For some applications of Diffusion Tensor Imaging (DTI) such as Fibre-Tracking, it is desirable to minimise the uncertainty associated with the estimate of the principal eigenvector of the DT. Lower uncertainties on the directions of the principal eigenvectors would lead to more reliable results. With this in mind, and in order to investigate the possible benefits of using a higher field, a comparison of DTI at 1.5 and 3.0 T was performed. We found significantly lower uncertainties associated with the principal eigenvectors at 3.0 T. This result suggests that Fibre-Tracking methods would benefit greatly from a higher magnetic field.

2131. Single-Shot Fast Spin-Echo Diffusion Tensor Imaging at 3T

Duan Xu[1], Roland Henry[1], Pratik Mukherjee[1], Reed Busse[2], Eric Han[2], Daniel B. Vigneron[1]
[1]University of California at San Francisco, San Francisco, CA, USA; [2]GE Medical Systems, Menlo Park, CA, USA

In this study, we investigated the use of a SSFSE based sequence to perform diffusion tensor imaging with minimal distortions throughout the brain using both a volume head coil and high sensitivity phased array coils in a 3T scanner. Previous results at 1.5T showed that DTI-SSFSE provides accurate ADC and Anisotropy measures. At 3T, EPI-based DTI demonstrated increased image distortions but the DTI-SSFSE provided distortion-free images with increased SNR over 1.5T. The phased array compatibility of this sequence permitted its use in cortical regions where it facilitated the visualization of small subcortical neuronal tracts and the quantitation of DTI parameters.

2132. Isotropic Multi-Slice Diffusion Imaging in the Presence of Physiological Motion using First Moment Motion Compensation and Navigator Echo Correction.

Bradford A. Moffat[1], Thomas L. Chenevert[1], Daniel E. Hall[1], Jadranka Stojanovska[1], Alnawaz Rehemtulla[1], Brian D. Ross[1]
[1]University of Michigan, Ann Arbor, Michigan, USA

Presented here is a practical diffusion pulse sequence and protocol that has been designed for routine 'high-throughput' imaging of animal models. The pulse sequence and reconstruction methodology combines the previously developed concepts of spin echo multi-slice imaging, isotropic diffusion weighting[1, 2], first moment motion and flow compensation, and navigator echo correction[3] to produce, high signal to noise and high resolution apparent diffusion coefficient images with minimal artifact. To demonstrate the protocol's versatility, presented are multi-slice coronal and transverse ADC maps of a rat brain with a 9L glioma, and transverse ADC maps of a mouse flank tumor.

2133. Physiological Measurements using Single-Shot 3D-GRASE: Diffusion- and T_2*-Weighting

Matthias Guenther[1], Koichi Oshio[1], David Feinberg[1]
[1]Advanced MRI Technologies, Sebastopol, California, USA

Diffusion- and T2*-weighting are essential tools for functional MRI studies. Time-resolved whole brain examinations are only possible with fast and robust imaging methods. We present a single-shot 3D-GRASE sequence with either diffusion- or T2*-preparation, which can acquire the whole brain in less than 1500ms. The Alsop-scheme is used to avoid artifacts due to the undetermined phase after preparation. Additional gradient pulses are used to correct for residual eddy currents. The results show the capability of the sequence for use in functional studies. The robust imaging scheme enables measurements at higher field strengths e.g. 3T.

2134. Novel Diffusion Spectroscopic Measurements in Rat Brain and Nerve

Edward C. Parsons, Jr.[1], Mark D. Does[2], John C. Gore[2]
[1]Yale University, New Haven, Connecticut, USA; [2]Vanderbilt University, Nashville, Tennessee, USA

Using a modified oscillating diffusion gradients and an EPI sequence, the motional spectrum of diffusing water has been measured in the rat brain and trigeminal nerve. This is the first measurement of the temporal spectrum of diffusion in a biological system. Measurements are made in both normal and globally ischemic states. The spectra reveal unique information that may help to discern the specific mechanism behind diffusion changes coincident with ischemia.

2135. Preservation of White Matter Diffusion Anisotropy Indices in the Fixed Mouse Brain

Shu-Wei Sun[1], Jeffrey J. Neil[1], Sheng-Kwei Song[1]
[1]Washington University School of Medicine, St. Louis, Missouri, USA

Most DTI mouse brain studies employ excised, fixed mouse brains. One key issue is the degree to which tissue architecture is preserved after fixation. The purpose of this study is to compare the structural features, as measured using DTI, of in vivo and ex vivo mouse brains. Overall, fixation of tissue leads to a ~ 60 % decrease in Tr(D) values with relative sparing of anisotropy indices. This result suggests that fixation causes a reduction of water permeability for cell membranes and other constituents while preserving tissue architecture.

2136. Improved Correlation between Diffusion Parameters and Cell Volume Fraction in High-Resolution Diffusion-Weighted Images

Rebecca Milman[1], Xiaohong Joe Zhou[1]
[1]University of Texas M.D. Anderson Cancer Center, Houston, Texas, USA

It has been reported that high b-value diffusion-weighted (DW) images can be characterized using a two-compartment model. Volume fractions of the diffusion compartments, however, have not been well correlated to tissue cell volume fractions. The purpose of this study is to achieve better correlation between diffusion compartments and cell volume fraction by reducing partial volume effects in DW images using a high-resolution imaging technique. Diffusion compartment parameters were calculated from the putamen of ten healthy subjects. The volume fraction of the fast-diffusing compartment was consistent (error = ±1.3%) and agreed with the expected extracellular volume fraction within ~9%.

2137. Diffusion Tensor Imaging of Post-Mortem Brain Slices (Fresh And Fixed) on a Clinical Scanner

Claudia A M Wheeler-Kingshott[1], Klaus Shmierer[1], Olga Ciccarelli[1], Phil Boulby[1], Geoff J M Parker[2], David H. Miller[1]
[1]Institute of Neurology, London, UK; [2]University of Manchester, Manchester, UK

Diffusion tensor imaging of post-mortem (PM) brain slices of Multiple Sclerosis (MS) patients was feasible on a 1.5T clinical scanner. The b-factor was optimised for the low water diffusion coefficients in PM tissue, and a diffusion-weighted multi-shot EPI acquisition was used to reduce susceptibility artefacts. The specimens were scanned fresh and rescanned after fixation in formalin. MS lesions and normal-appearing-white-matter showed some differences between fresh, fixed and in vivo brain. PM DTI has the potential to explore the correlations with histopathology data and in fresh brain might be useful to validate fibre tract reconstruction algorithms.

2138. Diffusion Characteristics of Large Molecules Assessed by Proton MRS on a Whole-Body MR System

Achim Lehnert[1], Jürgen Machann[1], Claus Detlev Claussen[1], Fritz Schick[1]
[1]Eberhard-Karls-University, Tübingen, Baden-Württemberg, Germany

This study reports the diffusion-sensitive investigations of quite large molecules in vivo and in vitro by MR-spectroscopy. For the first time, in-vivo diffusion studies of distinct human lipids are described. To achieve satisfying signal yield and strong diffusion-weighting, the STEAM-sequences employed were optimised. The method of sequence optimisation is described and its resulting usefulness is graphically presented.

2139. Bulk Sodium Diffusion in Rat Brain

James Andrew Goodman[1], Joseph J. H. Ackerman[1], Jeffrey J. Neil[1]
[1]Washington University in St. Louis, Saint Louis, Missouri, USA

Quantifying sodium ion diffusion in the extra- and intracellular compartments will provide mechanistic insight into the as yet unexplained marked decrease in water diffusion in CNS injury. As a first step, the apparent diffusion coefficients (ADCs) of bulk brain Na+ have been determined in vivo in rat. A surface coil transmit/receive adiabatic-pulse scheme is used to provide two dimensions of volume localization, thus minimizing echo time. The third dimension is determined by slice selection gradients on axis perpendicular to the coil plane. Preliminary findings indicate a bulk Na+ ADC of (1.07 +/- .08) x 10-3 mm2/s.

2140. Reducing Nyquist Ghosts in Gradient-Recalled Echo Echo-Planar Perfuson-Weighted Imaging

Michel Louis Lauzon[1], Richard Frayne[2]
[1]Seaman Family MR Research Centre, Calgary, Alberta, Canada; [2]University of Calgary, Calgary, Alberta, Canada

Perfusion-weighted imaging (PWI) sequences are used to diagnose the severity of acute stroke in patients. These techniques are often based on gradient-recalled echo echo-planar imaging (GRE-EPI). Because of its sensitivity to phase discrepancies, the required calibration scan may be corrupted and could lead to image artifact. Here, we propose using a hybrid PWI sequence that combines a spin-echo EPI reference scan (for calibration robustness) with a GRE-EPI data acquisition (for the desired T2*-weighting). Comparison of the conventional and hybrid PWI in an acute stroke patient shows reduced ghosting artifact using the hybrid sequence.

2141. Reduced Encoding of Diffusion Spectrum Imaging with Cross-term Correction

Ching-Po Lin[1], Wen-Yih Isaac Tseng[2], Jun-Cheng Weng[1], Van J. Wedeen[3], Jyh-Horng Chen[1]
[1]National Taiwan University, Taipei, Taiwan; [2]National Taiwan University College of Medicine, Taipei, Taiwan; [3]MGH Martinos Center for Biomedical Imaging, Harvard Medical School, Charlestown, Massachusetts, USA

Diffusion Spectrum MRI (DSI) is capable of defining orientations of intersecting fibers accurately, but the scanning procedure is overly time-consuming under the current sampling scheme. In this study, we have proved that decreasing the acquisition points to 62% is feasible by cross-term corrected reduced-encoding scheme. We calculated the diffusion cross-term from the acquired data in the center of q-space and correct the data in outer q-space by the data acquired with opposite diffusion gradients. Both phantom and rat brain models showed that this method can decrease DSI acquisition time while preserving the patterns and orientations of probability density function.

Diffusion Analysis: The Tensor and Beyond

Hall D Saturday 14:00 - 16:00

2142. Computation of the ADC, Relative and Fractional Anisotropy Maps in DT-MRI without a Diffusion Tensor Model

Khader M. Hasan[1], Ponnada A. Narayana[1]
[1]University of Texas, Houston, Texas, USA

Diffusion Tensor MRI (DT-MRI) is a promising modality for mapping the structure of deep tissues. The apparent diffusion coefficient (ADC), fractional anisotropy (FA) and relative anisotropy (RA) maps are commonly used in DT-MRI. In general, these maps are computed off-line after tensor decoding and diagonalization. This work demonstrates that ADC, RA and FA can be obtained from the first and second moments of the measured diffusion-weighted (DW) data. The proposed rotationally invariant DW-based indices, which can be implemented on line, are validated using full human brain DT-MRI measurements, acquired with a novel rotationally invariant and balanced icosahedral scheme.

2143. Quantitative Analysis of Diffusion Tensor Orientation: Theoretical Framework and Normal White Matter Anatomy

Yu-Chien Wu[1], Aaron S. Field[2], Andrew L. Alexander[1]
[1]W.M. Keck Laboratory Functional Brain Imaging & Behavior, Madison, Wisconsin, USA; [2]University of Wisconsin Medical School, Madison, Wisconsin, USA

DT-MRI provides useful information about the magnitude, anisotropy, and orientation of water diffusion in the brain. RGB color maps provide unique information about tensor orientation that can be used to assist with the identification of specific white matter tracts. However, color is not very quantitative since the colors appear discrete and it is difficult to detect slight variations in direction. In this study, a formalism is presented for the quantification of DT orientations in specified brain regions. The approach is used to evaluate directional organization and the lateral symmetry of DT-MRI data in the healthy human brain.

2144. The Effect on DT-MRI of Increased Number of Directions: Further Advances on Icosahedral Schemes

Philipp G. Batchelor[1], David Atkinson[1], Derek L.G. Hill[1], Fernando Calamante[2], Alan Connelly[2]
[1]King's College London, London, UK; [2]University College London, London, UK

The choice of gradient directions for diffusion sensitisation influences noise propagation from DWI to DTI. Icosahedral directions have been shown to have a very special algebraic feature, namely rotational invariance of the matrix used for reconstruction. A complementary aspect, the dependence on the number N of directions is what could be called the statistical behaviour of schemes. We show that the algebraic properties have a direct impact on the statistical behaviour (bias and std) of the angular variation of Fractional Anisotropy (FA) in the sense that icosahedral schemes have a better than expected dependence on N.

2145. Analysis of Fibre Directionality on Colour-Coded DTI (CDTI) using Geometrical Anisotropy Indices and the 2nd Eigenvector.

Jochen G. Hirsch[1], Christina Rossmanith[1], Stefanie Schwenk[1], Michael G. Hennerici[1], Achim Gass[1]
[1]University Hospital Mannheim, University of Heidelberg, Mannheim, Germany

CDTI includes some oversimplification in regard to the complexity of white matter as the largest eigenvalue and its associated eigenvector focus on a single dominant fibre direction. Common colour-coding schemes neglect additional information that can be gained from the second largest eigenvalue and its eigenvector. Geometrical anisotropy indices are helpful to differentiate high anisotropy regions, that are dominated by a single fibre direction or have input from at least one other large fibre component as can be demonstrated on planar anisotropy index maps. This "background" information is helpful for a more accurate concept of fibre architecture when interpreting CDTI images.

2146. Effects of Multi-Compartment Diffusion and Water Exchange on q-Space Imaging Echo Attenuation: A Computer Simulation

Chih-Liang Chin[1], Felix W. Wehrli[1], Scott N. Hwang[2], David B. Hackney[1]
[1]University of Pennsylvania Medical Center, Philadelphia, Pennsylvania, USA; [2]New York University Medical Center, New York, New York, USA

NMR q-space echo attenuation shows diffraction phenomena from structured materials, but so far none has been observed in biological tissues. Instead, displacement profiles of water molecules have been used as a surrogate to assess underlying tissue morphology. However, interpretation of q-space analysis is complicated in the presence of multi-compartment water diffusion and inter-compartmental exchange. Here we examine this effect by simulations on circular arrays and segmented rat spinal cord images. The results suggest that, depending on the degree of exchange, q-space echo plots may be described as the weighted sum or product of echo attenuations obtained from each compartment.

2147. Correlation of Fast and Slow Diffusion Coefficients in Human Internal Capsule with Diffusion Sensitization Direction

Robert V. Mulkern[1], Sridhar Vajapeyam[1], Stephan E. Maier[2]
[1]Children's Hospital, Boston, Massachusetts, USA; [2]Brigham and Women's Hospital, Boston, Massachusetts, USA

Synopsis: Biexponential modeling of brain water signal decay with b-factor over an extended b-factor range up to 5000 s/mm2 was performed in the internal capsule of human volunteers as a function of diffusion sensitization direction. The results show a strong correlation between the fast and slow diffusion coefficients as the diffusion sensitization direction is varied.

2148. The Importance of Compartmental T_2 to the Measurement of Water Diffusion in Acute Cerebral Ischaemia

David L. Buckley[1], Stephen R. Williams[1]
[1]University of Manchester, Manchester, UK

When considering the diffusion changes seen during acute cerebral ischaemia the influence of T2 is largely ignored. In this study, a two-pool model (incorporating restricted diffusion, relaxation and water exchange) was used to simulate data typical of those measured in human and experimental stroke. T2 relaxation was mono-exponential due to fast intracellular-extracellular water exchange. However, it was necessary to incorporate intra-compartmental changes in T2 (intracellular T2 increase, extracellular T2 decrease) to accurately simulate the diffusion changes observed *in vivo*. T2 may play an important role in the changes observed in acute stroke using diffusion imaging.

2149. Two-Compartmental Model of the Effect of Cortical Cell Swelling on the Measured Apparent Diffusion Coefficient

Nicolas Francisco Lori[1], Denis Le Bihan[1]
[1]Service Hospitalier Frederic Joliot, CEA, Paris, France

A model is proposed that describes the change in apparent diffusion coefficient caused by cell swelling. Use of reasonable anatomical and experimental parameters enables a quantitatively reasonable description of recent functional diffusion magnetic resonance imaging experiments.

2150. Correlation of water Diffusion, Cellular Exchange, Intracellular Restriction and Cell Growth.

Jean-Philippe Galons[1], Joseph L. Divijak[1], Kathy A. McGovern[1], Robert J. Gillies[1], Theodore Trouard[1]
[1]University of Arizona, Tucson, Arizona, USA

Although the exact mechanisms under-lying changes in the apparent diffusion coefficient of water (ADCw) following therapy are unknown, it is hypothesized that the increased ADCw is reflecting a decreased intracellular volume fraction caused by apoptosis associated cell shrinkage, necrosis, or vasogenic edema.. Using appropriate mathematical models, it is possible to interpret DWI in terms of physiological parameters, e.g. cell dimensions, membrane permeability, tortuosity of extracellular space and water concentration.(4-8). In this study, we describe the changes in cell volume fractions, water exchange and restrictions effect associated with cellular growth using a cultured human glioma cancer cell model (U251).

2151. Analysis of Slow Diffusion Component in Brain at 3 Tesla.

Stefanie Schwenk[1], Jochen G. Hirsch[1], Christina Rossmanith[1], Michael G. Hennerici[1], Achim Gass[1]
[1]University Hospital Mannheim, University of Heidelberg, Mannheim, Germany

The slow diffusion component has been of high interest as it may be sensitive to pathologic processes, but is hard to determine with current technical facilities since the data points reach noise level at high b-values. We compared biexponential fitting with the q-space-analysis for diffusion component analysis. DWI was performed at 3T on three subjects. Diffusion coefficients derived from q-space-analysis showed a narrow distribution (WM: 0.29±0.02, GM: 0.41±0.05), separating gray and white matter, whereas biexponential fitting showed much larger variability of the slow diffusion coefficients (WM: 0.16±0.1, GM: 0.40±0.2).

2152. High Resolution Diffusion Tensor Imaging of the Slow Components to Visualize the Differences of Diffusion Characteristics among Various White Matter Pathways

Atsushi Shiraishi[1], Yasuhiro Hasegawa[1], Tohru Sawada[2], Hidehiro Mizusawa[3], Kazuo Minematsu[1]
[1]National Cardiovascular Center, Suita, Osaka, Japan; [2]BF Research Institute, Inc., Suita, Osaka, Japan; [3]Graduate School of Medicine, Tokyo Medical and Dental University, Yushima, Tokyo, Japan

Use of high field MR scanner and application of the lowest possible b-values in indicating a biexponential signal decay enabled slow component diffusion tensor imaging to have excellent spatial resolution and SNR. These methods can clearly visualize the neural connection between the internal capsule and basal ganglia.

2153. A Stretched-Exponential Model of Distributed Diffusion Rates in Brain

Kevin M. Bennett[1], Kathleen M. Schmainda[1], Daniel B. Rowe[1], Kelly Rebro[1], James S. Hyde[1]
[1]Medical College of Wisconsin, Milwaukee, Wisconsin, USA

A stretched-exponential model of water diffusion was developed to account for the non-exponential signal-attenuation commonly observed in diffusion-weighted experiments in cerebral cortex. The stretched-exponential model makes no assumptions about the number of sub-voxel proton pools. One derives from it a statistical measure of the continuous sub-voxel distribution of diffusion coefficients. Fits of the stretched-exponential model to data from the cerebral cortex in rats were significantly better in 85% of voxels compared to bi-exponential fits. Whole-brain maps showed high contrast in sub-cortical structures, suggesting this model as a new technique for diffusion-related contrast.

2154. Quantifying Non-Gaussian Water Diffusion by Means of Pulsed-Field-Gradient MRI

Jens Hesselberg Jensen[1], Joseph A. Helpern[1]
[1]New York University School of Medicine, New York, New York, USA

The extent to which water transport in a tissue deviates from homogeneous, Gaussian diffusion can be quantified by a dimensionless statistical measure referred to as the excess kurtosis. By using pulsed-field-gradient spin echo MRI data acquired with large diffusion sensitizing gradients, we show how to estimate the excess kurtosis. In particular, the excess kurtosis can be approximately determined from the lower order terms of an expansion in the gradient strength of the logarithm of the signal intensity. This result is applied to estimate the excess kurtosis in healthy adult and newborn human brain and ischemic rat brain tissue.

Diffusion Analysis: Tractography

Hall D Sunday 13:30 - 15:30

2155. Improving Accuracy of Diffusion Tensor Computation and White Matter Fiber Tracking

Maolin Qiu[1], Song Lai[1]
[1]University of Connecticut Health Center, Farmington, Connecticut, USA

Robust algorithms in the presence of image noises are critical for reliable diffusion tensor (DT) computation and white matter fiber tracking. Two most popular algorithms were compared with a new approach- wLSL algorithm. It was found that wLSL is superior to both DL and LSL for DT computation. Schemes for tenor field regularization were evaluated by comparing the computational expenses and accuracy. A simple yet robust fiber-tracking algorithm was proposed which tracks fibers in the dual image space, and tracking results consistently demonstrated the robustness of the proposed scheme.

2156. Mapping Brain Connectivity with Statistical Fibre Tracking and Virtual Dissection

Patric Hagmann[1], Reto Meuli[2], Lisa Jonasson[1], Pierre Vandergheynst[1], Stéphanie Clarke[2], Philippe Maeder[2], Jean-Philippe Thiran[1]
[1]Swiss Federal Institut of Technology, Lausanne, Switzerland; [2]University Hospital, Lausanne, Switzerland

Most fibre tracking techniques were developed in a deterministic framework reducing the diffusion information to one single main direction, thus not taking into account the fibre directional uncertainty related to the diffusion tensor. We implemented a different approach that was statistical in nature and that took in account the whole diffusion information. This algorithm was then used to model globally the brain connectivity. The mass of connections thus generated was then virtually dissected to uncover different tracts. The connectivity pattern and the individual fibre tracts were then compared to known anatomical data; a good matching was found.

2157. Tractography Using Independent Components of Diffusion Tensor MR Images

Sungheon Kim[1], Jeong-Won Jeong[1], Manbir Singh[1]
[1]University of Southern California, Los Angeles, California, USA

The principal components of diffusion tensor are limited to represent only orthogonal three components whereas the underlying tracts in a voxel could be positioned in a non-orthogonal way. We have investigated an approach relying on independent components to allow tracking of multiple tracts in a voxel under the assumption of linear mixing of diffusion weighted MR signals by the individual tracts. The method was validated using Monte Carlo simulation data for various configurations of fiber crossings. The method was also successfully used to track white matter fibers within potential fiber crossing areas of the human brain.

2158. Automatic Subvoxel Detection of Singularities in Diffusion Tensor Fields

Thomas R. Barrick[1], Chris A. Clark[1]
[1]St. George's Hospital Medical School, London, UK

We have previously shown that fields of the principal diffusion direction are characterised by singularities. Singularities occur where two or more eigenvalues are equal so that the principal directions are undefined. Our previous work has shown that singularities present problematic regions for fibre tracking algorithms. Given that knowledge of these points can assist in the placement of seed regions for effective fibre tracking, we have developed a methodology for automatic subvoxel detection of singular points using the diffusion tensor field.

2159. Singularities and their Relevance to Tracking White Matter Structures

Thomas R. Barrick[1], Chris A. Clark[1]
[1]St. George's Hospital Medical School, London, UK

The technique of fibre tracking based on diffusion tensor imaging offers the possibility of determining the white matter pathways in vivo. We have shown previously that singular points occur in the principal direction field where two or more eigenvalues are equal so that the principal directions are undefined. Singularities occur where there is (i) fibre crossing, (ii) pathways pass close to one another in a voxel, and (iii) noise propagation into low anisotropy regions. In order to highlight the relevance of singularities on tracking the white matter we determined their effect on tracking the corticospinal system.

2160. Divergence/Convergence Effects on the Accuracy of White Matter Tractography Algorithms

Mariana Lazar[1], Andrew L. Alexander[2]
[1]University of Utah, Salt Lake City, Utah, USA; [2]University of Wisconsin, Madison, Wisconsin, USA

The fiber reconstruction reliability in diffusion tensor fields of non-zero divergence was investigated for several white matter tractography (WMT) algorithms using Monte Carlo simulations. Estimated tract accuracy was characterized by increased dispersion for divergent fields and decreased dispersion for convergent fields. WMT methods that integrate the path with interpolation were more sensitive to these effects than non-interpolating algorithms. The relations between tract dispersion and field characteristics such as signal-to-noise ratio and anisotropy characterizing zero divergence fields are altered in fields of non-zero divergence. This study investigates an aspect that was unaccounted in previous WMT error characterization studies.

2161. MRDTI Tracking of Branching White Matter Fiber Bundles

Richard Watts[1], Aziz M. Ulug[1]
[1]Weill Medical College of Cornell University, New York, New York, USA

The limited resolution that can be obtained with magnetic resonance diffusion tensor imaging (MRDTI) in a clinically acceptable acquisition time results in many voxels containing multiple fiber bundles. These fibers may run parallel initially but later diverge into separate tracts. Simulations are used to demonstrate that it is possible to track such branching fibers using a continuous tracking algorithm and multiple seed points within each seed voxel. In vivo results are presented showing tracking of the corticospinal tract as it fans out superiorly from the level of the internal capsule.

2162. Probabilistic Monte Carlo Based Mapping of Cerebral Connections Utilising Crossing Fibre Information

Geoffrey James Martin Parker[1], Daniel C. Alexander[2]
[1]University of Manchester, Manchester, UK; [2]University College London, London, UK

A methodology is presented for estimation of a probability distribution function (PDF) of voxel fibre orientations when one or two fibres are present in a voxel. The method models water diffusion in a single fibre by a Gaussian density function and in multiple fibres by a mixture of Gaussian densities. Monte Carlo streamline methods are used to establish probabilities of connection between brain regions using these PDFs.

2163. Identify 3-Dimensional White Matter Tracts by Directional Correlation Based Region Growing (DCRG) Method

Chien-Yuan Lin[1], Chung-Yi Hong[1], Sheng-Kwei Song[2], Chen Chang[1]
[1]Academia Sinica, Taipei, Taiwan; [2]Departments of Chemistry and Radiology, Washington University, St. Louis, Missouri, USA

Synopsis: Three-dimensional (3-D) structure of white matter tracts (WMT) is identified using directional correlation based region growing (DCRG) method on a multi-slice 2-dimensional (2-D) diffusion tensor imaging (DTI) data. The method and procedures of DCRG are described and examples of resulting WMT will be illustrated in this presentation. Introduction: There have been many reports using DTI to track WMT recently [1]. By tracing the pixels along the direction of the principal eigenvector v1, previously reported method traces many threads from initial points and then bundle all of them together to form white matter tracts. The differentiation between threads of adjacent

2164. Comparative Assessment of DT-MRI Fiber Tractography Algorithms

Burak Acar[1], Roland Bammer[1], Michael E. Moseley[1]
[1]Stanford University, Stanford, California, USA

DT-MRI based in-vivo fiber tractography (FiT) is based on following the principal eigenvectors of diffusion tensors. Despite its potential, FiT remains to be controversial due to the lack of a consensus on methodology. The degrees of freedom in FiT include i) data related parameters (structure, DWI parameters), ii) interpolation/regularization methods, iii) tracking methods per se. The FiT's performance was tested with different methodologies on 3D phantoms with virtually any geometry (rings, kissing and twisting fibers). Our results suggest that voxel size and SNR are the important parameters irrespective of the methodology, when the tracking step sizes are small.

2165. Resource Program for Tracking and Displaying of Fiber Bundles

Hangyi Jiang[1], Peter C.M. van Zijl[1], Susumu Mori[1]
[1]Johns Hopkins University School of Medicine and F.M. Kirby Research Center, Kennedy Krieger Institute, Baltimore, Maryland, USA

User-friendly software for tractography was developed. The algorithm is based on a simple linear propagation model without interpolation for time and memory efficiency. It contains an interactive ROI-placement interface. Fiber tracking is performed only once from all pixels inside the brain. A parameterized linear equation was used for rapid determination of the intercept between the traced line and pixel coordinates. Then, an index matrix for the fiber data was introduced to facilitate memory efficiency and instantaneous tract editing and visualization in two- and three-dimension interactively. For a 256x256x50 image matrix, the whole procedure takes less than 3 minutes (Pentium-III, 800MHz).

2166. Cerebral Neurography with Automated Analysis of Diffusion Spectra

Van Wedeen[1], David Tuch[1], Mette R. Weigel[1], Jingang Dou[1], Timothy G. Reese[1]
[1]MGH, Charlestown, Massachusetts, USA

We present a simple method to obtain a "sketch" of cerebral neural tracts from 3D q-encoded maps of diffusion displacement probabilities, MRI diffusion spectra. This automated method has the capacity to identify major cerebral tracts in normal subjects and tract interruption at the site of surgical transection.

2167. Diffusion Tensor, Anisotropy-Color-Coded, 3D Tractography of Brain Tumor Adjacent to the Pyramidal Tract

Haruyasu Yamada[1], Shigeki Aoki[1], Yoshitaka Masutani[1], Osamu Abe[1], Akira Kunimatsu[1], Harushi Mori[1], Takeharu Yoshikawa[1], Makoto Watanabe[1], Tomohiko Masumoto[1], Naoto Hayashi[1], Kuni Ohtomo[1], Hiroyuki Kabasawa[2]
[1]School of Medicine, University of Tokyo, Tokyo, Japan; [2]GE Yokogawa Medical Systems, Hino, Tokyo, Japan

The purpose of this study is to evaluate clinical feasibility of newly developed DT, anisotropy-color-coded, 3D tractography using seeded and line-tracking method in patients with a brain tumor adjacent to the pyramidal tract, and to evaluate correlation with the clinical measures and analyze fractional anisotropy (FA) indices along the obtained "pyramidal tract." It was useful to demonstrate normal anatomy, to show the relationship between eloquent fiber and tumor.

2168. Macrospcopic Anatomical Analysis of Human Brain White Matter Structures Based on Diffusion Tensor Imaging and Orientation-Component Analysis

Setsu Wakana[1], Hangyi Jiang[1], Lidia Mayumi Nagae-Poetscher[1], Xavier Golay[1], Peter van Zijl[1], Susumu Mori[1]
[1]Johns Hopkins University, Baltimore, Maryland, USA

A new technique to quantitatively analyze global white matter architecture based on diffusion tensor imaging is introduced. Gray and white matters are segmented based on anisotropy threshold. The white matter is then decomposed into fiber components along three orthogonal orientations, and the volumes and anisotropy of each component are separately calculated. This technique is combined with a Talairach-based brain normalization method. As a demonstration, 11 volunteer data were compared to data from a stroke patient. Inter-measurement, intra-rater, and inter-rater variability were highly reproducible. The results indicated that the technique can detect abnormalities that can not identified by visual inspection.

2169. Mapping the "Finger", "Foot" and "Lip" Subdivisions of the Corticospinal Tract: A Combined fMRI and DTI Study.

Stefan Sunaert[1], Aneta Antosik[1], Ron Peeters[1], Paul Van Hecke[1]
[1]University Hospitals KU Leuven, Leuven, Belgium

The corticospinal tract is a direct rapidly conducting link between the motor cortex and the motor neurons of the spinal cord. Subdivisions of the finger, foot and lip bundles of the corticospinal tract were visualised through the combined use of DTI and fMRI in six healthy volunteers scanned on a 1.5T imager. The significant somatotopic fMRI activations of the finger, foot and lip parts of the primary motor cortex were used as seed points for the DTI fiber-tracking. The lip, finger and foot bundles shift from anterior to posterior respectively within the posterior limb of the internal capsule.

2170. Probabilistic Mapping of Thalamo-Cortical Connections using Diffusion Imaging: Distribution, Strength and Routes

Heidi Johansen-Berg[1], Timothy EJ Behrens[1], Mark W. Woolrich[1], Stephen M. Smith[1], Claudia AM Wheeler-Kingshott[2], Gareth J. Barker[2], Phil A. Boulby[2], J M. Brady[1], P M. Matthews[1]
[1]University of Oxford, UK; [2]University College London, London, UK

We use a probabilistic tractography algorithm to define and quantify connections between human thalamus and cortex using diffusion imaging data. Quantitative mapping and thresholding of connection probability values reveals thalamic subregions with multiple cortical connections and other thalamic subregions with low probability of any cortical connectivity. We also explore the routes and destinations of thalamo-cortical connections. The relative strengths, distributions and routes of connections we find in the human brain are compared to literature on thalamo-cortical connectivity in the non-human primate.

2171. Estimated White Matter Connectivity Patterns of SMA and Pre-SMA

Andrew L. Alexander[1], Lindsey A. Nelson[1], Mariana Lazar[2], Victor M. Haughton[1]
[1]University of Wisconsin, Madison, Wisconsin, USA; [2]University of Utah, Salt Lake City, Utah, USA

Brain function is believed to involve both neuronal activity in gray matter and neuronal interconnectivity through white matter pathways between neural centers. Various functional mapping methods such as the BOLD technique examine the activity in areas of gray matter, but provide little information about connection pathways. In this study, the pathways associated with SMA and pre-SMA were estimated using diffusion tensor MRI and white matter tractography. Estimated tract segments were anatomically classified according to region. Consistent connectivity patterns for SMA and pre-SMA were observed across four healthy subjects.

2172. Threshold Criteria of Iterative Algorithm for Human Brain White Matter by Projected Diffusion Distance at 3T MRI

Tetsuo Sato[1], Kenichi Kashikura[2], Yoshiharu Yonekura[2], Kotaro Minato[1]
[1]Nara Institute of Science and Technology, Ikoma, Nara, Japan; [2]Fukui Medical University, Yoshida-gun, Fukui, Japan

We have already developed a novel method to assess white matter connectivity using diffusion tensor distance between neighborhood voxels. Here we apply the method to in vivo brain measurements at 3T MRI. Diffusion tensor distance is defined as the length from the center to the surface of the diffusion tensor. Using the iterative algorithm, we can segment typical white matter trajectories such as Corpus Callosum. Compared with other algorithms using eigenvalues of the diffusion tensor, our approach has flexibility in selecting connected regions by using basic characteristics of the diffusion tensor shape.

2173. Group Connectivity Maps of Major White-Matter Pathways in the Human Brain

Olga Ciccarelli[1], Ahmed T. Toosy[1], Geoff JM Parker[2], Claudia AM Wheeler-Kingshott[1], Gareth J. Barker[1], David H. Miller[1], Alan J. Thompson[1]
[1]Institute of Neurology, London, UK; [2]Imaging Science and Biomedical Engineering, Manchester, UK

We have constructed group connectivity maps of three major clinically relevant white matter tracts - the anterior callosal fibers, optic radiations, and pyramidal tracts - using Fast Marching Tractography, in 21 volunteers. Using SPM99 two group mapping techniques were investigated: the first generated maps that demonstrate inter-subject tract variability and degree of overlap; the second constructed a statistical image that represents the group effect. In the future, group mapping could investigate differences between normal subjects and patients affected by neurological diseases.

Diffusion Analysis: Applications

Hall D Monday 13:30 - 15:30

2174. Nerve Fibers and Nuclei in the Human Medulla Demonstrated by Line Scan Diffusion Tensor Imaging.

Hatsuho Mamata[1], Ferenc A. Jolesz[1], Stephan E. Maier[1]
[1]Brigham and Women's Hospital, Boston, Massachusetts, USA

Diffusion-weighted tensor imaging was used to demonstrate in-vivo nerve fibers within the human medulla. While the direction of the first eigenvector points predominantly in craniocaudal direction, the second eigenvector shows a well-organized pattern in the axial plane. At the inferior olivary nucleus level, the direction of the second eigenvectors agrees with the known anatomy of interconnecting fibers. The fractional anisotropy maps produced low values in the inferior olivary nucleus and other patchy low anisotropy areas, which may represent nucleus areas. Anisotropy values higher than cortical gray matter seem to reflect the density of the interconnecting nerve fibers.

2175. Cerebral White Matter Changes Identified by Post-Mortem Diffusion Tensor MRI

Sara Brockstedt[1], Martin Sjöbeck[1], Jimmy Lätt[2], Elisabet Englund[1], Elna-Marie Larsson[1]
[1]Lund University Hospital, Lund, Sweden; [2]Lund University, Lund, Sweden

The possibility to use diffusion tensor imaging (DTI) for investigations of cerebral white matter changes encouraged us to perform DTI in two post mortem brains of cases with a clinically suspected white matter pahtology. Conventional MR measurements including T1W-SE, T2W-TSE, T2-tFLAIR, T1-MPR and DTI was performed, using a Siemens 3T Allegra MR scanner. After MR scanning a neuropathological investigation was performed. A qualitative evaluation of conventional MR, DTI and the neuropathological examination revealed the same affected areas. Quantitative evaluation of the DTI measurements of a selected number of areas showed good correlation with both neuropathological and radiological findings.

2176. Diffusion and Volume Changes during Brain Development

Lijuan Zhang[1], Kathleen M. Thomas[1], Matthew C. Davidson[1], B J. Casey[1], Linda A. Heier[1], Aziz M. Ulug[1]
[1]Weill Medical College of Cornell University, New York, New York, USA

Human brain goes through microstructural changes during maturation. Quantifying these changes may allow better understanding of the normal brain development, thus may help in diagnosis of diseases that causes developmental delay. Previous diffusion imaging studies showed that the brain diffusion decreases during the first decade of life in both gray matter and white matter. In this study, we studied the diffusion changes in conjunction with volume changes by measuring the diffusion parameters and fitting to brain model.

2177. Diffusion-Weighted Micro MR Studies of Axonal Regeneration in Live Injured Excised Larval Sea Lamprey Spinal Cord

Masaya Takahashi[1], Hidemasa Uematsu[2], Guixin Zhang[2], Andra Popescu[2], Michel E. Selzer[2], David B. Hackney[2]
[1]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA; [2]University of Pennsylvania Medical Center, Philadelphia, Pennsylvania, USA

The purpose of this study was to investigate the changes in the apparent diffusion coefficients and diffusion anisotropy, after injury and during regeneration of axons in the perfused live spinal cord of sea lampreys. Diffusion measurements were conducted perpendicular (t-) and parallel (l-) to the orientation of the axons. At 5 weeks after the injury diffusional anisotropy was reduced in all regions studied. At 10 weeks, there was partial recovery, with increases in anisotropy above control values, in some regions. Our results demonstrate that ADC measurements are sensitive to the presence, number, and diameter of axons in the injured cord

2178. Imaging of Diffusion Anisotropy of Microcapillary in Bone using Diffusion Tensor MRI

Akihisa Kaneko[1], Masaki Sekino[1], Kikuo Yamaguchi[1], Yawara Eguchi[1], Shoogo Ueno[1]
[1]Graduate School of Medicine, University of Tokyo, Bunkyo-ku, Tokyo, Japan

Fluid in the microcapillaries of bone plays a significant role in producing stress-generated potentials and exhibits diffusion anisotropy. In this study, we investigated the diffusion anisotropy of the rat femur using diffusion tensor magnetic resonance imaging (DT-MRI). Motion probing gradients (MPGs) were applied in three directions with a b-factor of 1750 s/mm2. The ADC maps illustrated that diffusion parallel to the long axis of bone is larger than perpendicular diffusion. The parallel diffusion is attributed to the fluid in the Haversian canals. We successfully obtained the relative density of microcapillaries in bone.

BASIC SCIENCE FOCUS SESSION (WITH POSTERS)
Brain Perfusion: New Methods and Issues

Room 701B   Tuesday 13:30 - 15:30   Chairs: Leif Østergaard and John A. Detre

13:30 *2179*. Fast Measurements of Cerebral Perfusion and Arterial Hemodynamics during Visual Stimulation with Turbo TILT fMRI

Jeroen Hendrikse[1], Hanzhang Lu[2], Jeroen Van der Grond[1], Peter CM Van Zijl[2], Xavier Golay[2]
[1]UMC, Utrecht, Netherlands; [2]Johns Hopkins University and FM Kirby Research Center for Functional Brain Imaging, Baltimore, Maryland, USA

Transfer Insensitive Labeling Technique (TILT) was used in combination with a train of 13 consecutive acquisitions to increase the efficiency and precision of measurements of cerebral blood flow (CBF), transit and trailing times in functional perfusion imaging during visual activation. Activation maps obtained as a function of delay time showed a spatial shift of the activated areas from regions surrounding the arterial vasculature at early delay times to deeper into the brain parenchyma later on. At delay times over 1200 ms, CBF data upon activation were in agreement with the literature data on regional cerebral perfusion.

13:40 *2180*. Transit Time Imaging with Flow Encoding Arterial Spin Tagging (FEAST)

Jiongjiong Wang[1], David C. Alsop[2], Hee Kwon Song[1], Joseph A. Maldjian[3], Kathy Tang[1], Mitchell D. Schnall[1], John A. Detre[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA; [2]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA; [3]Wake Forest University School of Medicine, Winston-Salem, North Carolina, USA

Flow encoding arterial spin tagging (FEAST) is introduced as a technique to measure arterial transit time (ATT), which can be derived from the ratio between the perfusion signals acquired with and without appropriate bipolar gradients. The mean ATT from just below the Circle of Willis to the brain was approximately 1.1 and 1.4s for bipolar gradients with specific encoding velocity (Venc) of 29 and 8mm/sec respectively, and was shortest in the deep middle cerebral artery (MCA) territory. Clinical applications of FEAST demonstrated its utility in the diagnosis of cerebrovascular disease.

13:50 *2181*. Velocity Selective Arterial Spin Labeling using an Adiabatic Hyperecho Pulse Train

Eric C. Wong[1], Matthew Cronin[1]
[1]UCSD, La Jolla, California, USA

In Velocity Selective Arterial Spin Labeling (VS-ASL), arterial blood is magnetically tagged using velocity selective pulses with no spatial selectivity, resulting in small and uniform transit delays throughout the region of interest. We introduce here the use of a hyperecho based tagging pulse train that consists of BIR-4 adiabatic rotation pulses with gradient pulses interspersed, followed by a delay to allow for inflow and then image acquisition. This pulse train saturates flowing blood with improved velocity selectivity, B_1 insensitivity and off-resonance insensitivity, and also leaves static tissue magnetization inverted for background suppression.

14:00 *2182*. A Background-Suppressed, Multi-Slice Sequence for Obtaining Arterial Spin Tagging Images

Keith St. Lawrence[1], Joseph A. Frank[2], Peter A. Bandettini[2], Frank Q. Ye[2]
[1]Lawson Health Research Institute, London, Ontario, Canada; [2]National Institutes of Health, Bethesda, Maryland, USA

A multi-slice version of background-suppressed arterial spin tagging is presented. This sequence enables background-suppressed AST data to be collected in conjunction with BOLD data. Furthermore, by applying inversion pulses between slice acquisitions, the background signal is minimized in all slices. The utility of the sequence was demonstrated by acquiring AST and BOLD data during functional activation, and high resolution AST data.

14:10 *2183*. SEEPAGE: Spin Echo Entrapped Perfusion imAGE - A Non-Subtraction Sequence for Perfusion Imaging.

Lowri Cochlin[1], Andrew Blamire[1], Peter Styles[1]
[1]University of Oxford, Oxford, UK

SEEPAGE: a non-subtraction method for measurement of perfusion, has been developed by fitting both phantom and human data to theoretical predictions. SEEPAGE consists of selective saturation of in-slice spins, followed by a spin-echo train, trapping magnetisations irrespective of flow, yielding signal intensity only from spins that have entered the slice during acquisition. Five normal volunteers have been studied. Mean grey matter to white matter flow ratio's generated are 1.8 ± 0.5; within-subject coefficient of variation (CV) was 17%, between subjects CV was 28%. SEEPAGE eliminates many of the problems inherent in subtraction methods of perfusion imaging.

14:20 **2184. FAIR and DSC-MRI of Cerebral Reperfusion after Transient Ischemia in Rat Brain**

Janneke Schepers[1], Wouter B. Veldhuis[1], Rick M. Dijkhuizen[1], Klaas Nicolay[1]
[1]Dept. of Experimental in vivo NMR, Utrecht, Netherlands

In this study flow-sensitive alternating inversion recovery (FAIR) and dynamic-susceptibility contrast (DSC-) MRI were compared in a rat model of transient middle cerebral artery occlusion at 24 hours after reperfusion. In the lesion area FAIR and DSC-MRI indicated similar relative increases in cerebral blood flow (CBF). Quantified FAIR-CBF-values and relative indices of DSC-CBF showed a significant linear correlation. In addition DSC-MRI indicated that the increase in CBF was associated with an increase in cerebral blood volume. Both FAIR and DSC-MRI are capable of detecting hyperperfusion after transient ischemia; DSC-MRI revealed the probable cause of the hemodynamic changes.

14:30 **2185. A New Approach to Quantitative Cerebral Blood Flow Determination Using Gadolinium MR Perfusion Imaging**

Mahaveer N. Degaonkar[1], Elias Melhem[2], Xavier Golay[1], Peter B. Barker[1]
[1]Johns Hopkins Medical Institution, Baltimore, Maryland, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

A new approach for quantification of absolute values of cerebral blood flow using gadolinium bolus MR perfusion imaging is described. Maps of relative CBF are calculated using standard tracer kinetic techniques, which are then converted to absolute CBF using a calibration factor derived from phase-contrast MR angiography. The method was tested in 6 children with sickle cell disease, and CBF values were compared to those obtained by continous arterial spin labeling (CASL). Good agreement between CBF values determined by this new method and CASL were obtained in both white (R^2 = 0.77) and gray matter.

14:40 **2186. Quantification of Bolus-Tracking MRI: Improved Characterization of the Residue Function using Tikhonov Regularization**

Fernando Calamante[1], David G. Gadian[1], Alan Connelly[1]
[1]University College London, London, UK

Quantification using bolus-tracking MRI requires deconvolution of the arterial input function to calculate CBF and the residue function (*R*). The most common deconvolution method uses singular value decomposition. Although this method has been shown to quantify CBF accurately, it introduces unwanted oscillations in *R*. In cases where the actual shape of *R* is of interest (e.g. calculation of flow heterogeneity, or assessment of bolus dispersion) an alternative method is required. This work describes the use of a regularization method to quantify CBF and obtain a better characterization of *R*. The methodology was tested on simulated and patient data.

14:50 **2187. A Model of the Human Vasculature for Studying the Influence of the Contrast Injection Speed on Cerebral Perfusion MRI**

Matthias van Osch[1], Jeroen van der Grond[1], Max Viergever[1], Chris Bakker[1]
[1]University Medical Center Utrecht, Utrecht, Netherlands

A simulation model of the human vasculature is developed to study the effect of the injection speed of the contrast agent on the determination of quantitative perfusion parameters by bolus-tracking. The model is constructed as a network of vascular operators and is based on average physiological data of 35-year-old males. The contrast passage curves calculated with this model are within the biological variation as observed in a group of 15 patients. By using this model, it is shown that injection speeds smaller than 3 ml/s lead to a serious underestimation of the cerebral blood flow.

15:00 **2188. Regional Blood Volumes and Intravascular Water Lifetimes in Human Brain**

William D. Rooney[1], Thomas E. Yankeelov[1], Patricia K. Coyle[2], Frank W. Telang[1], Charles S. Springer[1]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]State University of New York, Stony Brook, New York, USA

Measurements of water proton R_1 (= 1/T1) during contrast reagent (CR) wash-out were obtained to investigate brain vascular properties in healthy controls at 4 T. A markedly non-linear relationship between blood and brain tissue R_1 values was found, indicating that transendothelial water exchange departs the fast exchange limit at clinically relevant blood CR levels. Mean fractional blood volumes of 1.7 % (± 0.1 %) for white matter and 2.7 % (± 0.2 %) for putamen were obtained. The estimate for mean intravascular water lifetime is 0.30 s (± 0.06 s) in both tissues.

15:10 **2189. Increased Dose Dynamic Range and Temporal Resolution of AIFs Without Additional Noise**

Melanie S. Kotys[1], Erbil Akbudak[1], Thomas E. Conturo[1]
[1]Washington University, St. Louis, Missouri, USA

Reliable arterial input functions (AIFs) require linear signals related to contrast agent concentration. The "zipper" phase shift ($\Delta\varphi$) based subtraction method has shown to consistently provide such measurements with additional benefits over other methods. Noise analysis as compared to other methods, however, has not been conducted. $\Delta\varphi$ noise levels produced by the zipper method were compared to those produced by the pairwise and baseframe methods through theory and simulations. The zipper method can function as a standard means of AIF curve reconstruction with greater dose dynamic range and increased temporal resolution without additional random noise compared to traditional processing techniques.

15:20 **2190. Automatic Arterial Input Function Detection from Dynamic Contrast Enhanced MRI Data**

Gernot Reishofer[1], Roland Bammer[2], Michael E. Moseley[2], Rudolf Stollberger[3]
[1]Technical University Graz, Graz, Austria; [2]Stanford University, Stanford, California, USA; [3]University of Graz, Graz, Austria

Quantification of hemodynamic parameters from DSC-MRI scans require the deconvolution of the AIF from the tissue response function. Methods for automatic arterial input function detection was developed and applied to both single-shot EPI and multi-shot EPI data of 12 stroke patients. The classification criterions involved inherent features of the arterial input, such as early bolus arrival and fast passage as well as high contrast agent concentration. Two classification criterions were tested and compared. In eleven cases an AIF could be reliable identified. The false positive detection rate was between 0% and 25% depending on the method and the data acquisition.

Contrast-Agent-Based Brain Perfusion Methods

Hall D Saturday 14:00 - 16:00

2191. Whole Brain 3D PRESTO Dynamic Susceptibility Contrast (DSC) Imaging at 3T: Effect of High-field on the Dosage of Contrast Media

Christoph Manka[1], Frank Träber[1], Wolfgang Block[1], Jürgen Gieseke[2], Jochen Textor[1], Hans H. Schild[1], Christiane Kuhl[1]
[1]University of Bonn, Bonn, Germany; [2]Philips Medical Systems, Best, Netherlands

The objective of this study was to investigate the quality of whole cerebral first-pass perfusion imaging at high magnetic field using a reduced dosages of Gd chelates. The aim was to find out whether the same diagnostic information about cerebral hemodynamics can be obtained at 3T by using only half or quarter of the standard dose at 1.5Tof Gd-DTPA

2192. Quantitative Vessel Size Imaging in Humans

Valerij G. Kiselev[1], Ralph Strecker[1], Oliver Speck[1], Sargon Ziyeh[1], Joachim Klisch[1], Juergen Hennig[1]
[1]University Hospital Freiburg, Freiburg, Germany

The comparison of contrast-enhanced transverse relaxation rates R2 and R2* is expected to provide in-vivo mapping of the mean cerebral vessel calibre, also referred to as vessel size index (VSI). A quantitative assessment of the VSI in brain tumour patients is presented for the first time. The obtained VSI are sensitive to the tumor type. A theoretical analysis shows that the natural paramagnetism of blood results in a systematic overestimate of the VSI depending on the contrast agent and measurement parameters. The meaning of the VSI is analysed in the context of actual vessel architecture.

2193. Blood Volume Quantification in Rat Spinal Cord using USPIO Enhanced CPMG MR Imaging.

Marielle Philippens[1], Giulio Gambarota[1], Jeroen Pikkemaat[1], Albert van der Kogel[1], Arend Heerschap[1]
[1]University Medical Center, Nijmegen, Netherlands

USPIO enhanced CPMG imaging was used to measure absolute blood volume by subtracting the density map before and after contrast agent injection. This method was applied to irradiated and non-irradiated rat spinal cord and resulted in blood volumes of 6% in gray matter (GM) and 4% in white matter (WM) in control animals and 8% (GM) and 6% (WM) in irradiated animals. The measured spinal cord blood volume is in the upper range of cerebral blood volume values reported in literature, 2-5%. An additional result is the imaging of large blood vessels which decrease in functionality after severe radiation damage.

2194. Water Permeability of Capillaries in the Subfornical Organ of Rats Determined by T_1 Relaxation Time Measured by ^{1}H MRI

Yoshiteru Seo[1], Akira Takamata[2], Takashi Ogino[3], Hironobu Morita[4], Masataka Murakami[5]
[1]Kyoto Prefectural University of Medicine, Kyoto, Japan; [2]Nara Women's University, Nara, Japan; [3]National Institute of Neuroscience, NCNP, Kodaira, Tokyo, Japan; [4]Gifu University, Gifu, Japan; [5]National Institute for Physiological Sciences, Okazaki, Aichi, Japan

The water permeability of capillaries in the subfornical organ (SFO) of rat was measured by a H1-NMR imaging in combination with Gd-DTPA^{2-}, which could not leak out from the capillaries in the SFO. From the difference of 1/T1 induced by Gd-DTPA^{2-} infusion, the rate constant for water influx to the capillaries was estimated to be 0.84 s^{-1} which corresponds with a diffusive membrane permeability (Pd) of 3.7 x 10^{-3} cm^{-1}. From this Pd value, we conclude that the capillaries in SFO have one of the highest water permeability values among all of the capillaries in the brain.

2195. A Method for Minimizing Measurement Variability in Cerebral Perfusion Imaging

Timothy Carroll[1], Richard McCarthy[1], Vibhas Deshpande[1], Ty Cashen[1], Brian Schirf[1], Ken Curtin[1]
[1]Northwestern University, Chicago, Illinois, USA

We have developed a method of accurately determining cerebral perfusion by performing independent calculation of the average rCBV in white matter using a steady-state approach. Rapid T1 measurements made prior to, and immediately following the perfusion measurements using a “bookend” technique are used to calibrate the MR perfusion measurements. Application of this technique in healthy volunteers yielded values of CBV and CBF that agree with published values.

2196. Dynamic Contrast Enhanced Whole Brain Perfusion using a Rapid 3D T_1-weighted Sequence

Paul S. Morgan[1], Alan R. Moody[1], Anne L. Martel[2], Andrew D. Cooper[2]
[1]University of Nottingham, Nottingham, UK; [2]University Hospital, Nottingham, UK

Dynamic contrast enhanced perfusion studies of the brain using MRI usually acquire multi-slice T_2* weighted echo planar images (EPI) or rapid T_1 weighted FLASH images. Identification of an arterial input function (AIF) on the former is difficult, whereas the latter is often single slice and suffers from a low signal-to-noise ratio (SNR). We have developed and implemented a rapid 3D T_1 weighted FLASH sequence on a clinical scanner utilizing parallel acquisition techniques that provides whole brain perfusion images with good SNR and a well defined AIF.

2197. T_1 Based Brain Perfusion Quantification

I K. Andersen[1], S Rosenbaum[1], K Sidaros[1], L Hanson[1], H B.W Larsson[2]
[1]Copenhagen University Hospital, Hvidovre, Denmark; [2]University Hospital, Trondheim, Norway

Since R_1 of blood changes proportional to contrast agent concentration, brain perfusion quantification should in theory be obtainable from R_1 measurements during bolus passage. In practice, the signals are small and noisy, since only the blood compartment contribute to the signal. In this study, a saturation-recovery sequence was further developed for multi-slice acquisition of R_1 during bolus passage. It is shown that without rescaling or normalization of any kind, the estimated perfusion values are comparable to PET values. The optimized sequence may thus provide improved perfusion quantification compared to the dynamic susceptibility contrast methods.

2198. A High Spatial-Temporal Resolution AIF Method for Bolus Cerebral Perfusion

Erbil Akbudak[1], Joanne Markham[1], Melanie Kotys[1], Glenn Foster[1], Thomas Conturo[1]
[1]Washington University, School of Medicine, Saint Louis, Missouri, USA

Temporal and spatial resolution limit the measurement of arterial input function (AIF) from the carotids in quantitative cerebral perfusion imaging. Saturation effects also limit AIFs at doses that elicit tissue responses. A single-shot echo-planar sequence was designed for neck AIF imaging with high spatial-temporal resolution at 3T with a short TE to minimize saturation. Magnitude and phase data were acquired at a 16x32 matrix, TE=8 ms, and 1.6 mm pixels (with interpolation). High quality AIF curves were obtained. The peak and recirculation were well defined. This approach may be combined with brain EPI for perfusion imaging.

2199. Input Functions from Echoplanar Hemodynamic Studies using Dynamic Susceptibility Contrast: A Numerical Model Compared to *In-Vivo* Results

Guillaume Duhamel[1], Cedric M.J. de Bazelaire[1], David C. Alsop[1]
[1]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

A measure of the arterial input function is required to attempt the measurement of blood flow with dynamic susceptibility contrast (DSC) MRI, but in the low resolution echoplanar images usually used for DSC, partial voluming and chemical shift severely distort signal curves from many voxels containing arteries. The effect of these phenomena on echoplanar images was explored both theoretically and experimentally for a wide range of vessel sizes and orientations. The results suggest that high quality input functions can be obtained from echoplanar data if suitable selection criteria for the source voxels are employed.

2200. Using Factor Analysis to Improve Estimates of the Arterial Input Function.

Anne L. Martel[1], Paul S. Morgan[1], Alan R. Moody[1]
[1]University Hospital, Nottingham, UK

In order to obtain quantitative measurements of brain perfusion it is necessary to measure the arterial input function (AIF). This is frequently done by selecting voxels corresponding to small arteries in the brain. The main problems are the poor signal to noise ratio in individual voxel signal intensity curves and the difficulty in identifying suitable voxels to minimise partial volume effects. This abstract describes how these issues can be addressed by carrying out principal components analysis (PCA) to smooth the data, followed by factor analysis which enables arterial voxels to be readily identified.

2201. Tracer Arrival Timing Insensitive Technique for Estimating CBF in PWI

Ona Wu[1], Leif Østergaard[2], Thomas Benner[1], Bruce Rosen[1], Robert Weisskoff[3], A. Gregory Sorensen[1]
[1]MGH Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, Massachusetts, USA; [2]Aarhus University Hospital, Aarhus, Denmark; [3]EPIX Medical, Inc., Cambridge, Massachusetts, USA

Perfusion-weighted MRI by bolus tracking has been shown to be highly sensitive in detecting tissue at risk of infarction in acute stroke but not very specific. We hypothesize that this lack of specificity is partly due to delay between tracer arrival in tissue and the arterial input function. We propose a technique that is insensitive to this delay by using a block-circulant matrix for deconvolution and minimizing oscillation of the derived residue function (oSVD). Using numerical simulations and clinically acquired data, we show that PWI estimates from standard SVD methods are weighted by delay while those from oSVD are not.

2202. Optimization of Echo Time in Perfusion Assessment at 3T

Oliver Thilmann[1], Elna-Marie Larsson[2], Freddy Stahlberg[1], Ronnie Wirestam[1]
[1]Lund University, Lund, Sweden; [2]Lund University Hospital, Lund, Sweden

Dynamic susceptibility contrast MRI has become a useful clinical tool for the assessment of cerebral perfusion. The introduction of a new generation of high-field scanners at 3T requests a re-evaluation of the employed imaging parameters. On a Siemens 3T Allegra head scanner, we determined the optimal echo time to be used in the gradient echo EPI sequence implemented for perfusion imaging. An examination of four echo times in the range of 21 to 45ms indicated that for an optimal signal-change to noise ratio, taking technical limitations and clinical demands into consideration, the shortest possible echo time should be applied

2203. Validity of the Contrast Reagent Concentration versus Signal Intensity Relationship in Brain Perfusion Imaging

Jeffry R. Alger[1], Chelsea S. Kidwell[1], Andrew J. Frew[1], Andre Fredieu[1], Shuichi Suzuki[1], Jeffrey L. Saver[1]
[1]David Geffen School of Medicine at UCLA, Los Angeles, California, USA

This study tested the hypothetical direct linear relationship between contrast reagent concentration and gradient-echo signal intensity that is frequently used in the quantitative evaluation of brain contrast reagent passage perfusion studies. Hospitalized stroke patients underwent two perfusion studies in which different amounts of contrast reagent were administered. The results indicate that the hypothetical relationship is not valid and suggest an alternative.

2204. *In-Vivo* GdDTPA Relaxivity Measurements in Rat Brain Lesions

Stephen Pickup[1], Andrew K. W. Wood[1], Harold L. Kundel[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

In-vivo measurements of GdDTPA relaxivity were performed in necrotic and normal rat brain. Lesions were induced in 9 rats by a localized freezing method. T1 maps of the lesions were generated before and after injection of GdDTPA (0.1 – 0.4 mmol/kg). Samples of normal and necrotic brain were collected at post mortem and analyzed for Gd content by atomic emission. Relaxivity measurements were also performed on solutions of GdDTPA in normal saline. The difference between the relaxivity of Gd in brain tissue (4.5±0.3 kg/mmol s) was not statistically different from that observed in the saline samples (4.8±0.1 kg/mmol s).

2205. Advantages of Frequency Domain Modeling in Magnetic Resonance CBF Quantification

J Chen[1], M R Smith[1], S Trochet[2], R Frayne[1]
[1]University of Calgary, Calgary, Alberta, Canada; [2]Ecole Nationale Supérieure des Télécommunications de Bretagne, Plouzané, Bretagne, France

In magnetic resonance (MR) perfusion studies, the accuracy of the cerebral blood flow (CBF) estimates, obtained as the maximum of the residue function obtained by discrete deconvolution, is affected by the experimental sampling rate used when measuring the arterial and tissue concentration curves. This inaccuracy is greatest in tissues where the mean transit time (MTT) is short, i.e. comparable to the sampling interval. The feasibility, and effectiveness, of reducing these sampling artifacts and obtaining unbiased CBF estimates by modeling the frequency-domain representation of the residue function is demonstrated through a novel Lorentzian modeling method.

2206. Removing CBF Artifacts Introduced during SVD Deconvolution

Michael R. Smith[1], Hong Lu[1], Sebastien Trochet[2], Richard Frayne[1]
[1]University of Calgary, Calgary, Alberta, Canada; [2]Ecole Nationale Superieure des Telecommunications de Bretagne, Plouzane, Bretagne, France

Cerebral blood flow (CBF) estimates can be obtained by deconvolving the tissue concentration curve with the arterial input function (AIF) using singular value decomposition (SVD). An under-estimation of the CBF occurs, from a broadening distortion of the residue function, R(t), when the number of eigenvalues used in the SVD solution is limited to control noise instabilities. The standard SVD algorithm does not correctly handle this distortion, especially when the arterial and tissue delay (ATD) is small. A re-formulated SVD (rSVD) algorithm is proposed to handle the R(t) distortions, and is shown to also remove other previously reported delay artifacts.

2207. Robust and Unbiased Adaptive Thresholding in SVD-Based Deconvolution of DSC-MRI Perfusion Data

Steven Pieter Sourbron[1], Robert Luypaert[1], Michel Osteaux[1]
[1]Vrije Universiteit Brussel, Brussels, Belgium

SVD-based deconvolution of DSC-perfusion data requires the selection of a threshold parameter in order to regularize the solution. We extend three methods that are well-established in the literature on regularization to the context of pixel-by-pixel MRI perfusion quantification. We evaluate these methods in terms of image quality and sensitivity to abnormalities in CBF and compare them to fixed- and adaptive thresholding paradigms from the MRI literature. We conclude that the L-curve criterion combined with Tikhonov regularization shows promise as a robust and unbiased thresholding method.

ASL-Based Brain Perfusion Methods

Hall D Sunday 13:30 - 15:30

2208. Perfusion by Non-selective Inversion Selective Excitation (NISE)

Essa Yacoub[1], Pierre-Francois Van de Moortele[1], Kamil Ugurbil[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

Arterial spin labeling techniques are commonly employed in MRI to monitor perfusion and perfusion changes due to neural activity, by tagging water protons in blood. The transit delay, the time between tagging and delivery of tagged spins into the imaging slice, is a significant source of degradation in flow maps and contrast. Tagging can be done near the slice of interest to reduce transit delay errors. Gaps are used because of imperfect profiles of tagging and excitation pulses. In this work, we propose a pulsed arterial spin labeling technique that, for a single slice, eliminates this problem without affecting contrast.

2209. Multislice Continuous Arterial Spin Labeling (CASL) with *S*lice-*O*rder *RoT*ation (*SORT*)

H. Michael Gach[1]
[1]University of Pittsburgh MR Research Center, Pittsburgh, Pennsylvania, USA

The goal of multislice continuous arterial spin labeled (CASL) MRI is to measure whole-organ perfusion using multislice acquisitions to minimize scan time. However, the perfusion signal decays between the application of the label and the image acquisition, resulting in lower perfusion signal-to-noise ratio (SNR) in slices that occur late in the acquisition window. Multislice CASL with *S*lice-*O*rder *RoT*ation (*SORT*) dynamically varies the slice order to: 1) expand the number of slices that can be measured during an acquisition, and 2) characterize the change in the perfusion signal during the transit and acquisition delays.

2210. Band-Limited Velocity Selective Arterial Spin Labeling (BVS-ASL) and Combination with Spatial Selective ASL (SS-ASL)

Tokunori Kimura[1], Masao Ikedo[1], Yu Tokunaga[1], Shinichi Kitane[1]
[1]Medical Systems R&D Center,Toshiba, Otawara, Tochigi, Japan

The purpose of this study is to evaluate the band-limited velocity selective arterial spin labeling (BVS-ASL) as a method of decreasing transit delay time of labeled arterial water. The BVS-ASL using bipolar VENC pulse can produce band-limited but nearly double ASL signal as with the method of using unipolar VENC pulse. We presented the BVS-ASL provided higher SNR ASL image in shorter TI and independent of spatial position compared to the spatial selective ASL (SS-ASL), and the combined method of BVS and SS-ASL can provide ASL image which is robust to the selection of TI. .

2211. A Novel Pulsed Arterial Spin Labelling Sequence to Allow the Investigation of Transit Times

Joanna Elizabeth Perthen[1], Fernando Calamante[1], David G. Gadian[1], Alan Connelly[1]
[1]Institute of Child Health, London, UK

To minimize interactions between inversion and excitation slice profiles in pulsed arterial spin labelling (PASL), it is common to use inversion slice profiles ~3 times wider than the imaging slice. The resulting transit time (δ) can introduce errors in the perfusion calculation. This study introduces a PASL method, based on a modification of the FAIR technique, which enables the use of a 1:1 ratio between subtracted slices. This sequence can be used to investigate whether δ can be reduced to a negligible level, or if the transit time to the exchange site *within* the slice is the significant limiting factor.

2212. High Field PASL Perfusion Imaging of Mouse Brain: Significance of the Width of the Tagging Region on the Arterial Input Function

David P. Lewis[1], Gaby S. Pell[2], Craig A. Branch[1]
[1]Nathan Kline Institute, Orangeburg, New York, USA; [2]Brain Research Institute, Melbourne, Victoria, Australia

High field PASL perfusion imaging of transgenic mouse brain has the potential to improve our understanding of various diseases. Since blood velocities are high and distances are short in the mouse, the arterial input and inflow of untagged blood are very significant to the perfusion model. We investigated the dependence of the perfusion signal in the mouse cortex on the spatial extent of the inversion tag and the included anatomy. We demonstrate that at high field, both the heart and lungs are important sources of tagged blood for the arterial input function.

2213. Dependence of Continuous Arterial Spin Labeling at the Neck upon the Post-Label Delay

Toralf Mildner[1], Robert Trampel[1], Wolfgang Driesel[1], David G. Norris[2], Harald E. Möller[1]
[1]Max Planck Institute of Cognitive Neuroscience, Leipzig, Germany; [2]FC Donders Centre for Cognitive Neuroimaging, Nijmegen, Netherlands

The dependence of the arterial spin labeling (ASL) signal change on the post-label delay (PLD) was investigated at 3 Tesla. ASL was performed using a circular surface coil of 6 cm i. d. which was placed over the common carotid artery. A helmet resonator and a spin-echo EPI sequence were used for imaging. Application of diffusion weighting with b = 10 s mm-2 and a finite labeling period of 3 s yielded an optimum post-label delay between about 1100 and 1400 ms. However, the overall change in sensitivity for varying PLD was low under these conditions.

2214. The Effects of the Order of Saturation and Inversion in Pulsed Arterial Spin Labeling

Karam Sidaros[1], Irene K. Andersen[1], Thomas T. Liu[2], Eric C. Wong[2], Richard B. Buxton[2]
[1]Copenhagen University Hospital, Hvidovre, Denmark; [2]University of California San Diego, La Jolla, California, USA

Presaturation is often used in pulsed arterial spin labeling to improve SNR. Although using multiple saturation pulses has some benefits, it may in some cases inadvertently cause incomplete static tissue subtraction. By swapping the order of saturation and inversion, the degree of static tissue subtraction can be improved considerably. This is demonstrated both in vivo and in phantom measurements. The optimal order of saturation and inversion depends on the RF pulses used.

2215. Inversion Efficiency and Measurement Error in Multiple-Coil Arterial Spin Labeling Experiments

Hee Kwon Song[1], Yan Zhang[1], Sailaja Anumula[1], Alexander C. Wright[1], Felix W. Wehrli[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA

Perfusion territory imaging studies utilizing separate labeling and imaging coils rely on selective labeling of individual carotid arteries. The adiabatic inversion efficiency of a surface labeling coil was investigated as a function of depth, coil current, and labeling gradient strength to determine the degree to which the blood in the ipsilateral and contralateral carotid arteries are affected. Expected errors in measurements of perfusion as a function of vessel depths and their separation are computed. The results of this study can be used to compensate for inaccuracies due to incomplete as well as undesired labeling of blood in the carotid arteries.

2216. The effect of B_1 Inhomogeneity on the Dynamic Signal and the Label Function in FAIR Perfusion Imaging

Janneke Schepers[1], Matthias J.P. van Osch[2], Lambertus W. Bartels[2], Sean N. Heukels[1], Klaas Nicolay[1]
[1]Dept. of Experimental in vivo NMR, Utrecht, Netherlands; [2]Image Sciences Institute, Utrecht, Netherlands

Quantification of perfusion by pulsed arterial spin labeling (PASL) techniques like FAIR can be affected by inflow of unlabeled blood. In this study arterial input function (AIF) measurements in the internal carotid artery of the rat were used to evaluate the effect of label slab width and inversion pulse power in the presence of a B_1-field with limited homogeneity. It was concluded that both the label slab width and the inversion pulse power affect the amount of label inflow and thus the FAIR signal. Acquisition of an AIF is a helpful tool to detect label function imperfections in PASL experiments.

2217. Presaturation Efficiency in Pulsed Arterial Spin Labeling in the Presence of B_1 Inhomogeneities

Karam Sidaros[1], Irene K. Andersen[1], Thomas T. Liu[2], Eric C. Wong[2], Richard B. Buxton[2]
[1]Copenhagen University Hospital, Hvidovre, Denmark; [2]University of California San Diego, La Jolla, California, USA

Presaturation is often used to increase SNR in arterial spin labeling (ASL). The presaturation efficiency of sinc pulses can be improved and B_1 sensitivity reduced by using multiple 90° sinc pulses without increasing SAR to the level of adiabatic pulse trains. The degree and dependence on B_1 of static tissue subtraction in ASL is also affected by the number of saturation pulses used.

2218. Evaluation of Systematic Quantification Errors in Velocity Selective Arterial Spin Labeling of the Brain

Guillaume Duhamel[1], Cedric M.J. de Bazelaire[1], David C. Alsop[1]
[1]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

Velocity selective sequences potentially permit arterial spin labeling (ASL) perfusion imaging with labeling applied very close to the tissue. Using a simple velocity selective pulse sequence, we evaluated the effects of systematic errors on the appearance and quantitative perfusion values obtained with velocity selective ASL (VS-ASL). Imperfect refocusing pulses and CSF motion both introduced important errors, which were minimized with improvements to the sequence. Resulting quantitative perfusion images showed good gray/white matter contrast but absolute perfusion values were approximately half that of spatially selective ASL studies.

2219. Reliability of Brain Perfusion with Pulsed Arterial Spin Labeling

Geon Ho H. Jahng[1], Xiaoping Zhu[1], Antao Du[2], Colin Studholme[2], Gerald B B. Matson[2], Michael W. Weiner[2], Norbert Schuff[2]
[1]University of California-San Francisco/VAMC, San Francisco, California, USA; [2]University of California-San Francisco, San Francisco, California, USA

Efficiency of PASL to tag blood water is one factor besides physiological and instrumental fluctuations that can limit the reliability of brain perfusion studies. This study compares the reliability of different PASL schemes, including EPISTAR, PICORE, and a new scheme termed DIPLOMA to measure perfusion on 13 subjects. DIPLOMA was best, achieving an intra-class correlation (ICC) between test-retest perfusion studies of 0.92 for mean perfusion of whole brain, followed by PICORE (ICC=0.82) and EPISATR (ICC=0.73). DIPLOMA substantially improved the reliability of perfusion measurements and therefore should provide more power in detecting differences between groups and individuals.

Diffusion and Perfusion Imaging: Clinical Applications

Hall D Monday 13:30 - 15:30

2220. Clinically Feasible Diffusion-Tensor Imaging for Fiber Tracking

Kei Yamada[1], Susumu Mori[2], Osamu Kizu[1], Hirotoshi Ito[1], Sachiko Yuen[1], Takao Kubota[1], Osamu Tanaka[1], Tsunehiko Nishimura[1]
[1]Kyoto Prefectural University of Medicine, Kyoto, Japan; [2]Johns Hopkins University, Baltimore, Maryland, USA

We implemented a diffusion-tensor imaging (DTI) scanning method that is short enough to facilitate clinical application. We tested our scanning protocol, which takes 4.5 minutes to those patients with brain tumors and confirmed that fiber-tracking images are available from the obtained data. Clinically useful information was derived from these images.

2221. Assessment of Diffusion-Weighted Echo-Planar Imaging Before and After Intravenous Application of Gd-DTPA

Clemens Fitzek[1], Hans Joachim Mentzel[1], Dieter Sauner[1], Werner A. Kaiser[1], Jürgen R. Reichenbach[1]
[1]Friedrich-Schiller University, Jena, Germany

EPI-DWI was acquired twice in 203 consecutively included patients as the first (before i.v. CM) and the last sequence after CM. ADC was quantified before and after CM in 72 patients and in 72 normal brain regions. 127/203 patients had pathologic MR findings. No significant signal differences on the isotropic DW images before and after CM even in lesions with a disturbed blood brain barrier were observed. No statistically significant difference between ADC values of lesion areas and contralateral normal areas was observed. Acquisition of EPI-DWI after CM is possible without loss of clinical information.

2222. High Resolution PROPELLER Diffusion Weighted Imaging in Clinical Practice

John P. Karis[1], James G. Pipe[1], Patricia L. Puppe[1], Nicholas Zwart[1], Adam McCullough[2], Joseph Heiserman[1]
[1]Barrow Neurological Institute, Phoenix, Arizona, USA; [2]Arizona State University, Phoenix, Arizona, USA

PROPELLER DWI has previously been shown to be of clinical value relative to EPI at equivalent resolution due to artifact reduction. This work investigates the additional diagnostic advantages of increasing resolution with PROPELLER DWI.

2223. Combining Independent Component Analysis and Diffusion Tensor MRI for the Detection of Stroke

Konstantinos Arfanakis[1], Dietmar Cordes[2], Victor M. Haughton[3], Howard A. Rowley[3], M Elizabeth Meyerand[3], Ian Alistair Heaton[1], Nolan R. Altman[1]
[1]Miami Children's Hospital, Miami, Florida, USA; [2]University of Washington, Seattle, Washington, USA; [3]University of Wisconsin, Madison, Wisconsin, USA

In this study, brain regions affected by stroke were detected in diffusion weighted (DW) images using independent component analysis (ICA), instead of conventional diffusion tensor post-processing techniques. ICA was applied directly on the DW ($b\neq0$) and b=0 images that were acquired with a conventional diffusion tensor sequence in stroke patients. In each study, one of the resulting independent components contained all the diagnostically important intensity changes that characterize the trace of the diffusion tensor following stroke. In all patients, this independent component also demonstrated higher contrast to noise ratio for regions affected by stroke, compared to the trace map.

2224. Evaluation of Signal and Contrast to Noise of Hemodynamic Indices in MR Perfusion Imaging of Acute Stroke

Michael A. Jacobs[1], Elisabetta Giugni[1], Norman J. Beauchamp[1], Argye E. Hillis[1], Robert J. Wityk[1], Lucas Restrepo[1], Peter B. Barker[1]
[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Time to peak maps have greater signal to noise and contrast to ratios in ischemic tissue than other hemodynamic indices in acute stroke. They also have the advantage of giving relatively little gray-white contrast in normal brain, giving a "flat background" against which to visualize lesions.

2225. Characterisation of Chronic Tissue Damage after Middle Cerebral Artery Infarction with DTI

Achim Gass[1], Jochen G. Hirsch[1], Christina Rossmanith[1], Kristina Szabo[1], Elena Kempf[1], Oliver Sedlaczek[1], Michael G. Hennerici[2]
[1]NMR Research Neurology, Mannheim, Germany; [2]University Hospital Mannheim, Mannheim, Germany

DTI provides information on microstructural integrity, while color coded DTI (CDTI) demonstrates fiber directions, both potentially improving visualisation of preserved and damaged tissue in chronic middle cerebral artery (MCA) stroke patients. Standardised MRI including DTI was obtained in 30 patients with chronic MCA stroke. All chronic lesions showed increased ADCs and reduced anisotropy delineated even lesions <1cm in diameter. CDTI demonstrated the severity of local damage and Wallerian degeneration in apparently unaffected tissue even far distant to large infarcts. CDTI provides improved anatomic information and facilitates identification and differentiation of the affected and preserved fiber bundles in atrophic areas.

2226. The Effect of Intravenous rt-PA Thrombolysis using Expanded 3-6 Hours Therapeutic Window: Perfusion and Diffusion MR Evaluation

Mingwang Zhu[1], Jianping Dai[1], Suxiang Wang[1]
[1]Beijing Neurosurgical Institute, Beijing, People's Republic of China

Purpose: To evaluate the effect of intravenous rt-PA thrombolysis using expanded 3-6 hours therapeutic window by perfusion imaging (PI) and diffusion weighted MR images (DWI). Material and Method: A total 12 hyperacute (3-6 hours after onset symtom) infarct patients was included in this study. The MR study, including T2WI, Flair, PI, DWI, MRA and CE-TWI, was performed in all cases before the intravenous rt-PA thrombolysis. The followup MR with identical pulse sequences was performed within 1 week after thrombolysis. To minimize the possible deviation between MR scans, the perfusion deficit was compare with contraliteral side and the degree of

2227. Hippocampal Diffusion Tensor Measurements in Temporal Lobe Epilepsy

Feroze B. Mohamed[1], Karine A. Khaled[1], Scott H. Faro[1], Alexander B. Pinus[2], Harris Ahmed[1], Mike Williams[1], John Haselgrove[3], Bassam Assaf[1]
[1]Drexel University, Philadelphia, Pennsylvania, USA; [2]Yale University, New Haven, Connecticut, USA; [3]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA

Non-invasive imaging techniques are becoming increasingly important and useful for localizing and characterizing the seizure focus in patients with Epilepsy. Diffusion Tensor Imaging (DTI) is a new imaging technique that can assess the molecular and biochemical environment of cerebral tissue non-invasively. The purpose of this study was to measure the diffusion changes in the hippocampus and investigate the role of DTI in lateralizing and localizing the likely seizure focus in patients with unilateral Temporal Lobe Epilepsy (TLE).

2228. Dynamics of Ictal and Postictal Brain Diffusion and Perfusion

Johannes A. Weber[1], Andreas Hufnagel[2], Armin de Greiff[2], Michael Forsting[2]
[1]University of Freiburg, Freiburg, Germany; [2]University of Essen, Essen, Germany

Focal alterations in the epileptogenic zone have been demonstrated by diffusion-weighted MR-imaging (DWI) following focal status epilepticus. This study tested the hypothesis that dynamic spatio-temporal alterations of brain diffusion and perfusion during the immediate postictal state will be detectable by serial DWI and perfusion weighted imaging (PWI) in extra- (ETE) and temporal lobe epilepsy (TLE). Serial postictal DWI and PWI changes appear to reflect origin and spread of the preceding seizure. A delineation of the epileptogenic zone appears to be possible.

2229. Fusion of DWI and Structural MRI with Radiation Dose Distributions for Quantitation of Radiation Effects in the Brain and Prediction of Response to Radiosurgery in Temporal Lobe Epilepsy

Xinhua Cao[1], Stephen Wong[1], Geoffrey Young[1], William Dillon[1], Roland Henry[1], Lynn Verhey[1], Nicholas Barbaro[1]
[1]UC San Francisco, San Francisco, California, USA

This research aims is to develop a computer-aided, quantitative image processing and analysis technique to determine whether gamma knife radiosurgery is effective in reducing or eliminating seizures in patients with temporal lobe epilepsy. The image processing workflow includes the 3D registration of radiation dosage map with stereotactic MRI, computation of volumes of interest (VOIs) with various % isodose lines, registration of stereotactic MRI with diffusion tensor images (DTI), and the computation and analysis of apparent diffusion coefficient (ADC) and anisotropic index (AI) maps in the pre-operation and post operation VOIs.

2230. Assessment of Acute Hemodynamic and Diffusion Changes in Patients with Prolonged Focal Seizures

Achim Gass[1], Jochen G. Hirsch[1], Ann-Katrin Poepel[1], Michael Fritzinger[1], Michael G. Hennerici[2], Bernd Pohlmann-Eden[1]
[1]NMR Research Neurology, Mannheim, Germany; [2]University Hospital Mannheim, Mannheim, Germany

Several functional MRI methods (diffusion-weighted (DW) MRI, blood oxygenation level dependent (BOLD) MRI, perfusion-weighting (PW) with dynamic contrast enhanced susceptibility sensitive MRI) are potentially clinically valuable tools in epilepsy patients. We performed acute and follow-up MRI including DWI and PWI in 8 patients with prolonged complex partial seizures. Signs of hyperperfusion indicating metabolic activation on PWI were accompanied by reductions of the ADC. Both findings were reversible on follow-up. Early tissue changes can be detected with PWI and DWI after prolonged ictal activity providing a new tool to study the pathophysiology in complex-partial epilepsy patients.

2231. Subcortical Fibers of Speech: DTI Fiber Tracking and Intra-operative Stimulation in Brain Tumor Patients

Roland G. Henry[1], Jeffrey I. Berman[1], Pratik Mukherjee[1], William P. Dillon[1], Mitchel S. Berger[1]
[1]University of California San Francisco, San Francisco, California, USA

Synopsis: Intra-operative stimulation is the gold standard for identifying functional cortical areas but is limited in its ability to localize sub-cortical extensions of these neurons that are largely unknown and are often distorted from their normal arrangement by the neoplasm. DTI fiber tracking can localize sub-cortical tracts but includes no functional information and therefore needs prior knowledge of some region of the tract. We report on DTI fiber tracking on patients undergoing intra-operative mapping during surgical treatment for brain tumor. The data on speech arrest and anomia illustrate the possibility of determination of brain architectural connectivity using these combined techniques.

2232. Perfusion Weighted Imaging Displays Mechanism of Arterio-Venous Shunting of Glioblastoma

Stephan Ulmer[1], Carsten Liess[2], Nadine Otto[1], Kay Engellandt[1], Claus-Christian Gluer[2], Olav Jansen[1]
[1]University of Kiel, Kiel, Germany; [2]CAU Kiel, Kiel, Germany

Glioblastoma are characterized by nuclear atypia, mitosis, necrosis and pathological microvascular proliferation. Using a bolus-traced dynamic T2*-weighted EPI sequence, maps for rCBV, rCBF and MTT can be determined. In glioblastoma rCBV and rCBF were increased compared to the grey matter of the affected hemisphere, whereas grey matter of the affected or non-affected hemisphere did not differ. Furthermore MTT that displays arterial and venous changes was halved in the grey matter of the affected hemisphere compared to the tumor. Hemodynamic changes in the affected hemisphere are due to arterio-venous shunting in the glioblastoma with an additional steal effect of the tumor.

2233. The Use of Diffusion/Conventional MRI in Planning, Monitoring and Studying Convection-Enhanced Taxol Delivery in Brain Tumors

Yael Mardor[1], Zvi Lidar[1], Yiftach Roth[1], Tali Jonas[1], Raphael Pfeffer[1], Stephan E. Maier[2], Meir Faibel[1], Arie Orenstein[1], Zvi Ram[1]
[1]Sheba Medical Center, Tel-Hashomer, Ramat-Gan, Israel; [2]Brigham and Women's Hospital, Boston, Massachusetts, USA

Convection is a novel approach to improve drug delivery into brain tumors by continuous drug infusion into tumors via a catheter. We used convection-enhanced Taxol delivery (CETD) to treat 15 patients with recurrent glioblastoma multiforme (GBM). We have shown that CETD has affinity to tumoral tissue and that it is hampered when reaching high ADC regions. Therefore, apparent diffusion coefficient (ADC) maps can be used prior to treatment to identify viable/cystic regions for optimizing catheter positioning. We have also shown that DWMRI can be used for assessing the convective process during treatment and conventional MRI for identifying tumor response

2234. The Potential of White Matter Fibre Tracking for Neurosurgical Planning of Brain Tumours

C A. Clark[1], T R. Barrick[1], M M. Murphy[1], B A. Bell[1]
[1]St. George's Hospital Medical School, London, UK

The technique of fibre tracking based on diffusion tensor imaging offers the unique possibility of determining the white matter pathways of the brain in vivo. In patients with cerebral tumours these pathways are often damaged or significantly displaced. Knowledge of the tumour location with respect to eloquent white matter pathways such as the cortico-spinal tracts is of great value to the neurosurgeon in planning the appropriate surgical strategy. We present here preliminary findings using the fibre tracking technique in patients with brain tumours and discuss the potential of the technique for neurosurgical planning.

2235. Survival Analysis in Patients with Glioblastoma Multiforme: Predictive Value of ^{1}H MRSI, Diffusion and Perfusion-Weighted MR Imaging

Joonmi Oh[1], Roland G. Henry[1], Andrea Pirzkall[1], Xiaojuan Li[1], Isabelle Catalaa[2], Susan Chang[1], Sarah J. Nelson[1]
[1]University of California San Francisco, San Francisco, California, USA; [2]Hôpital Purpan, Toulouse, France

This paper shows the potential value of pre-treatment in vivo Proton Magnetic Resonance Spectroscopic Imaging (1H MRSI), regional Cerebral Blood Volume (rCBV) and Apparent Diffusion Coefficient (ADC) in assessing the predictive value of survival of patients with Glio-Blastoma Multiforme (GBM). Significantly shorter time to survival was observed for patients with a large metabolic lesions and with low ADC within the T2 abnormality.

2236. Pre-Treatment Prediction of Brain Tumor Response to Radiation and Radiosurgery Therapies using High Diffusion-Weighted MRI

Yael Mardor[1], Yiftach Roth[1], Raphael Pfeffer[1], Arie Orenstein[1], Stephan E. Maier[2], Ouzi Nissim[1], Jacob Baram[1], Zvi Ram[1], Thomas Tichler[1], Roberto Spiegelmann[1]
[1]Sheba Medical Center, Tel-Hashomer, Ramat-Gan, Israel; [2]Brigham and Womans Hospital, Boston, Massachusetts, USA

Tumor water diffusion is correlated with tumor cellularity. Seventeen patients with twenty brain lesions were studied. Eight patients received fractionated radiation therapy and nine received single fraction radiosurgery. A pre-treatment diffusion index (R), reflecting tissue viability, was calculated from high diffusion-weighted MRI. R was found to correlate significantly with later tumor response or lack of response for the radiation patients. No such correlation was found for the radiosurgery patients. The correlation between the pre-treatment diffusion index and later tumor response indicates that HDWMRI may be used prior to initiation of treatment to predict the outcome of certain anti-tumor therapies.

2237. Preoperaive Evaluation of Malignancy in Gliomas using Diffusion Tensor Imaging

Takashi Inoue[1], Kuniaki Ogasawara[1], Takaaki Beppu[1], Akira Ogawa[1], Hiroyuki Kabasawa[2]
[1]Iwate Medical University School of Medicine, Morioka, Iwate, Japan; [2]GE Yokogawa Medical Systems, Hino, Tokyo, Japan

The purpose of this study was to assess the relationship between diffusion tensor (DT) magnetic resonance (MR) imaging and histological malignancy of gliomas. DT imaging was performed using a 3.0 Tesla MR scanner in 32 patients with gliomas. Fractional anisotropy (FA) and apparent diffusion coefficient (ADC) were calculated and compared with the histological malignancy of gliomas. The FA values of low grade gliomas were significantly lower than those of high grade gliomas. The FA threshold between low grade and high grade gliomas was 0.185. This is useful in deciding the surgical strategy or selecting the site of stereotactic biopsy.

2238. Assessment of Tumor Cell Infiltration along White-Matter Fiber Tracts Using Diffusion Tensor Imaging

Xiaohong Joe Zhou[1], Norman E. Leeds[1], Aziz H. Poonawalla[1], Jeffrey Weinberg[1]
[1]M.D. Anderson Cancer Center, Houston, Texas, USA

White-matter fiber tracts (WMFT) serve as a major pathway for malignant tumor cells to migrate. We have used diffusion tensor imaging (DTI) to investigate tumor cell infiltration along WMFT in malignant gliomas patients. Up to 74% reduction in relative diffusion anisotropy index was observed in the WMFT affected by the neoplasm. The decrease in diffusion anisotropy was also correlated with tumor recurrence in two patients. These findings indicate that DTI can be a valuable technique for assessing tumor cell invasion along WMFT and may predict tumor recurrence based upon diffusion anisotropy indices.

2239. Increased Subcortical Diffusion is Associated with Poorer Cognitive Scores in HIV

Christine C. Cloak[1], Linda Chang[1], Eric Miller[2], Thomas Ernst[1]
[1]Brookhaven National Laboratory, Upton, New York, USA; [2]University of California School of Medicine, Los Angeles, California, USA

Nine HIV patients and 9 healthy controls were evaluated for neuropsychological performance and studied with diffusion MRI to determine possible associations between cognitive changes and changes in apparent diffusion coefficients (ADC) that might result from HIV infection. Significant correlations were observed between cognitive measures of reaction time and memory and ADCs in subcortical and frontal white matter regions. Poorer performance was consistently correlated with increased diffusion.

2240. Evaluation of Corpus Callosum Anisotropy in Young Adults with Fetal Alcohol Syndrome Using Diffusion Tensor Imaging

Xiangyang Ma[1], Claire D. Coles[2], Mary Ellen Lynch[2], Stephen M. LaConte[1], Xiaoping Hu[1]
[1]Emory University/Georgia Tech, Atlanta, Georgia, USA; [2]Emory University, Atlanta, Georgia, USA

Diffusion tensor imaging was used to evaluate the corpus callosum diffusion anisotropy in six normal volunteers and five patients with fetal alcohol syndrome (FAS). A decreased fractional anisotropy (FA) along with an increased apparent diffusion coefficient (ADC) were observed in the corpus callosum in FAS patients compared with those in normals. Our results illustrate that DTI could be used in evaluating the integrity of corpus callosum in FAS patient. The diffusion anisotropy, represented by FA, may have the potential to be used as a clinical marker in the diagnosis of FAS and for assessing the severity of this disease.

2241. Reduced Fractional Anisotropy in the Splenium of Adolescents with Alcohol Use Disorder

Susan F. Tapert[1], Rebecca J. Theilmann[2], Alecia Schweinsburg[3], Sherry Yafai[4], Lawrence R. Frank[3]
[1]VA San Diego Healthcare System, UCSD, San Diego, California, USA; [2]VA San Diego Healthcare System, San Diego, California, USA; [3]UCSD, San Diego, California, USA; [4]School of Medicine, UCSD, San Diego, California, USA

Alcohol use disorders (AUD) affect about 23% of the adult American population causing cortical degeneration and ultimately affecting cognitive function. Previous MRI studies have reported brain white matter degradation in subjects with chronic alcoholism using volumetric imaging and DTI. However, white matter microstructure has not previously been examined in youth with AUD. DTI permits in-vivo quantification of the structural integrity of white matter. This study examines the fractional anisotropy (FA) of white matter tracts in the genu, body, and splenium of the corpus callosum in 8 adolescents with AUD and 8 demographically similar control subjects.

2242. Neurotoxicity in Ecstasy Users: A Preliminary Diffusion Tensor Imaging Study

Maartje Maria Léontien de Win[1], Cristina Lavini[1], Erik Jan Vlieger[1], Charles B.L.M. Majoie[1], Wim van den Brink[1], Liesbeth Reneman[1], Gerard J. den Heeten[1]
[1]Academic Medical Center, Amsterdam, Netherlands

In this study we examined a group of heavy ecstasy users by means of Diffusion Tensor Imaging. The resulting ADC and FA maps were analyzed using both ROI analysis and voxel by voxel analysis on a brain template independently. Both ROI and voxel by voxel analysis showed a marked increase in Fractional Anisotropy in the area of putamen and globus pallidus. Voxel by voxel analysis showed decreased ADC values in the area of the right insula. We hypothesize that the present findings most likely reflect astrogliosis.

Anatomic and Functional Assessment of Stroke

Hall D Saturday 14:00 - 16:00

2243. Separated Description of ACA and MCA Perfusion by "Color-Coded Perfusion Direction Map"using Arterial Spin Labeling Method: Evaluation of Collateral Circulation

Toshiaki Taoka[1], Hiroyuki Nakagawa[1], Satoru Iwasaki[2], Masahiko Sakamoto[1], Yukiko Okui[1], Takeshi Wada[1], Shinji Hirohashi[1], Katsutoshi Murata[3], Hajime Ohishi[1], Kimihiko Kichikawa[1]
[1]Nara Medical University, Kashihara, Nara, Japan; [2]Higashiosaka City General Hospital, Higashiosaka, Osaka, Japan; [3]Siemens Asahi Meditech, Tokyo, Japan

Our purpose is to evaluate collateral circulation by describing ACA and MCA perfusion area separately. Pairs of image set spin-labeled in the medial and lateral side were used. Pixel by pixel t-test was made and blue gradation was displayed for perfusion from lateral side (i.e. MCA), and red for perfusion by ACA. Twelve MCA stenosis and 12 intact MCA cases were examined and extensions of ACA perfusion area in MCA stenosis cases were described. This method is a non-invasive tool for evaluating distributions of ACA and MCA perfusion, and may be helpful in estimation of collateral circulations for stroke treatment.

2244. Measurement of the Perfusion Reserve Capacity using Doppler Sonography and Quantitative BOLD MRI in Patients with Neurovascular Disease

Oliver Speck[1], Sargon Ziyeh[1], Michael Reinhard[1], Andreas Hetzel[1], Jochen Rick[1], Susanne Guenther[1], Juergen Hennig[1]
[1]University Hospital Freiburg, Freiburg, Germany

In patients with neuro-vascular disease, the perfusion reserve capacity is an important predictor for the risk for ischemic events. Transcranial Doppler sonography (TCD) and quantitative BOLD methods were used to assess the perfusion increase during inhalation of a CO2-air gas mixture in patients. TCD and MRI were able to detect perfusion reserve deficits. However, discrepancies between the results of both methods remain. TCD measures the flow in few large arteries only and therefore does not provide direct information about brain tissue perfusion. BOLD MRI can in principle measure tissue perfusion increase and thus provide information about possible collateral blood supply.

2245. Relationships among ISODATA, DWI, MTT, and T_2 Lesions in Stroke

Hamid Soltanian-Zadeh[1, 2], Panayiotis D. Mitsias[1], Mohammad M. Khalighi[1], Mei Lu[1], Hassan B. Ebadian[1], James R. Ewing[1], Qingming Zhao[1], Suresh C. Patel[1], Michael Chopp[1]
[1]Henry Ford Health System, Detroit, Michigan, USA; [2]University of Tehran, Tehran, Iran

Eleven patients underwent our magnetic resonance imaging (MRI) stroke protocol conducted at acute, subacute, and chronic times, consisting of T1-(T1WI), proton-density-(PDWI), T2- (T2WI), diffusion- (DWI), and bolus tracking perfusion-weighted images (PWI). All images were co-registered and warped to the acute T2WI before analysis. Multi-parametric ISODATA, ADC, T2, and mean transit time (MTT) maps were created for each time point, and mean values and lesion sizes were estimated. Acute ISODATA lesion correlated well with acute DWI and MTT lesions. In some patients, acute MTT lesion over-estimated final lesion. Chronic ISODATA lesion correlated well with chronic T2 lesion and NIH stroke scale.

2246. Brain Iron Concentration Measured by MRI as a Risk Factor for Stroke Lesion Growth

David C. Alsop[1], Magdy Selim[1], Gottfried Schlaug[1]
[1]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, USA

Iron is a highly reactive agent that can increase oxidative stress by enhancing free radical concentrations. Higher tissue iron stores may lead to greater damage following ischemic injury. We tested the hypothesis that subjects with higher brain iron concentration during acute stroke experienced greater expansion into the penumbra. Brain iron, as measured by T2* in the putamen at 1.5 Tesla, was compared across subjects with the expansion of the stroke lesion, as measured by the ratio of the chronic to acute stroke lesion volume. Higher brain iron concentration was significantly correlated with greater expansion of the stroke lesion.

2247. Geography-based Assessment of Cerebral Infarction Improves Correlation with Clinical Outcome

Nina M. Menezes[1], Chloe Joan Lopez[2], Thomas Benner[2], Ruopeng Wang[2], Ona Wu[2], Ming Wang Zhu[2], Hannu Aronen[3], Jari Karonen[4], Yawu Liu[4], Juho Nuutinen[4], A. Gregory Sorensen[2]
[1]Harvard - Massachusetts Institute of Technology, Cambridge, Massachusetts, USA; [2]Massachusetts General Hospital, Boston, Massachusetts, USA; [3]Helsinki Central University Hospital, Helsinki, Finland; [4]Kuopio University Hospital, Kuopio, Finland

Lesion size is moderately correlated with clinical outcome in acute stroke. Here we demonstrate that the correlation between cerebral infarction on MRI and clinical outcome improves when lesion location is accounted for. We developed a voxel-by-voxel 'hazard atlas' from T2 images of 12 acute stroke patients. After co-registration, the volumes occupied by lesions were weighted according to clinical outcome as measured by the NIH Stroke Scale to create an atlas. This atlas was then applied to a different set of 12 patients to generate 'hazard scores' that correlated better with observed NIH Stroke Scale Scores than lesion volume alone.

2248. Evaluation of Cerebral Peduncle Degeneration of Acute Internal Carotid Artery Occlusive Disease by Diffusion Tensor Imaging and Perfusion Weighted Imaging in 3T

Xiang Liu[1], Jianping Dai[1], Shaowu Li[1], Guang Cao[2], Wei Sun[3]
[1]Beijing Neurosurgical Institute, Beijing, People's Republic of China; [2]Medical System of GE Company, HongKong, People's Republic of China; [3]Medical System of GE Company, Beijing, People's Republic of China

Degeneration of fiber tract is a important factor affecting motor function rehabilitation after stroke. We observed DTI of 11 volunteers and 16 patients with ICA occlusive disease combing with PWI. We find that FA and AI were more sensitive than ADC and T2WI for Wallerian degeneration, and in patients with CCD, bilateral cerebral peduncle could degenerate.

2249. A Comparison of FAIR and DSC-MRI Perfusion Imaging in a Rat Model of Permanent Ischemia

Janneke Schepers[1], Jeannette Hofmeijer[2], Rick Dijkhuizen[1], Klaas Nicolay[1]
[1]Dept. of Experimental in vivo NMR, Utrecht, Netherlands; [2]Dept. of Neurology, Utrecht, Netherlands

In this study flow-sensitive alternating inversion recovery (FAIR) and dynamic-susceptibility contrast (DSC-) MRI were compared in a rat model of permanent middle cerebral artery occlusion. In the core of the lesion FAIR and DSC-MRI indicated similar reductions in cerebral blood flow (CBF). However, in the perilesion areas FAIR detected larger reductions in CBF than DSC-MRI. This was associated with prolonged mean transit times as indicated by DSC-MRI, which may indicate that transit delays affected the FAIR CBF results. The study shows the importance of considering which perfusion MRI method is used when interpreting data obtained in stroke studies.

2250. A New Generation of Paramagnetic Contrast Agents: Applicability for Stroke Research

Peter Brunecker[1], Susanne Wegener[1], Jan Jungehülsing[1], Bianca Müller[1], Arno Villringer[1]
[1]Charité, Berlin, Germany

Exogenous MR contrast agents are broadly used in bolus track MRI of cerebral perfusion in acute ischemic stroke. In severely misery perfused ischemic tissue one could assume a better signal with higher tracer concentrations. On the other hand, local magnetic field inhomogenities in the vicinity of large blood vessels can introduce artefacts with potential consequences on the demarcation of the perfusion deficit on corresponding maps. Two commercially available application forms of Gadolinium contrast were tested for differences in bolus kinetics and field inhomogeneity effects in 24 patients with subacute ischemic stroke admitted to our University hospital in 2001.

2251. Turbo Spectroscopic Imaging in Acute Stroke - Preliminary Results

Astrid Stengel[1], Tobias Neumann-Haefelin[1], Heinrich Lanfermann[1], Friedhelm E. Zanella[1], Oliver Singer[1], Claudia Neumann-Haefelin[2], Ulrich Pilatus[1]
[1]Johann Wolfgang Goethe-Universität, Frankfurt, Germany; [2]Aventis Pharma Deutschland GmbH, Frankfurt, Germany

The present study demonstrates the feasibilty of using a turbo spectroscopic imaging (TSI) sequence with a considerably reduced acquisition time (compared to conventional CSI) in acute stroke patients, still allowing quantification of Lactate (Lac) and N-acetylaspartate (NAA). All acute stroke patients showed regions with increased Lac and different degrees of NAA reduction. Within the DWI lesion, we observed non-uniform increases in Lac and considerable differences in NAA reduction. Outside of the DWI lesion, most acute patients had areas with increased Lac and moderate decreases of NAA, clearly extending beyond the borders of the area of diffusion restriction.

2252. Cerebral Microbleeds in Hereditary Cerebral Hemorrhage with Amyloidosis, Dutch type

Rivka van den Boom[1], Marjolijn Bornebroek[1], Joost Haan[2], Mark A. van Buchem[1]
[1]Leiden University Medical Center, Leiden, Netherlands; [2]Rijnland Hospital, Leiderdorp, Netherlands

Microbleeds (MBs) have been found in different types of small vessel disease such as cerebral amyloid angiopathy (CAA) or hypertensive lipofibrohyalinosis. In hereditary cerebral hemorrhage with amyloidosis-Dutch type (HCHWA-D), a genetically form of CAA, MBs have never been described. We hypothesized that HCHWA-D would show a high rate of MBs. To test this assumption 27 HCHWA-D patients participated in a study to detect cerebral MBs, using T2*-weighted gradient echo MR images. The presence of MBs was correlated with demographic variables, hypertension, APOE genotype, and concomitant MR lesions.

2253. Comparison of Arterial Spin Labeling between Patients with Internal Carotid Artery Occlusion and Healthy Control Subjects

Jeroen Hendrikse[1], M JP Van Osch[1], Dirk R. Rutgers[1], Xavier Golay[2], Chris jg Bakker[1], Jeroen Van der Grond[1]
[1]UMC, Utrecht, Netherlands; [2]Johns Hopkins University and FM Kirby Research Center for Functional Brain Imaging, Baltimore, Maryland, USA

For the clinical interpretation of ASL results in patients with cerebrovascular disease currently the contralateral hemisphere is considered to be normal. However, several studies have shown a bilateral change of cerebral hemodynamics in these particular patients. To investigate if the contralateral hemisphere can be considered as internal reference for the diseased side in patients with cerebrovascular disease we compared the ASL signal behavior of 7 healthy control subjects with 9 patients with single sided occlusion of the internal carotid artery at 6 different delay times between labeling and acquisition

2254. Evaluation of the Limits of 8 Tesla Magnetic Resonance Spatial Resolution Using Epoxy-Resin Injection of the Microscopic Cerebral Arterial Vasculature

Donald William Chakeres[1], Roger A. Dashner[1], Allahyar Kangarlu[1], Klaus T. Baudendistel[1], David L. Clark[1]
[1]The Ohio State University College of Medicine and School of Public Health, Columbus, Ohio, USA

This study was designed to quantify the spatial resolution of MR images acquired at 8 Tesla (T). Techniques similar to those used for standard 8 T imaging of the human brain in vivo were utilized to generate high resolution gradient echo (GE) images of a postmortem human brain whose arterial system had been injected with an epoxy-resin. These images were then compared to digital photographs detailing the distribution of the arterial system on the surface of the same injected brain. There was excellent visualization of the microscopic arteries down to a minimum resolution of approximately 200 microns.

2255. MRI-Guided Histological Analysis of Postmortem Brain Slices

Tae-Seong Kim[1], Manbir Singh[1], Sungheon Kim[1], Chris Zarow[1], William G. Ellis[2], Helena Chui[1]
[1]University of Southern California, Los Angeles, California, USA; [2]University of California Davis, Davis, California, USA

Significant MRI abnormalities are commonly found in both cortical and subcortical regions in patients with subcortical ischemic vascular dementia and Alzheimer’s disease. However, with MRI signals alone, it is difficult to differentiate these lesions according to their distinct histologies. For better diagnosis and prognosis, pathological examination of postmortem brain slices is required. In this study, we mapped the MRI abnormalities to postmortem brain slices by co-registering postmortem slices to MRIs. The results show that a MRI-guided histological analysis helps to locate and better identify different types of lesions.

Carotid and Intracranial MR Angiography and MR Venography

Hall D Sunday 13:30 - 15:30

2256. MRA and CTA of the Carotid Arteries: A Comparison of Modern Techniques

Claudia Fellner[1], Michael Lell[1], Werner Lang[1], Ulrich Baum[1], Werner Bautz[1], Franz A. Fellner[2]
[1]University of Erlangen-Nürnberg, Erlangen, Germany; [2]Landesnervenklinik Wagner-Jauregg, Linz, Austria

High-resolution contrast-enhanced- (CE-) MRA and CTA for the supraaortic arteries as well as 3D time-of-flight- (TOF-) MRA focussing on the carotid bifurcation were compared in 25 patients. The examinations were performed on a 1.5 T MR-system and a 16-slice-spiral-CT-scanner. CE-MRA and CTA yielded similar results for stenoses of the internal carotid arteries. There was a slight trend to grade stenoses higher using CTA; this trend was a little bit more pronounced when comparing CTA with TOF-MRA. Our preliminary results indicate that CTA using a 16-slice-spiral-CT-scanner might be an alternative to MRA in patients with MR contra-indications.

2257. Is Balanced Turbo Field Echo a Clinically Viable Alternative for MOTSA?

Srirama Swaminathan[1], Kevin Demarco[2], Leonard Boccassini[2], Romhild Hoogeveen[3]
[1]Philips Medical Systems, Monmouth Junction, New Jersey, USA; [2]UMDNJ & RWJ, New Brunswick, New Jersey, USA; [3]Philips Medical Systems, Best, Netherlands

3D B-TFE acquisition technique for carotids imaging is compared with the routine clinical techniques such as 3D TOF and 3D CE-MRA on 20 patients. The axial B-TFE protocol includes a chemically selective pulse for fat saturation, and a cranial saturation slab planned right above the slices to saturate the venous return which is applied every TFE shot. A turbo factor of 32 with a TR/TE of 7/3.5 ms is used. B-TFE is faster and results in 40% increase in SNR than MOTSA. Work is in progress with B-TFE to reduce susceptibility artifact to turbulent flow and improved venous suppression.

2258. Observer Evaluation of Intracranial Aneurysm Detection Using Z-Buffer Segmentation of 3D TOF MRA Images

Brian E. Chapman[1], Janet O. Stapelton[2], Brett Christian[2], Bronwyn Hamilton[2], Gregory L. Katzman[2], Kevin R. Moore[2], Jay S. Tsuruda[2], Dennis L. Parker[2]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [2]University of Utah, Salt Lake City, Utah, USA

We evaluated intracranial aneurysm detection using vascular segmentations of 3D TOF MRA images. Images from 35 patients containing 29 aneurysms (avg. 7 mm) were processed using the Z-Buffer segmentation algorithm. After segmentation, densitometric reprojections with shaded surface highlighting were generated at view angles matching those generated clinically with MIP images. Three experienced neuroradiologists reviewed the images for aneurysms without reference to the original source images. The observers had high sensitivity in detecting aneurysms but had a modestly high number of false positives per image. This preliminary evaluation indicates the potential usefulness of the segmented images and provides directions for improvement.

2259. Noninvasive Follow Up of Coiled Intracranial Aneurysms using Time-of-Flight MR Angiography

Naoaki Yamada[1], Katsuhiko Hayashi[1], Kenichi Murao[1], Toshiharu Sakuma[1], Izumi Nagata[1], Hiroaki Naito[1]
[1]National Cardiovascular Center, Suita, Osaka, Japan

Success of treated intracranial aneurysms with Guglielmi detachable coils (GDCs) depends upon long-term follow up. Recent high resolution and short TE MR angiography can visualize residual flow in the coiled aneurysms noninvasively and more precisely than digital subtraction angiography (DSA).

2260. Contrast-Enhanced MR Angiography (CEMRA) of the Vertebrobasilar Circulation

Carina W. Fung[1], James C. Carr[1], Stephen F. Futterer[1], Mark D. Morasch[1], Benson P. Yang[1], Stephanie M. Shors[1], J. Paul Finn[1]
[1]Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA

CEMRA is a proven diagnostic tool in the carotid arteries, however few studies have addressed its accuracy in the vertebrobasilar system. The purpose of this study was to assess the sensitivity and specificity of CEMRA compared to DSA for detection of vertebrobasilar disease in a group of 40 patients. The sensitivity and specificity for detection of vertebrobasilar disease was 81% and 91%, respectively. We conclude that breath-hold CEMRA is accurate in detecting vertebrobasilar disease, and has the potential to provide a comprehensive evaluation of the head and neck circulation in a single study.

2261. Collateral Flow and Ischemic Brain Lesions in Patients with Unilateral Carotid Artery Occlusion.

Bob Bisschops[1], Karin Klijn[1], Jaap Kappelle[1], Alexander van Huffelen[1], Jereon van der Grond[1]
[1]University Medical Center, Utrecht, Netherlands

We investigated in 68 patients with unilateral occlusion of the internal carotid artery (ICA) the association between ischemic brain lesions and the presence or absence of collateral pathways. Collateral pathways were studied with MR-angiography, digital subtraction angiography and transcranial Doppler sonography. Patients with collateral flow via the anterior communicating artery (ACoA) have fewer and less extensive ischemic brain lesions independent of all other collateral pathways. This suggests that in patients with an ICA occlusion, collateral blood flow via the ACoA is the most important collateral pathway.

2262. Time Resolved 2D MRA of Arterio-venous Malformations with a Radial Projection Sliding Window Sequence

Jim M. Wild[1], Stuart Coley[1], Larry Kasuboski[2], Neil Woodhouse[1], David Capener[1], Edwin JR van Beek[1], Iain D. Wilkinson[1], Martyn NJ Paley[1], Paul D. Griffiths[1]
[1]University of Sheffield, Sheffield, UK; [2]Philips Medical, Cleveland, Ohio, USA

In this work angular under-sampled 2D time resolved radial projection MRA was developed and evaluated against a standard spin-warp sequence. With the technique it was possible to accurately spatially resolve blood flow in 3 patients with AVM with a temporal resolution hitherto unreported with spin-warp gradient echo sequences.

2263. Dynamic Imaging of Arterio-venous Malformations - MR Fluoroscopy at 3T

Paul E. Summers[1], Spyros Kollias[1], Anton Valavanis[1]
[1]University Hospital Zürich, Zürich, Switzerland

Depicting the passage of a contrast agent through vascular malformations is a key application of x-ray subtraction angiography. Previously reported MR versions of this procedure have shown potential, but were limited in respect to temporal and spatial resolution and contrast to noise ratios (CNR). Using fast gradient echo sequences together with parallel acquisition (SENSE) we are able to achieve acquisition matrices of 400x200 with half-second temporal resolution. At 3T we find the CNR is sufficient to visualize the vascular structure. Further improvements to temporal resolution and contrast to noise levels are needed before entering clinical practice.

2264. Contrast-Enhanced Selective Magnetic Resonance Venography of the Head

Makoto Amanuma[1], Kyoko Enomoto[1], Eito Kozawa[1], Waka Saito[1], Atsuko Heshiki[1]
[1]Saitama Medical School, Iruma, Saitama, Japan

Purpose: To obtain high-resolution and high-quality MR venograms using 3D magnetization prepared rapid gradient echo (MP-RAGE) imaging with contrast injection. Materials and methods: All studies were performed on a 1.5-T superconducting system (Magnetom Vision, Siemens Medical System, Erlangen, Germany). The pulse sequence was 3D MR-RAGE with TR 9.7 msec, TE 4.0 mm, and flip angle 25 degrees. The imaging matrix was 256x256, FOV was 230 x 230 mm, slice partition was 128, and slab thickness was 140 mm, to give a voxel size of 0.90 x 0.90 x 1.09 mm. The data were acquired twice, once before and once after

2265. Quantitative Comparison of the Visualization of the Micro Veins of 8 Tesla MR Magnitude and Phase Brain Images

Donald William Chakeres[1], Amir Abduljalil[1], Vera Novak[2], Greg A. Christoforidis[1], Ming Yang[1]
[1]The Ohio State University College of Medicine and the School of Public Health, Columbus, Ohio, USA; [2]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

This study evaluated the quantitative assessment of the micro vessels of the brain in three subjects. High-resoluition 8 Tesla (T) gradient echo (GE) MR magnitude images were post-processed and also displayed as magnitude weighted phase and pure phase images. The vessels were hand traced by two neuroradiologists and the total vessel pixel lengths per image were used as a measure of vessel density. Phase imaging significantly improved the vessel identification. This technique offers in vivo evaluation of the cerebral microvascularture with resolution approaching histologic brain studies.

Neurological MR

Hall D Monday 13:30 - 15:30

2266. Gray and White Matter Involvement in Neuropsychiatric Systemic Lupus Erythematosus (NPSLE) as Indicated by Magnetization Transfer Imaging (MTI)

Stefan CA Steens[1], Faiza Admiraal-Behloul[1], Gerlof PTh Bosma[1], Gerda M. Steup-Beekman[1], Tom WJ Huizinga[1], Mark A. van Buchem[1]
[1]Leiden University Medical Center, Leiden, Netherlands

Recently, using volumetric magnetization transfer imaging (MTI), brain damage was detected in systemic lupus erythematosus patients with neuropsychiatric symptoms (NPSLE) without abnormalities explanatory for the signs and symptoms on conventional MRI. The pathophysiological pathways leading to NPSLE are largely unknown. Although knowledge on the distribution of abnormalities could aid in the understanding of the disease, sofar MTI studies have focused on the brain parenchyma (BP) as a whole. In this study, we segmented the BP of inactive NPSLE patients and matched healthy controls into gray (GM) and white matter (WM) and demonstrated MT ratio (MTR) histogram abnormalities in both compartments.

2267. MR of the Fetal Central Nervous System

Elspeth Helen Whitby[1], Paul David Griffiths[1], Susan Rutter[2], Norman Davies[3], Sadick Variend[4], Martyn Paley[1]
[1]University of Sheffield, Sheffield, S Yorks, UK; [2]RDG Hopsital, Rotherham, Yorkshire, UK; [3]Jessop Wing, Sheffield, S Yorks, UK; [4]Sheffield Children's Hopsital, Sheffield, S Yorks, UK

Aims. To assess ultrafast MR techniques in imaging congenital central nervous system abnormalities of the fetus and compare the results with other antenatal and postnatal imaging techniques. Patients and methods: LREC approval was obtained prior to commencing the study. 93 Women, 19-36weeks gestation with a singleton pregnancy with known congenital abnormalities of the central nervous system, detected on antenatal ultrasound, were imaged on a 1.5T superconducting magnet. A single shot fast spin echo technique was used to produce T2 weighted images, acquisition time of 20 seconds. Echo train length 132, TR 20,000ms, TE 75ms, Field of view 25cm, matrix size-

2268. Clinical Imaging of the Brain with Ultrashort TE (Ute) Pulse Sequences

Peter D. Gatehouse[1], Adam Waldman[2], James R. van Dellen[2], Taigang He[3], Elizabeth D. Burman[3], Ian R. Young[3], Graeme M. Bydder[3]
[1]MRRS, Guildford, Surrey, UK; [2]Hammersmith Hospital NHS Trust, London, UK; [3]Imperial College, London, UK

Ultrashort TE (Ute)pulse sequences with TE = 80 microseconds were used to image the brain in fine normal controls and 12 patients. Long T2 suppression, pulses and subtraction of successive echoes were used to reduce the signal from long T2 components. Meninges showed increased and decreased short T2 components. Increase in short T2 signal was observed in angiomas, possible gliomas and perivascular fibrosis. Decrease was seen in gliomas, multiple sclerosis, edema and vascular disease. Increased contrast enhancement was also observed with the shortest TE images.

2269. Associations of Gray and White Matter Damage as Indicated by Magnetization Transfer Imaging (MTI) with the Presence of Antiphospholipid Antibodies in Neuropsychiatric Systemic Lupus Erythematosus

Stefan CA Steens[1], Faiza Admiraal-Behloul[1], Gerlof PTh Bosma[1], Gerda M. Steup-Beekman[1], Tom WJ Huizinga[1], Mark A. van Buchem[1]
[1]Leiden University Medical Center, Leiden, Netherlands

Recent studies using magnetization transfer imaging (MTI) have indicated damage to both the gray matter (GM) and white matter (WM) of systemic lupus erythematosus (SLE) patients with a history of neuropsychiatric symptoms (NPSLE). Antiphospholipid antibodies are known to play a role in the pathogenesis of focal NPSLE. In this study, we found an association between the presence of these antibodies and volumetric MT ratio (MTR) histogram parameters in a group of inactive diffuse NPSLE patients. Our results therefore suggest that antiphospholipid antibodies may also be associated with structural brain damage in diffuse NPSLE.

2270. Myelin Deficiencies Visualized *In Vivo*: An Illustrated Comparison of T_2 and Visual Evoked Potential in Shiverer and Wild-Type Mice

Melanie Martin[1], Timothy D. Hiltner[1], Carol Readhead[1], Scott E. Fraser[1], Russell E. Jacobs[1]
[1]Caltech, Pasadena, California, USA

The central nervous system (CNS) myelin sheath can be disrupted by auto-immune diseases like Multiple Sclerosis (MS) and myelin gene mutations. Common early signatures of MS include episodes of double vision and degradation of vision due to optic neuritis. Data presented here show a mutant mouse model with no CNS myelin has a significantly longer visual evoked potential (VEP) latency and T2 in white matter than the wild-type mouse. These data show the potential of using MRI to follow demyelinating lesions in vivo to determine the exact relationship among VEPs and the sizes, locations or histories of lesions.

2271. Magic Angle Imaging of the Median Nerve

Karyn E. Chappell[1], Andreanna D. Williams[1], Mark Bydder[1], David J. Gilderdale[1], Amy H. Herlihy[1], Walter L. Curati[1], Graeme M. Bydder[1]
[1]Imperial College, London, UK

MR neurography is an expanding field. Peripheral nerves are usually visualised with fat saturated or STIR sequences. Abnormalities are detected by changes in morphology as well as differences in signal intensity. With STIR sequences signal intensity in the normal median nerve may increase 46-175% when its orientation to Bo is changed from 0° to 55°. This effect is probably due to the high concentration of linearly ordered collagen-rich fibres in peripheral nerve. It is a potential pitfall in diagnosis. The change of signal with orientation may provide useful diagnostic information in disease.

2272. Response Assessment using MRI in Recurrent Malignant Glioma: Are Current Methods Valid?

Mary Frances Dempsey[1], Barrie R. Condon[1], Donald M. Hadley[1]
[1]Institute of Neurological Sciences, Glasgow, UK

This study was undertaken to validate response criteria for phase II studies of supratentorial malignant glioma and the new guidelines for evaluating response to treatment in solid tumours in recurrent malignant glioma. Serial MRI data of 49 patients were used to obtain 1d, 2d and 3d measurements of tumour burden to grade response. Survival time was calculated from diagnosis of recurrence to death. Analysis was performed to evaluate response grades as surrogate markers for survival and compare measurement techniques. Results of this analysis show that these current response gradings are not valid for assessing new therapy in recurrent malignant glioma.

2273. Using MRI to Quantify the Effect of Increased Airway Pressure on Intracranial Compliance and Pressure

Noam Alperin[1], Sang Lee[1], Anusha Sivaramakrishnanan[1], Christian Kremser[2], Ingo Lorenz[2], Christian Kolbitsch[2]
[1]University of Illinois at Chicago, Chicago, Illinois, USA; [2]University of Innsbruck, Innsbruck, Tirol, Austria

Cerebral physiology is strongly coupled with the respiratory system. Respiration can influence intracranial compliance and pressure through oxygenation states, which directly affect cerebral blood flow, and indirectly through the modulation of thoracic pressure, which can affect venous return. Characterization of mechanisms involved is important for respiratory therapy for brain injury patients in intensive care units to influence and regulate intracranial pressure or for patients suffering from respiratory insufficiency. A new MRI-based method has been developed to quantify intracranial compliance and pressure. The method was applied to investigate effect of airway pressure on cerebral blood flow, and intracranial compliance and pressure.

2274. Influence of Respiration of Spinal CSF Pulsation

Sigrid Friese[1], Uwe Hamhaber[1], Michael Erb[1], Uwe Klose[1]
[1]Dept. of Neuroradiology, Tuebingen, Baden-Württemberg, Germany

The cardiac related intracranial pulsations are the main influence on the spinal CSF movement. There is agreement about the additional influence of respiration which has not been imaged so far. The dynamic echo planar sequence (EPI) presented here delineates the influence of pulse and respiration on the spinal CSf pulsation. The physiological variation of the pulsation from the upper cervical to the lumbar region can be delineated. The influence of respiration is present on any spinal level with a maximum in the upper cervical and thoracolumbar region. We could not confirm a pronounced respiratory influence below an absolute stenosis.

2275. Comparison of MRI and CT Assessment of Sub-Thalamic Electrode Placement

Derek L. Hill[1], Ruth L. O'Gorman[2], Richard P. Selway[2], Campbell J. Reid[1], Gary R. Hotton[2], Elizabeth Hall[2], Jozef M. Jarosz[2], Charles E. Polkey[2]
[1]King's College London, London, UK; [2]King's College Hospital, London, UK

Deep brain stimulation is becoming widely used for the treatment of Parkinson's disease. The post-operative assessment of electrode placement is important in patient management and in assessing efficacy of the technique. CT is widely used in the assessment of electrode placement. MR has the potential to offer improved visualisation. We compare the localization obtained from MR and CT on eight patients, and relate clinical outcome to proximity of implanted electrode to radiologically identified sub-thalamic nuclei.

2276. Multiplanar Reconstruction of 3D FASE Cisternography for the Assessment of Neurovascular Compression

Koiku Yokoe[1], Satoru Nakano[1], Taro Togami[1], Hirofumi Asakura[1], Yoshihiro Toyama[1], Masahiro Kagawa[1], Takashi Ishimori[1], Satoshi Sugiura[2], Yuichi Yamashita[3], Shogo Nagao[1], Motoomi Ohkawa[1]
[1]Kagawa Medical University, Kita-gun, Kagawa, Japan; [2]Toshiba Corp. Medical R&D Center, Otawara, Tochiigi, Japan; [3]Toshiba Medical Systems Co.Ltd., Takamatsu, Kagawa, Japan

The generation of multiplanar reconstruction images along the facial nerve in 3D fast asymmetric spin-echo imaging with a slice thickness of 0.5 mm makes it possible to assess details of the target region and to determine the grade of nerve compression by adjacent vessels in patients with hemifacial spasm. In this study, 16 spastic sides and 16 normal sides in 16 patients with hemifacial spasm were evaluated. In most of the spastic sides, compression was observed less than 2 mm from the brain surface. In some spastic sides, light contact of the vessel was associated with facial nerve spasm.

2277. Quantification of Brain Atrophy in HIV-Infected Patients

Pippa Storey[1], Alejandro Chavez[1], Bruce Cohen[2], Leon Epstein[2], Robert R. Edelman[1], Ann B. Ragin[2]
[1]Evanston Northwestern Healthcare, Evanston, Illinois, USA; [2]Northwestern University, Chicago, Illinois, USA

Magnetic resonance imaging was performed in thin contiguous slices over the whole brain in nine HIV-infected patients and nine healthy control subjects, and used to evaluate the total volume of brain parenchyma and CSF in each person. The percentage of brain parenchymal volume was found to be significantly lower in the HIV-infected patients than the control subjects ($p<0.001$), and to show a significant correlation with Karnofsky performance status in the patients ($p<0.05$).

2278. Brain Edema and Blood-Brain-Barrier Changes in Severely Head Injured Patients. An MRI Study about 10 Cases

Anne Pasco-Papon[1], Aram Ter Minassian[2], Jean-Yves Tanguy[3], Benoit Denizot[4], Laurent Lemaire[4], Laurent Beydon[2], Jean-Jacques Le Jeune[1], Christine Caron[4]
[1]Unité InsermEritM0104, Angers, France; [2]Département d'Anesthésie-Réanimation, Angers, Maine et Loire, France; [3]Département de Radiologie, Angers, Maine et Loire, France; [4]Département de Radiologie, Angers, France

Maintenance of a cerebral perfusion pressure (CPP) around 70mmHg in severely head injured (SHI) patients is a still debated practice (increased formation of vasogenic edema). We analysed with diffusion imaging and post-contrast T1 weighted sequences the type of edema in relation with the BBB permeability changes in 10 SHI patients. The BBB permeability is affected only after day 9 and always in the initial decreased ADC areas. In accordance with the Starling law and the known molecular weight of MR contrast media, it is improbable that a high CPP could increase brain edema at least until day 10 post-trauma

2279. Quantification of CSF Flow at 3.0 T - Accuracy and Initial *In Vivo* Results

Freddy R. Stahlberg[1], Sara Brockstedt[1], Elna-Marie Larsson[1]
[1]Lund University, Lund, Sweden

Cerebrospinal fluid (CSF) flow and production can be measured using MR velocity mapping in the cerebral aqueduct. Limited spatial resolution may, however, lead to partial volume errors which - at the cost of SNR - can be reduced by increased in-plane resolution. We assessed the accuracy of high-resolution GRE velocity mapping at 3T by phantom verification of flow-versus-signal linearity and phase image quality and by determination of in vivo CSF flow curves in healthy volunteers. Accuracy was within 10% and reasonable flow values were obtained in vivo. We conclude that high-resolution CSF flow measurements can be made at 3T.

2280. Evidence of Respiratory Modulation of CSF Flow Dynamics using EPI

Mark E. Wagshul[1], David Ebin[1], Michael R. Egnor[1], Rajeev J. Gandhi[1], Josephine LoBrutto[1], Patricia E. Roche[1], Harshad D. Shanbhag[1], Lili Zheng[1]
[1]SUNY Stony Brook, Stony Brook, New York, USA

Utilizing the inflow enhancement effect in a rapid EPI image series, one can obtain information about the spectral components of blood and CSF flow due to cardiac, respiratory and other physiologically time-varying effects. We have used this type of imaging to study a group of healthy volunteers and have identified spectral features near the cardiac frequency corresponding to a respiratory-induced amplitude modulation of the cardiac pulsations, particularly prominent within the CSF flow spectra.

2281. MRI Lobar Atrophy Assessment and Cognition in Amyotrophic Lateral Sclerosis

Roland G. Henry[1], Cynthia Chin[1], Radhika Srinivasan[1], Jennifer Murphy[1], Catherine Lomen-Hoerth[1]
[1]University of California San Francisco, San Francisco, California, USA

To assess lobar atrophy in patients with Amyotrophic lateral sclerosis (ALS) with and without Frontotemporal Lobar Dementia (FTLD) by conventional MRI, spatially transformed normalized MRI and quantitative estimation of lobar volumes and compare with the clinical evaluation of cognitive status. Quantitative volumes were determined from regions defined on transformed normalized coordinates with fixed limits of T1 values defining brain from non-brain.

2282. Virtual Endoscopic Images Obtained by 3D FASE Cisternography: Usefulness in the Preoperative Evaluation of Neurovascular Compression

Takashi Ishimori[1], Satoru Nakano[1], Masahiro Kagawa[1], Toshiaki Kusuhara[1], Motoomi Ohkawa[1], Syogo Nagao[1], Yuichi Yamashita[2], Satoshi Sugiura[3]
[1]Kagawa Medical University, Kita, Kagawa, Japan; [2]Toshiba Medical Systems Co.Ltd., Takamatsu, Kagawa, Japan; [3]Toshiba Corp. Medical R&D Center, Otawara, Tochigi, Japan

3D FASE provides high spatial resolution and excellent contrast for a water image acquisition technique. Images composed of cubic voxels measuring 0.5x0.5x0.5 mm were acquired using this technique. The virtual endoscopic images obtained were of sufficiently high quality to allow fine structures to be visualized to some degree. It is thought that the 3D FASE technique is suitable for acquiring the source image data for generating virtual endoscopic images. The main advantage of generating virtual endoscopic images is that such images can be used for surgical simulation, permitting the neurosurgeon to perform surgical procedures with greater confidence.

2283. *In Vivo* Measurements of T_2 Relaxations in Human Brain Tumors and the Surrounding Brain

Soonmee Cha[1], Joonmi Oh[1], Eric Han[2], Jefferey Stainsby[3], Graham Wright[3], William Dillon[1], Sarah J. Nelson[1]
[1]University of California San Francisco, San Francisco, California, USA; [2]GE Medical System, Menlo Park, California, USA; [3]Sunnybrook and Women's College Health Science Center, Toronto, Ontario, Canada

The analysis of in vivo T2 relaxation provides quantitative assessment of tissue contrast and more specific information about the normal and diseased human brain. Using a six-echo multi-slice MR imaging pulse sequence, we observed that T2 values were higher in tumors than in normal white matter and a much shorter T2 component was noted in peri-tumoral regions of irradiated brain tumors.

2284. Application of GESEPI Images in Detection of Micro Hemorrhages in Traumatic Brain Injured Patients

Qing X. Yang[1], Jelena Lazovic-Stojkovic[1], Timothy J. Mosher[1], Paul J. Eslinger[1], Anna M. Barrett[1], Michael B. Smith[1]
[1]Penn State University College of Medicine, Hershey, Pennsylvania, USA

The purpose of this study is to evaluate feasibility of heavily T2*-weighted GESEPI images in detection of micro hemorrhages in traumatic brain injured patients. This study demonstrated improved detection of micro-hemorrhagic lesions after traumatic brain injury using the GESEPI technique compared to conventional gradient echo images.

2285. High Spatiotemporal Resolution SWI in SRT Patients

Song Lai[1], Arthur Pinkerton[1], Jianrong Shi[1], Maolin Qiu[1], Robert Dowsett[1]
[1]UConn Health Center, Farmington, Connecticut, USA

High spatiotemporal resolution susceptibility-weighted imaging (SWI) was applied in stereotactic radiotherapy patients. With comparable signal-to-noise ratio at the same 1mm2 in-plane resolution, this multi-shot EPI SWI sequence is 10 times faster than conventional FLASH SWI sequence. Compared with conventional T1-weighted sequence with which contrast agent is routinely necessitated for lesion detection, the SWI sequence detected lesions reliably without contrast agent, although the use of contrast agent was found to allow for even faster SWI due to T1 shortening effect. These high resolution SWI images provided exquisite details that help improving understanding of the pathophysiology of the brain lesions.

2286. Estimation of the Macromolecular Proton Fraction and Bound Pool T_2 in Multiple Sclerosis: A Quantitative Assessment of Magnetization Transfer.

Gerard Davies[1], Anita Ramani[1], Dan Tozer[1], Catherine Dalton[1], Claudia Wheeler-Kingshott[1], Alan Thompson[1], Gareth Barker[1], Paul Tofts[1], David Miller[1]
[1]UCL, London, UK

The fractional size of the restricted proton pool (f), and bound pool T2 (T2b) have been estimated using a quantitative analysis of the magnetization transfer (MT) effect. Forty nine subjects with MS and 27 healthy controls were studied revealing that f and T2b are reduced in MS lesions, but only f is abnormal in normal appearing tissue. This suggests that f and T2b provide complementary information about the disease processes.

2287. Evidence for Progressive MTR Abnormality in Normal Appearing Tisse in Early Relapsing-Remitting Multiple Sclerosis: A 2 Year Follow-Up Study.

Gerard Davies[1], Andreas Hadjiprocopis[1], Waqar Rashid[1], Colette Griffin[1], Declan Chard[1], Raj Kapoor[1], Gareth Barker[1], Paul Tofts[1], Alan Thompson[1], David Miller[1]
[1]UCL, London, UK

Magnetization transfer ratio histograms are sensitive to the evolution of normal appearing tissue pathology in multiple sclerosis (MS) yet it is unclear whether change over time is detectable in clinically early MS. For this reason, we have studied 23 subjects with early relapsing remitting MS and minimal disability together with 17 healthy controls. At baseline normal appearing grey and white matter MTR was significantly reduced in MS subjects and MTR change was detectable in both tissues at 1 and 2 year follow up.

2288. Solitary Metastases and High-grade Gliomas: Differentiation by Using Diffusion, Perfusion and Spectroscopic MR Imaging

I Chan Chiang[1], Gin Chung Liu[1], Twei Shiun Jaw[1], Yu Ting Kuo[1]
[1]Kaohsiung Medical University, Kaohsiung, Taiwan

Our study is to investigate the role of relative cerebral volume (rCBV), apparent diffusion coefficient (ADC) and spectroscopic imaging in the differentiation of high-grade primary gliomas from solitary metastases using a 3.0-T MR unit. The results reveal statistically significant elevations in Choline-to-creatine (Cho/Cr) ratio and rCBV in the peritumoral regions for high-grade gliomas as well as higher ADC in tumoral and peritumoral regions of metastases. Besides the peritumoral rCBV has highest specificity, the peritumoral Cho/Cr ratio on MR spectroscopy has highest accuracy and sensitivity in differentiation between the two tumor groups.

2289. Structural and Metabolic Asymmetries in the Hippocampus Increase with the Duration of Epilepsy

Pedro Miguel Goncalves Pereira[1], Mario Forjaz Secca[2], Alberto Leal[3], Constanca Ribeiro[4], Pedro Evangelista[4], Pedro Rosado[1], Luis Guerra[1]
[1]H. Egas Moniz, Lisboa, Portugal; [2]Universidade Nova de Lisboa, Lisboa, Portugal; [3]H. Fernando Fonseca, Amadora, Portugal; [4]Ressonancia Magnetica de Caselas, Lisboa, Portugal

Several lines of evidence suggest that hippocampal sclerosis in temporal lobe epilepsy is asymmetrically bilateral. The factors underlying such asymmetrical damage are relatively unexplored. This study correlates the asymmetry index of damage from hippocampal volumetry, relaxometry and NAA/(Cho+Cre) ratio with the duration of epilepsy. Results showed correlations between the degree of structural and metabolic asymmetries with the duration of seizure disorder.

2290. Localization and Delineation of Epileptogenic Zone using Magnetic Source Imaging

Jing Xiang[1]
[1]The Hospital for Sick Children, Toronto, Ontario, Canada

The aim of this study is to localize and delineate epileptic zone by using magnetic resonance Image (MRI) and magnetoencephalography (MEG). MEG combined with MRI is also called magnetic source imaging (MSI). Six children with localization-related epilepsy were studied using a 151-channel MEG system and 1.5 Tesla MRI system. The epileptic zones were simulated by using synthetic aperture magnetometry (SAM) combined with 3D-MR image. The locations of SAM peaks were in agreement with the clinical findings in 6 children (6/6). The results indicate that MSI can precisely localize and delineate epileptic zone.

2291. Grey Matter Abnormalities and Current Intellectual Functioning in Male and Female Individuals with Schizophrenia: A Voxel-Based Morphometry Study

Elena Antonova[1], Veena Kumari[1], Rozmin Halari[1], Elizabeth Zachariah[1], Ravi Mehrotra[1], Anil Kumar[1], Andy Simmons[1], Tonmoy Sharma[2]
[1]Institute of Psychiatry, London, UK; [2]Clinical Neuroscience Research Centre, Dartford, Kent, UK

Previous studies have found grey matter abnormalities in multiple brain regions of individuals with schizophrenia. The present study investigated whether current intellectual functioning can explain the differences in grey matter densities between patients with schizophrenia and normal controls. The study made use of the Voxel-Based Morphometry (VBM) method, which allows the comparison of grey matter densities of the entire brains of patients with controls. Diffuse grey matter density changes were found in patients with schizophrenia, most of which could not be explained by their lower current IQ. Male and female patients exhibited different patterns of grey matter alterations.

2292. High-Resolution MRI of Myeloarchitecture

Shella D. Keilholz[1], Alexander Vortmeyer[1], Sean Marrett[2], Lalith Talagala[1], Peter van Gelderen[1], Jeff Duyn[1], Alan P. Koretsky[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

High-resolution MR images were obtained in fixed brain tissue at 11.7 T and in vivo at 3T. Features apparent in the fixed tissue images (100 micron isotropic) include areas with varying degrees of myelination, well-delineated myelin stripes, and very small vessels (≤ 100 microns in diameter) traveling through the white matter. The features correlated well with histology. High-resolution T1-weighted in vivo images (about 400 x 400 x 500 microns) were then obtained and examined for the same features. A myelin stripe could be clearly seen, and there is also some evidence of small vessels traveling along with the white matter.

2293. T_1 in Postmortem Brains at 4T

R. A. Waggoner[1], Y. Kobayashi[2], G. Matsumura[2], N. Shiraishi[2], K. Tanaka[1], K. Cheng[1]
[1]Riken Brain Science Institute, Wakoshi, Saitama, Japan; [2]Kyorin University School of Medicine, Mitaka, Tokyo, Japan

T1 measurements were performed on fixed, postmortem brains at 4T. The T1s of cortical gray matter and white matter were found to be substantially shorter than in living brains at 4T, just as at lower fields. Surprisingly though, T1 in cortical gray matter and white matter was not substantially different at 4T than values reported in the literature for 0.15 and 0.5T. The T1 results of this study indicate that the length of time of storage in formalin (the fixative) has a larger impact on brain tissue T1s than variation in applied static magnetic field.

2294. Grey and White Matter Abnormalities in Patients with Chronic Toxic Encephalopathy: A Preliminary Study using DTI and ^{1}H MR Spectroscopy.

Cristina Lavini[1], Ieke Visser[2], Maartje M.L De Win[1], Charles B.L.M Majoie[1], Elisabeth M.W. Wekking[2], Liesbeth Reneman[1], Gert van der Laan[2], Gerard J. den Heeten[1]
[1]Academic Medical Center, Amsterdam, Netherlands; [2]Netherlands Center of Occupational Diseases, Amsterdam, Netherlands

In this study we have investigated 10 patients with Chronic Toxic Encephalopathy after long term occupational exposure to organic solvents using Diffusion Tensor Imaging (DTI) and Single Voxel 1H MRS. The study has highlighted local Diffusion (FA and ADC) abnormalities in the thalamus and frontal white matter, which correlated well to the neuropsychological test performances of the patients. A remarkable increase of FA in the putamen was also observed. An abnormal spectroscopic finding (elevated choline/creatine ratio) correlated to the depressive complaints.

2295. Differentiation of Idiopathic Parkinson's Disease, Multiple System Atrophy, Progressive Supranuclear Palsy and Healthy Controls using Magnetization Transfer Imaging

Thomas Eckert[1], Claus Tempelmann[1], Nils Bodammer[1], Jörn Kaufmann[1], Ariel Schönfeld[1], Thomas Peschel[2], Christoph Schrader[2], Michael Sailer[1], Hans-Jochen Heinze[1]
[1]OvG-University Magdeburg, Magdeburg, Germany; [2]Medical School of Hannover, Hannover, Germany

This study investigates the contribution of magnetization transfer imaging (MTR) to the differential diagnosis of parkinsonian syndromes. MTR medians of basal ganglia regions of controls and patients with idiopathic Parkinson's disease (IPD), multiple system atrophy (MSA) and progressive supranuclear palsy (PSP) were compared. Histopathological knowledge suggests a MTR reduction in the globus pallidus for PSP, in the putamen for MSA and in the substantia nigra for all patients. MTR measures closely matched the predicted patterns and allowed the discrimination between the different parkinsonian syndromes.

2296. The Comparison of Efficacy of Contrast Agent on Cerebral Metastasis at 1.5T and 3.0T

Yongmin Chang[1], Moon-Jung Hwang[1], Sung-Jin Bae[1], Chul-Ho Shon[2], Young-Joo Lee[1]
[1]Kyungpook National University Hospital, Taegu, Republic of Korea; [2]Dongsan Medical Center, Keymyung University, Taegu, Republic of Korea

There is at present little information available on MRI with contrast agents at high field strengths in clinical practice. In this study, we evaluate the efficacy of gadolinium chelates in metastatic brain diseases at 3.0T and compared with well-established data of 1.5T. The results show that a dose of 0.1 mmol/kg gadopentetate dimeglumine, which is the standard dose at 1.5T, enhances the lesions more significantly at 3.0T. This outcome might have been due to the longer intrinsic T1 of tissue at higher field strength that permit strong contrast agent-induced T1 shortening.

2297. Calibration Technique for Volumetric MRI of Alzheimer's Disease

Richard Philip Mallozzi[1], Daniel James Blezek[1]
[1]GE Global Research, Schenectady, New York, USA

Structural MRI of the central nervous system is emerging as a promising method to diagnose and track the progression of neuro-degenerative diseases such as Alzheimer’s disease. Such techniques often require longitudinal measurements over periods of months to years, with stability in the fractions of a percent. We have developed a phantom-based calibration technique to enable MR scanners to meet these stringent requirements on stability. In tests on phantoms, we have successfully reduced the effects of deliberately-introduced nonlinear gradient field changes by more than an order of magnitude.

2298. Magnetic Resonance Imaging of Brain Transverse Acoustic Waves

David F. Moore[1], Randall Pursley[1], Emilios Dimitriadis[1], S. Lalith Talagala[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

The mechanical properties of internal organs may be altered in disease processes with implications for diagnosis and therapy. Magnetic resonance elastography (MRE) combines the 3-D resolution of MR with measurement of vibration associated phase changes allowing estimation of tissue mechanical properties. The possibility of ‘non invasive’ measurement of mechanical properties in inaccessible organs, such as the brain, is particularly attractive. We present initial data demonstrating acoustic transverse wave transmission into the brain in human subjects. Acoustic coupling into the brain was found to be better at an excitation frequency of 125 Hz.

2299. Identification of the Epileptogenic Tuber with Diffusion-Weighted MRI in Patients with Tuberous Sclerosis and Epilepsy

Floor Jansen[1], Braun Kees[1], Onno van Nieuwenhuizen[1], Geertjan Huiskamp[1], Alexander van Huffelen[1], Jeroen van der Grond[1]
[1]University Medical Center, Utrecht, Netherlands

Patients with tuberous sclerosis complex (TSC) and drug-resistant epilepsy may be considered candidates for epilepsy surgery. However, as most patients have multiple, potentially epileptogenic, tubers, this option is often rejected. In this study we tested whether diffusion-weighted MRI enables differentiation of epileptogenic tubers from inert ones.

Head and Neck MR Imaging

Hall D Tuesday 13:30 - 15:30

2300. Fast and Ultrafast MR-Sialography

Joachim Graessner[1], Christian R. Habermann[2], Miriam C. Cramer[2], Juergen Ussmueller[2], Ulrich Koch[2], Gerhard Adam[2]
[1]Siemens AG Medical Solutions, Hamburg, Germany; [2]University Hospital of Hamburg, Hamburg, Germany

Fast clinical protocols are the backbone of todays clinical routine. Therefore, we developed a program of 3 fast and ultrafast 3D True Fisp and single-shot TSE sequences for the detection of the regular ductal system of the salivary glands. The resulting image quality of the regular ductal system was so convincing, that pathologic changes should be easily detectable.

2301. WITHDRAWN

2302. Determining Paranasal Sinus Ostial Patency with Hyperpolarized He-3 MRI: Theory and Phanthom Study

Masaru Ishii[1], David A. Roberts[2], Johan M. Edvinsson[2], Aman Jalali[2], Iman Khodaei[2], Jiangshang Yu[2], John S. Leigh[2], Mitchell Schnall[2], Rahim R. Rizi[2]
[1]Johns Hopkins University, Baltimore, Maryland, USA; [2]University of Pennsylvania, Philadelphia, Pennsylvania, USA

We present a mathematical model for describing the exchange of gases between the nasal cavity and the paranasal sinuses. This model may be used to analyze dynamic hyperpolarized helium ventilation studies of the paranasal sinuses. Key parameters such as relative os size may be extracted using this technique. Experimental verification of the model in phantoms is provided. This may lead to a practical functional test of sinus ostial patency.

2303. Dynamic Contrast Enhanced MRI of Squamous Cell Carcinomas in the Head-Neck Region

Mark Rijpkema[1], BertJan de Bondt[1], Johannes Kaanders[1], Albert van der Kogel[1], Arend Heerschap[1]
[1]UMC Nijmegen, Nijmegen, Netherlands

Tumor control rates for squamous cell carcinomas (SCC) in the head-neck region vary by site of the primary tumor. In this study dynamic contrast enhanced MRI using Gd-DTPA was applied to assess tumor vascularity, which may have a predictive value for radiation treatment outcome. While tumor volume and stage at different sites (larynx, hypopharynx, oropharynx) was comparable, the Gd-DTPA uptake rate kep (s-1) showed significant differences between SCC at the different sites in the head-neck region. However, no correlation with local control rates of head and neck tumors stratified to the tumor site was found.

2304. Sequence Protocols for Neuroimaging at 3 T: First Experiences in a Clinical Routine Setting

Wolfram Schwindt[1], Harald Kugel[1], Rainald Bachmann[1], Stephan Kloska[1], Thomas Allkemper[1], Bettina Pfleiderer[1], Bernd Tombach[1], Walter L. Heindel[1]
[1]University of Münster, Münster, Germany

Nowadays compact-built MR scanners with 3 T field strength suitable for clinical routine diagnostics become increasingly available. In order to exploit the higher signal to noise ratio for improved spatial or temporal resolution, sequences need to be modified for the use at higher field strength, because relaxation times and energy deposition in the tissue are field dependent. Our goal was to establish optimized, reliable protocols for clinical routine imaging of the neurocranium at 3 T. We report our experiences after examining 205 patients.

2305. 3D MRI Assessment of Face Morphology: Comparison to Photogrammetry

Zaki Taher[1], Ashvin Sologar[1], Stephen Bamforth[1], Chris Plewes[1], Derek Emery[1], Christian Beaulieu[1]
[1]University of Alberta, Edmonton, Alberta, Canada

Digital photogrammetry with cameras has been the modality of choice for measuring 3D coordinate data of facial landmarks and correlating abnormal facial structures to specific genetic syndromes. The role of MRI for evaluating face morphology was evaluated and compared to standard digital photogrammetry. 3D MPRAGE was used in conjunction with MRI visible markers that adhere to the face. 3D coordinates at 33 facial landmarks were compared in 10 normal volunteers. Photogrammetry is inaccurate at peripheral points on the face while MRI appears to provide accurate 3D coordinates of all facial landmarks.

Spine MR Imaging

Hall D Saturday 14:00 - 16:00

2306. Lumbar Spine MRI with a CTL Array Modified for Feet-First Patient Entry

Matt A. Bernstein[1], Joel P. Felmlee[1], Armen Kocharian[1], John Huston III[1], Paul F. McGough[1], Renee S. Jonsgaard[1]
[1]Mayo Clinic and Foundation, Rochester, Minnesota, USA

Standard use of cervical-thoracic-lumbar (CTL) arrays with contoured cervical supports available for our 1.5T scanner requires head-first patient entry into the magnet. Three linear CTL arrays were modified for foot-first patient entry to facilitate lumbar spine exams for claustrophobic or large patients. If a patient preparing for a lumbar spine exam expressed concern about claustrophobia, or was too large for the 60cm patient aperture, the technologist offered option of the foot-first entry. Based on N=68 uses of the foot-first array, we conclude that this mode of patient entry can facilitate clinical lumbar scanning, and we recommend its wider adoption.

2307. Isotropic Resolution Cervical Spine MRI Using 3DFSE Sequence

Lei Zhao[1], Ferenc A. Jolesz[1]
[1]Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA

A single-slab 3DFSE pulse sequence was implemented to acquire cervical spine images with isotropic spatial resolution (~ 1 mm3). Oblique plane images were obtained by reformatting the 3D data set after exams. It was shown that the high resolution original images and its oblique reformatted images have comparable image quality against the thick slice images acquired using 2D FSE methods. High-resolution 3DFSE scan does not only save total scan time compared to 2D FSE approach when multiple oblique scans are need, but also obtain ideal viewing angles virtually in any point of the 3D volume, providing optimal diagnostic information.

2308. Volume-Selective Excitation for Improved Imaging of the Spine

Glen Morrell[1]
[1]Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA

Imaging of the spinal cord is often limited by artifact arising from motion of the aorta, chest wall, and heart. Because the cord occupies only a small fraction of a typical sagittal field of view (FOV), resolution across the cord is low, which sometimes limits evaluation of abnormal cord signal. We present a method in which only a cylindrical volume containing the spinal cord and adjacent bony structures is excited. This technique eliminates pulsation artifact from the aorta and artifact from respiratory and cardiac motion, and allows higher resolution imaging of the spinal cord over a small FOV.

2309. Clinical Feasibility and Usefulness of Line Scan Diffusion Weighted Images (LSDWI) on 0.2 Tesla MR imager to Evaluate Cervical Spondylotic Myelopathy.

Masaaki Hori[1], Toshiyuki Okubo[1], Yasuhiro Nakata[1], Yuuko Adachi[1], Shigeki Aoki[2], Hiroshi Kumagai[1], Tsutomu Araki[1], Noriko Hirasawa[3], Kenji Suzuki[3], Toru Hayasaka[3]
[1]University of Yamanashi, Nakakoma, Yamanashi, Japan; [2]University of Tokyo, Bunkyo-ku, Tokyo, Japan; [3]GE Yokogawa Medical Systems, Hino, Tokyo, Japan

Diffusion-weighted imaging (DWI) may provide essential diagnostic information about spinal cord disorder, especially internal fibrous structure. DWI with line scan data acquisition (LSDWI) is a method with less susceptibility artifacts among several DWI sequences. In expectation of even lower susceptibility artifact, LSDI technique was applied to low magnetic field MR imager. The average ADC values in any directions decreased at the early clinical stage of cervical spondylotic myelopathy and increased at late stage, compared with normal volunteers. In diagnosis of the cervical spondylotic myelopathy, LSDWI technique may be a sensitive method to comprehend the structural characteristics of spinal cord pathology.

2310. Anisotropic Diffusion Changes on the Corticospinal Tract Affected in Cerebral Infarction: A Quantitative Analysis using Diffusion Tensor 3D White Matter Tractography

Akira Kunimatsu[1], Shigeki Aoki[1], Yoshitaka Masutani[1], Osamu Abe[1], Harushi Mori[1], Kuni Ohtomo[1], Hiroyuki Kabasawa[2]
[1]Tokyo University Graduate School of Medicine, Tokyo, Japan; [2]GE Yokogawa Medical Systems, Tokyo, Japan

We applied 3D white matter tractography obtained from diffusion tensor MR imaging (DT-MRI) to depiction of the corticospinal tract (CST) in patients with suspicion of acute or early subacute infarcts affecting the CST. The CST was tracked successfully and we measured fractional anisotropy (FA) values along the tract. Significant reduction in anisotropic diffusion was demonstrated on the CST within infarcts. 3D white matter tractography may be useful in quantitative evaluation of ischemic injuries on the CST.

2311. Sensitivity-Encoded Diffusion Tensor Imaging of the Cervical Cord

Mara Cercignani[1], Mark Andrew Horsfield[2], Massimo Filippi[1]
[1]Scientific Institute Ospedale San Raffaele, Milano, Italy; [2]University of Leicester, Leicester, England, UK

This work describes the implementation of a SENSE single-shot EPI pulse sequence for DT-MRI of the cervical cord, with the aim of measuring the diffusion tensor and assessing the feasibility of using the technique in the cord. The highly ordered arrangement of axons in the spinal cord makes diffusion measurements particularly interesting in this anatomical structure, and the investigation of several pathologies would benefit from DW-MRI of the cord. Unfortunately, the cord is also challenging to study with MRI, due to its geometry, and to the effects of CSF and lipids. A possible solution is the use of SENSE.

2312. Echo-Planar Diffusion Tensor Imaging of the Normal and Pathological Human Cervical Spinal Cord

Andrzej Jasinski[1], Patrick W. Stroman[2], Tomasz Skorka[1], Tomasz Banasik[1], Marcin Hartel[3], Marek Konopka[3], Piotr Pieniazek[3], Boguslaw T. Tomanek[2], Andrzej Urbanik[4]
[1]H. Niewodniczanski Institute of Nuclear Physics, Krakow, Poland; [2]Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [3]Diagnostic Imaging Center Helimed, Katowice, Poland, Poland; [4]Jagiellonian University Medical College, Krakow, Poland, Poland

DW images of cervical spinal cord (CSC) of 12 healthy volunteers and of 15 patients with neurological disorders following traumatic injury were recorded using modified single-shot diffusion weighted EPI (SSDWEPI) sequence. GE SIGNA LX Echo-Speed and SIGNA LX Echo-Plus were used for these experiments. ADC components determined for GM and WM of the CSC agree with published values. Clinically usable DTI images were obtained. For patients with mild disorders DTI images didn't show any changes in the CSC. In cases of severe post-traumatic disorders DTI showed details of injury demonstrating clinical feasibility DWI using SSDWEPI sequence.

2313. Application of Diffusion Weighted MRI in the Evaluation of Acute Myelopathy Syndromes

Seung-Koo Lee[1], Dong Ik Kim[1], Dong Joon Kim[1]
[1]Yonsei University College of Medicine, Seoul, Republic of Korea

The authors applied diffusion weighted imaging in the evaluation of acute myelopathy syndrome. Acute phase of multiple sclerosis and spinal cord ischemia showed DWI abnormality with reduction of ADC, while transverse myelitis and compressive myelopathy showed vasogenic edema. Spinal cord DWI is useful in the evaluation of acute myelopathy syndromes of the spinal cord.

2314. Positional Perfusion Change of the Cervical Spinal Cord in the Hirayama Disease

Izumi Anno[1], Tomonori Isobe[1], Akira Matsumura[1], Tadao Nose[1], Yuji Itai[1]
[1]University of Tsukuba, Tsukuba, Ibaraki, Japan

The cervical spinal cord MR perfusion of a patient with Hirayama disease was examined in both neutral and flexion position. One of the causes of this disease is discussed. Ischemic theory can be ruled out.

2315. Neoplastic or Non-Neoplastic Compression Fractures? Differential by Dual Phase Chemical Shift Imaging

Eito Kozawa[1], Makoto Amanuma[1], Atsuko Heshiki[1]
[1]Saitama Medical School, Iruma-gun, Saitama, Japan

In-phased and opposed-phase study is a well established method for assessing of fat and water components in the adrenal adenoma [1,2]. In-phased and opposed phase MRI has been also proven to be effective and noninvasive method for evaluating the in vivo fat and cellular marrow elements in bone marrow[3,4]. Detection of bone metastasis, and vertebral compression fracture by MRI is a well accepted method of choice [3,4]. However, even with MRI the cause of compression continuous to pose many problems. The purpose of this study is to evaluate the usefulness of in-phase and opposed phase MRI of bone

2316. Effect of Methylprednisolone on the MRI Appearance of Spinal Cord Injury

Adam E. Flanders[1], Anthony S. Burns[1], John Anthony Carrino[2]
[1]Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA; [2]Brigham & Womens Hospital, Boston, Massachusetts, USA

Purpose: To determine if the routine administration of methylprednisolone immediately following spinal cord injury has an effect on lesion severity demonstrated on MR imaging. Materials & Methods: Cervical spinal cord injured patients treated with the recommended dose of methylprednisolone (bolus 30 mg/kg + 5.4 mg/kg over 23 hours) administered within 8 hours of injury were compared to a group of cervical spinal cord injured patients who did not receive steroids. The neurologic degree of impairment (ASIA grade) and neurologic level of injury at time of admission were recorded.

2317. Utility of USPIO's in Spinal Cord MRI in a Murine Model of EAE

Richard Buist[1], XueJun Sun[1], Jennifer Wells[2], Kathie McCutcheon[1], Paula Jacobs[3], Jim Peeling[1], V. Wee Yong[2]
[1]University of Manitoba, Winnipeg, Manitoba, Canada; [2]University of Calgary, Calgary, Alberta, Canada; [3]Advanced Magnetics, Inc., Cambridge, Massachusetts, USA

A new USPIO (AMI-7228) has been used to detect lesions in vivo in spinal cords of mice with EAE. Shortly after injection of AMI-7228, hypointensity in T2-weighted (TE 27ms) images was observed. In normal mice the hypointensity disappeared at 24h post-contrast. In EAE mice, hypointensity was observed at 24h, sometimes encompassing the entire spinal cord but usually concentrated around the periphery. This hypointensity appeared in some mice 2 days prior to onset of symptoms and in most animals was retained throughout the course of disease. The areas of hypointensity corresponded well with histologically identified regions of inflammation.

2318. White Matter Lesion Load Quantification in Autoimmune Encephalomyelitis by High Resolution MR Microscopy of Rat Spinal Cord at 17.6 T

Thomas Weber[1], Thomas Neuberger[1], Andre Müller[2], Gerhard Giegerich[2], Ulrich Bogdahn[2], Axel Haase[1], Andreas Steinbrecher[2], Cornelius Faber[1]
[1]University of Wuerzburg, Wuerzburg, Germany; [2]University of Regensburg, Regensburg, Germany

Proton MRI is a very sensitive tool to detect central nervous system (CNS) lesions in multiple sclerosis (MS). New inflammatory CNS lesions reflecting disease activity can be detected ten times more frequently by conventional MRI than by clinical observation. In MS animal models such as experimental autoimmune encephalomyelitis (EAE) lesions are usually quantified by histopathological analysis. We present a method to quantify T2 lesion load in EAE spinal cords by high resolution magnetic resonance imaging in a much shorter time than possible by histopathological analysis.

2319. Micro- and Cellular Imaging of Experimental Spinal Cord Injury

Paula Foster-Gareau[1], Elizabeth Dunn[1], Greg Dekaban[1], Lynne Weaver[1]
[1]Robarts Research Institute, London, Ontario, Canada

We have used magnetic resonance microscopy to evaluate pathologic changes and inflammatory cell infiltration in spinal cord tissue in a clip compression model of traumatic spinal cord injury in the rat. Microimaging was achieved with a clinical whole body scanner, which is an unconventional approach to microimaging. To accomplish this, new tools and concepts that enable low-field MRM were developed and tested including a custom-built, insertable, high powered imaging gradient set, customized radiofrequency coils and optimized pulse sequence technology. For cellular imaging SCI rats were administered a superparamagnetic iron oxide contrast agent and imaged 36 hours later.

2320. The Observation of Water Compartmentalization *In-Vivo* in the Feline Lumbar Spinal Cord

Daniel Hallihan[1], Atiyah Yahya[1], Keith Wachowicz[1], Christopher Hanstock[1], Vivian K. Mushahwar[1], Peter S. Allen[1]
[1]University of Alberta, Edmonton, Alberta, Canada

The overall goal of this project is to develop NMR techniques for in-vivo assessment of spinal cord pathology after injury. In the present study, in-vivo transverse relaxation measurements of the feline cord were obtained from spin echo images by selecting individual ROIs in each of the grey or white matter and applying non-negative least squares analysis to fit the transverse decay in each ROI. White matter returned a unique component at ~20 ms corresponding to myelin water, whereas both the grey and white matter displayed components from axonal and extra-cellular water between 50 ms and 100 ms.

MR Safety and Bioeffects: Miscellaneous

Hall D Sunday 13:30 - 15:30

2321. Evaluation of Continous Vital Sign Measurements at Multiple Static Magnetic Field Stengths to 8 Tesla

Donald William Chakeres[1], Alayar Kangarlu[1], Harios Boudoulas[1], Donn C. Young[1]
[1]The Ohio State University College of Medicine and School of Public Health, Columbus, Ohio, USA

This study examines the effects of static magnetic field strengths up to 8 Tesla on the vital sign physiology of 25 human subjects. Pulse rate, respiratory rate, electrocardiogram, systolic and diastolic blood pressures, finger pulse oxygenation levels, external auditory canal temperature, and multiple fiber optic temperatures were repeatedly measured. The quantitative measures were then statistically analyzed. Statistically significant changes were related to the transition from supine to upright positions outside of the magnetic field. One statistically significant correlation was observed between the systolic blood pressures and field strength, but it had no clinical significance.

2322. Is There an Influence of Magnetic Resonance Imaging of the Brain on Subsequent MEG Examinations?

Clemens Fitzek[1], Jens Haueisen[1], Ralf Huonker[1], Stefan O.R. Pfleiderer[1], Hans J. Mentzel[1], Dieter Sauner[1], Ulrich Brandl[1], Werner A. Kaiser[1], Jürgen R. Reichenbach[1]
[1]Friedrich-Schiller University, Jena, Germany

In a recent abstract it was reported that MEG signals could not be detected following MRI. The aim of this prospective study was to investigate and to replicate these findings. Nine healthy volunteers underwent one MEG session before and two MEG sessions after MRI of the brain. MEG signals were detected and measured without any problems or interference in all volunteers. No significant differences were observed between the power spectra of spontaneous brain activity before and after MRI. There was no statistically significant difference between the source localization due to median nerve stimulation before and after the MRI scans.

2323. Very Large Attractive Forces Extend Outside Actively Shielded Short Bore MR Magnets

Göran Starck[1], Carl Schoster[2], Barbro Vikhoff-Baaz[1], Kerstin Lagerstrand[2], Sven Ekholm[2], Eva Forssell-Aronsson[2]
[1]Sahlgrenska University Hospital, Göteborg, Sweden; [2]Göteborg University, Sahlgrenska University Hospital, Göteborg, Sweden

The attractive magnetic force of an MR magnet represents a great hazard. Especially staff with MR experience may have a false confidence in the attractive force being relatively small around actively shielded magnets. However, our measurements show that the maximum attractive force of such a magnet can be very large also outside the magnet. Therefore, detailed knowledge of the attractive magnetic force of each magnet is important.

2324. Active Noise Reduction in a 4T Whole Body MR Imager

Ryan Geris[1], Chris K. Mechefske[1], Brian K. Rutt[2]
[1]Queen's University, Kingston, Ontario, Canada; [2]Robarts Research Institute, London, Ontario, Canada

We describe an Active Noise Cancellation (ANC) system that was tested in the laboratory and in a 4 Tesla MRI scanner. The system is similar to commercially available ANC headsets with the speaker and error microphone inside an ear defender. Inside the MRI the system preformed modestly well with a 4dB attenuation overall for an EPI input sequence. This does not include the attenuation of the ear defenders. The performance inside the MRI was below that when tested in the laboratory due to the diffuse sound field inside the MRI and not from any influence of the magnetic field.

RF Pulse Design

Hall D Monday 13:30 - 15:30

2325. Sub-Pulse Calibration for Forward-Backward Echo Planar 2D Selective RF Pulses

Markus Oelhafen[1], Roger Luechinger[1], Peter Boesiger[1]
[1]ETH Zurich, Zurich, Switzerland

Echo planar 2d selective RF pulses (2DRF) have recently been proposed in several applications. 2DRF however exhibit an extended pulse duration, since the selection gradients need to cover a 2D transmit k-space while the RF pulse is played out. Forward-backward designs of 2DRF are more time-efficient than their fly-back alternative. However, the faster pulses are subject to N/2 ghosting due to gradient imperfections and B0 inhomogeneities. In the present work we propose a method for sub-pulse calibration to suppress N/2 ghosts in forward-backward 2DRF and we demonstrate its effectiveness in real-time flow measurements.

2326. Equi-Ripple Design of Quadratic Phase RF Pulses

Rolf Feodor Schulte[1], Jeffrey Tsao[1], Klaas Paul Pruessmann[1], Peter Boesiger[1]
[1]University and ETH Zurich, Zurich, Switzerland

Quadratic phase RF pulses with high selectivity and broad bandwidths are developed using the Shinnar-Le Roux transformation. Unlike previous implementations, the required quadratic phase FIR filters are designed using the complex Remez exchange algorithm, which ensures an equi-ripple error function without the need for heuristic spectral weighting. It is argued analytically that these pulses yield near-optimal solutions in terms of minimising the B_1-amplitude. The effectiveness of typical pulses is demonstrated *in vitro* and *in vivo*.

2327. Design of Adiabatic Pulses beyond the Frequency Frame Adiabatic Condition

Lorenz Mitschang[1], Herbert Rinneberg[1]
[1]Physikalisch-Technische Bundesanstalt, Berlin, Germany

Adiabatic pulses are designed to obey the adiabatic condition with respect to the frequency frame which rotates at the instantaneous frequency of the pulse. This approach has been recognized to be too limited for the understanding of functionality of the well known sech/tanh pulse. We present a novel approach to pulse design based on the export of the adiabatic condition as the prime principle from the frequency frame to higher order frames. The method allows for tailoring of adiabatic pulses for a wide range of applications, because additional suitable constraints can be incorporated.

2328. Simulation of 3D Tailored RF Pulses for B_1 Inhomogeneity Compensation at 8 Tesla

Suwit Saekho[1], Tamer S. Ibrahim[2], Petra Schmalbrock[2], Fernando E. Boada[1], Victor Andrew Stenger[1]
[1]University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [2]The Ohio State University, Columbus, Ohio, USA

This work uses numerical simulations to evaluate the feasibility of multi-shot 3D tailored RF pulse methods for acquiring images with reduced B1 inhomogeneity artifact at ultra-high field strengths (7T and up). The tailored RF pulses were designed based on numerically simulated B1 maps at 8T for a 0.125M NaCl doped water phantom. Numerical integration of the Bloch equations found that series of sixteen 3.8 ms long pulses could be applied in separate acquisitions such that the composite excitation was a slab-select pulse for 3D imaging compensating for B1 inhomogeneity.

Parallel Imaging: Applications and Improvements

Hall D Tuesday 13:30 - 15:30

2329. Improving True-FISP Parallel Cine Imaging using a New Data-Acquisition Scheme for Coil Sensitivity Calibration

Qiang Zhang[1], Jaeseok Park[2], Debiao Li[2], Orlando Simonetti[1]
[1]Siemens Medical Solutions, Chicago, Illinois, USA; [2]Northwestern University, Chicago, Illinois, USA

This study introduces a new data acquisition scheme for coil sensitivity calibration. Final images were reconstructed using Generalized SMASH. Additional k-space central lines for self-calibrating parallel imaging (e.g. AUTO-SMASH, GRAPPA) were eliminated. Reference scans for coil sensitivity calibration and accelerated imaging scans were performed in the same measurement. Thus the calibration procedure was simple and the sensitivity misalignment problem due to possible patient motion was minimized. The new technique was also shown insensitive to chest movements in subject free breathing. Improved data acquisition efficiency over partially parallel acquisition (PPA) was demonstrated with excellent aliasing artifacts suppression.

2330. Dynamic Autocalibrated Parallel Imaging using TGRAPPA

Felix Breuer[1], Peter Kellman[2], Mark A. Griswold[1], Peter M. Jakob[1]
[1]University of Wuerzburg, Wuerzburg, Germany; [2]National Institutes of Health, Bethesda, Maryland, USA

In this study increased data acquisition efficiency in dynamic parallel imaging has been achieved by using a time interleaved acquisition scheme in combination with autocalibrated GRAPPA. In this approach no additional auto calibration signals (ACS) need to be acquired, since the signal from the adjacent time frames is used to assemble a full set of ACS lines for an improved GRAPPA reconstruction. This eliminates the main drawback of conventional GRAPPA, namely the need to acquire additional reference lines.

2331. Evaluation of Parallel Imaging in Standard Cardiac MRI

Kenman Gan[1], Michelle Noga[1], Alan H. Wilman[1]
[1]University of Alberta, Edmonton, Alberta, Canada

Parallel imaging based on both k-space (GRAPPA) and image-space (SENSE) processing was performed for standard cardiac imaging using a speed up factor of two. Seven normal volunteers were imaged using three CINE true-FISP views of the heart and black-blood fast spin echo of the aortic arch. The parallel imaging time savings were translated into reduced breathholds, reduced echo trains or increased spatial or temporal resolution. A cardiac radiologist ranked the images in a blinded comparison. Parallel imaging with reduced echo trains led to significantly sharper images. Increased CINE time resolution was also valuable; however most parallel imaging exhibited increased artifact.

2332. Improved VD-AUTO-SMASH Imaging

Zhigang You[1], Wingchi Edmund Kwok[1], Jianhui Zhong[1]
[1]University of Rochester, Rochester, New York, USA

VD-AUTO-SMASH parallel imaging technique has the advantage that it does not require an additional reference scan for coil coefficient calculation. However, SENSE technique is more widely tested and applied clinically due to its generally better image quality. We propose three different methods to improve VD-AUTO-SMASH technique: 1) determining coil coefficients from acquired phased encoding lines in non-central k-space, 2) using weighted average of all possible harmonics for coil coefficient calculation, and 3) using an optimized variable k-space sampling density. Imaging results show that these methods significantly reduce image artifacts, which may allow VD-AUTO-SMASH imaging to be more useful clinically.

2333. Assessment of Parallel Acquisition Techniques in Adrenal MR Imaging: Does Increased Temporal Resolution Significantly Improve Characterization of Adrenal Lesions?

Daniel T. Boll[1], Claudia M. Hillenbrand[1], Danielle M. Seaman[1], Jeffrey L. Duerk[1], Jonathan S. Lewin[1], Elmar M. Merkle[1]
[1]University Hospitals of Cleveland, Cleveland, Ohio, USA

Conventional coil reception and parallel array acquisition methods employed in adrenal imaging were compared, and the relationship between temporal resolution and image quality was analyzed. Sequences were applied in ten healthy volunteers and ten patients with adrenal gland lesions, and images were subsequently evaluated qualitatively and quantitatively. Acceleration of single acquisition TSE sequences through parallel imaging SMASH techniques incorporating autocalibration methods (GRAPPA) was found to lead to an increase in both diagnostic power and image quality and a reduction of breathing motion artifact, while improving temporal resolution and increasing contrast.

2334. Comparison of Three MRCP Technique with Respiratory-Triggered 3D Fast-Recovery FSE with Parallel Imaging Technique, Thick Single-section, and Thin Multisection Single Shot FSE Sequences

Takayuki Masui[1], Motoyuki Katayama[1], Shigeru Kobayashi[1], Atsushi Nozaki[2], Mitsuru Ikeda[3], Masayoshi Sugimura[1], Nobuko Okukgo[1]
[1]Seirei Hamamatsu General Hospital, Hamamatsu, Shizuoka, Japan; [2]GE Yokogawa Medical Systems, Hino, Tokyo, Japan; [3]Nagoya University Hospital, Nagoya, Aichi, Japan

Introduction: MRCP has been widely used in the evaluation of the pancreatobiliary system. MRCP using 2D SSFSE sequence might not be enough to provide information for non-dilated pancreatic duct and high order branches of the bile ducts. Compared with 2D technique, 3D technique with FSE can provide high SNR, but one of the major drawbacks is long acquisition time. Parallel imaging techniques using multicoils have been introduced and sensitivity encoding technique can be clinically used with commercially available multicoils. The purpose was to assess the feasibility of MRCP using respiratory-triggered 3D FR FSE sequence with sensitivity encoding technique; array

2335. Improvement of SNR for Knee Imaging using SENSE

Balavinayagam Sivalingam[1], Kevin F. King[2]
[1]University of Illinois, Chicago, Illinois, USA; [2]GE Medical Systems, Waukesha, Wisconsin, USA

Sensitivity Encoding (SENSE), which is normally used for scan time reduction, can be used to improve Signal to Noise Ratio (SNR) in MR images. In a gradient echo pulse sequence, the TR is increased, allowing the bandwidth to decrease to improve SNR, while keeping the scan time the same by using SENSE to decrease the number of phase encoding steps. Knee imaging SNR is typically limited by scan time making it a good application. The technique was verified using a phantom study and demonstrated in vivo with an SNR improvement of around 30%.

2336. Scan Time Impact of Reducing Slab Wrap in Slice Encode SENSE

Lisa Angelos[1], *Kevin F. King*[1], *Lloyd Estkowski*[2]
[1]GE Medical Systems, Milwaukee, Wisconsin, USA; [2]St. Lukes Medical Center, Milwaukee, Wisconsin, USA

In a 3D MR scan, design tradeoffs in the RF profile produce signal outside the prescribed slab resulting in slab wrap. In SENSitivity Encoding scans with FOV reduction in the slice encode direction, slab wrap increases the amount of aliasing in the central region of the slab. We can compensate for slab wrap aliasing by decreasing the SENSE reduction factor, but this modification increases scan time. Optimized image quality requires a tradeoff between RF pulse length and SENSE reduction factor. For some applications, scan time saved by shortening the RF pulse is lost to an increased SENSE reduction factor.

Parallel Imaging at the Limits

Hall D Saturday 14:00 - 16:00

2337. An Analysis of the Spatial Dependence of the Ultimate Intrinsic SNR for Parallel Imaging

Michael A. Ohliger[1], *Aaron K. Grant*[2], *Daniel K. Sodickson*[2]
[1]Harvard-MIT Division of Health Sciences and Technology, Cambridge, Massachusetts, USA; [2]Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

In previous work, we proposed a technique for determining the maximal SNR achievable from a parallel MRI reconstruction. Initial examples described the behavior of this SNR optimum at the center of an elliptic cylinder for a variety of imaging conditions. The present work explores the ultimate intrinsic SNR behavior at points away from the center of the sample. It is shown that – contrary to what is observed for fixed conductor arrangements – noise amplifications for an optimal coil decrease monotonically towards the edge of the sample, and reconstruction of the central point remains the SNR-limiting case.

2338. Resolution Enhancement in Single Echo Acquisition (SEA) MR Imaging

Steven M. Wright[1], *Mary Preston McDougall*[1]
[1]Texas A&M University, College Station, Texas, USA

A 64 channel receiver and 64 element radio-frequency coil array were used to acquire a series of echoes, forming 64 x 128 images with each echo acquisition. This paper proposes a resolution enhancement technique for single echo imaging in which successive images of high and low-frequency information are obtained by alternating the phase encoding gradient between two values, one which cancels the phase contribution of the coil elements and one which increases the phase across the element. By combining the two single echo data sets, resolution is increased while still providing an updated image with each echo.

2339. T_1 and T_2 Measurements Using TEM Coils with SENSE Parallel Imaging at 8T

Petra Schmalbrock[1], *Chastity DS Whitaker*[1], *Chad Mitchell*[1], *Amir Abduljalil*[1]
[1]The Ohio State University, Columbus, Ohio, USA

Parallel imaging using SENSE or SMASH with data from multiple receive surface coils has been used at low field strength (<3T) to reduce scan times for a variety of applications. In this work, we demonstrate that signal from multi-port TEM coils acquired with multiple independent receiver channels can be used to accurately measure T1 and T2 despite the fact that at ultra high fields, TEM coil and sample are coupled and have a complicated spatial receive sensitivity distribution.

2340. Design Considerations for Volumetric Arrays with Many Elements for Massively Parallel MRI

Matthias F. Mueller[1], *Mark A. Griswold*[1], *Axel Haase*[1], *Peter M. Jakob*[1]
[1]Universität Würzburg, Würzburg, Germany

In the last year, large receiver banks containing 64 receiver channels have been developed. The goal of this abstract is to determine which of the multitude of possible volumetric array coil designs could be used for arrays with 32-64 receiving elements. To this end, we simulated, constructed and analyzed various coil array designs which could potentially be used for head-sized cylindrical volumetric arrays with many channels. In our opinion, spiral surface coil arrays are a promising option for the construction of arrays with many coil elements for parallel MRI.

Parallel Imaging: Advances in Image Reconstruction

Hall D Sunday 13:30 - 15:30

2341. Parallel Generalized Series Imaging

Zhi-Pei Liang[1], Andrew Stenger[2], Jim Xiuquan Ji[1], Jingfei Ma[3], Fernando Boada[2]
[1]University of Illinois at Urbana-Champaign, Urbana, Illinois, USA; [2]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA; [3]University of Texas MD Anderson Cancer Center, Houston, Texas, USA

Many imaging applications require collecting a time series of images. Conventional methods acquire these images independently, leading to a trade-off between spatial and temporal resolution. To address this problem, this paper presents a novel algorithm to integrate generalized series imaging with parallel imaging using multiple receiver coils. Experimental results from contrast-enhanced MRI studies demonstrate that the proposed algorithm can produce high-quality dynamic images with large acceleration factors.

2342. Underdetermined Variable Density SENSE

Ulrich Katscher[1]
[1]Philips Research Laboratories, Hamburg, Germany

Parallel imaging enables the reduction of measurement time using multiple receive coils. Usually, the maximum reduction of measurement time is limited by the number of receive coils used. Underdetermined SENSE applies a-priori knowledge to enable reduction factors exceeding the number of receive coils. This a-priori knowledge can be obtained from, e.g., coil sensitivity determination. This study shows that the amount of a-priori knowledge can be reduced significantly, if the underlying Cartesian k-space trajectory has a variable density in preparation direction. Numerical studies have been performed using an abdominal input image measured on a volunteer.

2343. A Modified POCSENSE Technique for Accelerated Iterative Reconstruction from Sensitivity Encoded MRI Data

Alexei A. Samsonov[1], Eugene G. Kholmovski[1], Chris R. Johnson[1]
[1]University of Utah, Salt Lake City, Utah, USA

Recently, we have proposed a projection onto convex sets (POCS) based method for reconstruction from sensitivity-encoded data (POCSENSE). The POCS formulation of image reconstruction offers a straightforward and computationally efficient way to incorporate non-linear constraints into a reconstruction and improve the image quality in cases of ill-posed and underdetermined problems. However, POCSENSE demonstrates slow convergence in cases of high reduction factors. This limits the practical utility of the original technique. In this work, we present a novel method for reconstruction from sensitivity-encoded data based on extrapolated iterations of parallel POCS that overcome the limitation of the original POCSENSE technique.

2344. Spectral Estimation Techniques for Enhanced Reconstruction in Multiple-Coil Imaging

M Scheffe[1], G P. Zientara[1]
[1]Brigham &Womens Hospital/HarvardMedical School, Boston, Massachusetts, USA

Starting with the equations for the generalized SENSE algorithm used in parallel MRI, it is possible to interpret this optimum reconstruction procedure in terms of the spectral densities for the noise covariances for each of the coil images. This implies that a number of adaptive, high-resolution spectral estimation techniques can be applied to MRI processing for multiple coils, offering benefits in the trade-off between signal-to-noise ratio and resolution. Advantages and performance of several candidate algorithms will be examined, including examples from multiple-receive-coil phantom and cardiac data

2345. Parallel Imaging Using Cyclic Matrices

Kevin F. King[1]
[1]GE Medical Systems, Milwaukee, Wisconsin, USA

In SMASH parallel imaging, k-space is undersampled in the phase encoding direction and phased array coil sensitivity information is used to approximate a fully sampled k-space data set, which is then reconstructed by Fourier transformation. Restoring full k-space sampling is equivalent to solving a set of linear equations that can be written in matrix form. The sparse nature of the system, together with a cyclic property of the matrices, allows improved computational efficiency in approximating the solution. This permits a systematic tradeoff between image quality (solution accuracy) and reconstruction time.

Parallel Imaging with Non-Cartesian Trajectories

Hall D Monday 13:30 - 15:30

2346. Gridding- and Convolution-Based Iterative Reconstruction with Variable k-Space Resolution for Sensitivity-Encoded Non-Cartesian Imaging

Holger Eggers[1], Peter Boesiger[2]
[1]Philips Research, Hamburg, Germany; [2]Swiss Federal Institute of Technology Zurich and University of Zurich, Zurich, Switzerland

A concept for reducing the complexity of the iterative reconstruction for sensitivity-encoded non-Cartesian imaging is proposed. It includes switching between an explicit regridding and a fast convolution, and varying the resolution, with which k-space is sampled, during the processing. The total number of iterations required to achieve a satisfactory image quality is shown to remain unaffected by these changes. The total number of computations involved in the reconstruction, however, decreases considerably.

2347. Fast Parallel Image Reconstructions with Non-Cartesian Trajectories

Robin M. Heidemann[1], Mark A. Griswold[1], Peter M. Jakob[1]
[1]University of Wuerzburg, Wuerzburg, Germany

A fast reconstruction approach for partially parallel acqusition (PPA) techniques with non-Cartesian sampling trajectories is presented in this abstract. In our approach, the regridding of the non-Cartesian sampled lines is done with a PPA reconstruction. Necessary reconstruction parameters for a shift onto a cartesian grid are derived by a SMASH-like procedure. Instead of calculating these parameters for every required shift, this calculation is performed for only a few shifts. Reconstruction parameters for intermediate shifts are interpolated resulting in dramatically reduced reconstruction times.

2348. The GRAPPA Operator

Mark A. Griswold[1], Robin M. Heidemann[1], Peter M. Jakob[1]
[1]University of Wuerzburg, Wuerzburg, Germany

In this abstract we show that the GRAPPA reconstruction can be reformulated as a matrix operator, similar to ladder or propagator operators used in quantum mechanics, which shifts data in k-space. Using this formalism, we show that there exists an infinitesimal GRAPPA operator which shifts data in k-space by arbitrarily small amounts. Other desired k-space shifts can then be accomplished through repeated applications of this infinitesimal GRAPPA operator. Implications of these ideas are described.

2349. Direct Parallel Imaging Reconstruction of Radially Sampled Data Using GRAPPA with Relative Shifts

Mark A. Griswold[1], Robin M. Heidemann[1], Peter M. Jakob[1]
[1]University of Wuerzburg, Wuerzburg, Germany

The application of parallel imaging to non-Cartesian trajectories is non-trivial, requiring, in general, the solution of large systems of linear equations. In this abstract we demonstrate that in many cases this process can be greatly simplified using a k-space reconstruction with relative shift operations. As a particular example, it is shown that missing projections from a projection reconstruction trajectory can directly reconstructed with a GRAPPA reconstruction when different weights are used along the read-out direction.

2350. Radial SMASH for Parallel Back Projection Reconstruction MRI

Ray F. Lee[1], Christopher J. Hardy[1], Paul A. Bottomley[2]
[1]GE Global Research Center, Niskayuna, New York, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

An analytic transform was developed to compose radial projections rather than rectilinear phase-encoding lines, using the sensitivity profiles of a volume phased array. The initial simulation and experimental results suggest a new kind of parallel MRI, which we call radial SMASH, in which the degree of decimation can greatly exceed the number of elements in the phased array.

2351. Broadband Multi-Coil Reconstruction using Spiral Trajectories

Jin Hyung Lee[1], John Pauly[1], Diwght Nishimura[1]
[1]Stanford University, Stanford, California, USA

By using multiple coils with localized sensitivities, imaging time can be decreased by encoding just for a single coil's sensitivity region. Data read from each coil can be separately reconstructed with different iso-center and can be cut and pasted together based on the prior knowledge of the location of each coil. However, if under-sampling is performed in the readout direction, the signals that are of interest get filtered out by the anti-aliasing filter. Therefore, separate demodulating hardware with different dynamic demodulating frequency, phase control is necessary. Here we demonstrate this method for spiral trajectories.

RF Coils

Hall D Tuesday 13:30 - 15:30

2352. A Novel Asymmetric RF Body-Coil

Kai-Michael Luedeke[1], Peter Roeschmann[1], Johan A. Overweg[1], Volkmar Schulz[1]
[1]Philips Research, Hamburg, Germany

A whole body RF transmit coil was designed and built featuring a non-cylindrical envelope. The shape of the coil is matched to the inner contour of a novel, highly efficient asymmetrical gradient coil. The 16-rod band pass coil has been configured such, that two orthogonal resonance modes are obtained, each generating a uniform RF-field. Homogeneity, sensitivity and quality factor are comparable to the equivalent cylindrical design.

2353. A 4T Anatomically Conformal Head and Neck Volume Resonator for High Field Imaging and Angiography

Enzo Barberi[1], Sudath Dayasundara[1], Joe Gati[1], Brian Rutt[1], Ravi Menon[1]
[1]The Robarts Research Institute, London, Ontario, Canada

An anatomically conformal volume resonator which can be used in transmit/receive mode or transmit-only mode for high field head and neck imaging applications is presented.

2354. Frequency Limits and Radiation Resistance for Volume Coils

Jinfeng Tian[1], Thomas Vaughan[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

To investigate the operational frequency and efficiency ranges for high field head coils, three unloaded RF volume coils were modeled by the Finite Difference Time Domain (XFDTD) method. Rung capacitance and radiation resistance were calculated versus the transverse mode resonant frequency for low pass configurations of a birdcage, a shielded birdcage, and a transmission line (TEM) resonator. Simulation results predict that practical birdcages are frequency limited to less than 200 MHz operation by radiation resistance and / or inductance, whereas the TEM resonator of the same size can achieve an operational frequency of 400 MHz.

2355. A Modification of the Slotted Tube Resonator and its Application for Brain Imaging

Arnon Neufeld[1], Menahem Levin[1], Gil Navon[1]
[1]Tel Aviv University School of Chemistry, Tel Aviv, Israel

A modified Slotted Tube Resonator (STR) was designed and built for small animal imaging at 8.46T. Full correction of the sample effect on the resonator's three degrees of freedom: tune, match and homogeneity balance is feasible. Imaging experiments showed B1 uniformity to be comparable or better than that of a typical birdcage. Excellent agreement exists between the simulated and the measured B1 uniformity. Additionally, a modification of the STR, which includes extra current elements, is described. A simulation of its B1 intensity map indicates an improved B1 uniformity. This modification does not change the simple nature of the circuit.

2356. Sensitivity Shaping using a Current Divider

Ashok Menon[1], Derek Seeber[1], Jovan Jevtic[1]
[1]IGC Medical Advancs, Inc., Milwaukee, Wisconsin, USA

A RF current splitting technique is presented that provides an increased level of design flexibility to control the B1 sensitivity of a loop. In a Phased array T/R coil, the objective is to maintain B1 homogeneity during the transmit mode while conforming to an ergonomically shaped mechanical coil design. This has been accomplished using a capacitance current divider between two adjacent or non-adjacent loops, thus placing loops in parallel instead of series. Simulated results show significant improvement of homogeneity without altering coil geometries or changing the number of loops.

2357. Improved RF Coil Geometry for Lower Extremity Imaging

Ryan Brown[1], Azma Mareyam[1], Eric Reid[1], Yi Wang[1]
[1]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA

Surface coil geometry is investigated to improve SNR for lower extremity imaging. It is found that a "æ-coil" consisting of two 180º open cylindrical elements provides a good configuration for minimal inter-element coupling, uniform sensitivity over a desired imaging volume, and easy leg access. Dedicated lower extremity coils are highly valuable for the widely accepted peripheral MRA, where an image of the entire lower extremity from the abdomen to the feet is required. In this study, we investigate orthogonal coil geometry to minimize coupling between coil elements in a surface coil dedicated to lower extremity imaging.

2358. An RF Microstrip Resonator for Imaging at 11.7T

Tim Fisher[1], Gene Bogdanov[1], Reinhold Ludwig[1], Afonso C. Silva[2], Hellmut Merkle[2], Craig Ferris[1]
[1]UMASS Medical School, Worcester, Massachusetts, USA; [2]National Institutes of Health, Bethesda, Maryland, USA

The lumped-element RF coil approximation breaks down as the wavelength approaches load dimensions, resulting in field inhomogeneity, radiative losses and reduced quality factor. Newly developed lumped/distributed simulations have proven sufficiently accurate in predicting the behavior of high-frequency coils. Thus far, correlation between simulation and practical results has only been established at 200MHz (4.7T, protons), and 300MHz (7T). This work reports on the construction of an eight-element microstrip resonator for imaging at 500 MHz (11.7T). The coil's performance is tested both in transmit/receive and transmit-only mode in conjunction with a surface coil.

2359. HTS Tape RF Coil for Low Field MRI

M. C. Cheng[1], K. H. Lee[1], K. C. Chan[1], K. K. Wong[1], E. S. Yang[1]
[1]HKU Jockey Club MRI Engineering Center, Hong Kong, People's Republic of China

A 5-inch RF receiving coil for 0.21T MRI system was developed using multifilament Bi-2223 High Temperature Superconducting (HTS) tape. The coil was designed to enclose the imaging sample so as to enhance the filling factor and field-of-view (FOV) over traditional HTS thin-film surface coil. A cryostat has also been developed to suit such application. In both human and saline phantom MR images, the Bi-based coil at 77K has demonstrated a 3 times signal-to-noise improvement over an equivalent room temperature copper coil.

2360. Resonator Designs for Very High Field ^{1}H and X-Nuclei *In-Vivo* and *Ex-Vivo* Microscopic MRI Experiments

Volker Christian Behr[1], Daniel Gareis[1], Markus Oechsner[1], Thomas Neuberger[1], Daniel Haddad[1], Cornelius Faber[1], Axel Haase[1]
[1]University of Würzburg, Würzburg, Bavaria, Germany

New high field spectrometers require specifically adapted and optimized hardware to benefit from their field strengths. In this abstract resonators designed to operate at frequencies up to 750 MHz, the larmor frequency of 1H at 17.6 T, are presented. At this very high frequency issues of coupling, sensibility to even smallest imbalances in the current distributions and resonance shifts due to different samples have to be addressed very carefully for those resonators. Their performance is demonstrated in in-vivo and ex-vivo imaging experiments and results of preliminary studies on phantoms as well as preserved dolphin fetuses and living mice are shown.

2361. The 4-point-drive Litzcage - An MRI RF CP Coil with an Exceptionally Wide Tuning Range

F. David Doty[1], George Entzminger[1], John P. Staab[1], John Zempel[2], Joel R. Garbow[2]
[1]Doty Scientific, Inc., Columbia, South Carolina, USA; [2]Washington University, St. Louis, Missouri, USA

We report results from a novel rf coil and balancing circuit that demonstrate simplified tuning procedures and improved B1 homogeneity for circularly polarized (CP) rf volume coils. We denote these "litzcages", as they embody both paralleled conductors with insulated crossovers, as in prior linear "litz coils", and the capacitively segmented phase shifts common to birdcages. Several 4-point-drive circuits were tested that efficiently symmetrize perturbed coils. These features improve the tuning range by an order of magnitude. The coils and balancing circuits are demonstrated on rat brain studies in a 38 mm coil on an open-access platform at 200 MHz.

2362. Quadrature Coil Postion Invariant to B_0

Ronald D. Watkins[1]
[1]General Electric, Niskayuna, New York, USA

A unique quadrature volume coil design will be shown that is invariant with respect to angle relative to B0 as well as invariant with respect to polarization direction of B0. A well known limitation of MR coils is that the B1 sensitive axis of the coil should always be kept in an orientation perpendicular to the B0 magnetic field for maximum sensitivity and SNR. In quadrature volume coils employing 90 degree combiners into a single receiver channel, another limitation well known is that the rotation direction of the received signals must match the polarization direction of the B0 field.

2363. Effects of Geometry, Excitation, and Spatial Positioning on the Birdcage Coil Performance

Tamer S. Ibrahim[1], Robert Lee[1]
[1]The Ohio State University, Columbus, Ohio, USA

The General Electric (GE) birdcage head coil [1] is modeled to determine its performance for both the 1.5 T and 3 T systems under quadrature excitation for a variety of head positions within the coil as well as choices for excitation of the coil. Results are presented to show the importance of considering these factors on image quality, especially for the 3 T system.

2364. Tissue Equivalent Phantoms at 470 MHz

B. L. Beck[1], K. A. Jenkins[1], J. R. Rocca[1], H. Kim[1], J. R. Fitzsimmons[1]
[1]University of Florida, Gainesville, Florida, USA

MRI hardware engineers incorporate phantoms into coil development because of the strong interaction between biological systems and the B1 of the coil. Typically, bottles of saline have been used to emulate biological systems. However, with the continuing march to higher field strengths and frequencies, these bottles of saline have started to fail as biological mimics. We have developed compartmentalized tissue equivalent phantoms using a combination of salt, sugar, water, and a gelling agent. We made 'half rat' and 'full rat' phantoms with compartments having permittivities and conductivities equivalent to those found in a real rat.

2365. Modified Perturbation Method for TEM Volume Coil Tuning and Evaluation

Nikolai I. Avdievich[1], Hoby P. Hetherington[1]
[1]Albert Einstein College of Medicine, Bronx, New York, USA

TEM volume coils have been shown to have superior SNR compared to Bird Cage (BC) coil at high frequencies (>100 MHz) due to lower radiation loss and improved current distribution. However, TEM resonators require more careful tuning than a standard BC coil. Specifically, the splitting between modes in the TEM coil are substantially smaller that of BC coil making the B1 more susceptible to sample distortion. To optimize TEM coils on the bench we have developed a modified perturbation method to map magnetic and electric fields and visualize current flow in each coil element in real time.

2366. 6-inch HTS Coil for Human Imaging

K. H. Lee[1], B. P. Yan[1], K. C. Chan[1], K.K. Kelvin Wong[1], M. C. Cheng[1], S. M. Yeung[1], E. S. Yang[1]
[1]HKU Jockey Club MRI Engineering Center, Hong Kong, China, People's Republic of

High Temperature Superconductor (HTS) was used on MR coils to improve SNR. Typical HTS coils are thin film surface coils with limited FOV, and they are used to image samples, small animals or peripheral human anatomies. With the advance of HTS technology, we have developed an HTS coil for 0.22T MR system with a 6”-diameter YBCO thin film. The coil can image anatomies as deep as 4.5cm from surface. It has 200% - 300% improvement in SNR compared to copper and cool copper coils. This large HTS coil has extended the potential of HTS human imaging.

2367. SNR Gain of Cooled Surface Coils

Jaroslaw Wosik[1], Lei Ming Xie[1], Lian Xue[1], Krzysztof Nesteruk[2], James A. Bankson[3], Morteza Naghavi[4], John D. Hazle[3]
[1]University of Houston, Houston, Texas, USA; [2]Polish Academy of Sciences, Warszawa, Poland; [3]The University of Texas M.D. Anderson Cancer Center, Houston, Texas, USA; [4]The University of Texas Houston School of Medicine and Texas Heart Institute, Houston, Texas, USA

Several investigators have demonstrated that cryogenically cooled normal metal or high temperature superconducting (HTS) surface probes can be used to significantly improve the SNR of small volume MRI measurements. We report specifically on performance of 2" diameter cooled probes operating at 77 K for small-ROI imaging at 1.5 T, and based on agreement with simulations, conclude when significant gains will be available to HTS probes. The SNR gain expected from the use of a HTS coil instead of a metal for various ROI and coil sizes has been calculated for five typical MRI frequencies and compared with experimental data.

2368. An 8-Channel SENSE-Optimized Phase Array Neurovascular Coil for 3T Horizontal System

Xiaoyu Yang[1], Yun-Jeong Yang[1], Keith Richmond[1], Labros S. Petropoulos[1]
[1]USA Instruments, Inc., Aurora, Ohio, USA

A SENSE-optimized Neurovascular Phased array coil suitable for 3T horizontal systems is presented. The coil is designed to provide SENSE imaging from the area covering the top of the human head to the Arch. The shape, size and spacing between the elements were optimized to provide minimum g factor values for reduction factor up to 2(R=2), without degradation on the image quality achieve by the conventional phased array design. In vivo imaging was performed using conventional, GRAPPA techniques with R=2. No significant degradation on SNR or imaging quality between GRAPPA and conventional head images was observed.

2369. SENSE-Optimized Phase Array Cardiac Coils for 3T Horizontal Systems

Xiaoyu Yang[1], Yun-Jeong Yang[1], Cliff Colwell[1], Labros Petropoulos[1]
[1]USA Instruments, Inc, Aurora, Ohio, USA

Two SENSE-optimized cardiac Phased array coils suitable for 3T horizontal systems are presented. The two configurations consist of either 6 or 8 mutually decoupled non-overlapping elements. The shape, size and spacing between the elements were optimized to provide minimum g factor values for reduction factor up to 4(R=4) inside the cardiac region, without degradation on the image quality achieve by the conventional phased array design.. In vivo cardiac imaging was performed using conventional, SENSE and GRAPPA techniques with R=2. No significant degradation on SNR or imaging quality between SENSE, GRAPPA and conventional cardiac images was observed.

2370. Optimized Coil Array for High Resolution Microscopic Imaging at 1.5 and 3 T

Christoph Leussler[1], Christian Findeklee[1], Adrian Knowles[2]
[1]Philips Research Laboratories, Hamburg, Germany; [2]Philips Medical Systems, Best, Netherlands

The design and application of an optimized coil array for microscopic imaging is described. Reducing the size of the individual coils requires optimization with respect to resistive losses. We have investigated different coil designs for field strengths of 1.5 and 3 T. Main challenges are the application of SENSE for high resolution imaging of cartilage, diffusion imaging, T2 mapping and anatomical imaging. The additional SNR of the microscopic array can be used either for the improvement of the resolution or the reduction of the scan time.

2371. A New Phased Array Spine Coil for Vertical Field MRI System

Limin Feng[1], Mark Zou[1], Sean Bartolin[1], Vincent Chen[1]
[1]USA Instruments, Inc., Aurora, Ohio, USA

A new phased array structure that consists of several butterfly coils is used to design the spine coil for the vertical field MRI system. The butterfly coil array other than the traditional loop coil in the new spine coil is used to receive MR signal in H-F direction. Compared with the traditional spine coil, the new coil has the simpler mechanical structure, lighter weight, higher reliability and no limit for the patient size. The test in Philip 1T open system shows the new and traditional coils have almost the same SNR in the spine region.

2372. A Two-Channel HTS Thin-Film Phased Array Coil For Low Field MRI

M. S. Chow[1], S. M. Yeung[1], K. H. Lee[1], Q. Y. Ma[1], E. S. Yang[1]
[1]University of Hong Kong, Hong Kong

A new 2-channel 4” HTS phased array coil and probe are presented. Although single HTS surface coil imaging was demonstrated a factor of 3 SNR improvement for in-vivo human imaging in low-field MRI system, the FOV and the penetration depth were limited to the size of HTS wafer up to 3”. The new coil design in this project demonstrates a 66% increase in FOV and retains 300% SNR gain in single HTS surface coil. The penetration depth is enhanced by 39%. The result shows the possibility of future multi-channel HTS phased array design for large area imaging.

2373. A Novel Planar Design of 200 MHz Superconducting Array

Jaroslaw Wosik[1], Krzysztof Nesteruk[2], Lei Ming Xie[1], Lian Xue[1], James A. Bankson[3], John D. Hazle[3]
[1]University of Houston, Houston, Texas, USA; [2]Polish Academy of Sciences, Warszawa, Poland; [3]The University of Texas M.D. Anderson Cancer Center, Houston, Texas, USA

We report on the design and fabrication of a novel planar 200 MHz two-coil array. The array was designed to be made out of superconducting YBCO 2” films, and for easy cryo-packaging has built-in planar capacitors for both coil decoupling and capacitive connection to the matching and tuning network. Each 1” diameter coil consists of patterned, double sided copper or YBCO films on 2" round dielectric substrates. In this part of work, the SNR enhancement expected from using cold copper or superconductors for single coil or phased array designs are calculated, discussed and compared with experimental results.

2374. Decoupling of Planar-Pair RF Coil Arrays using Printed Capacitance

Mary Preston McDougall[1], Steven M. Wright[1]
[1]Texas A&M University, College Station, Texas, USA

Parallel imaging methods are driving increased interest in array coils with large numbers of elements. A significant problem in large arrays is maintaining adequate decoupling of elements without requiring complex networks. This paper describes decoupling results obtained using a printed distributed capacitance pad between planar pair elements. The method maintains simplicity while providing nearly 20dB of decoupling between all elements.

2375. A Coil Coupling Model For Optimization Algorithms

Rock Hadley[1], Dennis L. Parker[1]
[1]University of Utah, Salt Lake City, Utah, USA

We have developed a model for the signal and noise coupling between planar surface coils that accounts for the electric and magnetic coupling between coils. This model accounts for the mutual inductance coupling effects on the noise and signal voltages between coils and can incorporate the effects of a transformed preamplifier input impedance. This model facilitates understanding SNR profiles for various coil combinations and is ideal for implementation in coil design optimization algorithms such as the genetic algorithm where all coupling terms need to be included in the cost function to adequately compare non-optimal chromosomes or coil configurations.

2376. Loss-Less Blocking Circuits to Combine Local Quadrature ^{13}C Coils with Quadrature ^{1}H Decoupling Coils for Human Head at 3T

Dennis WJ Klomp[1], Arno PM Kentgens[2], Arend Heerschap[1]
[1]UMC Nijmegen, Nijmegen, Netherlands; [2]University of Nijmegen, Nijmegen, Netherlands

Proton irradiation for decoupling and NOE can improve the in-vivo detection of X-nuclei. The local coil for X-nuclei generally has a fixed orientation compared to the associated ^{1}H-decoupling coil to minimize inductive coupling, limiting individual mechanical optimization. Implementation of ^{1}H-blocking circuits in the X-coils can overcome these limitations. Since at high B_0 field-strength the Quality factor of the X-coil is dominated by tissue losses, these blocking circuits are getting loss-less. Here we present the first local quadrature ^{13}C-coil with loss-less blocking circuits that hardly affect the ^{1}H-field of a fully coupled homogeneous quadrature ^{1}H-coil for a human head at 3T.

2377. Floating Radio Frequency Balun for Suppression of Shield Currents

Derek Seeber[1], Jovan Jevtic[1], Ashok Menon[1]
[1]IGC Medical Advancs, Inc., Milwaukee, Wisconsin, USA

Shield currents or common mode currents affect coil tuning, coil to coil coupling in phased array coils and most importantly can cause serious patient burns from the “hot” cables. Traditionally in MRI, shield currents are reduced by cable traps consisting on a wound coaxial cable with a tuned resonance circuit between successive turns of the coaxial cable. This method increases losses and affects the overall phase distance. We present a cable trap that does not connect or solder to the cable and is completely splitable, allowing easy fitting over any cable without affecting any coil parameters.

2378. Determining the Impedance Matching Requirements of RF Coils using the Transmission-Line Modelling Method

Paul Joseph Cassidy[1], Kieran Clarke[1], David J. Edwards[1]
[1]University of Oxford, Oxford, England, UK

The Transmission-Line Modelling (TLM) method is used to determine the impedance matching requirements of RF coils using equivalent lumped-element circuit components of R, L, C, k and M extracted from the simulations. These in turn are used to derive equivalent circuit representations for the RF coils. Then electric circuit theory is applied to the equivalent circuit representations to determine their impedance matching requirements for capacitive and inductive impedance matching schemes. Experimental verification gave agreement of < 0.5 pF for the matching capacitance, which was sufficient for component selection purposes.

2379. Analytic Calculation of Mutual Resistance versus Angular Separation for a Pair of Surface Coils Irradiating a Lossy Sphere of High Dielectric Constant

James S. Tropp[1]
[1]GE Medical Systems, Fremont, California, USA

Normalized mutual resistances are calculated analytically, as a function of angular separation, for a pair of circular surface coils (each of radius 3 cm) irradiating a sphere -- of dielectric constant 80, conductivity 0.5, and radius 9 cm -- at 64 MHz, 128 MHz, and 200 MHz. For all frequencies, the predicted noise covariances drop from 1 (perfect correlation) at zero separation (coils perfectly overlapped), to about 0.2 at separation of $\pi/2$ (coil axes perpendicular).

2380. HTS Coil Design using Artificial Neural Network and Fuzzy Interference System

Pan Hui[1], Gary X. Shen[1]
[1]The University of Hong Kong, Hong Kong

The design of High Temperature Superconducting (HTS) RF coil highly relies on the computer simulation because HTS materials are very expensive and the coil fabrication requires high accuracy. Normally, the simulation for the HTS coil design is time consuming and not straightforward. In this paper, two novel approaches for HTS coil design, the electromagnetically (EM) trained artificial neural networks (EM-ANN) and the electromagnetically trained fuzzy inference systems (EM-FIS) are presented. These two models can simplify the normal simulation and speed up by millions of times. Therefore, the difficult tuning procedure of HTS coil can be easily simulated before its fabrication.

2381. Direct Capacitor Determination in FDTD Modeling of RF Coils

Graeme McKinnon[1], Zhangwei Wang[2]
[1]GE Medical Systems, Waukesha, Wisconsin, USA; [2]University of Illinois at Chicago, Chicago, Illinois, USA

One problem in the finite difference time domain (FDTD) modeling of resonant RF coils is determining the capacitor values appropriate for the desired resonance condition. Traditionally this is performed iteratively, and is computationally intensive. Here a quicker method is presented whereby the capacitor values are calculated directly from the impedance seen by ideal current sources placed at the capacitor locations.

2382. Computer Aided Design of SENSE Arrays for Small-Animal Imaging

James A. Bankson[1]
[1]The University of Texas M.D. Anderson Cancer Center, Houston, Texas, USA

A fast, simple algorithm has been developed for assisting in the optimized development of array coils for parallel imaging of small animals. The algorithm uses a priori estimates for overall sample geometry and target region-of-interest to calculate B1-field maps and SNR maps resulting from accelerated sensitivity encoded imaging. Positions and sizes of array elements are varied within given geometric constraints, and an image quality metric is used to search for the optimal arrangement. Perturbations of sub-optimal starting configurations have yielded coil designs that exhibit significant SNR improvements over the predefined region of interest for several acceleration values in simulation.

2383. Group Therapy for a Three-Ring Birdcage Designed for SENSE Applications

T. Eagan[1], *T. Chmielewski*[2], *J. Flock*[2], *Y.-C. Cheng*[1], *T. Kidane*[1], *Sh. Shvartsman*[2], *G. Demeester*[2], *W. Dannels*[2], *R. Brown*[1]
[1]Case Western Reserve University, Cleveland, Ohio, USA; [2]Philips Medical Systems (Cleveland), Cleveland, Ohio, USA

An eight-rung three-ring birdcage has been used (a) to explore its utility as a SENSE coil and (b) to test a new method for coil analysis. SENSE images have been obtained with this coil. A theoretical approach based on group theory was used to calculate in closed-form the seventeen normal mode frequencies of the coil. The symmetry of the system is a key to finding analytical expressions for the normal mode frequencies. Good agreement was found between the frequency measurements and calculations. The method thus represents an effective approach to symmetric systems with larger degrees of freedom.

2384. Group Theoretical Approach to RF Coil Design

T. Eagan[1], *Y.-C. Cheng*[1], *T. Kidane*[1], *H. Mathur*[1], *Sh. Shvartsman*[2], *R. Brown*[1]
[1]Case Western Reserve University, Cleveland, Ohio, USA; [2]Philips Medical Systems (Cleveland), Cleveland, Ohio, USA

A group-theoretic method is presented for finding closed-form solutions for the normal mode frequencies for coils possessing at least a modicum of symmetry. The coil symmetry allows one to block-diagonalize Kirchhoff's laws. One may then find the normal modes and their frequencies for each block independently. For many coils of interest in MR applications, the frequencies can therefore be expressed in closed form. Such solutions allow one to consider design questions about mode degeneracy of particular relevance to the parallel imaging community. Also, recent work has shown the value of having such solutions in developing coil 'simulators.'

2385. Simulations of a ReCav Coil Loaded with an Adult Rat at 400-500MHz

Christopher Michael Collins[1], *Barbara L. Beck*[2], *Weston Schreiber*[1], *Jeffrey R. Fitzsimmons*[2], *Michael Bruce Smith*[1], *Stephen J. Blackband*[2]
[1]Penn State College of Medicine, Hershey, Pennsylvania, USA; [2]University of Florida, Gainesville, Florida, USA

In preparation for animal experiments near 11T, we performed simulations for a ReCav coil at frequencies from 400 to 500 MHz. Some interesting observations have resulted, including that central brightening due to wavelength effects may be significant even in the rat head at these frequencies and that resonant frequency and field pattern of the ReCav coil are not greatly affected by whether the coil is driven with inductive loops or directly across capacitors.

2386. Computer Simulations for Optimization of Design Parameters for Intravascular Imaging Microcoil Construction

Eddy Y. Wong[1], *Claudia M. Hillenbrand*[2], *Jonathan S. Lewin*[2], *Jeffrey L. Duerk*[2]
[1]Case Western Reserve University, Cleveland, Ohio, USA; [2]University Hospitals of Cleveland, Cleveland, Ohio, USA

With the evolution of minimally invasive MRI procedures, high-resolution vessel wall imaging has emerged as an application where optimized coil design is paramount for successful imaging. In diagnostic vascular procedures, where identification of pathology depends on varying grayscale intensities, imaging coils with homogeneous responses are a critical requirement. Design parameters also require optimization in order to minimize inhomogeneities and maximize SNR. Computer simulations represent a means by which different parameters can be rapidly examined and individually optimized. Imaging coils are constructed to verify simulation results.

2387. Non-Uniform Current Distributions and High Field B_1 of Cylindrical RF Coils Filled with Uniform Dielectric

Harvey E. Cline[1], *Richard P. Mallozzi*[1], *Ronald D. Watkins*[1], *Douglas Kelley*[2]
[1]GE Global Research Center, Niskayuna, New York, USA; [2]GE Medical Systems, Milwaukee, Wisconsin, USA

High magnetic fields applications require a uniform B1 field. We present here a fast and simple technique for incorporating the effects of non-uniform current distribution on the B1 field and the coil inductance. Standing wave patterns are observed in high field MR images because the short RF wavelength. The B1 field in cylindrical RF coils filled with a uniform dielectric and conductive material is modeled with the retarded vector potential.

2388. Comparison of B_1 Field Homogeneity *In Vivo* vs. in Uniform Phantoms at 3 T Using a Standard Birdcage Head Coil

Nicola De Zanche[1], Atiyah Yahya[1], Peter S. Allen[1]
[1]University of Alberta, Edmonton, Alberta, Canada

At high B_o fields the distribution of the RF field is strongly dependent on the dielectric properties of tissue. This fact influences radio frequency probe design and performance. In the present study B_1 homogeneity of a birdcage coil is compared at 128 MHz in the head and in phantoms of similar size using the double angle method. Results confirm the presence of field focussing both in vivo and in an aqueous phantom where it is more pronounced, suggesting that a more realistic material needs to be found to construct realistic flood-field phantoms.

2389. Evaluation of a Multiturn Transmission Line Resonator for Localized MR Microscopy at 1.5T

Marie Poirier-Quinot[1], Jean-Christophe Ginefri[1], Luc Darrasse[1], Anne-Lise Coutrot[2], Elisabeth Dufour-Gergam[2], Jean-Pierre Grandchamp[2]
[1]U2R2M, Orsay, France; [2]IEF, Orsay, France

The development of localized MR microscopy on large MRI systems at 64 MHz requires to design very small coils to achieve a high SNR associated with a high spatial resolution. However reducing the size of conventional surface coils (CC) made of discrete elements generates lack-of-room problems due to the need of high-value, high-quality capacitors. The solution proposed here is to use the Multiturn Transmission Line Resonator (MTLR) design1 to develop small-sized coils having no discrete elements. The performances of a MTLR are compared to a CC of equivalent size by means of numerical calculations, RF measurements and MRI experiments

2390. Transmit Homogeneity at High Fields: Computational Effects of "B_1 Shimming" with an Eight Element Volume Coil

Patrick Ledden[1]
[1]Nova Medical, Inc, Wakefield, Massachusetts, USA

We computationally demonstrate a significant increase the B1 excitation homogeneity over the human head at 128MHz, 300MHz, and 400MHz with optimization of the rung currents on an eight element volume coil. Using a commercially available FDTD field solving package and head model, quadrature excitation of the volume coil was found to provide B1 fields that had a standard deviation of 12% at 128MHz , 25% at 300MHz, and 39% at 400MHz which were reduced to 6%, 14%, and 15%, respectively, on an axial slice with optimization of the phases and amplitudes of the currents on the volume coil.

2391. Central Brightening due to Constructive Interference Despite Dielectric Resonance with Central Magnetic Field Minimum

Christopher Michael Collins[1], Weston Schreiber[1], Qing X. Yang[1], Michael Bruce Smith[1]
[1]Penn State College of Medicine, Hershey, Pennsylvania, USA

To aid in discussion about the mechanism for central brightening in high field imaging, it is demonstrated with both numerical calculations and experimental images at 3T in a 34cm-diameter spherical phantom, that with two carefully placed surface coils it is possible to create central brightening even when one coil causes a dielectric resonant pattern with a central B1 field minimum.

2392. Calculations of B_1 Distribution, SAR, and SNR for a Body-Size Birdcage Coil Loaded with Different Human Subjects

Wanzhan Liu[1], Christopher M. Collins[1], Michael B. Smith[1]
[1]Penn State College of Medicine, Hershey, Pennsylvaia, USA

Calculations of the RF magnetic (B1) field distribution, the specific absorption rate (SAR), and the signal-to-noise ratio (SNR) for a body size birdcage coil loaded with two different human subjects at 64 MHz and 128 MHz are presented. Subject 2 is larger and more muscular than subject 1. At both frequencies, loading the coil with subject 2 results in less homogeneous B1 field distribution, higher SAR, and lower SNR than does loading the coil with subject 1.

2393. Numerical Evaluation of Power Radiated by a Loaded Volume Coil at High Fields

Wanzhan Liu[1], Qing X. Yang[1], Christopher M. Collins[1], Michael B. Smith[1]
[1]Penn State College of Medicine, Hershey, Pennsylvania, USA

The amount of power radiated by a birdcage coil at 64, 128, and 170 MHz (1.5, 3, and 4 T) and by a TEM coil at 170, 300, and 345 MHz (4, 7, and 8 T) was estimated using computer models. The radiation loss increases with the increase of frequency and becomes significant at 300 MHz for a head size TEM coil and at 128 MHz for a body size birdcage coil. The radiation loss is less when the coil is loaded with dielectric sample.

2394. The TEM Resonator Modes: A Study at High Field MRI

Tamer S. Ibrahim[1], Chad Mitchell[1], Ryan Gilbert[1], Petra M. Schmalbrock[1], Donald w. Chakeres[1]
[1]The Ohio State University, Columbus, Ohio, USA

In this work the modes of the TEM resonator are explored experimentally and numerically at ultra high field MRI. The 3D numerical model was based on the finite difference time domain (FDTD) method. The coil and the load were treated together as a single system at all the steps of the model. The results demonstrate the accuracy of the developed numerical system in predicting the performance of the resonator. The possibility of using the aforementioned modes for specific types of imaging applications is reviewed.

2395. Field Calculation and Design of Body RF Coil with Multiple Strips for Open MRI System by Circuit Analysis and Pseudo Electric Dipole Radiation

Gyong-Luck Khym[1], Seung-Hak Ryu[1], Yeun-Chul Ryu[1], Hyung-Jin Yang[1], Chang-Hyun Oh[1]
[1]Korea University, Seoul, Republic of Korea

The structure of the body RF coil of the permanent-magnet open MRI system is optimized using a new field calculation method. The low field RF coil is composed of 4 sub-coils at each side of both the bottom and the top of the clear space and each sub-coil has 3 main strips. Current distribution in the strips and B1 field in the imaging area has been calculated by using circuit analysis and pseudo electric dipole radiation method. Coil dimensions are optimized based on the calculation results showing the utility of the design method.

2396. Moment Method and Finite Element Method in the Design of Flat RF Transmit Coils of Permanent MRI

Xu Chu[1], Rixin Lai[1], Xiaomin Zhu[1], Xiaohua Jiang[1]
[1]Tsinghua University, Beijing, People's Republic of China

A moment method (MOM) is developed for analysis of flat RF transmit coils of permanent MRI that usually have a single-turn D-shaped structure of wide strips. The harmonics analysis module (HA) of ANSYS is also investigated. Results of MOM show that within the field range of $B_0 \leq 0.5T$ both current and field distributions agree with those calculated by HA under assumption of only one tuning point at the middle of the arc return path. This indicates that to speed up the design process HA can be used to optimize the coil geometries while MOM be used for determining the tuning capacitance.

2397. A Reciprocity Formula for NMR Reception, Including the Gyrotropism of Nuclear Paramagnetism

James S. Tropp[1]
[1]GE Medical Systems, Fremont, California, USA

A reciprocity principle for NMR reception is given, which takes explicit account of the gyrotropism of the medium arising from nuclear paramagnetism. The presence of co- and counter- rotating radiofrequency fields in the impressed source term leads to an apparent contradiction with the usual quantum description of magnetic resonance in the rotating frame: specifically that spins cannot exchange energy with a field rotating oppositely from their own sense of precession. A possible resolution is suggested involving the phasor nature of reciprocity formulae.

2398. Design of a Self-Tuned RF Resonator for Use as an Intravenous Catheter

Franklin Hockett[1], Anne M. Morawski[1], Shelton D. Caruthers[2], Xin Yu[1], Samuel A. Wickline[1]
[1]Cardiovascular Magnetic Resonance Laboratories at Washington University in St. Louis, St. Louis, Missouri, USA; [2]CMRL and Philips Medical Systems, St. Louis, Missouri, USA

A self-tuned RF resonator has been developed for use as an intravenous catheter. The prototype is intended for use at 1.5 Tesla; however, electronic characterization indicates compatible performance at 4.7 Tesla. A unique feature of the resonator is the lack of any separate tuning or matching components because the coil is tuned by its own distributed capacitance and matched by applying the input signal at the proper impedance coil turn. The coil has been used successfully to produce images of a fixed swine aorta immersed in a phantom.

2399. Endorectal Coils and Interface for 3.0 Tesla Imaging and Spectroscopy

George J. Misic[1], Donna C. Feo[1], Keith Callen[1], David Stanley[2], Kiaran McGee[3], Bradley J. Adams[1]
[1]Medrad, Inc., Indianola, Pennsylvania, USA; [2]GE Medical Systems Advanced Science Lab, Milwaukee, Wisconsin, USA; [3]The Mayo Clinic, Rochester, Minnesota, USA

3.0 Tesla imaging and spectroscopy open the possibility of high resolution results with endorectal coils [Ecoils], either alone or with an external Array Coil. We present a design for a high performance Ecoil that can be mechanically optimized for prostate, cervical, colon, or other body cavity imaging, and two interface devices. Test results both with phantoms and with a human subject demonstrated a signal to noise ratio that was more than double that available with current 1.5 Tesla hardware. The feasibility and utility of 3.0 Tesla Ecoil imaging with and without associated array coils has been demonstrated.

2400. Evaluation of Internal MRI Coils using Ultimate Intrinsic SNR

Yigitcan Eryaman[1], Haydar Celik[1], Imad Amin Abdel-Hafez[1], Ergin Atalar[2]
[1]Bilkent University, Ankara, Turkey; [2]Ankara, Turkey

In this work, we calculated an upper bound for signal-to-noise ratio (SNR) that can be obtained using internal coils. These calculated values can be used as a reference to evaluate the performance of internal MRI coils. As an example, we tested the performance of the loopless antenna design. Various disposable internal coils exist for use in the rectum[1], vagina, esophagus[2], urethra[3], and blood vessels[4]. Although there is a clear increase in SNR in the MRI images when these coils are used, it is not known if whether they perform better than the best external coil.

2401. Catheter Tip Tracking and Visualisation with a Single Receiver Coil

Sven Zuehlsdorff[1], Stefano Ferrari[1], Reiner Umathum[1], Steffen Volz[1], Wolfhard Semmler[1], Michael Bock[1]
[1]German Cancer Research Center, Heidelberg, Germany

A catheter design is proposed to perform active catheter tip tracking and visualization of the distal catheter end simultaneously. A small tracking coil and an extended twisted pair coil are connected in series and mounted near the end of a catheter. With the help of a special miniature detune circuitry the tracking coil can be switched off during MR imaging using a very small DC current. For the interleaved tracking experiment the DC current is not applied and the MR signal is predominantly received by the tracking coil.

Magnets, Gradients, and Systems

Hall D Saturday 14:00 - 16:00

2402. Robust Simulation of Spin Dephasing using Randomized Spin Positions and Distributed Processing

Donghui Yin[1], Qunli Deng[1], Jonathan Sharp[2]
[1]National Research Council of Canada, Winnipeg, Manitoba, Canada; [2]National Research Council of Canada, Calgary, Alberta, Canada

MR pulse sequence simulations based on a finite regular array of spins cannot satisfactorily model arbitrarily large spin dephasing - since whenever adjacent spins accumulate a phase difference of n 2pi spurious rephasing occurs. In such a model spurious signals can only be suppressed by increasing the number of simulated spins. We show that by the use of a finite number of randomly positioned spins, all spurious signals can be eliminated - for any degree of dephasing. Parallel processing hardware is very helpful in these simulations which require multiple spins / voxel.

2403. R-Wave Triggering Using Two Channel Vector ECG.

R. Hughes[1], S. Collins[1], P. Gatehouse[1], D. Firmin[1]
[1]Royal Brompton Hospital, London, UK

A hardware based real-time, two channel vectorcardiogram ECG for R-wave gated cardiac magnetic resonance imaging is being developed. Two ECG channels are derived from three electrode placements on the patient using a common signal point. Outside the magnet a reference threshold point is manually set to give a reliable R-wave trigger from the vector magnitude of the signals derived from the patient. With the patient in a high field magnet (1.5T) reliable triggering can still be achieved in the presence of a magnetohydrodynamic flow artifact.

2404. Effects of Electromagnet Power Supply Performance on MRI

Nathaniel Matter[1], Blaine Chronik[1], Steven Conolly[1], Greig Scott[1]
[1]Stanford University, Stanford, California, USA

The design of an MR system that uses electromagnets for the readout field must assure that noise and interference from the magnet power supply do not limit system performance. We examine the effect of power supply noise and interference in our low field electromagnet and show that these place a limit on the performance of our MR system.

2405. A High-Accuracy Field Plotting Rig

J. Matwiy[1], B. Matwiy[1], P. Unger[1], D. I. Hoult[1]
[1]National Research Council Canada, Winnipeg, Manitoba, Canada

A field plotting rig is described, in which perturbations of the main field B0 caused by the rig itself and also by the micro-probe holding a small doped water sample, have been rendered negligible. Positional accuracy on the surface of a sphere is estimated to be 1mm and a linewidth of 6 Hz is obtained.

2406. B_0 Maps using Three-Dimensional Phase Imaging

Harvey E. Cline[1], Siegwalt Ludke[1], Mika W. Vogel[2], Xuli Zong[1]
[1]GE Global Research Center, Niskayuna, New York, USA; [2]Erasmus Universiteit, Rotterdam, Netherlands

Patient susceptibility is a source of magnetic field variations that limit high field image quality. In Vivo shimming provides improved magnetic field homogeneity over a user selected ROI. Three-dimensional in vivo phase images were unwrapped to create a B0 map. Ellipsoidal regions of the brain B0 map were sampled and fit a 17 term spherical harmonic series. Measured coefficients of magnetic field variation determine the shim coil strengths needed for designing a 7T MRI system.

2407. Measurement of B_0 Field Inhomogeneity Changes due to Subject Repositioning after High Order Shim

Chen Lin[1], Matt A. Bernstein[1], John D. Port[1]
[1]Mayo Clinic, Rochester, Minnesota, USA

Although time consuming, high order shim (HOS) can improve field homogeneity. HOS is performed over an operator-specified volume of interest. The purpose of this study is to measure the changes in field homogeneity when the subject is repositioned with superior/inferior table motion in between the series of a MR exam. The results could be used to decide whether or not HOS should be repeated.

2408. Regularization of the Hoult & Deslauriers Pseudoinverse Target Field Method

Kuan J. Lee[1], Martyn Paley[1], Iain D. Wilkinson[1], Paul Griffiths[1]
[1]University of Sheffield, Sheffield, Yorkshire, UK

Coil design using the target method of Hoult & Deslauriers specifies only a few target points, allowing the field outside the target region to "float". However, this requires solving an underdetermined set of linear equations, for which the usual pseudoinverse solution can be highly oscillatory. Three methods of regularizing the pseudoinverse: subset selection (SS), truncated SVD (TSVD) and Tikhonov regularization (TK) were compared for uniform, linear and cubic target fields. SS found the sparsest solutions, but for low order fields, TSVD and TK fields matched the target over a larger volume. Higher order fields were similar for all methods.

2409. Approach to Design an Efficient Resistive Magnet for MRI

Héctor Sánchez[1], Carlos Cabal[1], Carlos Garrido[1], André Briguet[2], Hervé Saint-Jalmes[2]
[1]Universidad de Oriente, Santiago de Cuba, Cuba; [2]UPRESA 5012 - CNRS, Université Claude Bernard - Lyon I, Villeurbanne, Lyon, France

An alternative procedure to design low field resistive magnet for Magnetic Resonance Imaging is presented. The conductor is located uniformly over the cylindrical surface and is considered as coil elements. Applying the linear programming method with upper and lower constraints bounds, the current density is constrained to a fixed value in order to produce a desired magnetic field. This approach minimizes the power and preserves the predefined homogeneity, resulting in a spatial cluster that defines the coil's magnet. An efficient whole body 0.1 T resistive magnet with a peak-peak field homogeneity of 11 ppm over 40 cm DSV is obtained.

2410. Short Main Magnet Cylindrical Coils: The Next Generation?

Y.-C. Cheng[1], T. Eagan[1], T. Kidane[1], Sh. Shvartsman[2], M. Thompson[2], R. Brown[1]
[1]Case Western Reserve University, Cleveland, Ohio, USA; [2]Philips Medical Systems (Cleveland), Cleveland, Ohio, USA

A short main magnet has the attractive capability of openness but implies a more difficult shielding problem. We present a method for improvements in main magnet design, and we illustrate it with the stretch goal of attempting a 1.1 m length, 1.5 T design. The method incorporates a series of steps involving Lagrange multiplier techniques, discretization, and optimizing wire bundle positions. The attempted design leads to a competitive DSV and 5-Gauss footprint, at the cost of a large increase in the current density. We discuss the possibility that this high density can be accommodated with today's technology.

2411. New Devices for Mobile NMR/MRI

Peter Blümler[1], Mark C. Brown[2], Geoff Dunn[2], Nathan Routley[2], Dimitris A. Verganelakis[2], Michael J. D. Mallett[2]
[1]MPI for Polymer Research, Mainz, Germany; [2]University of Kent at Canterbury, Canterbury, Kent, UK

Although developed for applications in materials science and associated industries, mobile NMR/MRI devices receive increasing interest for medical applications. Two new developments of mobile NMR/MRI scanners are presented. The first is a 0D-3D MRI expansion of a palm size probe which allows relaxation and diffusion measurements with penetration depths up to 10mm. This NMR-MOUSE (MObile-Universal-Surface-Explorer) has been extended to produce depth profiles via sweep coils. It can be used to characterise skin properties. The second is ring-shaped and able to image objects with a diameter of 20cm. It can be employed for imaging of limbs, joints and small animals

2412. Investigation by Target Field Method of Limiting Factors in MAMBA Step Fields

Kuan J. Lee[1], Martyn Paley[1], Iain D. Wilkinson[1], Paul Griffiths[1]
[1]University of Sheffield, Sheffield, Yorkshire, UK

The use of MAMBA (Multiple Acquisition with Macro B0 Array) step-fields for simultaneous multi-slice imaging without extra receive channels has recently been demonstrated in-vivo. However, step-fields require high-order magnetic fields which impose demanding coil current requirements. We use the pseudoinversion target field method, regularized by truncated SVD, to examine the limits of step-fields. We find that the radial gradient is the largest source of inhomogeneity; this decreases exponentially as steps are placed further apart, to below 1% of step size at step separation = radius.

2413. Biradial Shim Coil Design using a Linear Programming Algorithm

Sharon E. Ungersma[1], Hao Xu[1], Greig C. Scott[1], Blaine A. Chronik[1], John M. Pauly[1], Steven M. Conolly[1]
[1]Stanford University, Stanford, California, USA

The advent of dedicated MRI scanners tailored to specific body parts has led to an increasing number of non-cylindrical scanner geometries, for which non-cylindrical gradients and shims are needed. A linear programming algorithm was developed to design minimum-power biradial shim coils. The coils can be designed on an arbitrary surface to produce any order shim over an arbitrary target region. The algorithm was used to design shim coils for a biradial head imager with a spherical target region for brain imaging.

2414. Gradient Trade-Offs: Current Variations versus Shielding Constraints

R. Brown[1], Sh. Shvartsman[2], Y.-C. Cheng[1], T. Eagan[1], T. Kidane[1]
[1]Case Western Reserve University, Cleveland, Ohio, USA; [2]Philips Medical Systems (Cleveland), Cleveland, Ohio, USA

A straightforward procedure is described for balancing the needs for good shielding and smooth current distributions in gradient coil design in MRI. In theoretical studies, the better the shielding, the larger the current spatial variations. Large continuous current variations are difficult to discretize and manufacture as an etched or wired coil assembly. With the procedure described in this paper, however, a search for the desired middle ground can be carried out by the tuning of a single variable. An example for a cylindrical transverse gradient coil is given.

2415. Gradient Coil Design Using Quadratic Programming with Relaxed Target Field

Héctor Sánchez[1], Carlos Cabal[1], André Briguet[2], Hervé Saint-Jalmes[2]
[1]Universidad de Oriente, Santiago de Cuba, Cuba; [2]UPRESA 5012 - CNRS, Université Claude Bernard - Lyon I, Villeurbanne, Lyon, France

A minimum inductance gradient coils design method is described. The current density is expressed as the sum of orthogonal functions. The linear field constraints are obtained from Biot-Savart law and relaxed through introduced uniformity error. The procedure, through quadratic programming optimization algorithm, provides the minimum amplitude of each axial oscillating mode of the current density that produces the desired field and maximizes the figure of merit. A new optimal coil length versus coil radius relation ship is obtained depending on the region of interest and the targeted gradient uniformity error. A transverse gradient coil is designed for a MRI machine.

2416. Method of Gradient Coil Design that Allows Control of the Residual Eddy Current Effect

Gordon D. DeMeester[1], Michael A. Morich[1], Shmaryu M. Shvartsman[1], Zhiyong Zhai[1]
[1]Philips Medical Systems, Cleveland, Ohio, USA

Conventional shielded gradient coil design methods assume long shield coils that must be truncated (apodized). This introduces field leakage outside the shield and increases the eddy currents in surrounding metal structures, hence increasing the residual eddy currents that need correction. Eddy current effect that is not constant throughout the imaging volume makes correction more difficult. We present a method of shielded gradient coil design that includes finite coil lengths from the beginning of the design and allows one to control uniformity of the eddy current effect over the surface of an imaging volume to desirable levels.

2417. Design of a Uni-planar Gy Surface Gradient Coil

Rostislav Lemdiasov[1], Reinhold Ludwig[1], Karl Helmer[1], John M. Sullivan[1], Craig Ferris[2]
[1]Worcester Polytechnic Institute, Worcester, Massachusetts, USA; [2]UMASS Medical School, Worcester, Massachusetts, USA

A new design approach and implementation methodology for uniplanar gradient coils for animal studies is presented. The Biot-Savart integral equation is discretized on the basis of numerical inverse formulation. This formulation involves a constraint cost function between the desired field in a particular region in space and the current distribution in the coil plane. The problem can be transformed into a matrix equation whose solution yields discrete rectangular current elements with magnitudes and directions within the specified coil plane. The discrete current elements can be synthesized into an overall wire configuration by combining individual wire loops.

2418. Actively Shielded Multi-Layer Gradient Coils Optimised for Cooling

James Leggett[1], Stuart Crozier[2], Richard Bowtell[1]
[1]University of Nottingham, Nottingham, Nottinghamshire, UK; [2]University of Queensland, Brisbane, Queensland, Australia

Very large magnetic field gradients are required in a variety of NMR experiments. Access to such gradients is often limited by the rapid increase in gradient coil resistance with efficiency, resulting from the reduction in conductor cross-section as the number of wires increases. Adopting a multi-layer approach to coil design gives a more favourable scaling. The three-dimensional nature of the resulting current distribution, however, could cause difficulties in cooling the coil's underlying layers. Here we describe a new method for designing screened multi-layer coils optimised for cooling, which is based on a model of heat flow in the coil.

2419. A Crescent-Shaped Transverse Gradient Coil for Permanent MRI

Guanghui Shen[1], *Xiaohua Jiang*[1], *Xu Chu*[1]
[1]Tsinghua University, Beijing, People's Republic of China

An optimal approach based on Biot-Savart law for designing gradient coils used in permanent MRI is presented. The interaction between the currents and the ferromagnetic material is also modeled during optimization. Each turn of the designed transverse coil has a crescent-shaped geometry , which is composed of several line currents and an arc current. Coordinates of the vertices defining the turns are varied to improve the performance of the coil. Numerical simulations involving Finite Element Analysis(FEA) is performed to verify the optimal result. Both numerical result and experimental result are presented.

2420. A Planar Gradient Set for Rapid MR Imaging

Cornelius von Morze[1], *Paul A. Bottomley*[2], *John F. Schenck*[1], *Christopher J. Hardy*[1]
[1]GE Global Research Center, Niskayuna, New York, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

Gradient performance and safety issues critically limit high-speed cardiac, neurofunctional, and diffusion MRI and fiber tracking. Because local gradient coils can produce high gradient amplitudes and slew rates without excessive gradient power, we performed a computer optimization of small planar gradient coils, to minimize power dissipation and net torque and maximize linearity. The result is a practical design for whole-body cylindrical magnet systems that produces gradient amplitudes and slew rates an order of magnitude better than those available on current MRI systems for the same power, with maximum dB/dt levels limited by the localized nature of the fields.

2421. Modal Analysis of a Gradient Coil Insert for a 4T MRI Scanner

Guozhi Z. Yao[1], *Chris K. Mechefske*[1], *Fenglin L. Wang*[1], *Andrew Alejski*[2], *Brian K. Rutt*[2]
[1]Queen's University, Kingston, Ontario, Canada; [2]Robarts Research Institute, London, Ontario, Canada

High magnetic field strength and high gradient switching rates are becoming ever more commonplace in MRI scanners. These and other factors are combining to yield high sound pressure levels. In order to predict the vibration and acoustic response of a real gradient coil inserted into a 4T scanner, a Finite Element Analysis (FEA) was carried out. The results were verified through experimental modal testing. It was found that the experimental results were in good agreement with the FEA results. Future work will involve the use of these FEA models to predict gradient coil vibration and acoustic responses to various inputs.

2422. Analysis of Gradient Induced Acoustic Noise Characteristics in a 4T MRI Scanner using EPI

Weidong Li[1], *Chris K. Mechefske*[1], *Carl Gazdzinski*[2], *Brian K. Rutt*[2]
[1]Queen's University, Kingston, Ontario, Canada; [2]Robarts Research Institute, London, Ontario, Canada

Gradient coil induced acoustic noise was measured in a 4 T MRI system along the centerline using echo planar imaging (EPI) sequences. The acoustic noise spectra were calculated and used to compare the acoustic response distribution along the centreline. The frequency response functions (FRFs), measured using sinusoidal sweeps, were then employed to predict the sound pressure levels (SPLs) due to EPI input sequences. The results show that the predictions using the FRFs were close to the measured SPLs. This method can be applied to predict acoustic noise levels due to other scanning sequences.

2423. Characteristics of Acoustic Noise Measurement and Distribution in a 4 T MRI System

Weidong Li[1], *Chris K. Mechefske*[1], *Carl Gazdzinski*[2], *Brian K. Rutt*[2]
[1]Queen's University, Kingston, Ontario, Canada; [2]Robarts Research Institute, London, Ontario, Canada

The acoustic noise generated by high-field, high switching speed MRI scanners can reach extreme levels. In an effort to understand the characteristics of this acoustic noise, experiments were conducted in a 4 Tesla Varian/Siemens whole-body MRI system. First, the influence of eddy currents on acoustic measurement hardware was investigated under acoustically unshielded and shielded conditions. Second, the acoustic frequency response functions (FRFs) were obtained at selected positions. The results show that FRFs are able to reveal generic acoustic transmission characteristics. We also found that eddy currents in the microphone added no significant amount to the acoustic noise levels measured.

2424. Reducing Peripheral Nerve Stimulation Due to Switched Transverse Field Gradients Using an Additional Concomitant Field Coil

Richard Bowtell[1], *Martin Bencsik*[1], *Roger Bowley*[1]
[1]Nottingham University, Nottingham, Nottinghamshire, UK

Peripheral nerve stimulation due to time varying gradients limits the gradient strengths that can be used in MRI. In the case of transverse gradient coils, it is the concomitant fields which are responsible for stimulation. Here we describe the design of a new coil arrangement consisting of a transverse gradient coil, paired with a coil designed to produce a uniform concomitant field. This arrangement allows the concomitant field to be reduced at a controllable axial location, without compromising gradient homogeneity. Simulations indicate that this approach can allow higher gradient switching rates to be achieved without causing nerve stimulation.

Specialized Imaging Apparatus and Components

Hall D Sunday 13:30 - 15:30

2425. A Multi-Sample, Multi-Mode RF Coil System for a Standard MRI Scanner

H. Douglas Morris[1], A. Scott Chesnick[1]
[1]National Institutes of Health, Bethesda, Maryland, USA

An outgrowth of the progress in genome research is the need to evaluate the expression of a genetic modification in the developing or adult animal. MRI has been shown to be an excellent method for phenotyping the mouse, the mammalian genomic model of choice. The exponential increase in recent years of mouse genome experimentation requires a concomitant increase in the ability to rapidly image many samples. We have constructed a multi-mouse volume imaging coil and associated signal handling electronics that can simultaneously image 4 mice.

2426. MRI Compatible Bio-Reactor for Monitoring the Development of Tissue Engineered Aortic Valves

Gustav J. Strijkers[1], Marcel C.M. Rutten[1], Evelyne A. van Dam[1], Frank P T Baaijens[1], Klaas Nicolay[1]
[1]Eindhoven University of Technology, Eindhoven, Netherlands

We have built a MRI compatible bio-reactor for culturing and monitoring implantable tissue-engineered aortic valves. Since the deformation history of the valve leaflets is crucial for their development, the valve construct can be subjected to physiological flows and pressures. The aortic flow patterns around the valve can be measured in detail with phase contrast MRI. There is an excellent agreement between the measured and calculated flow fields.

2427. The Use of a Decoupled Coil System and Relaxation Agents to Improve Perfusion Chamber Data

Keith Wachowicz[1], Isidro Bonilla[1], Richard E. Snyder[1]
[1]University of Alberta, Edmonton, Alberta, Canada

NMR data derived from a tissue sample held in a perfusion chamber (where a physiological buffer solution continually flows past the tissue sample at a set rate) were found to vary depending on the rate of flow. A decoupled transmit/receive coil system tailored for use with the perfusion chamber was developed to remove this flow dependency. This new coil system was tested and found to significantly reduce problems due to flow. Relaxation agents were also tested with the perfusion chamber to nullify negative effects of the buffer. Fe^{3+} was found to work best with nerve tissue.

2428. MR of the Non-Sedated Neonate using a MR Compatible Incubator with a Built-In Coil.

Elspeth Helen Whitby[1], Paul David Griffiths[1], Torsten Lonneker-Lammers[2], Ravi Srinivasan[3], Dan Connoley[4], Martyn N. Paley[1]
[1]University of Sheffield, Sheffield, S Yorks, UK; [2]Lammers Medical Technology, Lubeck, Germany; [3]Advanced Imaging Research, Cleveland, Ohio, USA; [4]Royal Hallamshire Hospital, Sheffield, S Yorks, UK

Aim: To assess the practicalities of performing MR imaging using a purpose built incubator (head coil system) to scan non-sedated neonates using fast imaging techniques. Materials and methods: Local ethical committee approval was obtained prior to the trial. Patients: Seven neonates, who had a known or suspected intracranial pathology, were recruited into the trial. None of the babies were sedated at the time of the MR examination. A physician experienced in neonatal resuscitation was present throughout the time of the scans and remained in the scan room. Saturation and ECG monitoring was performed continually during the MR examination using

2429. Symmetry Analysis of a 2n Port, n-way Splitter/Combiner

Randy Duensing[1], Charles Saylor[1], David Molyneaux[1]
[1]MRI Devices, Gainesville, Florida, USA

The discrete component quadrature hybrid commonly used in MRI is analyzed using primarily symmetry. The analysis lends itself to a synthesis procedure as well. Unequal 4-port power splitters are synthesized. Additionally, the symmetry of the 4 port network is generalized to allow synthesis of 6 and 8 port hybrid like circuits which could also be extended to include unequal power splitting

2430. Linear Balanced Duplexer T/R Switch

Ronald D. Watkins[1], Douglas A.C. Kelley[2]
[1]GE Global Research, Schenectady, New York, USA; [2]GE Medical Systems, Waukesha, Wisconsin, USA

A linear balanced duplexer is introduced and demonstrated as a means of implementing a transmit receive switch in an MRI imaging system. An ideal T/R switch must have two operating modes. In transmit it must provide a low loss path between the transmitter and coil and high isolation from transmitter to the preamplifier. In receive mode it must provide a low loss path between the coil and preamplifier, and high isolation from the coil to the transmitter in order to protect the preamplifier from damage.

2431. Contrast Enhanced Intravascular Detection of Vulnerable Plaque using SPIO and a Novel MRI Catheter

Paul Cherukuri[1], Ward Casscells[1], James T. Willerson[1], Silvio Litovsky[1], Jaroslaw Wosik[2], Lian Xue[2], James A. Bankson[3], Chun Yuan[4], Morteza Naghavi[1]
[1]Texas Heart Institute, Houston, Texas, USA; [2]University of Houston, Houston, Texas, USA; [3]MD Anderson Cancer Center, Houston, Texas, USA; [4]University of Washington, Seattle, Washington, USA

Vulnerable plaques are macrophage rich plaques. We have previously shown that super paramagnetic iron oxide (SPIO) nanoparticles are avidly taken up by macrophages, localize in the cap of inflamed atherosclerotic plaques and are visualized by MRI. Limited SNR with MRI presents challenges for non-invasive imaging of vulnerable plaques in small arteries. Here, we report on a coaxial quarter-wavelength MRI catheter for intravascular imaging of plaque after SPIO injection. Tests were conducted in phantom, normal New Zealand, and Watanabe atherosclerotic rabbit aortas before and after SPIO injection. The reported design provides a significant enhancement in S/N ratio comparing to surface coil.

2432. Small-Diameter Cylindrical Markers Encased in Single-Loop Coils for Motion Tracking

Andrew M. Elliott[1], Yunhong Shu[1], Matt A. Bernstein[1]
[1]Mayo Clinic and Foundation, Rochester, Minnesota, USA

MR markers that are both small and intense present conflicting design requirements, but they enable applications in motion tracking and correction, and in catheter tracking. One solution is to encase each marker in its own coil, which can be either inductively coupled or hardwired. We developed a 0.6mm inside-diameter cylindrical marker encased in a single-turn inductively coupled coil. Marker lengths of 10-17cm have been achieved, allowing motion correction of multiple planes in a 3D volume with the RINGLET motion correction. Signal boost of a factor of 10 or better are achieved by encasing the marker in the coil.

New RF Applications

Hall D Monday 13:30 - 15:30

2433. B1AC-MAMBA : Combined B_0 and B_1 Array Coil Parallel Imaging

Martyn Paley[1], Kuan Lee[1], Jim Wild[1], Stan Fichele[1], Elspeth Whitby[1], Iain Wilkinson[1], Edwin van Beek[1], Paul Griffiths[1]
[1]University of Sheffield, Sheffield, Yorkshire, UK

Combination of an in-plane B1 sensitivity encoding technique (SENSE) with a simultaneous multiple slice B0 field step technique (MAMBA) has produced a high scan time reduction factor (R=4) whilst reducing the required number of receiver channels and coils compared to SENSE only methods.

2434. MRI, NMR, and EPR Resonators for Medical Research

Ilia Geifman[1], Iryna Golovina[2]
[1]Oakton Community College, Des Plaines, Illinois, USA; [2]Institute of Physics of Semiconductors, Kiev, Ukraine

The ferroelectric resonators (FR) increase the sensitivity of nuclear magnetic resonance, electron paramagnetic resonance methods, and provide higher quality of MRI. The ferroelectric resonators create a possibility to observe natural paramagnetic impurities in EPR and to register more isotopes in NMR. Using ferroelectric resonators in medicine can substitute special doping to register EPR and NMR spectra. It will be possible to investigate in vivo in EPR because it is no longer necessary to insert object into the cavity. The FR can be located outside the cavity. Here we will calculate the sizes of NMR, EPR, and MRI resonators.

2435. Development of a Dielectric Equivalent Gel for Better Impedance Matching for Human Skin

Hiroo Ikehira[1], Takahiro Sunaga[1], Takayuki Obata[1], Shigeo Furukawa[1], Mitsuru Tamura[1], Eiji Yoshitome[1], Shuji Tanada[1]
[1]National Institute of Radiological Sciences, Chiba-shi, Chiba-ken, Japan

In this study, solid-type water-based gelatin-honey gels were developed which have the electrical characteristics of skin tissue. It was demonstrated that a stable and homogeneous gel, with a relative dielectric constant ε' chosen from desired ranges found in skin, can be made. Above 300 MHz, acquiring MR images of high quality is difficult because of the increase in operating RF (radio frequency). The main factor affecting image quality is a dielectric resonance phenomenon, which can cause distortion. Electromagnetic wave impedance mismatching of the air/tissue interface may also cause dielectric in homogeneity, especially at the epidermal surface.

2436. 3D MR Imaging of Sodium by using a Volume Coil

Guenter Steidle[1], Hansjoerg Graf[1], Fritz Schick[1]
[1]Section on Experimental Radiology, Tuebingen, Baden-Wuerttemberg, Germany

23Na MRI is considered to be an important tool for in vivo studies in humans because of high contrast between normal and pathological regions. However, due to the low natural abundance in biological tissue, sodium imaging provides poor-quality and low-resolution images with very low SNR and long acquisition time compared with conventional 1H imaging. A volume coil was designed allowing a sufficient penetration throughout the whole abdomen and thorax. A spoiled 3D GRE sequence was optimized with respect to relaxation times of extracellular sodium, which allows to acquire images with an acceptable SNR in a reasonable measurement time.

MR Safety and Bioeffects: Computational Modelling

Hall D Tuesday 13:30 - 15:30

2437. Simplifying Gradient Coil Modeling in FDTD Calculations

Graeme McKinnon[1]
[1]GE Medical Systems, Waukesha, Wisconsin, USA

The finite difference time domain (FDTD) method can be used to estimate electric fields and currents induced in a human by gradient switching. One difficulty is in accurately modeling the complexity of the gradient coil's conductor geometry. It is shown here how the FDTD algorithm, in this low frequency regime, can be modified such that the need for explicit modeling of the gradient conductor geometry is replaced by a much simpler static calculation of the empty coil's vector potential.

2438. A Quasi-Static FDTD Approximation Reduces Computation Time

Graeme McKinnon[1]
[1]GE Medical Systems, Waukesha, Wisconsin, USA

When using the finite difference time domain (FDTD) algorithm to calculate gradient coil induced electric fields in tissue, convergence is very slow. This is due to the relative permittivity values of tissue being in the order of 10^5 at these low frequencies. Method of moment calculations, on the other hand, typically invoke a quasi-static approximation whereby, among other things, the displacement current is ignored. Here it is shown that a similar quasi-static approximation can be introduced into the FDTD approach, by setting the relative permittivity to unity, resulting in a significant improvement in the convergence speed.

2439. A New Model for Gradient Induced Peripheral Nerve Stimulation

Beibei Zhang[1], *Graeme C. McKinnon*[2], *Brian K. Rutt*[1]
[1]Robarts Research Institute, London, Ontario, Canada; [2]GE Medical Systems, Milwaukee, Wisconsin, USA

It has been hypothesized that gradient-induced peripheral nerve stimulation (PNS) thresholds decrease when the gradient linearity region diameter of spherical volume (DSV) increases. It is also often assumed that PNS thresholds are accurately characterized by a linear (or hyperbolic) model with a single time constant, and that the electric field variation with DSV explains the DSV-dependence. We have made PNS threshold measurements which confirm the first hypothesis but contradict the latter assumption. Here we propose a linear model with two terms and two time constants that fits the experimental data considerably better than the simple linear model.

2440. Modeling Human Tissues in Pulsed Gradient Fields

Christopher Michael Collins[1], *Blaine A. Chronik*[2]
[1]Penn State College of Medicine, Hershey, Pennsylvania, USA; [2]Stanford University, Stanford, California, USA

Since human tissues are dispersive (have frequency-dependent electrical properties) and realistic gradient pulse shapes contain a spectrum of frequencies it is necessary to examine how best to model human tissues in pulsed gradient fields for MRI. Here we utilize a full-Maxwell numerical method to calculate the electrical fields created by an ideal gradient field with a time course like that of the front end of a trapezoid in a spherical sample of varying electrical properties. Results indicate that it is not necessary to model human tissues as dispersive for gradient coil calculations.

2441. Specific Absorption Rate at 1.5 and 3 Tesla: A Numerical Study of the Birdcage Coil

Tamer S. Ibrahim[1], *Robert Lee*[1]
[1]The Ohio State University, Columbus, Ohio, USA

The GE birdcage head coil is modeled to determine the specific absorption rate (SAR) distribution for the 1.5 T and 3 T system. An anatomically detailed human head/shoulder model was placed within the coil. The shoulder model is especially important because there is concern about heating occuring where the end rings of the head coil are closest to the shoulders. Results are presented for various head positions and excitations.

2442. Relationship among SAR, RF Grequency and Tissue

Chun Sheng Wang[1], *Gary X. Shen*[1]
[1]The University of Hong Kong, Hong Kong

SAR is one of the most important parameters and as a guideline for MRI safety. The relationships among SAR, different tissues and different resonant frequencies have not been discussed quantitatively. In this abstract, we present some comparisons and results about this important issue

2443. Measured Excitation and Reception Fields of a Surface Coil at 298 MHz

Haiying Liu[1], Xiaoliang Zhang[1], Peter Anderson[1], Kamil Ugurbil[1], Wei Chen[1]
[1]University of Minnesota, Minneapolis, Minnesota, USA

A 3D MRI scheme was used to measure excitation and reception fields of a RF coil system at 7T for different loading conditions. The scheme is based on probing the system response to two RF excitations. The results revealed a spatial dissimilarity in the excitation and reception fields. Both field profiles depend on the characteristics and geometrical relationship of the load in addition to RF coil design. Considering that the bulk magnetization density of the load is measurable, this provides a practical technique for probing both fields in situ without the knowledge of load.

2444. Head Imaging Using Head Transmit Coil and Body Transmit Coil at 3T

Gordon D. DeMeester[1], Zhiyong Zhai[1], Michael A. Morich[1], Paul R. Harvey[2]
[1]Philips Medical Systems, Cleveland, Ohio, USA; [2]Philips Medical Systems, Best, Netherlands

In a whole body MRI system, the combination of volume transmit coil and local receive coil is often used for best B1-field uniformity and maximum SNR. At 3T or higher field, a local transmit coil may be used for certain imaging positions, such as head imaging. Here we present the results of using a FDTD method to calculate B1-field and SAR in the head of a human body model at 3T using both a body transmit coil and a head transmit coil. Simulation shows that, using the head transmit coil can result in acceptable B1-field uniformity with lower SAR.

MR Safety: Implants and Catheters

Hall D   Saturday 14:00 - 16:00

2445. Cardiac Pacemakers and MRI: Safe Evaluation of 47 Patients Using a 1.5-Tesla MR System Without Altering Pacemaker or Imaging Parameters

Edward T. Martin[1], James A. Coman[1], Willis Owen[2], Frank G. Shellock[3]
[1]Oklahoma Heart Institute, Tulsa, Oklahoma, USA; [2]University of Oklahoma College of Medicine, Tulsa, Oklahoma, USA; [3]Institute for Magnetic Resonance Safety, Education, and Research, Los Angeles, California, USA

Cardiac pacemakers are the most common electronically activated implants found in patients referred for MRI procedures. Unfortunately, the presence of a pacemaker is a strict contraindication for MRI. This investigation evaluated 47 patients with pacemakers (not pacemaker dependent) undergoing MRI at 1.5-Tesla. Pacemaker and imaging parameters were not altered. Each pacemaker was thoroughly interrogated prior to and after MRI. Monitoring of symptoms, heart rate, and ECG was conducted. MRI at 1.5-Tesla was performed safely in all patients without incidents or complaints. Importantly, it was unnecessary to change the pacemaker settings or to alter the MRI scan parameters to achieve safety.

2446. MRI with Implanted Neurostimulators: Safety Issues

Jens Christoph Georgi[1], Volker M. Tronnier[1], Sabine Heiland[1]
[1]University of Heidelberg Medical Center, Heidelberg, Germany

The goal of our study was to evaluate and minimize possible hazzards for patients with implanted deep brain neurostimulators caused by fast switching gradients or RF-power in clinical functional, perfusion and diffusion MRI. Electrodes were placed in a NaCl-solution-filled phantom. Measurement of induced voltage and heating was performed during scanning of clinical standard sequences for functional imaging. Depending on the sequence and the experimental setting, the induced voltage was between 1V and more than 7000V and temperature rise was between 0.2 and 60 C. Sparks could also be observed. Functional MRI with implanted neurostimulator is possible, if certain rules are followed.

2447. RF Heating Along Metallic Catheters during a Clinical MRI Examination

Cristina Armenean[1], Mircea Armenean[1], Olivier Beuf[1], Emmanuel Perrin[1], Frank Pilleul[1], Alejandro Bordelois[2], Hervé Saint-Jalmes[1]
[1]Université Claude Bernard Lyon 1, Villeurbanne, France; [2]Universidad de Oriente, Santiago, Cuba

Heating of biological tissues along metallic wires placed in MRI scanner has become an important question with the development of interventional MRI. This paper presents results about temperature variation due to RF heating along a wire with two different lengths during a MRI examination. Measured values are compared with simulation results. Study shows that the temperature elevation may be important and does not appear only at wire tips.

2448. Risk of Tissue Heating During MRI Due to Long Metallic Implants Estimated by Correlation of Signal Change and Temperature Increase

R. Girnus [1], V. Hesselmann [1], K. Luyken [2], G. Nimtz [3], J. Bunke [4], B. Krug [1], K. Lackner [1]
1 Department of Radiology, University of Cologne, Cologne, Germany, 2 Department of Stereotaxy and Functional Neurosurgery, University of Cologne, Colgne,Germany, 3 II. Department of Physics, University of Cologne, Colgne, Germany, 4 Philips Medical Systems, Hamburg, Germany

The antenna effect is the main source for temperature increase of long metallic objects. In order to estimate wether a resonance effect occurs, a quantitative analysis of the signal intensity in the vicinity of the wire may replace a direct invasive temperature measurement. 2D-gradient echo sequences with flip angles between 5° and 150° were used for scanning a copper wire with different length which was partly surrounded by a copper sulfat solution. The spatial inhomogeneity of the images, the location of artifacts and the flip angle at which the signal reached the maximum reflected whether resonance is possible.

Non-Presented Abstracts

2500. Blood Oxygenation Level-Dependent Functional MRI during Deep Brain Stimulation to Anterior Thalamic Nucleus in a Seizure Patient

Yuan Yu Hsu[1], Ho Ling Liu[2], Tony Wu[3], Shih Tseng Lee[4]
[1]Department of Radiology, Chang Gung Memorial Hospital, Taipei, Taiwan; [2]MR Center, Chang Gung Memorial Hospital, Taipei, Taiwan; [3]Department of Neurology, Chang Gung Memorial Hospital, Taipei, Taiwan; [4]Department of Neurosurgery, Chang Gung Memorial Hospital, Taipei, Taiwan

To our best knowledge, this is the first report of blood oxygenation level-dependent (BOLD) functional MRI during deep brain stimulation (DBS) for seizure control. A 21-year-old woman had motor seizures relieved by high frequency (100 Hz) DBS to anterior thalamic nuclei (ATNs). BOLD functional MRI during right ATN stimulation showed signal decreases in bilateral posterior cingulate gyri and anterior frontal cortices, and left posterior frontal and parietal cortices, indicating decreases in cerebral blood flow and oxygenation in these areas. Further studies based on these preliminary findings may elucidate the pathophysiology of DBS-induced neuromodulation and the functional connectivity underlying seizure occurrence.

2501. Comparison of single- and dual-tracer dynamic contrast-enhanced MRI to immunohistochemical measures of microvascular density using CD31 staining and intravital lectin perfusion

Robert Chappell Orth[1], James A. Bankson[1], Roger E. Price[1], Edward F. Jackson[1]
[1]M.D. Anderson Cancer Center, Houston, TX, United States

Correlations between MR measures of whole blood volume per unit volume of tissue (v_b) and immunohistochemical (IHC) measures of microvascular density (MVD) were investigated using single- (Magnevist) and dual-tracer (Gadomer-17/Magnevist) pharmacokinetic models. All experiments were performed using a Bruker 4.7T imaging spectrometer on athymic nude mice inoculated in the inguinal mammary fat pad with MDA-MB-435 human breast cancer cells. The vb values generated using the dual-tracer model agreed with MVD measurements. Data generated from single-tracer studies did not correlate with IHC measures of MVD. Dual-tracer pharmacokinetic modeling offers a non-invasive alternative to traditional measures of the intratumoral microvascular environment.

2502. Progress towards a comprehensive, pediatric renal exam

Richard A. Jones[1], Damien Grattan-Smith[1]
[1]CHOA/Emory University, Atlanta, GA, United States

MRI has great potential for examining the pediatric renal and urinary systems in a single examination and can provide both excellent anatomical information and functional information. This abstract present our initial results from two studies; 1) Using diffusion MRI to study the kidney and 2) a clinical study of the utility of dynamic, contrast enhanced MR for studying the renal and urinary systems. For the latter study the split renal function and renal transit times were calculated and were well correlated with those obtained using nuclear medicine.

2503. Impact of motion correction on quantitative analysis of dynamic contrast enhanced MRI of kidney tumors

Hendrik von Tengg-Kobligk[1], Guang Jia[1], Matt J. McAulifffe[2], Peter L. Choyke[2], Michael V. Knopp[1]
[1]The Ohio State University, Columbus, OH, United States; [2]National Institutes of Health, Bethesda, MD, United States

Motion of organs is an undesirable occurrence during dynamic contrast enhanced MR imaging especially relevant for pixel based quantitative analytical methods. Targeted region-of-interest analysis is susceptible to motion related errors in unregistered time-series datasets. We evaluated the capabilities of an automated registration algorithm using a pixel-based similarity cost function to register the time-series datasets of patient’s kidneys. Subsequently; we analyzed the effect of motion correction an quantitative ROI based analysis. We found that the methodology is robust and reproducible and, as expected, substantial effects on quantitative parameters we noticed. Motion correction does improve classification of tissue enhancement patterns.

2504. Quantitation of cartilage T2 in a clinical setting at 1.5 Tesla: development and validation of a multi echo pulse sequence

Thomas Mendlik[1], Sonja Christine Faber[1], Christian Glaser[1], Maximilian Reiser[1]
[1]Department of Clinical Radiology, University of Munich-Grosshadern, Munich, Germany

For quantitation of cartilage T2, four different multi echo pulse sequence designs were implemented on a 1.5 Tesla clinical imager and compared to single spin echo experiments. After validation of the sequences with a set of phantoms, the techniques were applied to five human patellae ex-vivo. Depending on the sequence design, the calculated T2 values showed deviations from +27% to -29% (phantoms) and from +56% to -11% (cartilage). The results implicate, that detailed information on the pulse sequence used for quantitation of cartilage T2 is essential to make data comparable between different research groups.

2505. Effect of diffusion on estimates of oxygen extraction fraction from asymmetric spin echo and multi-echo gradient echo/spin echo sequences: Comparison of experimental and Monte Carlo simulation results

Peter Christopher Nicholas[1], Hongyu An[1], Weili Lin[1]
[1]University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

Recently a novel method has been presented for the quantification of Oxygen Extraction Fraction and fractional cerebral venous blood volume using both a Multiple Echo Gradient Echo, Spin Echo, and an Asymmetric Spin Echo sequence. This method relies upon asymptotic approximations for the MR signal in the static dephasing regime. We compare experimental MR signal data (measured at two field strengths) with Monte Carlo diffusion simulations and find that diffusion is a very likely explanation for certain discrepancies between the measured signal and the signal predicted based upon the assumption of static spins.

2506. Real-time functional MRI-guided proton MR spectroscopy at 3 Tesla: A motor cortex study in healthy controls and patients with ALS

Wolfgang Block[1], Frank Träber[1], Christoph Manka[1], Lukas Scheef[1], Christoph Pohl[2], Rolf Lamerichs[3], Jürgen Gieseke[4], Thomas Klockgether[2], Hans Schild[1]
[1]Dept. of Radiology, University of Bonn, Bonn, Germany; [2]Dept. of Neurology, University of Bonn, Bonn, Germany; [3]Philips Medical Systems, Best, Netherlands; [4]Philips Medizin Systeme, Hamburg, Germany

The correct placement of the VOI in MRS is important to avoid inclusion of non-target tissue as much as possible. VOI size used in MRS at 1.5 T was often a compromise between gaining sufficient SNR and accepting partial-volume effects. To improve results, it is desirable to reduce VOI size. Increased SNR at high-field MR provides the opportunity to reduce the VOI size substantially. Real-time fMRI performed prior to MRS should be used for an accurate image-guided alignment of the VOI to target tissue. As a model for fMRI-guided motorcortex MRS, patients with ALS and controls were investigated at 3T.

2507. Interleaved Variable-Density 1D Fourier Velocity-Encoding

Julie DiCarlo[1], Bob Hu[2], Dwight Nishimura[1], John Pauly[1]
[1]Stanford University, Stanford, CA, United States; [2]Stanford University and Palo Alto Medical Foundation, Palo Alto, California, United States

One-shot Fourier velocity-encoding (FVE) has the ability to measure velocities up to 2.5 m/s in real-time. Two variable-density FVE trajectories are interleaved to reconstruct images at the same resolution and 2x velocity field of view (FOV) to detect fast jet velocities. Alternatively, FOV can be held constant and velocity resolution can be improved. The use of interleaved trajectories increases the number of velocity-frequency samples while minimizing off-resonance effects.

2508. Contrast Enhancement of the Liver at 1.5 T and 3.0 T

Hanns-Joachim Weinmann[1], Hans Bauer[1], Ines Heinzelmann[1], Claudia Heyer[1], Bernd Misselwitz[1]
[1]Schering AG, Berlin, Germany

The purpose of this study was to evaluate the potential of liver-specific MR contrast agents at 3.0 T. Two agents were investigated, the Gd based chelate gadoxetate (Gd-EOB-DTPA), and the SPIO Resovist. The liver of rats, who received the agents at different doses, were excised and the signal intensities were recorded at 1.5 and 3.0 T by means of T1 and T2 weighted sequences. Both types of agents exhibited a good contrast enhancement at the two different field strengths. The T1 agent were less effective at the high field strength due to strong T2* effects of the liver tissue.

2509. Different progression rates for subcortical white matter lesions in healthy elderly males and females

Dominique M.J. van den Heuvel[1], Faiza Admiraal-Behloul[1], Hans Olofsen[1], Gerard Jan Blauw[1], Rudi G.J. Westendorp[1], Eduard L.E.M. Bollen[1], Nicole Schmitz[1], Mark A. van Buchem[1]
[1]Leiden University Medical Center, Leiden, Netherlands

Elucidating the causes of white matter lesions (WML) in healthy elderly recent studies have emphasized the role of sociodemographic variables like age and gender on the prevalence of WML. In the present longitudinal study we found an interaction effect of age with gender in relation to subcortical white matter lesions (SWML). Our results therefore suggest different progression rates of SWML for men and women. The progression of periventricular white matter lesions (PVWML) did not differ between sexes. SWML may be responsible for the observed higher incidence of dementia in women, particularly in old age.

2510. Using Voxel-Based Morphometry to study the neural correlates of semantic knowledge and aberrant social behaviour in frontotemporal dementia

Guy B. Williams[1], Peter J. Nestor[2], John R. Hodges[2]
[1]Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Neurology Unit, University of Cambridge, Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom

Voxel based Morphometry has been used to investigate the correlations between cognitive and behavioural performance and atrophy in different regions of the brain in a heterogeneous group of patients with frontotemporal dementia. Structural MR scans acquired using a 3T Bruker scanner were processed using the SPM99 analysis package for normalisation, segmentation and in an ANCOVA analysis with covariates for semantic and behavioural test scores. This confirmed the correlation between temporal lobe atrophy and deficit in semantic processing ability, and showed a correlation between behavioural disturbance and medial frontal lobe atrophy.

2511. Mapping Brain Size and Cortical Surface Gray Matter Density in Major Depression

Martina Ballmaier[1], Elizabeth R. Sowell[2], Paul M. Thompson[2], Anand Kumar[3], Helen Lavretsky[3], Suzanne E. Welcome[2], Heather deLuca[2], Arthur W. Toga[4]
[1]Laboratory of Neuro Imaging Department of Neurology UCLA School of Medicine, Los Angeles, CA, United States; [2]Laboratory of Neuro Imaging Department of Neurology UCLA School of Medicine, Los Angeles, CA, United States; [3]Neuropsychiatric Institute UCLA School of Medicine, Los Angeles, CA, United States; [4]Laboratory of Neuro Imaging Department of Neurology UCLA School of Medicine, Los Angeles, CA, United States

Neuroimaging research has provided suggestive links between the orbitofrontal cortex (OFC) and depression. For the first time, we used spatial analyses of brain size and gray matter at the cortical surface in elderly depression. Prominent brain size reduction was found in the depressed subjects in OFC regions bilaterally, without size reduction of any other region. Significant gray matter abnormalities appeared in the parietal cortex bilaterally, where a robust gray matter density increase was observed. In addition, we found close spatial relationships between decreased brain size and gray matter density abnormalities in the OFC.

2512. Comparison of High-Resolution Spin-echo and Gradient-echo BOLD fMRI at 9.4 T

Fuqiang Zhao[1], Ping Wang[2], Seong-Gi Kim[2]
[1]Center for Magnetic Resonance Research, U. of Minnesota, Minneapolis, MN, United States; [2]Brain Imaging Research Center, Neurobiology Department, U. of Pittsburgh, Pittsburgh, PA, United States

To examine spatial specificity and signal changes of spin-echo and gradient-echo BOLD fMRI signals, the cat visual stimulation model was used at an ultrahigh magnetic field, 9.4T. The gradient-echo BOLD signal contains activation at tissue as well as draining vessels, especially at surface vessels. The large vessel activation induced by the extravascular effect around large vessels is significant. However, when the spin-echo BOLD technique is used, the large vessel contribution is reduced, improving spatial specificity to tissue. The averaged ratio of DR2* to DR2 is 2.09 in tissue and 8.16 in the large draining vein area.

2513. Heteronuclear MRI of Substrates interacting with Gd(III) complexes

Silvio Aime[1], Enzo Terreno[1], Fulvio Uggeri[2]
[1]Department of Chemistry IFM - University of Torino, Torino, Italy; [2]Bracco Imaging S.p.A., Milano, Italy

The acquisition of heteronuclear (e.g. 13C, 19F, 31P) MR images of substrates at 10 - 100 mM concentration is made possible by the drastic reduction of the relaxation times of the substrate nuclei upon interaction with a paramagnetic Gd(III) chelate. The paramagnetic agent is designed to form thermodynamically stable (but kinetically labile) ternary adducts with the substrate molecules.

2514. Paramagnetic CEST Agents: Relaxation *versus* Exchange

Shanrong Zhang[1], A. Dean Sherry[2]
[1]University of Texas at Dallas, Richardson, TX, United States; [2]University of Texas at Dallas & University of Texas Southwestern Medical Center, Richardson, TX, United States

Several LnDOTAM complexes (Ln3+=Pr3+ to Yb3+, except for Gd3+) were examined as prototype paramagnetic chemical exchange saturation transfer (PARACEST) agents. Their CEST properties are compared by considering relaxation effects on bulk water versus chemical exchange. The predominant factor govening CEST efficiency is shown to be chemical exchange rather than relaxation, although the latter property does make an impact. This knowledge extends the range of paramagnetic lanthanide ions that may be considered as PARACEST agents.

2515. Effects of EEG electrodes and RF coils in simultaneous EEG - MRI recording, with a HR model

Leonardo M. Angelone[1], Andreas Potthast[1], Sunao Iwaki[1], Florent Segonne[1], Lawrence Wald[1], Bruce Fischl[1], John W. Belliveau[1], Giorgio Bonmassar[1]
[1]Massachusetts General Hospital, Charlestown, MA, United States

This study investigates the effects of the electromagnetic fields on human-head tissues during simultaneous EEG/MRI recording. We present simulations using the Finite Difference Time Domain (FDTD) algorithm and a realistic high-resolution head model. We used surface and birdcage RF coils with 124 EEG electrodes. Results show that the presence of EEG electrodes produces an increase of the local Specific Absorption Rate on the skin. This increase is higher using a birdcage coil. These results discourage the use of standard EEG electrodes during MRI recording.

2516. Robust segmentation of the thalamus using Kohonen algorithm from diffusion tensor images

Julien Dauguet[1], Vincent Frouin[1], Yann Cointepas[1], Dominique Hervé[1], Nicholas Ayache[2], Philippe Hantraye[1]
[1]CEA, Service Hospitalier Frédéric Joliot, Orsay, France; [2]INRIA, Epidaure Project, Sophia Antipolis, France

The thalamus plays a central role in the brain.

2517. Continuous Moving Table 3D Phase Contrast: Feasibility Using the FLIPR Technique

Fred J. Browning[1], Charles A. Mistretta[1], Tianliang Gu[1], Yong Zhou[2], Jason A. Polzin[2], Sean B. Fain[1]
[1]University of Wisconsin, Madison, WI, United States; [2]GE Medical Systems, Milwaukee, WI, United States

Floating table Isotropic PR (FLIPR) gives an extended FOV in a single exam by acquiring data during continuous table motion. Combining this technique with 3D Phase Contrast (PC) angiography eliminates the need for mask subtraction and provides flow information via the phase difference. The feasibility of PC during table motion is demonstrated using a flow phantom.

2518. What Is the Smallest Real Detectable Change in Lesion Volume and Brain Atrophy in Multiple Sclerosis?

Xingchang Wei[1], Charles R.G. Guttmann[2], Simon K. Warfield[2], J. Ross Mitchell[1]
[1]Department of Radiology and Neurosciences, Seaman Family MR Research Center, University of Calgary, Calgary, AB, Canada; [2]Center for Neurological Imaging, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States

The smallest real detectable change from automated quantification of MRI-derived T2 lesion volume and brain atrophy in multiple sclerosis was assessed using a statistical approach to estimate the inter-scan standard error of measurement (SEM). The SEM was 0.234 ml (5.25% of the grand mean) for lesion volume and 0.0052 for brain parenchymal fraction (0.62% of the grand mean). The minimum detectable change for individual patients between two successive scans, and the number of patients that should be monitored for a trial at a given power and significance level can be calculated using the obtained SEM and the equations provided.

2519. Multi-slice echo planar spectroscopic imaging in multiple sclerosis.

Henrik Kahr Mathiesen[1], Thomas Tscherning[2], Per Soelberg Sorensen[2], Olaf B. Paulson[1], Lars G. Hanson[1]
[1]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital, Hvidovre, Denmark; [2]Copenhagen University Hospital, Rigshospitalet, N/A, Denmark

Magnetic resonance spectroscopy (MRS) provides information about neuronal loss or dysfunction by measuring N-acetyl-aspartate (NAA) in multiple sclerosis (MS) patients. MRS has demonstrated pathological changes in normal appearing white matter (NAWM), and correlates better to disability than conventional MRI. Most studies have been limited to single-voxels or measurements of whole-brain NAA only. We present echo planar spectroscopy imaging (EPSI) as a promising alternative to non-localised spectroscopy for obtaining whole brain NAA estimates in addition to measurements of metabolites in specific areas (e.g. NAWM, MS lesions).

2520. MRI of malignant breast tumours: Comparison of two analysis programs for the assessment of enhancement kinetics

Marja Helena Berg[1], Sinikka Inkeri Aukee[1], Pauli Antero Vainio[1], Timo Veikko Pietiläinen[2], Paula Katriina Mustonen[3], Ritva Liisa Vanninen[1]
[1]Kuopio University Hospital, Department of Clinical Radiology, Kuopio, Finland; [2]Kuopio University Hospital Department of Clinical Pathology, Kuopio, NA, Finland; [3]Kuopio University Hospital Deparment of Surgery, Kuopio, Finland

Twentytwo consecutive patients with a diagnosed breast malignancy underwent MRI (Siemens Vision) of the breast. The dynamic enhancement study (one precontrast, 5 postcontrast 3D FLASH sequences) was reviewed with the Siemens Vision analysis program and dedicated GE software (GEs). The initial signal increase (SI) within the first three minutes and the slope value of the enhancement within the first minute were calculated. The SI was not statistically significantly different between the two analysis programs. The slope values were greater using the Siemens program (p=0.04). There was no additional benefit from the (GEs) for the analysis of the enhancement curve.

2521. MR-leakography after endovascular repair of aortic aneurysms prior and post embolization: Comparison with MSCT and DSA

Stefan Christian Kraemer[1], Johannes Goerich[2], Reinhard Pamler[2], Andrik Aschoff[2], Hans-Juergen Brambs[2], Walter Heindel[1]
[1]University of Muenster, Muenster, Germany; [2]University of Ulm, Ulm, Germany

A comparative study of MRI, MSCT and DSA was performed to evaluate the diagnostic possibilities after endovascular repair of abdominal aortic aneurysms. The focus was on leak detection, planning of the interventional procedure and MR-artifacts depending on the type of graft used. Ten patients with leak suspicion were examined by either modality prior and post DSA and additional interventional treatment. MRI included CE-enhanced MRA as MSCT included CTA while selective intraarterial DSA served as gold standard.

MRI proved to be superior to MSCT concerning leak detection and successful coil embolization. Imaging artifacs after embolization were neglectible for MR.

2522. Reproducibility of Proton Magnetic Resonance Spectroscopy in Children

Frank P. MacMaster, MSc[1], Normand Carrey, MD[2], Mark Given, RTMR[3], Sara Sullivan, RTMR[1], Matthias H. Schmidt, MD[3]
[1]IBD (Atlantic), Halifax, Nova Scotia, Canada; [2]Dalhousie University, Halifax, Nova Scotia, Canada; [3]IWK Health Centre, Halifax, Nova Scotia, Canada
This study sought to investigate the temporal stability of proton magnetic resonance spectroscopy (1H-MRS) measures across an 8-week time span. Three short echo spectra were acquired in 10 healthy children at baseline and after 8-weeks. LCModel was used to analyze the data. Only small changes in metabolite concentrations were noted across the 8-week period. 1H-MRS is a viable tool for investigating changes due to treatment in brain chemistry in pediatric populations.

2523. Cortical activation ipsilateral to tactile and electrical somatosensory stimulation detected with high field *f*MRI in macaques: a new finding elucidated with invasive electrophysiology

Michael L. Lipton[1], Kai Ming Fu[1], Craig A. Branch[1], Charles E. Schroeder[1]
[1]The Nathan S Kline Institute for Psychiatric Research and Albert Einstein College of Medicine, Orangeburg and Bronx, NY, United States

Our initial fMRI experiments in anesthetized monkeys using electrical stimulation of the median nerve produced a surprising finding. In addition to expected activation of areas 3b and 1 contralateral to the stimulus, activation was detected ipsilateral to the stimulus (Fig1.). This result is paradoxical because there is no known anatomical substrate for it (e.g., ipsilateral thalamic or callosal projections to 3b). We explored this paradox further by looking for ipsilateral fMRI activation to tactile stimuli, and by exploring the neural correlates (electrophysiology) of ipsilateral activation in area 3b.

2524. Combined functional and Diffusion Tensor MRI of the in vivo neural circuitry in cat visual cortex at 9.4T

Mina Kim[1], Mathieu Ducros[2], Itamar Ronen[1], Keun-Ho Kim[1], Elia Formisano[3], Kamil Ugurbil[1], Rainer Goebel[3], Dae Shik Kim[1]
[1]University of Minnesota, Minneapolis, MN, United States; [2]University of British Columbia, Vancouver, British Columbia, Canada; [3]University of Maastricht, Maastricht, Limburg, Netherlands

Fiber tracking in combination with fMRI is one of the most advanced applications for investigating the pattern of the neuronal circuitry. In this study, fMRI and DTI were performed in the same cat visual cortex. The foci of fMRI activation were utilized as the seeding points for 3D DTI fiber reconstruction, and the fractional anisotropy was calculated as standard procedures for each voxel. Subsequently, fMRI and DTI tracing data were superimposed onto the spherical maps of the anatomical data. This enabled us to visualize the relationship between retinotopic representation and the thalamocortical and interhemispheric connections in a non-invasive manner.

2525. Non-invasive monitoring and tracking of cellular cardiomyoplasty

Kevin Scott Cahill[1], Sean A. Germain[1], Glenn A. Walter[1], Barry J. Byrne[1]
[1]University of Florida, Gainesville, Florida, United States

In this study, we sought to determine a novel mechanism to non-invasively monitor cardiac cell grafts through the use of magetic resonance imaging of superparamagnetic iron-oxide labeled myoblast transplants. Primary rat myoblasts were harvested and labeled with Feridex I.V.-poly-l-lysine and surface aggregates removed. Incubation with Feridex I.V.-poly-l-lysine complexes resulted in a 100% labeling efficiency for the primary myoblast. Feridex I.V-poly-l-lysine labeling did not interfere with normal cellular differentiation in vitro or cardiac engraftment in vivo. We anticipate that this technique will allow for safe, continuous monitoring of cell transfer to the myocardium.

2526. Magnetic Resonance Direct Thrombus Imaging (MRDTI) as a first line investigation for pulmonary embolism - the PDQ trial.

Alan R. Moody[1], Ian Crossley[1], Sharon Morby[1], Gota Delay[1]
[1]Nottingham University, Nottingham, Nottinghamshire, United Kingdom

Diagnosis of pulmonary embolism (PE) remains challenging. In recent years attempts have been made to substitute less invasive tests into diagnostic algorithms. The Pulmonary embolus Diagnosis at Queen's (PDQ) trial is an assessment of four different diagnostic algorithms for the diagnosis of PE using outcome as the primary end-point. One limb of this trial included MRDTI as a first line investigation for PE. The aim of this trial was to assess the outcome of patients undergoing MRDTI and the feasibility of using this investigation as a first line test.

2527. Small early enhancing hepatic lesion in cirrhosis or chronic hepatitis: Evaluation with multi-arterial phase contrast-enhanced dynamic MR imaging of the whole liver

Katsuyoshi Ito[1], Shinji Koike[1], Takeshi Fujita[1], Katsumi Sasaki[1], Ayame Shimizu[1], Toshinobu Tsukuda[1], Naofumi Matsunaga[1]
[1]Yamaguchi University School of Medicine, Ube, Yamaguchi, Japan

We evaluated the value of multi-arterial phase (6 phases) contrast-enhanced dynamic MR imaging of the whole liver obtained during the single breath-hold in distinction of small (< 3cm) hypervascular hepatocellular carcinomas (HCCs) from hypervascular pseudolesions in patients with cirrhosis or chronic hepatitis. Rapid central washout following the early enhancement of the lesion and coronal enhancement surrounding the lesion are highly specific and diagnostic findings of small hypervascular HCCs if present.

2528. Superparamagnetic iron oxide (SPIO)-enhanced T1-weighted gradient echo (T1W-GRE) MR imaging: A clue for differentiating hepatocellular carcinoma (HCC) from focal nodular hyperplasia (FNH).

Akihiro Tanimoto[1], Hiroshi Shinmoto[1], Shigeo Okuda[1], Nobuya Higuchi[1], Sachio Kuribayashi[1]
[1]Keio University School of Medicine, Tokyo, Japan

To evaluate the efficacy of SPIO-enhanced T1W-GRE in differentiating HCC from FNH, MR imaging findings of 31 HCC and 15 FNH were reviewed. 24 of 31 HCC showed low signal intensity as compared with the liver. 10 of 15 FNH showed high signal intensity, 5 of 15 showed iso intensity. Ring enhancement was noted in 20 of 31 HCC but in none of FNH. Lesions showing ring enhancement and/or low signal intensity as compared with the liver on SPIO-enhanced T1W-GRE were probably HCC (29 of 31). SPIO-enhanced T1W-GRE could provide additional diagnostic information in characterizing hepatocellular lesions.

2529. Simplified 3D T2 Musculoskeletal Imaging with Chemical Shift Separation and Visualization

Nicole L. Werner[1], Michael J. Tuite[1], Ethan K. Brodsky[1], Aiming Lu[1], Thomas M. Grist[1], Walter F. Block[1]
[1]University of Wisconsin-Madison, Madison, WI, United States

Conventional knee imaging often uses Fast Spin Echo (FSE) with fat suppression to provide proton and T2-weighted 2D slices in the sagittal and coronal planes in four overall scans. We present a method to provide this information with isotropic 3D resolution using Vastly Undersampled Isotropic Projection Imaging (VIPR) with true-FISP contrast. Two scans with low and moderate flip angles create proton density and T2-weighted volumes respectively. Instead of fat suppression, the VIPR technique produces separate fat and water volumes for each scan. We present a tool to display the fat and water simultaneously in arbitrary planes.

2530. Application of a multi-element microscopy array for cartilage imaging at 3.0T

Adrian Knowles[1], Christoph Leussler[2], Sjef Gulpers[1]
[1]Philips Medical Systems, Best, Noord Brabant, Netherlands; [2]Philips Research, Hamburg, Germany

As new drug regimes are introduced for the treatment of cartilage, or osteoporosis there is an ever increasing need to provide quantitative non-invasive methods of investigation. In this study we utilise a four element(50mm diameter) phased array microscopy coil in order to achieve improved spatial resolution, and signal:noise, on a 3.0T clinical MR system whilst maintaining clinically acceptable scantimes.

2531. Comparison of different deconvolution techniques for quantification of renal blood flow using an intravascular contrast agent

Lars Johansson[1], Stefan Schoenberg[2], Håkan Ahlström[1], Atle Bjornerud[3]
[1]Dept. of Radiology, Uppsala University Hospital, Uppsala, Sweden; [2]Institute for Clinical Radiology Ludwig-Maximilians-University, Munich, Germany; [3]Dept. of Radiology, Rikshospitalet, Oslo, Norway

Synopsis: The purpose of this study was to investigate different methods for quantitative measurements of renal blood flow. Dynamic T2* weighted imaging was performed during first pass of an intravascular contrast agent in 8 patients. No significant difference was found between non-parametric FFT, parametric FFT and the SVD method. The mean flow for all patients differed between 309 and 350 ml/100g/min between the methods. The mean standard deviation between the methods for each patient was 53 ml/100g/min.

2532. Evaluation of uterine leiomyoma vascularity based on double-echo dynamic R2* MR imaging: a feasibility study

Shigeo Okuda[1], Koichi Oshio[1], Hiroshi Shinmoto[1], Akihiro Tanimoto[1], Nobuya Higuchi[1], Masahiro Jinzaki[1], Hironori Asada[2], Sachio Kuribayashi[1]
[1]Keio University School of Medicine, Tokyo, Japan; [2]Keio University School of Medicine, Tokyo, Japan

1) We applied double-echo dynamic R2* (rate 1/T2*) MR imaging (R2*I) to evaluate vascularity of uterine leiomyoma.

2) The administration of gonadotrophin-releasing hormone (GnRH) analogue is performed as a conservative treatment to reduce the size of uterine leiomyoma. T2WI and Gd-enhanced T1WI are useful to predict the efficiency, however, it is not satisfactory. This study showed that R2*I has a possibility to promote the accuracy of the prediction of GnRH analogue efficiency.

2533. Age-Associated Changes in Apparent Diffusion Coefficient of human corpora cavernosa with diffusion-weighted Echo-Planar MR imaging

Satoru Takahashi[1], Minoru Koga[2], Masami Takeyama[2], Yoshifumi Narumi[1], Hironobu Nakamura[1]
[1]Osaka University, Graduate school of Medicine, Suita, Osaka, Japan; [2]Osaka Chuou Hospital, Osaka, Japan

Non-invasive measurements able to predict trabecular histology would improve impotence management, because decreased trabecular smooth muscle content in corpora cavernosa contributes to erectile dysfunction in the aging process. The purpose of this study was to investigate the age-associated changes in apparent diffusion coefficient (ADC) of the human corpora cavernosa. Sixty male patients underwent diffusion-weighted EPI. The ADC values of the corpora cavernosa and the corpus spongiosum were calculated, and the relationships between an increase in age and these values were analyzed. The ADC value of the corpora cavernosa significantly increased with age.

2534. A Spatio-Temporal Analytic Approach for Improved Detection of Activation in Silent fMRI

William F. Christensen[1], Zerrin F. Yetkin[2]
[1]Brigham Young University, Provo, UT, United States; [2]University of Texas Southwestern Medical Center at Dallas, Dallas, TX, United States

Silent event related FMRI (sFMRI) of auditory cortex activation is reported to overcome the confounding effects of background scanner noise. However, the sFMRI technique requires long acquisition times (30 to 40 min) to achieve statistically significant activation. Using a statistical model that accounts for the spatial and temporal correlation structure of the hemodynamic response, sFMRI becomes feasible with shorter acquisition time (9 min). The resulting activation images exhibit substantially more spatial continuity. Additionally, the approach exhibits desirable inferential properties including a lower false-positive rate than the naive two-sample t test, which ignores the correlations present in the data.

2535. Differential Transport of Mn2+ ion in Mouse Models of Alzheimer's Disease

Robia G. Pautler[1], Yuling Sheng[2], Russell E. Jacobs[2]
[1]Caltech, Pasadena, United States; [2]Caltech, Pasadena, CA, United States

During aging, the olfactory system is known to decline. Previous work has demonstrated the axonal transport of Mn2+ along the olfactory pathway in mice. In this study, we used Manganese Enhanced MRI (MEMRI) to measure the axonal transport rate of Mn2+ in young versus aged mice. A mouse model of Alzheimer's disease (AD) was also examined. Our results indicate that Mn2+ transport declines during aging. This observed decline was more dramatic in the model of AD starting at six weeks of age. The potential of using MEMRI as a predictive measure of neurodegenerative diseases is discussed.

2536. Diffusion MR detection of early white matter changes in the SIV primate model of neuroaids

Julian Z. He[1], Jane B. Greco[1], Kit Mui[1], Sahar Aminipour[1], John Kim[1], Robert Fuller[1], Eva Ratai[1], Magret Lentz[1], Prabhat Sehgal[2], Susan V. Westmoreland[2], Alex de Crespigny[1], R Gilberto Gonzalez[1]
[1]MGH, Boston, MA, United States; [2]NERPRC, Southborough, MA, United States

In this study of SIV macaques, FA and ADC measurement were performed in four different anatomic locations in the animal brain, we found that the fractional anisotropy was significantly decreased in the splenium of the corpus callosum between the pre-inoculation and 11 days post-inoculation. The result shows that DTI can be used to detect changes in the SIV infected macaque very early in the course of infection, and suggests DTI will prove useful in the study of the pathogenesis of SIV infection.

2537. Regional quantification of lung ventilation parameters using polarized helium3 imaging

David Dupuich[1], Yves Berthezène[2], Pierre-Louis Clouet[2], Vasile Stupar[1], Emmanuelle Canet[2], Yannick Crémillieux[1]
[1]laboratoire de RMN, Villeurbanne, Rhône, France; [2]CREATIS, Lyon, Rhône, France

The purpose of this study was to apply hyperpolarized 3He dynamic ventilation imaging for assessment and quantification of local ventilation parameters. Both acquisition technique and signal processing procedure, referred as a whole as SPIRO (Sliding Pulmonary Imaging for Respiratory Overview), were tested in vivo in healthy rats and broncho-constriction methacholine induced animal models using a contrast media injector for controlled 3He flow and volume injection in the animal lungs. Parametric maps of gas arrival time, filling time constant, inflation rate, gas volume were generated. Inflation rate values measured in the lungs were found to decrease with increasing doses of methacholine.

2538. Comprehensive morphological and functional MR assessment of early neonatal brain injury in a piglet model.

Berit Holthe Munkeby[1], Kristin Lyng[1], Jan Frederik Frøen[1], Eldrid Winther-Larsen[1], Jan Henrik Rosland[2], Hans Jørgen Smith[1], Ola Didrik Saugstad[1], Atle Bjørnerud[1]
[1]Rikshospitalet, Oslo, Norway; [2]Aker Univeristy Hospital, Oslo, Norway

Aim: To develop a pig model for early diagnosis of brain injury in neonates using MR perfusion and diffusion imaging. Methods: Hypoxia-ischemia (HI) was induced for 30 min. in newborn domestic pigs (n=10; age 12-36 hrs), followed by 2.5 hrs reoxygenation/reperfusion. Perfusion (rBF) and diffusion (ADC) maps were obtained pre-, during-, 30 min post- and 2.5 hrs post-HI. Results: Extent of ischemia was well delineated on the rBF maps and degree of collateralization varied significantly between animals complicating interpretation of post HI changes. ADC was significantly reduced during HI, with a slight increase towards baseline at 2.5 hrs.

2539. REduced Scan Time Phase Encoded Echo Planar Imaging (REST-PEEP)

David N. Guilfoyle[1], Jan Hrabe[1]
[1]Nathan Kline Institute, Orangeburg, New York, United States

A new form of Phase Encoded Echo Planar (PEEP) is presented in this work. In this new approach the number of separate experiments is halved compared to the standard PEEP experiment. By using alternating gradient blips, two experiments can be made within one acquisition. This scheme can be used for Chemical Shift Imaging as well as 3D spatial imaging. Preliminary results for both CSI and 3D measurements are presented in this study.

2540. Single-shot dual-echo EPI detects functional activation of the cerebellum during duration working memory task

Klaus Mathiak[1], Ingo Hertrich[1], Nikolaus Weiskopf[1], Wolfgang Grodd[1], Hermann Ackermann[1]
[1]Univ Tuebingen, Tuebingen, Germany

The cerebellum was suggested to subserve cognitive function by timing operations. In order to conduct a functional imaging study of the basal brain structures, we applied single-shot dual-echo echo planar imaging (EPI). As compared to conventional EPI, image distortion and acquisition time (TA = 1.8 sec / 28 slices) were reduced without deteriorating the contrast-to-noise ratio (CNR). Using TE = 28 and 66 ms at 1.5 T, echoes were combined for locally optimal T2*-weighted CNR. Right Crus I of the cerebellum exhibited increased signal selectively to working memory operations on auditory pause durations (30 140 ms) independent of stimulus parameters.

2541. Longitudinal In-Vivo Proton MRS Studies of SIV / Macaque Model of NeuroAIDS

Robert Alan Fuller[1], Eva-Maria Ratai[1], Jane B. Greco[1], Julian He[1], Ken E. Sakaie[1], Patricia Lani Lee[1], Magaret Lentz[1], John P. Kim[1], Prabhat K. Seghal[2], Andrew A. Lackner[3], Susan V. Westmoreland[4], R. Gilberto Gonzalez[5]
[1]Martino Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]New England Regional Primate Research Center, Southborough,, MA, United States; [3]Tulane Regional Primate Research Center, Covington, LA, United States;

[4]New England Regional Primate Research Center, Southborough, MA, United States; [5]Martino Center for Biomedical Imaging, Neuroradiology Division, Massachusetts General Hospital, Boston, MA, United States

A longitudinal in vivo proton MRS brain study of the SIV/macaque model of neuroAIDS resulted in 3 striking observations. Most notable was the finding that elevated basal ganglia Cho predicted subsequent development of SIV encephalitis. Second, a negative correlation between the neuronal marker NAA and viral load was observed, with NAA diminishing as plasma virus levels increased. Finally, we found a significant correlation in both the basal ganglia and frontal cortex between the Cho level and the CD8+ T cell lymphocyte count. These observations have significant clinical implications since proton MRS has emerged as the preeminent neuroimaging method.

2542. Quantification of age-related white matter lesions: a semi-automated method

Faiza Admiraal-Behloul[1], Dominique van den Heuvel[1], Jorrit Schaap[1], Hans Olofsen[1], Nicole Schmitz[1], Mark A. van Buchem[1]
[1]Leiden University Medical Center, Leiden, Netherlands

The goal of this work was to develop an accurate semi-automated method to quantify cerebral white matter lesion load in a large study in geriatric subjects (527 subjects scanned twice). The time window to analyze one scan was set at 25 minutes including user interaction. In our approach, the computer segments automatically the lesions, then the user reviews and corrects false positives/negatives. The automatic segmentation part was evaluated for scan-rescan variability with and without repositioning in 9 subjects. The intra and inter rater variability was estimated in 10 subjects. The obtained Intra Class correlation Coefficients (ICC) showed very high reproducibility.

2543. Visual Assessment of MR Perfusion Imaging: A Dose Finding Study

Eike Nagel[1], Ingo Paetsch[1], Daniela Foell[2], Christoph Klein[1], Simon Schalla[1], Eckart Fleck[1]
[1]German Heart Institute, Berlin, Germany; [2]Albert-Ludwgs-Universität, Freiburg, Germany

We aimed to determine the optimal dose for a visual detection of perfusion defects. 49 patients scheduled for invasive angiography were examined at adenosine stress and rest. Patients were assigned to three different dose groups of gadodiamide (0.05, 0.1 and 0.15 mmol). Results: The highest diagnostic accuracy was reached for a dose of 0.1mmol gadodiamide/kg body weight (sensitivity: 89%; specificity: 80%).

2544. The Role of Imaging time after Gd-DTPA injection on Infarct Size Measurements With Contrast-Enhanced MRI in a canine reperfused infarct model.

Luciano C. Amado[1], Bernhard L. Gerber[1], Sandeep N. Gupta[2], Gilberto Szarf[1], Joao A. C. Lima[1], Dara L. Kraitchman[1]
[1]Johns Hopkins University, Baltimore, Maryland, United States; [2]GE Medical Systems, Baltimore, Maryland, United States

Delayed contrast-enhanced MRI was used to assess infarct size in a closed-chest canine model of acute myocardial infarction (MI). Images were acquired up to 30 minutes after contrast injection. Infarct size and transmurality extent by MRI was measured using thresholding by the full width at half maximum (FWHM) criterion. MRI results were compared for different delay times and no statistically significant differences were found, as confirmed by Bland-Altman plots. Using an objective technique as FWHM, imaging time between 5 and 30 minutes after contrast injection can be used interchangeably to determine infarct size.

2545. Instrument Tracking System Using Fluor Markers.

Gösta Ehnholm[1], Matti Lindström[1], Mika Ylihautala[1], Erkki Vahala[1]
[1]Philips Medical Systems MRT Finland, Vantaa, Finland

MRI has been used increasingly to guide various clinical interventions.Tracking of the tools has been done in different ways, including a separate, e.g. optical, system, or the use of pickup coils for sensing the change in gradient field strength. Magnetic resonance methods have also been popular, many using dedicated microcoils around proton markers. We demonstrate a novel and robust MR method using 19F markers.

2546. Real Time MRI Needle Tracking

Eyal Kochavi[1], Haim Azhari[1]
[1]Technion IIT, Haifa, Israel, Israel

A new technique for MRI needle tracking is presented. The technique is based on k-space investigation of the difference image between the current dynamic frame and a reference one. Using only a few central k-lines of the difference image and a nonlinear optimization procedure the parameters that characterize the Sinc signature generated by the needle are resolved, and the needle location is obtained. The procedure was tested in computer simulations and in actual MRI scans. An acceleration factor of five was obtained using only six sampled k-lines. A typical RMS error of 1-2 pixels in needle tip location was achieved.

2547. Non-invasive characterisation of the severity of hepatitis C related liver disease using ^{31}P-magnetic resonance spectroscopy.

Adrian Lim[1], Nayna Patel[1], Gavin Hamilton[1], Joseph Hajnal[1], Simon Taylor-Robinson[1]
[1]Imaging Sciences, Faculty of Medicine, Imperial College, London, United Kingdom

There is no satisfactory non-invasive test to grade severity of diffuse liver disease. We performed in vivo hepatic ^{31}P MRS (ISIS: TR 10,000ms; 70mm^3 voxel) in 15 normal volunteers and 48 patients with hepatitis C virus (HCV) related liver disease. An increase in the PME/PDE ratio ($p<0.001$) was observed with increasing severity of disease. This study suggests that ^{31}P MRS can differentiate mild from moderate hepatitis and cirrhosis. It is an encouraging non-invasive tool and should be used as an adjunct in the work up of patients with diffuse liver disease.

2548. Vector Field Restoration for MR Phase Contrast Velocity Mapping

Yin-Heung Pauline Ng[1], Spencer Sherwin[1], Guang-Zhong Yang[1]
[1]Imperial College of Science, Technology and Medicine, London, United Kingdom

The analysis of blood flow patterns plays an important role in the study of cardiovascular function. To improve the accuracy of the quantitative analysis of flow features in MR flow velocity images, we propose a variational method formulated as a constrained optimization problem for the restoration of flow vector fields. A new computational algorithm based on the First Order Lagrangian method is proposed for solving the optimisation problem. The proposed method has been validated with both simulated flow data and MR velocity maps acquired from patients with sequential MR examination following myocardial infarction.

2549. Influence of dielectric resonance phenomena on calibration of NMR signals measured by high field MRS using local transmit/receive coils

Frank Seifert[1], Gerd Wuebbeler[1], Florian Schubert[1], Herbert Rinneberg[1]
[1]Physikalisch-Technische Bundesanstalt, Berlin, Germany

Due to the wave behavior of the B1 field at B0 fields ≥3T a pronounced asymmetry exists between the clockwise and counter-clockwise rotating transversal B1 field components causing a considerable imbalance between the transmitting and receiving sensitivities of a NMR coil. This unwanted artifact affects the absolute calibration of MR spectra based on the principle of reciprocity. To address this issue B1 field measurements in phantoms and in vivo at 3T and FDTD calculations were performed. In applications in vivo coil errors of the amplitude calibration constant of up to 80% were observed affecting clinical high field MRS considerably.

2550. Differentiating High-Grade and Low-Grade Neuroepithelial Brain Tumors: Stereotactic Biopsy versus Proton MR Spectroscopy

Sebastian Herminghaus[1], Ulrich Pilatus[1], Matthias Setzer[1], Gerhard Marquardt[1], Heinrich Lanfermann[1], Volker Seiffert[1], Friedhelm E. Zanella[1]
[1]Johann Wolfgang Goethe-Universität, Frankfurt, Germany

Grading of unresectable brain tumors is performed on biopsy samples obtained by CT- or MR-guided stereotactic biopsy. This prospective study tested the hypothesis that single voxel 1H MRS and stereotactic biopsy are of equivalent diagnostic value, with regard to differentiating high-grade from low-grade brain tumors. In a series of 80 consecutive patients observer-independent classification of tumor 1H MR spectra and histopathology performed on stereotactic biopsy samples yielded consistent results in 72 cases (concordance: $p<0.0005$; Cohens Kappa: 0.76; sensitivity/specificity: 89%/94%). The result indicates that both methods are of similar value with respect to differentiating high-grade and low-grade brain tumors.

2551. DETERMINATION OF BIOENERGETIC RESERVE IN ARTHRITIS-INDUCED MUSCLE DYSFUNCTION BY IN-VIVO 31P NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Craig J. Galban[1], Shari M. Ling[1], Christine E. Kasper[2], Richard G. S. Spencer[1]
[1]National Institutes of Health, Baltimore, Maryland, United States; [2]Johns Hopkins University, Baltimore, Maryland, United States

It is unclear whether muscle dysfunction in arthritis is secondary to disuse-induced atrophy or to specific correlates of the arthritis process. We hypothesized that, in fact, the biochemical and bioenergetic sequelae of arthritis would differ significantly from those of pure atrophy. We investigated muscle function, muscle bioenergetics, cytokine expression, and muscle fiber type in the rat secondary to atrophy, adjuvant-induced arthritis, and a combination of these. Our results suggest that muscle dysfunction secondary to arthritis and to atrophy are distinct.

2552. Muscle specific strength, intramuscular energy metabolism, and other indices of mitochondrial function are not altered in HIV-infected patients with marked peripheral lipoatrophy

Giorgos Sakkas[1], Jane Kent-Braun[2], Kathleen Mulligan[1], Julie Doyle[3], Mark Knudsen[3], Ian Lanza[2], Danielle Bartholomew[2], Makani DaSilva[1], Thomas Schleich[4], Morris Schambelan[1]
[1]UCSF/SFGH, San Francisco, CA, United States; [2]University of Massachusetts, Amherst, MA, United States; [3]VA/UCSF, San Francisco, ca, United States; [4]UCSD, Santa Cruz, CA, United States

Lipoatrophy (LA) in patients with HIV infection may be a manifestation of mitochondrial toxicity. We compared measures of muscle specific strength, energy metabolism and intramyocellular lipids in 8 HIV+men with severe LA and 8 HIV+ with normal body fat content. Those with LA had marked fat depletion but no changes in total lean body mass. There were no differences in strength in the tibialis anterior muscle. PCr/Pi ratio and pH did not differ between groups at rest and during recovery after exercise. We detected no evidence of disturbed energy metabolism HIV-infected men with LA.

2553. 3T MR imaging of contrast enhancing brain tumors. Intra-individual comparison of standard and half-standard clinical dose at 3T and 1.5T

Carsten Krautmacher[1], Henriette Tschampa[1], Frank Träber[1], Winfried A. Willinek[1], Mark Born[1], Jochen Textor[1], Horst Urbach[1], Christiane Kuhl[1], Jürgen Gieseke[2], Hans H. Schild[1]
[1]Department of Radiology, University of Bonn, N/A, Germany; [2]Philips Medical Systems, N/A, Germany

Contrast enhanced MRI is a gold standard in the diagnosis of brain tumors. In clinical practice, 0.1mmol/kg of Gadolinium-contrast agent is commonly considered the standard dose.

As T1-relaxation times and SNR increase with field strength, T1-shortening contrast agents may be more effective at higher magnetic fields.

To quantify these effects in-vivo, we performed an intra-individual comparative trial on patients with contrast enhancing brain lesions. Aim was to find out whether the increased SNR and CNR and the increased relaxation times at higher magnetic field allow one to reduce the dose of contrast agent at a given lesion contrast.

2554. Responsive Paramagnetic CEST Agents

Silvio Aime[1], Enzo Terreno[1], Daniela Delli Castelli[1], Flemming Ullrich Nielsen[2]
[1]Department of Chemistry IFM - University of Torino, Torino, Italy; [2]MRI Center - BioIndustry Park, Colleretto Giacosa, TO, Italy

Paramagnetic CEST agents are a novel class of negative contrast media whose mechanism of action is based on saturation transfer (ST) through chemical exchange. If the CEST agent possesses two different sets of mobile protons, the evaluation of their ST ratio is independent from the absolute concentration of the agent, a fundamental requisite for designing responsive systems. On this basis, selected macrocyclic Lanthanide(III) complexes have been investigated as responsive probes for the assessment of pH and concentration of metabolites.

2555. Comparison of the Dendrimer-Based Macromolecular Contrast Agents for the Dynamic Micro-Magnetic Resonance Lymphangiography

Hisataka Kobayashi[1], Satomi Kawamoto[2], Noriko Sato[3], Peter L. Choyke[3], Michael V. Knopp[4], Robert A. Star[5], Thomas A. Waldmann[1], Yutaka Tagaya[1], Martin W. Brechbiel[1]
[1]NCI/NIH, Bethesda, Maryland, United States; [2]Johns Hopkins University, Baltimore, Maryland, United States; [3]CC/NIH, Bethesda, Maryland, United States; [4]The Ohio State University, Columbus, Ohio, United States; [5]NIDDK/NIH, Bethesda, Maryland, United States

Few methods are currently available to visualize the lymphatic system. We have recently developed a method of micro-magnetic resonance lymphangiography (MRL) in mice. In this study, three dendrimer-based MRI contrast agents; PAMAM-G8, DAB-G5, and PAMAM-G4, were compared for particular visualization of the lymphatic system. Additionally, two established MRI contrast agents of intravenous use; Gadomer-17 and Gd-[DTPA]-dimeglumine (Magnevist) were used as comparative control agents. PAMAM-G8 was advantageous for visualizing lymphatic vessels. DAB-G5 was suited for visualizing lymph nodes. PAMAM-G4 showed intermediate characteristics between PAMAM-G8 and DAB-G5. Clear images were not obtained using Gd-[DTPA]-dimeglumine, while lymph modes were detectable with Gadomer-17.

2556. TUMOR TARGETING OF A PARAMAGNETIC CONTRAST AGENT USING NIOSOMES BEARING GLUCOSE LIGANDS AND PEG RADICALS

Alain Luciani[1], Jean-Christophe Olivier[2], Olivier Clément[3], Nathalie Siauve[4], Florence Gazeau[5], Edmond Kahn[6], Pierre-Yves Brillet[4], Bertrand Bessoud[4], Guy Frija[4], Charles-André Cuenod[4]
[1]Hôpital Européen Georges Pompidou, Paris, France; [2]Faculté de Pharmacie Galénique, Poitiers, France, France; [3]Hôpital Européen Georges Pompidou, Paris, France, France; [4]Hopital Européen Georges Pompidou, Paris, France, France; [5]LMDH, Jussieu, Paris, France, France; [6]INSERM U494, Paris, France, France

In order to improve tumor-targeting, magnetic agents can be linked to different vectors and especially to liposomes or niosomes (polymeric vesicles) bearing specific tumor ligands 1-3. Several authors have suggested that additional liposome coating with polyethylene-glycol (PEG) radicals (so-called sterically stabilized vesicles) allowed reduced reticulo-endothelial (RES) clearance and thus provided additional efficient passive targeting to tumor cells 4,5.

Our aim was to design and optimize tumor targeting of a paramagnetic contrast agent encapsulated in a chitosan based polymeric vesicle (niosome) bearing both PEG radicals and glucose-ligands targeted towards tumor over-expressed GLUT-1 glucose transporters.

2557. Cellular imaging of magnetically labelled hybridomas in mice

Pierre Smirnov[1], Florence Gazeau[2], Maite Lewin[1], Nathalie Siauve[1], Charles Andre Cuenod[1], Claire Wilhelm[2], Edmond Kahn[1], Catherine Vayssettes[1], Jean-Claude Bacri[2], Guy Frija[1], Olivier Clement[3]
[1]Faculté Necker Inserm U 494, Paris, France, France; [2]LMDH, CNRS UMR 7603, Paris, France, France; [3]Faculté Necker Inserm U 494, Paris, France

Hybridoma cells were labelled with anionic superparamagnetic iron oxide nanoparticles. Quantification of iron load was obtained by Magnetophoresis (measurement of cell velocity in a magnetic field gradient) and Electron Spin Resonance. Splenic uptake of labelled hybridomas was studied with MRI at 1.5 T. Maximum iron uptake by hybridomas was 5 pg with a good correlation between both methods. A decrease in MRI signal was observed in the spleen 24 hrs after injection of 20 millions cells, consistent with an uptake of labelled hybridomas by this organ. This study demonstrates the feasibility of cellular imaging using anionic particles.

2558. In vivo Detection of Gastric Cancer in Rats by Electron Paramagnetic Resonance Imaging

Guanglong He[1], Tomiko Mikuni[2], Sergey Petryakov[1], Mohanad M. Fallouh[1], Yuanmu Deng[1], Periannan Kuppusamy[1], Masaharu Tatsuta[2], Jay L. Zweier[1]*
[1]EPR Center, Davis Heart and Lung Research Institute, The Ohio State University College of Medicine, Columbus, Ohio, United States; [2]Department of Gastrointestinal Oncology, Osaka Medical Center for Cancer and Cardiovascular Diseases, 1-3-3 Nakamichi, Higashinari-Ku, Osaka 537-8511, Japan

Electron Paramagnetic Resonance Imaging (EPRI) has provided in vivo information regarding alterations in the redox state of tumors. Using 3-CP (3-carboxamido-2,2,5,5-tetramethylpyrrolidine-N-oxyl) spin probes, EPRI was performed in a rat gastric cancer model induced by 1-methyl-3-nitro-1-nitrosoguanidine (MNNG) to visualize the redox alteration in gastric carcinoma. In the treated rats with gastric cancer tumors it was observed that holes were present at the locations of the tumors due to its higher reduction rate. We concluded that the gastric cancer tumors could be distinguished from the normal tissue based on the difference in its rate of radical metabolism.

2559. *In vivo* Investigation of The Skin Redox Status Using EPR Imaging

Guanglong He[1], Mohanad M. Fallouh[1], Periannan Kuppusamy[1], Jay L. Zweier[1]*
[1]EPR Center, Davis Heart and Lung Research Institute, The Ohio State University College of Medicine, Columbus, Ohio, United States

Electron paramagnetic resonance imaging (EPRI) instrumentation at S-band (2.2 GHz) has been developed to enable in vivo mapping of the redox status of the skin of rats. 15N-PDT (4-oxo-2, 2, 6, 6-tetramethyl piperidine-d16-1-15N-oxyl) used as redox probe. Superoxide dismutase (SOD)-mimetic compound (dichloro (4R,9R,14R,19R)-3,10,13,20,26-pentaazatetracyclo [20.3.1.04,9.014,19] hexacosa-1(26),22(23),24-triene) was used to induce alterations in the redox status by mediating the oxidative stress and antioxidant potential of the skin constituents. Skin metabolic properties interpreted as the reduction rate constants were obtained. From the EPRI of the SOD-mimetic treated skin, it was observed that the nitroxide in the deeper layer was diminished faster.

2560. High-Resolution Microscopic MRI (μMRI) Study of Early Experimental Osteoarthritis of Canine Tibial Plateau Cartilage

Hisham A. Alhadlaq[1], Yang Xia[1], Jonathan B. Moody[1], John Matyas[2]
[1]Oakland University, Rochester, MI, United States; [2]University of Calgary, Calgary, Alberta, Canada

Microscopic MRI (μMRI) is used to study experimental model of osteoarthritis (OA) in tibial cartilage. T2 relaxation images reveal that at the early stages of OA, tibial cartilage exhibits intense band, correlated with the most random zone, similar to normal cartilage. Also, T2 is able to detect a change in the total thickness due to OA. However, the change in total thickness is not significant in the center of the tibia. We observe variations in the degree of OA, measured from the change in the total thickness and T2 profiles, which suggest a topographical difference of OA effect.

2561. Brain templates for the elderly

Faiza Admiraal-Behloul[1], Dominique van den Heuvel[1], Hans Olofsen[1], Nicole Schmitz[1], Mark A. van Buchem[1]
[1]Leiden University Medical Center, Leiden, Netherlands

MR images of geriatric subjects are not congruent with the Montreal Neurological Institute (MNI) brain templates for three main reasons: brain atrophy, presence of large white matter lesions and finally lower signal-contrast between white and gray matter. The purpose of this work was to generate new templates dedicated to studies on geriatric subjects. We normalized 432 brains (237 males and 195 females, mean age 74.8 ± 3.37 years) and generated proton density (PD), T2, intracranial (IC) and cerebro-spinal fluid (CSF) average images. Furthermore, we generated prior probability distribution maps of age-related white matter lesions.

2562. A Combination of Rigid and Elastic Registration Methods for a Standard Atlas of the Knee

J P. Slavinsky[1], Eugene Ozhinsky[1], Sharmila Majumdar[1]
[1]University of California, San Francisco, San Francisco, California, United States

In osteoarthritis and cartilage studies, quantitative inter-subject analysis is often difficult due to anatomical variation. This study describes a combination of registration techniques that defines a point-to-point mapping between two image volumes. Based on manually placed landmarks in two volumes, two transformations are computed: a rigid-body transformation that minimizes the squared distance between corresponding landmarks and an elastic transformation based on compactly supported radial basis functions. Results are shown for the spatial normalization of a source femur to a target femur. Slices and femoral cartilage thickness maps are shown for the volumes.

2563. Phased Array Sensitivity Correction using Discrete Wavelet Regularization

Christina Triantafyllou[1], Anders Dale[1], Bruce Fischl[1], Susanne Knake[1], Lawrence Wald[1]
[1]MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States

Spatial intensity inhomogeneities arising from multiple phased array receiver coils require a two-step normalization procedure. Firstly, the surface coil transfer function must be computed, and secondly, this spatial profile must be deconvolved from the observed image. In this method, the transfer function of the phased array coils is estimated from the ratio of two calibration scans, one acquired with a whole body coil and the other with a phased array. We have also developed a regularization scheme that pretreats the underlying noise characteristics of the measured image, and enables the inversion to be performed in a numerically stable way.

2564. Velocity analysis is the preferential approach in evaluating Magnetic Resonance velocity maps of coronary artery bypass grafts

Liesbeth P. Salm[1], Susan E. Langerak[1], Hubert W. Vliegen[1], J. W. Jukema[1], Jeroen J. Bax[1], Aeilko H. Zwinderman[2], Ernst E. van der Wall[1], Albert de Roos[1], Hildo J. Lamb[1]
[1]Leiden University Medical Center, Leiden, Netherlands; [2]Academic Medical Center, Amsterdam, Netherlands

Forty-nine patients with previous CABG underwent coronary angiography and cardiovascular magnetic resonance of the grafts to determine coronary flow and flow reserve. Volume flow and velocity analysis of the grafts was performed and compared.

Bland-Altman analysis showed close agreement between both analyses. Comparison of ROC areas-under-the-curve of both analyses revealed no significant differences for detection of stenoses ≥70%. In single vein grafts, diagnostic accuracy for volume flow and velocity parameters was 92% and 93%, respectively. Velocity analysis appears to be the method of preference, as this approach is less time-consuming and has a comparable diagnostic accuracy as volume flow analysis.

2565. A Deformable Model Approach for Automatic Detection of Tag Features in 3D within a Bayesian Framework

Yasheng Chen[1], Amir A. Amini[1]
[1]Washington University in St. Louis, St. Louis, MO, United States

A 3D B-spline deformable model is employed to track the location of cardiac tissue material points with its spline parameters. We propose an automatic approach for tag features tracking in multiple parallel short-axis and spiral long-axis image slices. This approach formulates the tag detection problem in a Bayesian framework. The tag lines on 2D images are tracked with the model curves derived from intersecting the image slices with iso-parametric surfaces within the 3D B-spline model.

2566. Non-contrast enhanced abdominal MR angiography using steady-state coherent sequence

Noriyoshi Morimoto[1], Yuji Watanabe[1], Takashi Tabuchi[1], Hideki Mitsui[1], Kazuaki Nakada[1], Masayuki Kumashiro[1], Kazuyuki Yamamoto[1], Keisuke Ohtsuki[1], Makoto Obara[2], Masako Nagayama[1]
[1]Kurashiki Central Hospital, Kurashiki, Okayama, Japan; [2]Philips Medical Systems Corp., Minato-ku, Tokyo, Japan

Steady-state coherent gradient-echo sequences have been applied to abdominal imaging of the abdomen. Both flowing and static fluid shows high signal intensity relative to other tissues, which has proved to be favorable for imaging the vascular system without any contrast material.

In this sequence, fat suppression technique is essential to demonstrate small vessels of the abdomen. Among the three FS strategies, SPIR, ProSet and Phase Cycling technique, PC gave the excellent image contrast with minimal artifact.

2567. A Simple Single Shot Interleaved EPI Sequence for fMRI

David N. Guilfoyle[1], Matthew Hoptman[1], Patrick S. O'Donnell[1], Karen Nolan[1]
[1]Nathan Kline Institute, Orangeburg, New York, United States

A simple single shot interleaved EPI experiment is presented in this work. The basic premise is to break down the EPI acquisition into an odd number of interleaves applied in immediate succession with variable flip angles. In this approach there is no loss of temporal resolution compared to conventional EPI but susceptibility distortions are minimized. The technique was applied in an fMRI experiment of the human amygdala at 3T, which is known to be problematic.

2568. Electric Current Type Selective Electric Current Density Imaging Techniques

Igor Sersa[1]
[1]Jozef Stefan Institute, Ljubljana, Slovenia

Three techniques for electric current density imaging (CDI), two standard ones DC-CDI and AC-CDI and a new AC-DC-CDI, are compared in their ability to selectively detect electric current of different type of charge carriers. It is demonstrated with experiments on a model sytem that the DC-CDI technique detects electric current of mobile ions only, the AC-DC-CDI technique of fixed ions only and the AC-CDI technique of both types of charges. The three techniques may play an imporatnt role in the study of electric conductivity phenomena in biological systems.

2569. Increased In-plane Heterogeneity Resulting from Reduced Refocusing Flip Angles in Fast Spin Echo Imaging at High Fields

Jason Kraig Mendes[1], Derek J. Emery[1], Alan H. Wilman[1]
[1]University of Alberta, Edmonton, Alberta, Canada

When performing fast spin echo imaging at magnetic fields of 3 T and higher, the tendency has been to reduce the refocusing flip angles in order to overcome RF heating problems. This work illustrates that reducing the flip angles can lead to increased in-plane heterogeneity in the image (15% more heterogeneous for a 33% reduction in refocus flip angle). This effect is not visible at 1.5 T, but is significant at 3 T and higher fields. The effect is demonstrated and explained using 1.5 T and 3 T fast spin echo images.

2570. Diffusion Model Based Non-linear Warping for Distortion Corrections in Diffusion Tensor Images.

Siamak Ardekani[1], Usha Sinha[1]
[1]UCLA, Los Angeles, CA, United States

EPI based diffusion tensor images suffer from geometric distortions both due to local magnetic field inhomogeneities as well as eddy current effects arising from the large diffusion gradients applied to obtain diffusion weighted images. Previous work has used affine transformations to align images from a diffusion-weighted set to a baseline image with no diffusion weighting. We propose a non-linear warping method based on optical flow that aligns the baseline and diffusion weighted images to a diffusion image generated from a corresponding T2 weighted SE image.

2571. Interactive Inhomogeneity Map for use in Single Voxel Magnetic Resonance Spectroscopy Localization

David Neustadter[1], Moshe Gomori[2]
[1]GE Medical Systems, Netanya, Israel; [2]Hadassah University Hospital, Ein Karem, Jerusalem, Israel

When performing single voxel proton spectroscopy in the brain, the clinical utility of the spectra is often reduced by peak widening resulting from local magnetic field inhomogeneity. We have developed a tool that uses phase maps to construct a map in which the value of each pixel indicates the total magnetic field inhomogeneity within a voxel of a particular size centered at that location. This map allows the user to avoid regions of local inhomogeneity when prescribing the spectroscopy voxel, thereby improving the clinical utility of the resulting spectra.

2572. General Electrophysiology System for MRI

Giorgio Bonmassar[1], Patrick P. Purdon[2], John W. Belliveau[3]
[1]Massachusetts General Hospital, Charlestown, United States; [2]MIT, Cambridge, MA, United States; [3]Massachusetts General Hospital, Charlestown, MA, United States

In this work we present a new system for recording different types of electrophysiological signals during Magnetic Resonance Imaging (MRI). The same instrument can perform 32 channels EEG and EPR recordings at 1 KS/s or up to 20 KS/s using 8 channels. This enables concurrent recordings of EEG scalp potentials and intercranial recordings at different sampling rates. The system can also be used for recording during MRI: galvanic skin response (GSR), electromyogram (EMG) and electrical impedance tomography (EIT).

2573. Quantification of Anti-Angiogenesis: Longitudinal Monitoring of Blood Volume and Vascular Water Exchange Rate in Response to VEGF-R2 Tyrosine Kinase Inhibitor

Young Ro Kim[1], Alex Petrovsky[2], D Shalinsky[3], D Hu-Lowe[3], Ralph Weissleder[2], Alex Bogdanov[2]
[1]NMR/MGH, Charlestown, MA, United States; [2]CMIR/MGH, Charlestown, MA, United States; [3]Pfizer Pharmaceutical, San Diego, CA, United States

The feasibility and efficacy for monitoring vascular parameters were investigated using steady state MRI technique. Mice with human MV522 xenografts were treated with AG013925 VEGF-R2 Tyrosine Kinase (TK) inhibitor and were imaged after three treatments and one week course of 2xBID. The measured blood volume (Vb) was 2.66±0.99% for the striated muscle and 2.52±1.47% for the tumor one week after the implantation. Tumor Vb markedly decreased after one day of treatment and remained low. The vascular water exchange rate in tumor vessels was much higher than that of striated muscle before the treatment while the treatment significantly reduced the rate.

2574. Correlation of metabolite content, tumor grade and heterogeneity in breast cancer biopsies

Beathe Sitter[1], Hans E. Fjoesne[2], Jostein Halgunset[3], Tone F. Bathen[1], Steinar Lundgren[4], Ingrid S. Gribbestad[1]
[1]SINTEF Unimed, MR-Center, Trondheim, Norway; [2]Trondheim University Hospital, Department of Surgery, Trondheim, Norway; [3]Trondeim University Hospital, Department of Histology, Trondheim, Norway; [4]Trondheim University Hospital, Department of Oncology, Trondheim, Norway

Metabolic profile of breast cancer specimens varies between samples. The aim of this study was to investigate the correlation between metabolite concentrations and histopathological grading and sample tissue composition. Cancer tissue (n=12) and non-involved tissue (n=4) from breast cancer patients was analyzed using HR MAS and examined microscopically after MR analysis. Metabolite concentrations were estimated and correlated to patient diagnosis. Cholines were found in higher concentrations in tumor than in non-involved tissue. The histopathological examination showed a variable composition of fat, connective and glandular tissue and that content of tumor cells varied from 0 to 75%.

2575. Breast Cancer biopsy heterogeneity assessed by microMRI, histopathology and HR MAS spectroscopy

Ingrid S. Gribbestad[1], David Axelson[2], Beathe Sitter[1], Jostein Halgunset[3], Tone F. Bathen[1], Hans E. Fjoesne[4], Steinar Lundgren[5]
[1]SINTEF Unimed MR Center, Trondheim, Norway; [2]MRi Consulting, Kingston, Ontario, Canada; [3]Trondheim University Hospital, Department of Pathology, Trondheim, Norway; [4]University Hospital of Trondheim, Department of Surgery, Trondheim, Norway; [5]University Hospital of Trondheim, Department of Oncology, Trondheim, Norway

Breast tissue composition varies considerably among different biopsy samples. The aim of the study was to correlate microMRI, histopathological findings and HR MAS from the same samples to investigate the effect of sample heterogeneity on biochemical profiles of breast biopsies. The microMRI data was acquired after the HR MAS experiment and analysed using multivariate image analysis, including SIMCA and k means cluster analysis. Tumor content determined by histopathology varied from 0 to 80%. Multivariate analysis of the microMRI data showed that image components could be estimated, suggesting that microMRI can assess sample heterogeneity in MRS studies.

2576. Micro-Magnetic Resonance Lymphangiography in Lymphatic Disease Model Mice Using a Novel Dendrimer-based MRI Contrast Agent

Hisataka Kobayashi[1], Satomi Kawamoto[2], Noriko Sato[3], Robert A. Star[4], Thomas A. Waldmann[1], Yutaka Tagaya[1], Martin W. Brechbiel[1]
[1]NCI/NIH, Bethesda, Maryland, United States; [2]Johns Hopkins University, Baltimore, Maryland, United States; [3]CC/NIH, Bethesda, Maryland, United States; [4]NIDDK/NIH, Bethesda, Maryland, United States

Few methods are currently available to visualize the entire deep lymphatic system in mice. We have developed a new method of micro-magnetic resonance lymphangiography (MRL) in mice, which employs a dendrimer-based MRI contrast agent [G8-(1B4M-Gd)$_{1024}$]. Micro-MRL imaging clearly visualized most of the mouse lymphatic system, including both lymphatics and lymph nodes in mice. The method enabled us to detect lymphangitic dilatation of lymphatic vessels and distinguish between lymphoma/lymphoproliferative, metastatic, and inflammatory lymphoadenopathy. We conclude that micro-MRL can detect abnormal lymphatic system and classify different immunological and hematological disorders in mice.

2577. Standard 0.5 M Gd-Chelate (Magnevist®) vs. Weak Protein Interacting 0.5 M Gd-Chelate (MultiHance®) vs. 1.0 M Gd-Chelate (Gadovist®): Dose-independent Effect on Image Quality of Pelvic 3D MRA

Mathias Goyen[1], Christoph U. Herborn[1], Florian M. Vogt[1], Thomas C. Lauenstein[1], Jörg F. Debatin[1], Stefan G. Ruehm[1]
[1]University Hospital Essen, 45122 Essen, NRW, Germany

Intraindividual, double-blinded, cross-over comparison of Gd-DTPA (Magnevist®), Gd-BOPTA (MultiHance®) and Gadobutrol (Gadovist®) in five volunteers and seven patients with PAOD. All volunteers received a fixed volume of Gadovist® 1.0 corresponding to a dose between 0.1 and 0.15 mmol/kg BW. For the Magnevist®- and MultiHance®-exam the contrast agent volumes and flow rates were doubled. The PAOD-patients underwent the Magnevist® and Gadovist®-exam. Significantly higher SNR- and CNR-values were found in the Gadovist® and MultiHance®-enhanced pelvic 3D MRA-data ($p< 0.05$, mean SNR/CNR-increase: 70%) compared to the Magnevist-exam. Pelvic MRA image quality provided by Gadovist® 1.0 and MultiHance® exceed that achieved with Magnevist®.

2578. Comparison of three blood pool contrast agents for 1.0T MR angiography in dogs

Naoki Kato[1], Michihito Inagaki[1], Takashi Yokawa[1], Hanns-Joachim Weinmann[2]
[1]Nihon Schering K. K., Osaka, Japan; [2]Schering AG, Berlin, Germany

The purpose of this study was to compare three MR blood pool agents (SH U 555 C, Gadomer-17, MS-325) at 1.0 T in dynamic and equilibrium phase abdominal magnetic resonance angiography (MRA) in dogs. The dose-dependency of the blood pool agents were investigated and compared to an extracellular gadolinium chelate (Magnevist). Our results demonstrate that excellent MRA images in dynamic and equibrium phase can be performed at 1.0 T with all blood pool agents.

2579. Gadolinium-enhanced Fat-saturated 3D Steady State Free Precession (FIESTA) Imaging for MR Portography

Yasuo Amano[1], Atsushi Nozaki[2], Katsuya Takahama[1], Maki Amano[1], Tatsuo Kumazaki[1]
[1]Nippon Medical School, Tokyo, Japan; [2]GE Yokogawa Medical Systems, Tokyo, Japan

The goal of this study is to assess the feasibility of gadolinium-enhanced fat-saturated 3D FIESTA for MR portography. Fat-saturated 3D FIESTA and fast SPGR were performed in 20 cases, while the order of sequences was randomized. The signals of portal, superior mesenteric, and splenic veins, liver and fat adjacent to vessels, and the image quality of MR portography were asessed. Fat-saturated 3D FIESTA provided higher vascular signal, greater signal difference between portal vein and liver or fat and more flexible time window compared with fat-saturated 3D fast SPGR. Gadolinium-enhanced fat-saturated 3D FIESTA is of great value for MR portography.

2580. MRV in the assessment of pediatric veno-occusive disease

Irrem Batool[1], Andrew James Watt[1]
[1]The Royal Hospital for Sick Children, Glasgow, United Kingdom

Symptomatic veno-occlusive disease is common in patients undergoing chemotherapy via long-term central venous access. Venography is the standard method of assessing the central veins in adults but this is an unpleasant an invasive procedure for the unwell child. The purpose of this study was to assess the utility of MRV of the central veins in children for identifying veno-occlusive disease.

Patients were recruited by identifying those children undergoing other imaging for symptomatic central veno-occlusive disease and performing MRV using the 2D time of flight (2D-TOF) technique of the thoracic and\or pelvic veins.

2581. Centrally Fat-saturated Three-dimensional MR Angiography Technique of Abdomen with Excellent Fat-suppression and Minimal Prolongation of Breath-hold

Yasuo Amano[1], Katsuya Takahama[1], Tsuyoshi Matsuda[2], Maki Amano[1], Kazuhiro Furukawa[1], Tatsuo Kumazaki[1]
[1]Nippon Medical School, Bunkyo-ku, Tokyo, Japan; [2]GE Yokogawa Medical Systems, Hino-shi, Tokyo, Japan

The goal of this study is to perform centrally fat-saturated 3D MRA using fat-suppression pulses placed in the central 30% portion of the k-space of an elliptical centric order to suppress the fat signal while minimizing prolongation of breath-hold. This 3D MRA suppressed the fat signal of the abdomen as effectively as the previously reported fat-saturated 3D sequences while reducing prolongation of breath-hold. Contrast-enhanced centrally fat-saturated 3D MRA with intensive application of fat-saturation in the central k-space provided abdominal MRA images with excellent¡¡fat¨Csaturation, large signal difference between arteries and fat¡¢ and minimal prolongation of breath-hold.

2582. Improved Fat Suppression for Dynamic MR Imaging of the Breast

Wolfgang Buchberger[1], Christian Kremser[2], Maria Bernathova[2], Ammar Mallouhi[2]
[1]University Hospital, Innsbruck, Austria; [2]University Hospital, Innsbruck, Tirol, Austria

Introduction:

Besides dynamic curve analysis, the assessment of morphologic features plays an important role in distinguishing between benign and malignant breast lesions by dynamic contrast enhanced MRI. In order to improve the contrast between enhancing lesions and the surrounding fatty tissue, subtraction is usually performed with fast dynamic imaging techniques. However, motion related artifacts lead to significant blurring of lesion margins on subtracted images. It was the purpose of this study to assess the feasibility and clinical utility of using water excitation for fat suppression in dynamic breast MRI.

2583. Hepatocellular Carcinoma: Efficacy of Single Breath-hold, Multi-arterial Phase Contrast-enhanced Dynamic MR Imaging of the Liver with Subtraction Techniques

Katsumi Sasaki[1], Katsuyoshi Ito[1], Takeshi Fujita[1], Shinji Koike[1], Ayame Shimizu[1], Toshinobu Tsukuda[1], Naofumi Matsunaga[1]
[1]Yamaguchi University School of Medicine, Ube, Yamaguchi, Japan

We tried to determine the diagnostic ability of a single breath-hold, multi-arterial phase contrast-enhanced dynamic MR imaging with subtraction techniques for hepatocellular carcinomas. We obtained MR arterial perfusion images by subtracting first phase images from third phase images. We compared early-arterial phase (third phase) source images and late-arterial phase (sixth phase) source images with subtracted arterial perfusion images. The lesion-to-liver contrast ratio on subtracted MR arterial perfusion images were significantly higher than that on other images. This study suggests that subtracted MR arterial perfusion images will contribute to improve diagnostic MR ability for hypervascular hepatocellular carcinomas.

2584. Intraductal Papillary Mucinous Tumor of the Pancreas: Four-Year MRI Follow-up

Diane Bergin[1], Laurence Parker[1], Donald G. Mitchell[1]
[1]Thomas Jefferson University Hospital, Philadelphia, PA, United States

Purpose:

Based on a characteristic appearance, intraductal papillary mucinous tumors (IPMTs) are diagnosed by MR images. Our purpose was to determine the morphological progress of intraductal papillary mucinous tumor diagnosed by magnetic resonance imaging on serial follow up over a 4 year period.

Methods:

We identified retrospectively twelve patients with MR features of intraductal papillary mucinous tumor who had follow up by gadolinium enhanced 1.5 Tesla MRI and MRCP over a 4 years. Tumor size and location, main and branch pancreatic duct dilation, and duct communication with tumor were noted. Internal septation, tumor nodularity and enhancement of tumor were noted.

2585. Small hyperintense hepatic lesions on T1-weighted images in patients with cirrhosis: Evaluation with serial MR imaging

Ayame Shimizu[1], Katsuyoshi Ito[1], Kensaku Shimizu[1], Shinji Koike[1], Naofumi Matsunaga[1]
[1]Yamaguchi University School of Medicine, Ube, Yamaguchi, Japan

We evaluate the frequency and clinical significance of small(<2cm) hyperintense hepatic lesions in the cirrhotic liver on T1-weighted MR images seen at serial MR imaging. Small hyperintense hepatic lesions on T1-weighted MR images without early enhancement on contrast-enhanced dynamic studies in patients with cirrhosis usually showed no interval growth or disappeared during the serial MR imaging. These lesions may more frequently be clinically being or hyperplastic nodules than HCCs.

2586. Detection of pararectal lymph node metastasis of rectal cancer by 3D half-Fourier RARE

Satoru Nakano[1], Takayuki Sanomura[1], Taro Togami[1], Yoshihiro Toyama[1], Fuminori Goda[1], Takashi Ishimori[1], Yuichi Yamashita[2], Satoshi Sugiura[3], Motoomi Ohkawa[1]
[1]Kagawa Medical University, Kita-gun, Kagawa, Japan; [2]Toshiba Medical Systems Co.LTD, Takamatsu, Kagawa, Japan; [3]Toshiba Corp. Medical R&D Center, Otawara, Tochigi, Japan

In the preoperative evaluation of patients with rectal cancer, it is important to diagnose pararectal lymph node metastasis accurately. On 3D half-Fourier RARE images the venous plexus appears as an area of high signal intensity, and only the lymph nodes show low intensity in the high intensity of pararectal fat. Moreover, images with a 1-mm slice thickness generated by MPR permit the size and structure of lymph nodes to be assessed with a high degree of precision. In 33 surgical cases, the diagnosis of pararectal lymph node metastasis showed a sensitivity of 0.92 and a specificity of 0.80.

2587. A novel technique for estimation of differential renal blood flow and differential renal clearance

Michael Pedersen[1], Yimin Shi[2], Peter Anderson[3], Hans Stødkilde-Jørgensen[1], Jens Christian Djurhuus[2], Isky Gordon[3], Jørgen Frøkiær[2]
[1]MR Research Center, Aarhus, Denmark; [2]Institute of Experimental Clinical Research, Aarhus, Denmark; [3]Department of radiology, London, United Kingdom

A novel approach is presented to estimate differential renal blood flow (DRBF) and differential renal clearance (DRC) using Gd-DTPA enhanced MRI. DRBF was estimated by the principle of cardiac output fractionation, and DRC was estimated by Patlak analysis. The analysis was applied on rat kidneys having different degree of renal failure. Our results suggest that DRBF and DRC can be estimated from the acquired single slice Gd-DTPA enhanced signal intensity vs time curve, and that conversion of signal intensity into quantitative measures does not provide additional accuracy of DRBF and DRC.

2588. The Natural History of Pelvic Heterotopic Ossification: MRI Evaluation of Chronic Cases

James L. Fleckenstein[1], Mark E. Schweitzer[2], Anthony S. Burns[2], Lisa Ann Wuermser[1]
[1]University of Texas Southwestern Medical Center, Dallas, Texas, United States; [2]Thomas Jefferson University, Philadelphia, Pennsylvania, United States

Serial MRI evaluation of 17 patients with chronic heterotopic ossification (HO) revealed that HO is surprisingly dynamic and variable. The abnormal tissue may increase or decrease in size over time, regardless of signal characteristics.

2589. Diffusion MRI of soft tissue tumors

Hildur Einarsdóttir[1], Magnus Karlsson[2], Johan Wejde[3], Henrik Bauer[4]
[1]Dept. Radiology, Karolinska Hospital, Stockholm, Sweden; [2]Dept of Hospital Physics, Karolinska Hospital, Stockholm, Sweden; [3]Dept of Histopathology, Karolinska Hospital, Stockholm, Sweden; [4]Dept of Ortopedics, Karolinska Hospital, Stockholm, Sweden

Diffusion MR imaging of 34 soft tissue tumors, 16 benign and 18 malignant, was performed before and/or after pre-operative radiotherapy. The ADC value of one large ROI was chosen to represent each tumor. The mean ADC values of benign and non-treated malignant tumors overlapped extensively 1,85 and 1,6 x 10-3 mm2/s respectively. The exception was benign myxomas which had substantially higher ADC values than myxomatous sarcomas which they otherwise resemble. There was a significant difference (p < % 5) in ADC values of the pre-operatively radiated sarcomas and non-treated malignant tumors. This might be exploited to evaluate therapy response.

2590. The Assessment of Hemodynamic status of Soft Tissue Hemangioma As a Predictor For The Decision of Therapeutic Modalities Using T1/T2* Gradient Dual Echo Sequence

Yong-min Huh[1], Jin-suck Suh[1], Kyoo-ho Shin[2], Dae Hong Kim[1], Eun Joo Kim[1]
[1]Dept. of Diagnostic Radiology, yonsei university college of medicine, Seoul, Korea, Republic of; [2]Dept. of Orthopedic Surgery, Yonsei University College of Medicine, Seoul, Korea, Republic of

The purpose of this study was to assess hemodynamics of soft tissue hemangiomas by using rBF. Seven patients, who underwent perfusion imaging using T1/T2* gradient dual echo sequence, were enrolled. It was investigated in both Sephadex flow phantom and soft tissue hemangiomas that flow effect can be expressed by FA values. The value of rBF could represent hemodynamics of soft tissue hemangiomas so that it helped determine choice of the treatment modalities. Regarding to FA, there were inconsistent results between experiment and patients data. Since moderate correlation was found between FA and rBF values, future studies are needed.

2591. $T_{1\rho}$MRI of Experimentally Induced Osteoarthritis in a Porcine Animal Model

Andrew James Wheaton[1], Arijitt Borthakur[1], George R. Dodge[2], Jennifer DiCesare[2], H. R. Schumacher[3], Ravinder Reddy[1]
[1]University of Pennsylvania, Philadelphia, PA, United States; [2]Nemours Biomedical Research A.I. duPont Hospital for Children, Wilmington, DE, United States; [3]Department of Medicine University of Pennsylvania, Philadelphia, PA, United States

$T_{1\rho}$-weighted MR images were used to quantitatively measure experimentally induced osteoarthritis in an in vivo porcine model. Six pigs were given an injection of porcine IL-1β 6 h prior to undergoing $T1_{1\rho}$ MRI. The $T1_{1\rho}$ relaxation rate ($1/T1_{1\rho}$) of IL-1β treated patellae was measured to be 29% lower than control patellae indicating a loss of proteoglycan. The MR data is in accordance with histochemical and immunochemical findings.

2592. Numerical optimisation of diffusion measurements in cartilage using Cramer-Rao lower bound theory

Oscar Brihuega-Moreno[1], Frank Patrick Heese[2], Laurance D. Hall[2]
[1]University of Cambridge, Cambridge, United Kingdom; [2]University of Cambridge, Cambridge, Cambridgeshire, United Kingdom

A method to determine the optimum b-values for the highest precision measurements over a range of apparent diffusion coefficient (ADC) values is presented using water diffusion in porcine patellar cartilage as a model system. Compared to linear b-value sampling schemes or b-value schemes optimised about a single ADC value, the optimised scheme presented here measures the ADC values over the whole range with the smallest average coefficient of variance (COV) and with the smallest range in COV values. Using this scheme, all ADC values in the range can be measured with the greatest confidence.

2593. Proton MR Spectroscopy of Calf Muscle in Kennedy's Disease

Irina Mader[1], Juergen Machann[1], Jochen Karitzky[2], Beate Wietek[1], Bernhard Boehm[3], Fritz Schick[1]
[1]Section for Experimental Radiology, Tuebingen, Germany; [2]Neurologic University Hospital, Ulm, Germany; [3]Division of Endocrinology and Diabetes, Ulm, Germany

Kennedy's disease is caused by an expansion of a CAG trinucleotid repeat in the androgen receptor gene[1], and leads to a degeneration of the lower motor neuron[2]. Clinical symptoms consist of a weakness of the limbs and a diabetes mellitus. Muscular biopsy reveals an atrophy and myopathic changes[3]. The purpose of the study was to find out, (i) whether there is a predominant involvement of particular muscles of the calf, (ii) to compare spectral changes in KD and DM to prove the influence of the metabolism, and (iii) whether there is a link to the number of CAG repeats.

2594. ^{1}H MRS analysis of marrow fat of rat tibia after hind leg unweighting

Chin-Shoou Lin[1], Sujeeta Bhatt[1], Nadia Biassou[1], Dan Nguyen[1], Erini Makariou[1], Dieter Schellinger[1]
[1]Georgetown University Hospital, Washington, DC, United States

Osteoporotic patients develop fractures secondary to bone loss and weakening. We previously reported a correlation between bone weakening and increases in percent fat fraction (%FF) of vertebra using localized 1HMRS. This study investigated the correlation between %FF and osteoporosis. Seventeen male rats underwent 1HMRS before and after hind leg unweighting. All spectra demonstrated singlet peaks at 4.7ppm (H2O) and 1.3ppm (-CH2) with drastic increases in mean %FF after one week of unweighting (+108%). Earlier studies showed an association between bone loss and weightlessness. Our data are the first to demonstrate a correlation between %FF and weightlessness-induced osteoporosis.

2595. Quantitative assessment of lumbar bone marrow in aplastic anemia with line scan spectroscopic imaging

Hiroshi Shinmoto[1], Suketaka Momoshima[1], Koichi Oshio[1], Akihiro Tanimoto[1], Nobuya Higuchi[1], Shigeo Okuda[1], Sachio Kuribayashi[1], Ikuko Isshiki[2], Shinichiro Okamoto[2]
[1]Department of Diagnostic Radiology, Keio University, Shinjuku-ku, Tokyo, Japan; [2]Department of Internal Medicine, Keio University, Shinjuku-ku, Tokyo, Japan

A line scan MR spectroscopic imaging method was applied to lumbar bone marrow in aplastic anemia for quantitative assessment of relative water and fat fractions. The use of relative long TR and multiple echoes permits T2 measurements and T2-corrected estimates of water and fat fractions in single acquisition. Nine patients with aplastic anemia and 14 sex and age-matched volunteers were examined. The results showed relative fat contents were significantly higher in the patients with aplastic anemia. Since this technique is easy and quick in a clinical setting, it will be promising as a follow-up study after treatment in aplastic anemia.

2596. Automatic tuning of MR left ventricle segmentation using genetic algorithms

E. Angelie[1], P.H.J. de Koning[1], H.C. van Assen[1], M.G. Danilouchkine[1], G. Koning[1], R.J. van der Geest[1], J.H.C. Reiber[1]
[1]Leiden University Medical Center, Leiden, Netherlands

This paper is aimed at designing a self-adaptive optimization system for an automated cardiac left ventricular contour detection algorithm. A Genetic Algorithm (GA) was used as a tuning method to optimize the settings of the automated contour detection of the MASS package. The performance of the tuning method was evaluated on ten clinically obtained short-axis examinations comparing manually and automatically detected contours. After optimization, an average degree of similarity of 74% was found. Compared with the inter-observer agreement of 73%, we conclude that GA-based optimization is an effective and efficient method to increase the reliability of our automated contour detection.

2597. Contrast properties of manganese in heart imaging: a comparison of the contrast properties of MnCl2 and Mn-DPDP

Rolf Eriksson[1], Lars Johansson[2], Tomas Bjerner[1], Håkan Ahlström[1]
[1]department of radiology, Uppsala, Uppland, Sweden; [2]Amersham Health R&D, Uppsala, Uppland, Sweden

-Synopsis

Manganese is a metallic element that forms ions with paramagnetic properties. In this study relaxivity measurements in pig myocardium are used to show that different manganese-containing substances behave differently regarding uptake and contrast effects in the myocardium. It is also shown that the Mn^{2+} ions persist in myocardial tissue for a long time after injection but leave the bloodstream at a much faster rate. These effects can possibly be related to the molecular behavior of the manganese ions.

2598. Inner Volume Black-blood Fast Spin Echo Cardiac MRI with Parallel Imaging

Belinda SY Li[1], Qun Chen[2], Jason A. Polzin[3], Reed F. Busse[4], Robert R. Edelman[2]
[1]GE Medical Systems, Evanston, IL, United States; [2]Evanston Northwestern Healthcare, Evanston, IL, United States; [3]GE Medical Systems, Waukesha, WI, United States; [4]GE Medical Systems, Menlo Park, CA, United States

The inner volume fast spin echo (FSE) technique, in which the excitation pulse's slice selection gradient is moved to the phase-encoding axis and thus allows an imaging field-of-view (FOV) to be smaller than the object in this dimension, has been combined with the use of ASSET parallel imaging in the application of black-blood cardiac MRI. This is used to either (i) improve patient comfort and reduce overall motion artifacts by allowing for a shorter breath-hold time, or (ii) improve image "sharpness" by reducing the echo train length (ETL) while maintaining the same total scan time.

2599. Quantitative measurements of myocardial 1/T1 in the beating heart based on minimum chi-square segmentation.

Atle Bjørnerud[1], Tomas Bjerner[2], Lars Johansson[2], Håkan Ahlström[2]
[1]Rikshospitalet, Oslo, Norway; [2]Uppsala University Hospital, Uppsala, Sweden

Aim: To develop a semi-automatic method to detect myocardial regions with minimal motion for improved 1/T1 quantification.

Methods: 1/T1 in blood and myocardium as a function of contrast agent concentration was quantified using a Look-Locker sequence in eight healthy domestic pigs. The goodness-of-fit of the imaging data to the inversion recovery curve was assessed by generating chi-square maps on a pixel-by-pixel basis. Myocardial regions of interest were selected from myocardial pixels with a chi-square value similar to that in blood.

Results: From the chi-square maps, areas with minimal motion could be identified which enabled reproducible 1/T1 estimations in the heart.

2600. Quantitative assessment of myocardial blood volume and water exchange in a pig model using an intravascular contrast agent.

Atle Bjørnerud[1], Tomas Bjerner[2], Lars Johansson[2], Håkan Ahlström[2]
[1]Rikshospitalet, Oslo, Norway; [2]Uppsala University Hospital, Uppsala, Sweden

Aim: To measure myocardial blood volume and water exchange rates in vivo in a pig model. Methods: 1/T1 in blood and myocardium was varied using an intravascular contrast agent and blood volume (BV) , water exchange frequency (f), intra- and extravascular proton residence times (τi , τe) were estimated using a two-compartment water exchange limited relaxation model which accounted for biexponential relaxation. Results: The following values were obtained (mean±SD): BV=11.2 ± 2.1 mL/100 g, f=1.39 ± 0.52 s-1, τi =107 ± 63 ms and τe =708 ± 264 ms.

2601. Acquisition-weighted 31P-MR-spectroscopy for detection of regional alterations after posterior myocardial infarction in humans

Meinrad Beer[1], Matthias Spindler[2], Herbert Köstler[1], Jörn Sandstede[1], Diertbert Hahn[1]
[1]Institut für Röntgendiagnostik, Würzburg, Bavaria, Germany; [2]Medizinische Klinik, Würzburg, Bavaria, Germany

Acquisition-weighted 3D-CSI allows analysis of different parts of the left ventricle –including the inferior wall. Applying this technique alterations of energy metabolism could be detected for the first time in humans with inferior wall infarctions.

2602. AngioSURF - based Assessment of Atherosclerosis: (How) Does Total-Body 3D MR Angiography Influence Patient Management? Clinical Experience in 250 Patients with PAOD and 100 Asymptomatic Individuals

Mathias Goyen[1], Christoph U. Herborn[1], Susanne C. Goehde[1], Florian M. Vogt[1], Harald H. Quick[1], Knut Kröger[1], Jörg F. Debatin[1], Stefan G. Ruehm[1]
[1]University Hospital Essen, 45122 Essen, NRW, Germany

250 patients with PAOD and 100 asymptomatic individuals were examined on a 1.5 T MR-Scanner (Siemens Sonata®) by means of AngioSURF-based total-body 3D MRA employing five 3D data sets over 72s (MultiHance®, BRACCO: 0.2 mmol/kg BW). Clinical relevant disease outside the peripheral vasculature (for PAOD-patients) or in any vascular segment (for asymptomatic individuals) was found in 52 patients with PAOD (and in ten of the 100 asymptomatic individuals); in nine (three) of those subjects subsequent interventional or surgical therapy was performed: total-body 3D MRA does have an impact on patient management.

2603. A tactile somatosensory stimulator for fMRI using von Frey filaments

Antti Korvenoja[1], Juha Koivisto[2], Synnöve Carlson[3], Hannu J. Aronen[4]
[1]Radiology, Helsinki Univ Central Hosp, Helsinki Brain Research Center, Helsinki, Finland; [2]Radiology, Helsinki Univ Central Hosp; Neuroscience unit, Inst Biomed/Physiol, Univ of Helsinki, Helsinki Brain Research Center, Helsinki, Finland; [3]Neuroscience unit, Inst Biomed/Physiol, Univ of Helsinki, Helsinki Brain Research Center, Helsinki, Finland; [4]Radiology, Helsinki Univ Central Hospital, Helsinki Brain Research Center, Helsinki, Finland

We have developed a novel stimulation device, which enables us to deliver tactile somatosensory stimuli with von Frey filaments during fMRI experiments. These filaments are commonly used by clinicians to evaluate somatosensory status of patients. The stimulator can be triggered under computer control. In a pilot study we have demonstrated that this type of stimulus produces responses in expected areas of the brain (primary and secondary somatosensory cortices and supplementary motor area).

2604. Accelerating Multi-Echo Reference Scans for Removing Nyquist Ghosts

Robert A. Kraft[1]
[1]Wake Forest University School of Medicine, Winston-Salem, North Carolina, United States

Echo planar images suffer from geometric and intensity distortions as well as Nyquist ghosts. Point spread function mapping techniques can correct geometric and intensity distortions but require additional information to remove Nyquist ghosts. Multi-echo reference scans are the preferred method for removing Nyquist ghosts since they can compensate for distortions from field inhomogeneity, eddy currents, and other off resonance effects. However, the long scan times associated with multi-echo reference scans often make this impractical. A technique is presented that acquires a multi-echo reference scan capable of removing Nyquist ghosts with at least a five-fold reduction in scan time.

2605. Investigation of the Neurophysiological Basis of Resting State Networks Using Modulation of Bilaterality by Disease Burden

Marilena De Luca[1], Steve Smith[1], Nicola De Stefano[2], Paul M. Matthews[1]
[1]FMRIB Centre, Oxford, United Kingdom; [2]Institute of Clinical Neurology, Siena, Italy

Correlations between BOLD signal changes across the brain have been suggested to reflect correlated neuronal activity that reflects functional connectivity. However, it is difficult to distinguish vascular correlations not directly related to neural activity from BOLD changes related to neuronal activity. One way of testing this makes use of the observation that patients with multiple sclerosis (MS) show increasing relative ipsilateral motor cortex activity as disease burden rises. We found a strong disease-associated relationship between contra- and ipsilateral motor cortex signal correlations in movement-associated and resting datasets suggesting that the resting state correlations reflect relative neuronal activity.

2606. fMRI Hemodynamic Delay Estimation within a Spatiotemporal System Identification Framework.

C.J. Long[1], V. Solo[2], B. Fischl[1], B. Rosen[1], E.N. Brown[3]
[1]MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [2]University of New South Wales, Sydney, NSW, Australia; [3]Dept. of Anesthesia & Critical Care, MGH., Boston, MA, United States

We describe a method for estimating the hemodyamic delay in the context of a general system-identification procedure. This scheme treats latency as one of a number of co-dependent parameters in a non-linear regression problem. The resulting estimates may therefore be interpreted using standard confidence bounds, which enable subsequent significance testing of the resulting delay maps. Computation of this delay involves calculating the ratio between a serially correlated noise covariance gained at each point in the dataset, and a variance component formed from the associated timeseries and a predefined physiological model.

2607. Reproducibility of Human Brain Activity Following Repeated Oesophageal Stimulation

Steven John Coen[1], Lloyd J. Gregory[2], Lidia Yágüez[1], Deanna Hall[2], Edson Amaro[1], Simon Smale[3], Steve CR Williams[1], David G. Thompson[2], Qasim Aziz[2]
[1]Institute of Psychiatry, London, United Kingdom; [2]University of Manchester, Manchester, United Kingdom; [3]Kings College Hospital, London, United Kingdom

Despite the recent growth in studies on the central processing of visceral sensations, the test-retest reliability of the neural correlates of visceral sensation remain unclear. In order to test the variance between scan sessions, at the group level, volunteers underwent a modified box-car functional magnetic resonance imaging (fMRI) experiment, involving periods of non-painful and painful oesophageal stimulation on three separate occasions. Painful stimulation produced robust activation in many cerebral regions previously associated with visceral processing. Non-painful stimulation activated a similar network but showed greater variability between scans.

2608. Mapping selective dopamine receptor activation using pharmacological MRI

M D. Ireland[1], A S. Lowe[1], M F. James[2], R A. Leslie[3], S C. Williams[1]
[1]Institute of Psychiatry, London, England, United Kingdom; [2]GlaxoSmithKline Pharmaceuticals, Harlow, Essex, United Kingdom; [3]Dalhousie University, Halifax, Nova Scotia, Canada

Pharmacological MRI was used to study the the dopamine D_2/D_3 receptor agonist quinelorane in alpha-chloralose anaesthetised rats. T2*-weighted gradient-echo imaging was performed at 4.7T, and images pre-processing and analysed using SPM99. Significant BOLD signal increases were detected within the nucleus accumbens, corpus striatum and olfactory nuclei, areas rich in D_2 and D_3 receptors, where quinelorane binds with high affinity, and reduces dopamine release *in vivo*. This study demonstrates that changes induced by dopamine receptor agonists can be visualised in chloralose-anaesthetised animals, and patterns of quinelorane-induced activation are concordant with its known *in vivo* effects and binding patterns.

2609. Microglial Activation and BBB Compromise in HIV Dementia

Malcolm J. Avison[1], Avindra Nath[2], Robin G. Avison[1], Rodney A. Bales[1], Fred A. Schmitt[1], Richard N. Greenberg[1], Joseph R. Berger[1]
[1]University of Kentucky, Lexington, KY, United States; [2]Johns Hopkins University, Baltimore, MD, United States

1H-MRS and contrast-enhanced MRI were used to examine the relationship between degree of microglial activation judged by mI/Cr, and severity of BBB compromise assessed by post-contrast T1-weighted signal enhancement in HIV+ patients with and without HIV dementia (HIVD). The relationship of these MR abnormalities to HIVD severity was also examined. Post-contrast enhancement was significantly correlated with mI/Cr in the basal ganglia, consistent with the idea that microglial activation underlies the BBB abnormalities observed in HIVD, Both post-contrast enhancement and mI/Cr were significant predictors of HIVD severity, confirming the importance of microglial activation and BBB compromise in HIVD pathogenesis.

2610. Pure sensory and motor activation patterns do not induce cross-modal plasticity in blind subjects

Elke Ruth Gizewski[1], Thomas Gasser[2], Armin de Greiff[3], Michael Forsting[1]
[1]Neuroradiology, University hospital, Essen, Germany; [2]Neurosurgery, Essen, NRW, Germany; [3]Neurology, Essen, NRW, Germany

Cortical reorganization is described in blind subjects related to Braille reading. The purpose of our study was to differentiate whether occipital activation of blind subjects during Braille-reading is task-specific or only triggered by sensory or motor area activation.

All blind individuals reading Braille during functional MRI showed activation of the visual cortex. Application of peripheral electrical stimuli revealed activation of the somatosensory cortex and pure motor tasks showed praecentral activation. However, both tasks revealed no activation of visual cortex.

Our results suggest, that activation of the visual cortex in blind subjects is related to higher and more complex brain functions.

2611. Evidence of Oesophageal Stimulus Intensity Dependant Response in the Human Anterior Cingulate and Primary Somatosensory Cortex

Steven John Coen[1], Lloyd J. Gregory[2], Lidia Yágüez[1], Deanna Hall[2], Edson Amaro[1], Simon Smale[3], Steve CR Williams[1], David G. Thompson[2], Qasim Aziz[2]
[1]Institute of Psychiatry, London, United Kingdom; [2]University of Manchester, Manchester, United Kingdom; [3]Kings College Hospital, London, United Kingdom

Studies investigating the neural correlates of non-painful and painful oesophageal stimulation have produced variable results. Furthermore, regions involved in the encoding of stimulation intensity are not fully understood. Using a standardised method for establishing quantifiable intensities of oesophageal stimulation, the neural correlates of four levels of oesophageal stimulation were investigated. Stimulation resulted in a complex pattern of cerebral activation that was similar across different levels of stimulation intensity. The anterior cingulate gyrus (ACG) and primary somatosensory cortex (SI), both showed evidence of stimulus dependent response, which may be a result of encoding of intensity and unpleasantness or levels of attention.

2612. Functional MRI of nonagenarians during a visual recognition task

Hu Cheng[1], Michal Beeri[1], Daniel Wollman[1], Mark Weinberger[1], Isak Prohovnik[1]
[1]Mount Sinai School of Medicine, New York, NY, United States

We performed functional MRI during a visual recognition task in cognitively intact oldest-old (nonagenarians), old subjects, (age 70-80), and young subjects (less than 55). Common images were viewed before MRI, and then presented along with unfamiliar objects during BOLD imaging. Significant differences were observed in the group analysis only, showing that the oldest-old demonstrated increased activation in the left temporal, parietal, and frontal cortices, and cingulate gyrus as compared with younger subjects. These results are consistent with the hypothesis that normal age-related changes in memory function include recruitment or compensation using multiple brain regions in the simple recall tasks.

2613. Application of Group Independent Component Analysis (ICA) to Mental Calculation : A fMRI Study

Chiao Yuan Lin[1], Yu Te Wu[2], Tzu Chen Yeh[1], Jen Chuen Hsieh[1]
[1]Integrated Brain Research Laboratory Dept. Medical Research & Education Taipei VGH, Taipei, Taiwan, Taiwan; [2]Institute of Radiological Science, National Yang-Ming University, Taipei, Taiwan, Taiwan

Group ICA[1] extended from individual ICA can be used to analyse fMRI data from a group of subjects. In this mental calculation study, group ICA was applied to investigate the difference and consistency between abacus experts and college students. Our results show group ICA is also capable as individual ICA of extracting the common task-related components from the confounding and non-task-related ones in each group. Despite approximate fronto-parietal activation during calculation in both groups, left IPL, superior part of SMG and ACC activated with the LPFC were only observed in expert group, which may be specific to their exceptional abilities.

2614. Repeatability of motor and memory tasks in healthy elderly volunteers

Ian Marshall[1], Enrico Simonotto[1], Ian J. Deary[1], Alasdair Maclullich[1], Klaus Ebmeier[1], Emma Rose[1], Joanna Wardlaw[1], Nigel Goddard[1]
[1]University of Edinburgh, Edinburgh, Scotland, United Kingdom

There is enormous enthusiasm to apply functional MRI to neuroscience research. However, little is known about the robustness of the fMRI technique [1,2], especially in older subjects. Day-to-day repeatability of results on given subjects is extremely important in the assessment of patients in serial studies. We tested the repeatability of finger-tapping and N-back memory tasks in a group of 11 healthy, elderly male volunteers. Each subject was scanned three times at weekly intervals. Reliable cortical activation was found for all subjects and sessions. A random effects analysis revealed those brain regions producing the most consistent and the most variable activity.

2615. Compartmentalisation of water diffusion in mouse brain after ischemia and cold injury.

A. SCHWARCZ[1], P. BOGNER[2], P. MERIC[3], J.L. CORREZE[3], Z. BERENTE[4], T. DOCZI[1], B. GILLET[3], J.C. BELOEIL[3]
[1]Dept. of Neurosurgery, University of Pecs, Pecs, Hungary; [2]Diagnostic Institute, University of Kaposvar, Kaspovar, Hungary; [3]ICSN-CNRS, Gif sur Yvette, France; [4]Dept. Biochemistry, University of Pecs, Pecs, Hungary

Two main rates of diffusion of water in the living brain tissue can be evidenced. Their assignment to the water diffusion in the extra cellular space and the intracellular space remains questionable since the relative weights of the two diffusing rates do not match the relative volumes of those two water compartments in brain. The purpose of this study was to determine the diffusing compartment in several locations of mouse brain and their evolution in pathological states to attempt to assess this hypothesis.

2616. 3-Nitropropionic Acid Increases Cortical and Hippocampal, But Not Striatal, Taurine in the Rat: Metabolic Profiling with HR-MAS 1H-MRS

Todd Ryan Mitchell[1], Matthew Peter Galloway[1], Navid Seraji-Bozorgzad[1], Gregory James Moore[1]
[1]Brain Imaging Research Division, Dept of Psychiatry, Wayne State University School of Medicine, Detroit, MI, United States

3-nitropropioninc acid (3NP) is an irreversible inhibitor of succinate dehydrogenase (SDH) (Beal MF 1993) and repeated systemic administration of 3NP induces striatal lesions similar to those found in Huntington's Disease (HD). Recent studies have revealed neuroprotective effects of taurine in the 3NP model of HD (Rivas-Arancibia S 2001). Therefore, we used 1H HR-MAS MRS to determine the 3NP-induced neurochemical profile in specific areas of the rat brain with a special emphasis on taurine. In the cortex and hippocampus of 3NP treated rats, taurine levels increased approximately 100% in contrast to a non-significant increase in the striatum.

2617. Opposite Effects of MDMA and SKF-38393 on Striatal GABA: Neurochemical Profile with HR-MAS 1H-MRS

Matthew P. Galloway[1], Todd R. Mitchell[1], Navid Seraji-Bozorgzad[1], David A. Briston[1], Jamie Chioini[1], Stanley T. Fricke[1], Gregory J. Moore[1]
[1]Wayne State Univ Sch Med, Detroit, MI, United States

MDMA is widely abused and neurotoxic to dopamine and serotonin neurons in non-human primates. Despite its documented neurotoxicity, abuse of MDMA continues unabated in large part due to the lack of overt neurotoxicity in humans. Thus a neurochemical biopsy to document the effects of MDMA would be of considerable value in assessing both the neurotoxicity and neuropharmacology of MDMA. We have utilized high-resolution magic angle spinning 1H-magnetic resonance spectroscopy (HR-MAS MRS) to determine the effect of MDMA and the D1 agonist SKF-38393 on the MRS-visible neurochemical profile in rat striatum. MDMA increased (40%)and SKF decreased (25%)striatal GABA.

2618. MRI transverse relaxation rates in Tg-HD94 mice: A reversible model of Huntington's Disease.

Fortunato Battaglia[1], Victor Dyakin[1], Ai Yamamoto[1], Ottavio Arancio[1], Rene' Hen[1], Craig A. Branch[1]
[1]The Nathan Kline Institute, Orangeburg, NY, United States

The relationship between mutant expression of huntingtin protein in a transgenic mouse model of Huntington's disease, reversal of the expression of the protein by doxycycline, and localized high field cerebral T2 in transgenic mice was examined. Our preliminary findings support the hypothesis that mutated huntingtin protein expression, and more importantly its reversal, may be sensitively monitored by MRI methods, providing a valuable means for assessment of new and novel treatments of this disease.

2619. In Vivo GABA Detection with Improved Selectivity and Sensitivity by Localized Double-Quantum Filter Technique at 4.1T

Fei Du[1], Wen-Jang Chu[1], Baolian Yang[1], Jan A. den Hollander[1], Thian C. Ng[1]
[1]University of Alabama at Birmingham, Birmingham, Al, United States

Gama-aminobutyric acid (GABA) is difficult to be detected with the conventional single quantum technique. Using a highly selective read pulse, DANTE, and at the facility of increased sensitivity and chemical shift resolution at high field 4.1T, GABA editing by Double Quantum Filter (DQF) with robust suppression of Creatine (Cr) and Glutathione (GSH) was achieved. Furthermore, GABA DQF editing spectra were acquired with echo time (TE=77ms), macromolecular signals that could contaminate to GABA editing were found to be negligible.

2620. MR Spectroscopy Follow-up of Lactate and Lipid signals and Correlations to Cognitive Function

Paul E. Sijens[1], Tom den Heijer[2], Sarah E. Vermeer[2], Monique M. Breteler[2], Albert Hofman[2], Matthijs Oudkerk[1]
[1]University Hospital Groningen, Groningen, Netherlands; [2]Erasmus MC, Rotterdam, Zuid-Holland, Netherlands

It was recently demonstrated that the prevalence of MRS detectable brain lactate and lipid signals differs between non-demented elderly women and men. Women had a higher prevalence of lactate and lipid signals than men. It remained unclear whether lactate and lipid signals are still present when persons are evaluated years later. Presented in this study is an assessment of the changes in the prevalence of lactate and lipid with aging of almost 4 years in both men and women. Furthermore, we wanted to investigate whether lactate or lipid signals had clinical significance by studying cognitive decline over time.

2621. The Structural Basis Of Functional Dysconnectivity in Schizophrenia: Insights from Diffusion Tensor MR Imaging

Jonathan Burns[1], Dominic Job[1], Mark Bastin[1], Heather Whalley[1], Tom MacGillivray[1], Eve Johnstone[1], Steve Lawrie[1]
[1]University of Edinburgh, Edinburgh, Mid-Lothian, United Kingdom

Schizophrenia may be a disorder of fronto-temporal cortical connectivity. Diffusion tensor MR imaging (DT-MRI) has the potential to identify the structural correlates of impaired functional connectivity as it measures the diffusion of water molecules within the axons of neurons. In compromised white matter (WM) tracts, diffusion is less constrained than in healthy WM fibres giving rise to reduced diffusion anisotropy. In schizophrenia one might expect reduced anisotropy bilaterally in specific association tracts such as the uncinate fasciculus (UF), fibres from the anterior cingulate (AC) and the superior longitudinal fasciculus (SLF). Here we investigate this hypothesis.

2622. Anterior Cingulate Cortex and Anosognosia in mild Alzheimer's disease: A potential relationship as demonstrated by fMRI

Mateja de Leonni Stanonik[1], R. Kent Hutson[2], John H. Dougherty Jr.[2], Charles Angelo Licata[2]
[1]U. of Tennessee Graduate School of Medicine, Knoxville, United States; [2]U. of Tennessee Graduate School of Medicine, Knoxville, TN, United States

Anosognosia, the inability to recognize illness in one Self, can affect patients with Alzheimer's disease (AD) and complicate their management. It may occur in the earliest stages of AD and affect more than 40% of patients. The mechanism of anosognosia for cognitive deficits remains unknown.

This study examines the mechanism and neural substrates for anosognosia using SnPM analysis of functional MRI (fMRI) data in 10 AD patients compared to 13 normal age-matched control subjects. The Counting Stroop, a Stroop Test-variant specialized for functional imaging, which utilizes blocks of neutral and incongruent words was employed as the activation paradigm.

2623. Brain Metabolism in Vascular Dementia and Alzheimer's Disease Assessed by Quantitative in vivo Proton MR Spectroscopy

Ulrich Pilatus[1], Anna du Mesnil de Rochemont[1], Sebastian Herminghaus[1], Lutz Froelich[1], Jürgen Peters[1], Thomas Kratzsch[1], Konrad Maurer[1], Heinrich Lanfermann[1], Friedhelm E. Zanella[1]
[1]Johann Wolfgang Goethe-Universität, Frankfurt, Germany

his study aimed to characterize the neurochemical profile of Vascular Dementia (VD) using quantitative single voxel 1H MRS of cortical and subcortical brain areas and discuss its potential diagnostic impact in comparison with Alzheimer's disease (AD) and healthy controls. Compared to AD and controls, significantly decreased concentrations of creatine were detected in the parietal cortex (PGM) pointing to the pathophysiology of VD. Both, AD and VD showed decreased NAA concentrations. The ratio of CSF to tissue water, evaluated from the T2 decay of unsuppressed water, which can serve as an indicator for atrophy was increased in AD in VD.

2624. Diffusion Tensor Imaging in ALS Compared with Proton MR Spectroscopy

Irina K. Mader[1], Michael Erb[1], Marc Gleichmann[2], Joerg B. Schulz[2], Wolfgang Grodd[1], Uwe Klose[1]
[1]Section for Experimental MR of the CNS, Tuebingen, Germany; [2]Neurologic University Hospital, Tuebingen, Germany

Diffusion tensor imaging (DTI) may give information about the axonal impairment of the motor neurons in amyotrophic lateral sclerosis (ALS) by changes of the patterns of anisotropy, e.g. fractional anisotropy (FA). Proton MR spectroscopy is thought to provide surrogate markers for the axonal integrity. In this study, changes of FA were compared with spectral changes in identical anatomic regions (motor area - MA) of nine patients with ALS and ten healthy controls. In patients, choline and the FA were positively correlated, whereas the mean of the FA in the MA was not different between patients and controls.

2625. Voxel-Level Cross-Subject Statistical Analysis of Brain Atrophy in early Relapsing Remitting MS patients

Nicola De Stefano[1], Mark Jenkinson[2], Leonello Guidi[3], Maria Letizia Bartolozzi[3], Antonio Federico[1], Stephen M. Smith[4]
[1]University of Siena, Siena, Tuscany, Italy; [2]Howard Florey Institute, Melbourne, Australia; [3]Empoli Hospital, Empoli, Tuscany, Italy; [4]University of Oxford, Oxford, Oxfordshire, United Kingdom

The estimation of global atrophy rate is gaining popularity as a sensitive measure of brain volume change, for example as a marker for disease progression or effectiveness of disease treatment. In this abstract we extend our automated method of atrophy estimation to allow for voxel-wise cross-subject statistical analysis – i.e. to allow the investigation of different atrophy rates in different parts of the brain, without the need to pre-specify regional ROIs. This new method is tested in a group of early relapsing remitting multiple sclerosis patients. Results show significant regional brain volume changes over 1 year followup.

2626. Proton MRS of the hippocampus and neurodevelopmental outcome at 8 years in children who were born preterm

Floris Groenendaal[1], Maarten Rijpert[1], Jeroen van der Grond[1], Ingelot van Haastert[1], Linda Simone de Vries[1], Karin J. Rademaker[1]
[1]University Medical Center, Utrecht, Netherlands

1H-MRS of the hippocampus, memory tests and IQ-tests were performed in 50 8-year-old children born preterm (<=32 weeks and/or <=1500 g) and compared to data of 20 controls born at term. IQ was significantly lower in the children born preterm (98 ± 12 in the study group vs. 109 ± 9 in the controls), but not the'15 words test' and the N-acetylaspartate/(choline + creatine) ratio of the hippocampus. No left-to-right differences could be demonstrated with 1H-MRS. We conclude that hippocampal changes play only a minor role in the reduced IQ of 8-year-old children born preterm.

2627. Diffusion Imaging at 3T using Sensitivity Encoding (SENSE)

Christiane K. Kuhl[1], Juergen Gieseke[1], Christoph Manka[1], Winfried Willinek[1], Hans Schild[1]
[1]University of Bonn, Bonn, Germany

DI at 3T offers improved SNR and CNR compared to 1.5T, but is associated with substantial image distortions. We investigated the diagnostic benefit of SENSE for cerebral ssh SE-EPI diffusion imaging at 3T. First, a systematic analysis of image quality and SNR with increasing SENSE factors was performed on 5 volunteers. A SF of 3, resulting in a TE of 69ms, was identified as the best trade off . 10 patients were imaged with "conventional" protocol (TE 79ms) and SENSE protocol. A substantial improvement of image quality was achieved by SENSE, in particular in areas close to the skull base.

2628. Steps towards solving the crossing fiber problem: a DTI study in cat brain at 9.4T

Mathieu Ducros[1], Mina Kim[2], Itamar Ronen[2], Kamil Ugurbil[2], Nicholas Swindale[1], Dae-Shik Kim[2]
[1]University of British Columbia, Vancouver, BC, Canada; [2]University of Minnesota, Minneapolis, MN, United States

Fiber tracking algorithms reported so far suffer from a common ill-posed problem known as the partial volume effect. In particular, in regions where white matter fiber bundles cross, the reconstructed tracts may not accurately represent anatomical tracts. We have developed a fiber tracking method that addresses this issue. We demonstrate the performance of our method on DTI data acquired at 9.4T in cat brain.

2629. Combining DTI and conventional neurotracing in ex vivo human optic chiasm

Dae Shik Kim[1], Itamar Ronen[1], Jaekeun Park[1], Mina Kim[1], Kamil Ugurbil[1], Ralf A. W. Galuske[2]
[1]Center for Magnetic Resonance Research, University of Minnesota Medical School, Minneapolis, MN, United States; [2]Max-Planck-Institute for Brain Research, Frankfurt, Hessen, Germany

The use of DT-MRI for in vivo fiber reconstruction could greatly expand the explanatory power of functional MRI by providing the patter of connectivity which underlies the cortical information processing. This potential benefit of DT-MRI is greatly hampered by the fact, however, that no ¡ gold standard¡± exists about the validity of the most fiber reconstruction algorithms that exist today. In the present study, we have combined DTI fiber reconstruction with conventional neurotracing techniques in ex vivo human optic chiasm. The veracity of the DT-MRI fiber reconstruction was assessed in both the uniform and crossing zones of the optic chiasm.

2630. Measurement of cerebral blood flow with dynamic susceptibility contrast MRI and comparison with O-15 PET

Jun-ichiro Enmi[1], Takuya Hayashi[1], Shin-ichi Urayama[1], Hiroshi Watabe[1], Hidehiro Iida[1], Naoaki Yamada[1]
[1]National Cardiovascular Center, Suita, Osaka, Japan

The errors of cerebral blood flow (CBF) in dynamic susceptibility contrast MRI (DSC-MRI) were investigated by comparison with O-15 positron emission tomography (PET). In DSC-MRI, the overestimation of CBF, as well as CBV in the affected hemisphere was observed. The simulations suggested overestimation of MRI-CBF was caused by the overestimation of MRI-CBV, attributed to a non-linear relationship between MR signal intensity and contrast agent concentration.

2631. Hemodynamic segmentation of MR brain perfusion images using Independent Component Analysis, Thresholding, and Bayesian Estimation (ICA-TBE) techniques

Yi Hsuan Kao[1], Wan Yuo Guo[2], Yu Te Wu[1], Kuo Ching Liu[1], Wen Yan Chai[1], Chiao Yuan Lin[1], Yi Shuan Hwang[1], Jy Kang Liou[2], Hsiu Mei Wu[2], Hui Cheng Cheng[2], Tzu Chen Yeh[2], Jen Chuan Hsieh[2], Mu Huo Teng[2]
[1]National Yang-Ming University, Pei-Tou, Taipei, Taiwan; [2]Taipei Veteran General Hospital, Pei-Tou, Taipei, Taiwan

Dynamic-susceptibility-contrast perfusion imaging is a widely used imaging tool for in vivo study of cerebral blood perfusion. However, visualization of different hemodynamic compartments is less investigated. We use independent component analysis, thresholding, and Bayesian estimation to concurrently segment different tissues on perfusion images of normal volunteers. Based on the spatio-temporal hemodynamics, sequential passages and microcirculation of contrast-agent particles in brain tissues are decomposed and analyzed. Late and multi-phasic perfusion, indicating the presence of contrast agents, is observed in choroid plexus and CSF areas. An arterial input function is modeled from an arterial area on the same slice.

2632. Automated Method of Improving ROI Homogeneity for Quantitative Perfusion Imaging

Evan Delucia-Deranja[1], Frank E. Hospod[2], George C. Newman[2]
[1]SUNY at Stony Brook, Stony Brook, New York, United States; [2]University of Wisconsin, Madison, Wisconsin, United States

A simple scheme for automating voxel purification to obtain maximal tissue homogeneity is introduced. The method is based on the assumption that the most homogeneous population of voxels will be revealed as the steepest portion of the slope of a cumulative frequency plot of area under the curve. In patients with carotid artery disease, the automated method retained 25% fewer voxels than standard subjective methods but produced no difference in CBV in the 13 bilateral ROIs sampled. This simple method reduces the time for tissue analysis while eliminating user bias.

2633. A 3D FAIR Perfusion Sequence with Reduced Pulse Profile Interaction Errors

Jan Hrabe[1], David N. Guilfoyle[1], David P. Lewis[1]
[1]Nathan S. Kline Institute, Orangeburg, NY, United States

A 3D Flow-sensitive Alternating Inversion Recovery (FAIR) sequence is presented that uses phase oversampling in the slice direction to significantly reduce the pulse profile interaction errors in the perfusion-weighted images. The inversion slab width can thus be reduced to almost match the imaging slab. The error profile across the slab is characterized in a phantom and the sequence utility is demonstrated by 3D brain perfusion imaging of a human volunteer.

2634. High Resolution Diffusion Tensor Imaging in patients with temporal lobe epilepsy due to cortical dysplasia - a study at 3T

Susanne Knake[1], David H. Salat[1], P. E. Grant[1], Bruce Fischl[1], Thomas Benner[1], Doug N. Greve[1], Dave S. Tuch[1], Steven M. Stufflebeam[1], Hideaki Shiraishi[1], Edward B. Bromfield[2], Donald L. Schomer[3], Mary T. Foley[1], Anders M. Dale[1], Eric Halgren[1]
[1]Massachusetts General Hospital, NMR Center, Charlestown, MA, United States; [2]Brigham and Women's Hospital, Boston, MA, United States; [3]Beth Israel Deaconess Medical Center, Boston, MA, United States

Cortical dysplasias (CD) are a common cause of epilepsy. CD are widespread including changes in the white matter (WM), but are difficult to detect by MRI. DTI was used in 5 patients with cortical dysplasias and in 3 non-lesional extra-temporal epilepsies (ETE). Fractional Anisotropy (FA), a DTI measure of white matter integrity, was measured in a single region in each hemisphere. Patients with CD, but not ETE, showed a significant interhemispheric differences in FA in the central temporal WM. DTI may be useful in the detection of CD in epilepsy patients and may contribute to their presurgical evaluation.

2635. Perfusion imaging of meningioma using continuous arterial spin labeling (CASL): Comparison with histopathological features

Hirohiko Kimura[1], Hiroaki Takeuchi[2], Yoshio Koshimoto[1], Hirotsugu Kado[1], Toshihiko Kubota[2], Harumi Itoh[1]
[1]Dept. of Radiology, Fukui Medical University, Matsuoka, Fukui, Japan; [2]Dept. of Neurosurgery, Fukui Med. Univ., Matsuoka, Fukui, Japan

Continuous arterial spin labeling is one of the arterial spin labeling method which has potential to quantify local perfusion. we think, it may also disclose the feature of vasculature of tumors. Though it is well known that meningioma is one of hypervascular tumors in the central nervous system, the conventional MRI method cannot image the vasculature directly without contrast media. we have applied CASL to patients with Meningioma. In this study, we have aimed to clarify whether the signal intensity of CASL-PWI may have the relationship to the density of microvessels in the histopathological specimen from the same patient.

2636. Abnormal Cerebral Blood Flow Heterogeneity Predicts Clinical Scale and Infarct Size in Hyperacute Stroke

Jussi Perkiö[1], Lauri Soinne[2], Leif Østergaard[3], Johanna Helenius[2], Aki Kangasmäki[1], Sami Martinkauppi[1], Oili Salonen[1], Sauli Savolainen[1], Markku Kaste[2], Hannu J. Aronen[1]
[1]Dept Radiology, Helsinki Univ Central Hospital, Helsinki, Finland; [2]Dept Neurology, Helsinki Univ Central Hospital, Helsinki, Finland; [3]Dept Neuroradiology, Århus University Hospital, Århus, Denmark

Dynamic susceptibility contrast MRI was applied on ten ischemic stroke patients at 1.5 Tesla in hyperacute phase (<6hrs), at 24 hrs and a week after the onset of symptoms. The clinical status of the patients was determined in conjunction of all imagings by National Institute of Health Stroke Scale (NIHSS). The size of abnormal hyperacute flow heterogeneity correlated with NIHSS measured at hyperacute phase ($P<0.01$), at 24 hrs ($P<0.01$), and at one week ($P<0.01$). Additionally, the size of abnormal hyperacute flow heterogeneity correlated with infarct size measured with diffusion weighted imaging at 24 hrs ($P<0.05$) and at one week ($P<0.05$).

2637. Characterisation of Water Diffusion Dnisotropy Changes in Stroke using Eigenvalue Analysis

Hadrian Alexander Luscombe Green[1], Alonso Pena[1], Sally G. Harding[1], Christopher J. Price[2], Joseph V. Guadagno[2], Elizabeth A. Warburton[2], John D. Pickard[1], Jonathan H. Gillard[3], T Adrian Carpenter[1]
[1]Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Dept of Neurology, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [3]Dept of Radiology, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom

Water diffuses preferentially along white matter tracts in the brain due to the directional organisation of tissue constituents such as cellular membranes and myelination. Diffusion can be expressed mathematically as a diffusion tensor, which in graphical terms corresponds to an ellipsoid. Unfortunately multiple ellipsoid shapes can give rise to the same fractional anisotropy and mean diffusivity values. The eigenvalues of the diffusion tensor can be used to draw inferences about the diffusion properties of the axonal tract, because the major eigenvector is parallel to the longitudinal direction of the white matter tract, and the intermediate and minor eigenvectors are perpendicular.

2638. A Voxel-Based Morphometric Study of HIV-1 Patients at 4 Tesla

Dana Carasig[1], Linda Chang[1], Sheeba Arnold[1], Dardo Tomasi[1], Christine Cloak[1], Thomas Ernst[1]
[1]Brookhaven National Laboratory, Upton, New York, United States

Voxel-based morphometry (VBM) were performed in 19 seronegative controls and 18 HIV patients. Logarithmic plasma viral load were correlated positively with gray matter (GM) and negatively with white matter (WM) in the basal ganglia and negatively with posterior parietal GM in HIV patients. Manual morphometry was performed in the subcortical GM structures, which demonstrated reduced volumes. Findings suggest WM atrophy in the basal ganglia in relation to increasing viral load instead. The apparent correlation of GM and viral load in the basal ganglia may be due to inflammation processes or increased iron deposition due to HIV-associated neurotoxicity.

2639. Is more better? Comparison of 4 and 8 channel head coils using standard T2-sequence and iPAT

Elke Ruth Gizewski[1], Stefan Madewald[2], Isabel Wanke[1], Mark E. Ladd[2], Michael Forsting[1]
[1]Neuroradiology, University hospital, Essen, Germany; [2]Dep. of Diagnostic and Interventional Radiology, Essen, Germany

Array coils offer increased signal-to-noise ratio (SNR) over standard volume coils adjacent to array elements while preserving the SNR at the center of the volume. Parallel acquisition techniques (PAT) lead to an SNR decrease. In this study we sought to answer the question whether central SNR is still acceptable in two different array coils when using PAT. The 4-channel head coil has the disadvantages of inhomogeneity and, when using PAT, less SNR compared to the standard volume head coil. The 8-channel head coil was superior in SNR and homogeneity compared to 4-channel and volume head coil, even when using PAT.

2640. Gadolinium Enhancement of Cerebral Infarction on T1WI: Blood-Brain Barrier Breakdown or Luxury Perfusion Validated by MR Perfusion Imaging

CHENG-YU CHEN[1], Ing-Jye Huang[2], Yi-Jui Liu[2], Hsiao-Wen Chung[2], Chang-Shin Lee[1]
[1]Dept. of Radiology, Tri-Service General Hospital, Taipei, Taiwan, R.O.C., TAIPEI, TAIWAN, Taiwan; [2]Dept. of Electrical Engineering, National Taiwan University, Taipei, Taiwan, R.O.C, TAIPEI, TAIWAN, Taiwan

Paramagnetic contrast enhancement of ischemic brain is commonly seen 7-10 days after ictus on routine computed tomography and T1-weighted (T1W) magnetic resonance imaging (1). This enhancement has been reported to be stage-dependant, hypothetically attributed to the timing of blood brain barrier (BBB) disruption or abundant reperfusion after ischemic injury, a condition often referred to luxury perfusion (2). To prove the hypothesis, however, a longitudinal survey on the changes of enhancement on T1W images and hemodynamics of cerebral infarction is desirable. The purpose of our study was to determine the relationship between the enhancement on T1W images and reperfusion of cerebral infarction from acute to chronic stages.

2641. Brain Lesions with Restricted Water Diffusion: Evaluation with Magnetic Resonance Diffusion-Weighted Imaging and Proton MR Spectroscopy

Cheng-Yu Chen[1], Shy- Chyi Chin[1], Chang- Shin Lee[1]
[1]Department of Radiology, Tri-Service General Hospital and National Defense Medical Center, TAIPEI, TAIWAN, Taiwan

Background and Purpose

Diffusion-weighted magnetic resonance (MR) imaging is now considered a valuable tool in evaluating various CNS disease processes with restricted water diffusion, which is thought to be due to reduced extra-cellular spaces. The purpose of this study is attempt to correlate CNS lesions with characteristic restricted water diffusion and their proton MR spectroscopic results.

Materials and Methods

105 patients with hyperintense cerebral lesions on DWI (b=1,000 sec/mm2) and decreased apparent diffusion coefficient (ADC) were included, those including 2 brain abscess, 2 maple syrup urine disease, 2 Creutzfield-Jacob disease, 1 neurometabolic disease, 1 acute heroin intoxication, 1 herpes encephalitis.

2642. Optimised brain T_1 measurement using multiple flip angle gradient-echo acquisitions

Paul Armitage[1], Christian Behrenbruch[2], Michael Brady[3]
[1]University of Edinburgh, Edinburgh, Midlothian, United Kingdom; [2]Mirada Solutions Limited, Oxford, Oxon, United Kingdom; [3]University of Oxford, Oxford, Oxon, United Kingdom

Measurement of the longitudinal relaxation time (T1) is useful for characterising various disorders such as brain tumours, as well as being required for quantification of contrast agent passage through the brain. This work describes the measurement of T1 using a series of spoiled gradient-echo acquisitions each acquired with a different RF flip angle. It is shown how the flip angle choice is critical if accurate measurements are desired, simulations are performed to determine the optimum parameters for typical imaging situations in the brain, and these are verified with experimental data acquired from phantoms and healthy volunteers.

2643. Good images do not guarantee better diagnosis: CISS in diagnostics of retinoblastoma

Elke Ruth Gizewski[1], Isabel Wanke[1], Christine Jurklies[2], Michael Forsting[1]
[1]Neuroradiology, University hospital, Essen, Germany; [2]Dep. of Ophthalmology, Essen, Germany

Retinoblastoma are common retinal tumors in newborn and young children. Diagnostic work-up is of utmost importance for adequate therapy. We used 3D CISS and thin-slice fat-set sequences to evaluate the value of clinical relevance and analysis of retro orbital structures infiltration. MRI revealed an infiltration of retro bulbar structures in 6 of 72 patients in high resolution contrast enhanced T1 weighted images. The CISS sequence was mainly helpful for three-dimensional visualization of tumor extension and was accepted as a helpful pre-surgical tool by the ophthalmologists. However, the infiltration of retrobulbar structures could not be revealed with CISS sequence.

2644. Differentiation between benign and malignant compression fractures by measuring apparent diffusion coefficients of vertebral body bone marrows with the single shot fast spin echo sequence of high b-va

Yasuhiro Nakata[1], Toshiyuki Okubo[1], Masaaki Hori[1], Yuko Adachi[1], Hiroshi Kumagai[1], Tsutomu Araki[1]
[1]University of Yamanashi, Nakakoma-gun, Yamanashi, Japan

The aim of this study was to measure the ADC values in benign and malignant compression fractures and thus to evaluate the effectiveness of DW-SSFSE to differentiate between them. In all forty-three patients, the ADC could be calculated. Mean ADC value (1.15+-0.19 x 10-3mm2/sec) of benign compression fracture (n=40) were significantly higher ($p<0.05$) than those of (0.84+-0.19) metastatic one (n=39). When an ADC smaller than 1.10 x 10-3mm2/sec was used for predicting malignant compression fracture, the accuracy of 78%, with 77% sensitivity and 78% specificity, was obtained. ADC measurements may be useful in differentiation between benign and malignant compression fractures.

2645. Verification of a Technique that Provides Isolation to Opposing Loops with Variable Separation

Steven Davis[1]
[1]GE Medical Systems, Waukesha, Wisconsin, United States

Contemporary approaches to Shoulder Imaging involve two primary concepts. Concept 1 has fixed geometry, isolated loops. Concept 2 has variable geometry, non-isolated loops. For Concept 1, multiple assemblies are necessary to fit a large patient population size range. Flexibility is lost. For Concept 2, loop cross coupling changes over a large patient population size range. Image quality is lost. Concept 3, which has variable geometry, variable-isolation loops, is introduced. Concept 3 provides full patient population size range fit while maintaining loop isolation over the full range. The result is optimum image quality over full population range.

2646. FDTD Simulation of a Spine Transceive Phased Array

Jim Caserta[1], *David M. Peterson*[1], *Jeffrey R. Fitzsimmons*[1]
[1]University of Florida, Gainesville, FL, United States

The finite difference time domain method is used to predict local 1g average SAR values in a spine transceive phased-array. A linear drive is compared to a quad drive. For the 2x2 array, circularly polarized field strength is compared at different points in the array with different contributions from each array element. SAR values for three different sequences are estimated from simulated results, and found to be within relevant limits.

2647. FDTD Simulation of an 11T Re-entrant Cavity Volume Coil

Jim Caserta[1], *Barbara L. Beck*[1], *Jeffrey R. Fitzsimmons*[1]
[1]University of Florida, Gainesville, FL, United States

Finite-difference time-domain simulations were performed on a re-entrant cavity (re-cav) volume coil. Simulations at 470MHz are compared to 11T images. Simulations show inhomogeneities for all field components (Bx, By and B+), which are comparable to images. The coil is tuned to 470 MHz using Gaussian pulses with Fourier transform of the output, and observing leg current magnitudes and phases. The simulated field patterns resemble the images, showing both bright and dark regions, however differences are expected because of differences in phantom dimensions.

2648. Use of Cylindrical Meanderline Catheter Coils for Intravascular Imaging

Christian T. Farrar[1], *Van Wedeen*[1], *Jerome L. Ackerman*[1]
[1]Massachusetts General Hospital, Charlestown, MA, United States

In order to improve the performance of MR imaging and spectroscopy of atherosclerotic plaque we are investigating the use of novel RF coil structures with B_1 field profiles tailored to the geometry of the arterial wall. We have found that a cylindrical meanderline (zigzag) coil design provides a sensitive detection volume that is restricted to a cylindrical shell, thereby maximizing the filling factor for plaques while reducing the blood signal. In this study the performance of the cylindrical meanderline coil is evaluated and compared to the more commonly employed loopless and single loop intravascular coil designs.

2649. Quantification of the Spatial Distribution of SAR at 3.0T using MR Thermal Imaging.

Paul R. Harvey[1], *Heidi van Hulten*[1], *Zhiyong Zhai*[2]
[1]Philips Medical Systems, Best, Netherlands; [2]Philips Medical Systems, Cleveland, Ohio, United States

The maximum temperature rise is of concern with respect to the potential for undesired RF power deposition to cause injury to a patient. At higher field strengths, the SAR limit is reached sooner and so it is of considerable importance to validate any assumptions that are used in the design of the software/hardware that is used to enforce the SAR limits on a clinical MRI system. MR based thermal imaging has been utilized to directly quantify the spatial distribution of SAR, at 3.0T, within a saline spherical head model. The results have been compared with those expected from FDTD simulation.