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NEWSLETTER OF THE SECTION FOR MAGNETIC RESONANCE TECHNOLOGISTS

IN THIS ISSUE

President's Letter

John A. Koveleski, R.T. (R)(MR)

With this year's Annual Meeting behind us, its back to the real world of daily scanning. The Executive Committee and Policy Board have already been to work on SMRT activities since the meeting in May.

The Executive Committee had it's first telephone conference in July and new issues were discussed.

Maureen Hood, our External Relations Committee Chair, is busy as usual. She will be attending the Health Professions Network meeting in Madison, Wisconsin, in September representing SMRT. We've also created a subcommittee in the External Relations Committee. Muriel Cockburn, Policy Board member, from Glasgow, Scotland, will head the new Global Development Subcommittee and will interact with other MRI technologist groups throughout the world. Muriel will also try to generate interest in parts of the world where the SMRT has little involvement. This is an opportunity for the SMRT to provide the quality education that we're all familiar with to other technologists.

Laurian Rohoman, from Montreal General Hospital, is the Program Chair for next year's Annual Meeting in Toronto, Ontario, Canada. Laurian and the 2003 Program Committee are already hard at work organizing the agenda for next year's meeting. It may sound a bit premature but a lot of work goes into organizing a meeting of this magnitude. We're strongly encouraging electronic abstract submission for the Toronto meeting. Laurie reports that she hopes to have a completed program ready by this fall.

Julia Lowe, from Indianapolis, Indiana, is the Education Chair for this year. The Education Committee is a very busy committee within the SMRT. Julia reports that the Joint Review Committee for Education in Radiologic Technology (JRCERT) has finalized their standards for MRI course curriculum and they will take effect on 1 January 2003. The SMRT offered input and assisted the JRCERT in developing a more standardized curriculum for MR technology programs. Julia's committee will be busy in the near future once the abstracts for Toronto have been submitted.

Heidi Berns, SMRT Past President, from Iowa and the Chair of the Nominations Committee and the Awards Committee. Heidi is currently gathering names of candidates for the SMRT Policy Board election, which will be held in the fall. She's also soliciting candidates for the Crues-Kressel Award. If you would like to nominate a colleague, please e-mail or call Heidi immediately.

Cindy Comeau, from New York City, is our Regional Seminars Committee Chair for this year. Cindy reported that Mark Spooner hosted a very successful Northeast Regional in Utica, New York, in June. Future Regional Seminars will be in Atlanta and Montreal in September. It's a lot of work but very rewarding to host a Regional.

The local Chairperson of the seminar will work with Cindy in organizing the seminar and will also receive a free one-year membership to the SMRT. It was nice to have a Regional in central New York and we look forward to Laurian Rohoman hosting our first Eastern Canada Regional. The SMRT Local Chapter organizers in Atlanta always do a spectacular job in hosting their Regional as well. I look forward to seeing many of you in Atlanta and Montreal.

Bobbie Burrow, from Atlanta, Georgia, is the Local Chapter Committee Chair. There are currently eight local chapters. They are Atlanta (Georgia), Iowa City (Iowa), Springfield (Illinois), Kansas City (Missouri), Wichita (Kansas), Central Pennsylvania, Rhode Island, and Australia/New Zealand. Drop Bobbie a line if you're interested in starting your own local chapter.

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***President's Letter** continued*

Scott Kurdilla, from Pittsburgh, is the Chair of the By-Laws Committee. Scott was busy in Honolulu rounding up some new faces to serve on his committee.

Ray Cruz, from the state of Washington, is returning for his second year as Membership Committee Chair. Ray reports that the SMRT has 1181 members and also that the renewal rate dropped by 5% from last year. His committee has formulated a questionnaire that will be mailed to those who have dropped their membership in an effort to ascertain their reasons for not continuing their membership. For US$75 each year, the SMRT has so much to offer. Examples include reduced registration fees for Regional and Annual SMRT educational meetings, the *Signals* newsletter, and the ever-popular *SMRT Educational Seminars* (AKA Home Studies). The home studies offer American technologists all the credits they need to satisfy their certification though the ARRT plus you may learn something by reading these as well!

Kelly Baron, from Indiana, chairs the Publications Committee and Julie Strandt-Peay is the *Signals* Editor. Kudos goes out to both Kelly and Julie for their efforts in two of the most demanding roles in the SMRT. By now, you should have received your *MRI of the Ankle and Foot* home study. Make sure you complete the quiz and return it to the SMRT. It's worth three credits.

Maureen Ainslie, President-Elect, from the Duke Image Analysis Lab, is in the process of creating a new feature on the SMRT Website. "Highlight Your Site" which will give SMRT members the opportunity to tell the SMRT community about their site. Look for this in the near future. Drop an e-mail to Maureen (maureen.ainslie@ duke.edu) if you'd like your site featured.

As you can see, it's been a busy few months for the SMRT Board since our meeting in Honolulu in May. As volunteers, we have to find the time in our busy schedules to do our SMRT responsibilities. We welcome comments and contributions to our organization. Why not get involved yourself? It's a great way to contribute to the MR world and also a good way to make new friends.

As always, please feel free to contact me at: jak3264@aol.com if you have any questions or concerns. ●

The Student Scope submissions previously featured in *Signals* will be moving to the SMRT Website http://www.ismrm.org/smrt. The Education Committee is spearheading this project and revising the guidelines to aide students with their submission. Look for this popular feature on the SMRT Website in early 2003! ●

Editor's Letter

Julie Strandt-Peay, B.S.M., R.T. (R)(MR)

Greetings, This issue of *Signals* is packed with topical information for you! SMRT President, **John Koveleski**, brings us up to date on activities since the Annual Meeting. Check out what your elected Policy Board members are doing as they serve to chair their standing committees. Publication Chair, **Kelly Baron**, announces the newest home study and a change in the question and answer format. **Laurian Rohoman**, 2003 Program Chair, has already initiated the planning course for next year's meeting.

News from the imaging world is brought to you by **Maureen Hood**, SMRT External Liaison. See what is occurring that may affect you or your work place. Also, for those of you who are ARRT Registered, be sure to keep up to date with the latest developments.

You are responsible for the progress and direction of the SMRT by your informed vote. Don't miss out on this opportunity to select the leaders and potential award recipients of your organization.

We continue to share with you the information from the **Annual Meeting**. In this issue of *Signals* you will find the abstracts of those presenters who were awarded second place in the various categories. Our educational perspective continues with an article by **Bill Faulkner** addressing low-field scanners. A generous contributor to the SMRT, **Frank Shellock**, shares his research on devices used for interventional studies. MR technologist, **Jim Hamilton**, shares his views on Gradient Echo Imaging.

Regional Seminar news is brought to us by **Mark Spooner**. Be sure to check for upcoming Regional Seminars near you on the SMRT Website. The website is in the process of being expanded to include an electronic copy of *Signals,* an area to boast about your site, and opportunities for students to share their work. And last of all, note the upcoming meetings and activities that are of interest to you....you don't want to miss any of these great offerings. ●

Update on
SMRT Educational Seminars

Kelly D. Baron B.S., R.T. (R)(MR), Chair, SMRT Publications Committee

Thank you for all your wonderful comments about the Neuroanatomy home study. We hope that you enjoy the *MRI of the Ankle and Foot* issue just as well. Because of your suggestions, the Publications Committee will strive to provide one anatomy issue per year! A change you will notice, starting with the issue, *MRI of the Foot and Ankle,* is that the quiz answer sheet has been separated from the booklet. This is a cost effective method to facilitate any changes that may need to be made to question sets when these issues are reprinted in the future. You now have in your hands, *MR Imaging of the Breast,* which is lengthy, but is packed full of much needed information. After completing it, you will have grasped the very latest MR imaging techniques used for the breast. The remaining issue of the year will be *Diffusion Weighted Imaging of the Brain.* This issue is a short and sweet synopsis of a very useful technique. Please feel free to contact the SMRT office or me at: baron4mri@woh.rr.com if you would like to participate in producing a home study by reviewing material, authoring questions, or proofing the text. As always your suggestions and comments are welcomed. ●

Are you a new SMRT member? Did you miss an earlier issue?

All of the previously published ***SMRT Educational Seminars*** home studies are now available for purchase by SMRT Members in good standing for only US$20 per issue.

For more SMRT membership information or an order form, please e-mail: **smrt@ismrm.org** or visit the SMRT Website: **http://www.ismrm.org/smrt**

The SMRT gratefully acknowledges

MRI Devices Corporation
Waukesha, Wisconsin, USA

for their generous support of the 2002 *SMRT Educational Seminars* home study series. This donation demonstrates the consideration of MRI Devices Corporation for quality MR technologist education. Contact information can be found at: www.mridevices.com

Announcing the SMRT 12th Annual Meeting

Laurian Rohoman, R.T. (R)(MR), 2003 Program Committee Chair

The SMRT would like to invite technologists from around the world to attend the Twelfth Annual Meeting of the Section for Magnetic Resonance Technologists. This meeting will be held 9 to 11 May 2003 in conjunction with the Eleventh Scientific Meeting and Exhibition of the International Society for Magnetic Resonance in Medicine at the Metro Toronto Convention Centre in Toronto, Ontario, Canada.

The goal of the SMRT is to provide quality educational opportunities for the MR technologist and to establish and maintain a high level of professionalism in the field. MR technologists are faced with many challenges: keeping abreast of advancing technology, the ever expanding field of MR, coping with the day-to-day problems of technologist shortages, and a continuously increasing workload. We must strive to maintain a high standard of performance in addition to continuing to provide optimal patient care.

The agenda of the Annual Meeting will be geared toward bringing technologists the latest information on developments in MR technology that will be of value whether one is from a clinical or research site. The topics chosen and speakers invited will be based on the comments and feedback received from the attendees of previous annual meetings.

The Meeting will commence with a Poster Exhibit and Walking Tour Reception at 18:30, on Friday evening 9 May 2003. This will be a great way to learn about new and innovative clinical and research studies that are being performed by our colleagues worldwide. It also provides a great opportunity to interact with the poster authors and to meet and share ideas with fellow technologists from around the world.

An important aspect of the meeting remains the submission of abstracts for oral and poster presentations by technologists. Proffered papers will be interlaced throughout the sessions. We strongly encourage all technologists to participate in the meeting by submitting an oral or poster abstract. The deadline for SMRT abstract submissions will be **17 January 2003.** Again this year, the SMRT will continue with the online process for abstract submissions. The SMRT experienced a 100% electronic submission rate for the 2002 meeting abstracts. Online abstract submission will be available on the SMRT Website: http//www.ismrm.org/smrt. The proffered papers and posters have been one of the highlights of past SMRT meetings.

The SMRT Annual Business Meeting will be held on Saturday, 10 May, giving members a chance to actively participate in the professional MR organization.

As Chair of the 2003 Program Committee, it is my pleasure to invite you to attend this meeting and to join the SMRT in bringing to technologists, an exciting, quality educational weekend in the wonderful city of Toronto. ●

SMRT External Liaison Report

Maureen Hood, B.S.N., R.N., R.T. (R)(MR) External Liaison Chair

The SMRT is a member of the Associated Sciences Consortium of the Radiological Society of North America (RSNA) that works hard each year to present a variety of courses geared to the disciplines that work within the radiology or diagnostic imaging fields. The RSNA Annual Meeting in Chicago is coming up December 1-6, 2002. The mini-symposia and refresher courses put on by the Associated Sciences Consortium have been a huge success since switching to the Sunday through Friday format. The RSNA board was very pleased with the quality of the presentations last year. This year's mini-symposia are going to be covering the new combined PET/CT scanners with strategies on how to manage them. The Associated Sciences Consortium has a booth at the RSNA staffed by volunteers from the SMRT as much as possible. If you are attending the RSNA, please support the Associated Sciences presentations and stop by the booth to say hi.

The SMRT continues to be an active member of the Health Professions Network (HPN), an association of allied health societies dedicated to communication, consensus, and advocacy on behalf of allied health professionals. Radiology technologists (including MR technologists) were highlighted as the "Allied Health Profession of the Month" for June 2002. To view the article, go to http://www.healthpronet.org/ahp_month/06_02.html. Also included on the HPN website is a listing of activities and links of interest including conferences, scholarship opportunities, and other allied health links.

Among its many activities, the HPN has been bringing people together to work on the allied health workforce shortage. The American Society for Healthcare Human Resource Administration (ASHHRA) has been studying the American workforce as well as the Bureau of Health Professions. They found that one in every ten Americans in the workforce is employed in healthcare, with forty percent of the healthcare workforce employed in hospitals. The demand for healthcare workers is expected to continue to grow through the year 2010. Currently, there is a shortage of all healthcare workers with the greatest shortages found with pharmacists, radiological technologists, billing/coding clerks, laboratory technologists, registered nurses, housekeeping and maintenance personnel. Unfortunately no one has a simple solution to the workforce challenge although the American Hospital Association has identified that the shortage of healthcare professionals is at crisis levels. Current recommendations by ASHHRA include increasing recognition of people as a key strategic resource, investing in retention of employees, recruitment and development of care givers, increasing interest in healthcare career and educational programs, and making healthcare systems the employers of choice. The American Hospital Association has a new report titled *"In Our Hands: How Hospital Leaders Can Build a Thriving Workforce,"* which can be found at: http://www.hospitalconnect. com/aha key_issues/ workforce index.html. This is an excellent source of strategies for hospitals battling the workforce shortage.

Another resource our involvement with the HPN allows us to enjoy is the sharing of information for education programs in allied health. The World Health Organization's "Healthy People 2010" initiative has a big push toward increasing culturally competent care. Educational programs need to incorporate cultural competencies into their curricula. The Center for Health Professions, University of California at San Francisco, provides access to educators its new curriculum *"Toward Culturally Competent Care: A Toolbox for Teaching Communication Strategies."* The curriculum is designed to teach skills for practical communication between health care providers and patients. The curriculum includes both didactic and lab exercises. This curriculum is available through request by visiting the UCSF website at: http://www.futurehealth.ucsf.edu.

The Joint Review Committee on Education in Radiologic Technology (JRCERT) has announced its Standards for Accredited Educational Program in Magnetic Resonance, effective January 1, 2003. The JRCERT is the only organization recognized by the U.S. Department of Education for the accreditation of education programs for radiographers and radiation therapists in the United States. The JRCERT promotes excellence in education and enhances quality and safety of patient care through the accreditation of educational programs. You can view the MR standards by going to the downloads page at: http://www.jrcert.org/. The JRCERT encourages all existing MR educational programs to apply for accreditation.

This past year, the SMRT has been involved in consulting with the JRCERT in helping formulate the subcommittee that will be charged with reviewing educational programs in magnetic resonance. Any MR technologist, MR educator, or MR physicist interested in possibly serving on this subcommittee can contact Maureen Hood at: mhood@usuhs.mil to have your name included on an interest list. This is an interest list only! At this time, the subcommittee is *not* finalized. Further information will be released after the JRCERT finalizes the subcommittee structure. The actual selection of the subcommittee will be conducted by the JRCERT. ●

Your Vote Counts!

Heidi Berns, M.S., R.T. (R)(MR), SMRT Past-President, Nominating Committee Chair

It is that time of year when you have the opportunity to participate in the future of the SMRT. As a voting member you not only have the privilege but the responsibility to vote for the individuals who will become the President-Elect and the new Policy Board Members. As your ballot arrives please take some time to review the qualities and experience of the candidates and select those individuals whom you think will serve you and the SMRT well. This is your chance to determine the future leadership of the SMRT. You will also have the occasion to select the recipient of the Crues-Kressel Award.

The President-Elect position is a three-year commitment, beginning as President-Elect followed by President and then Past President. As a member of the Executive Committee, the President-Elect is mentored for one year and then becomes the President. During the year as President, this leader represents the SMRT to the parent society, ISMRM, and presides over all of the business of the SMRT. This includes contact with all eleven standing committees, as well as any other pertinent issues that arise. As Past President this person serves on the Executive Committee to ease the transition from one year to the next and is Chair of the Nominating and Awards Committees.

Policy Board members are elected for a three-year term, and are expected during that time to chair at least one of the eleven standing committees and serve on others as needed. Those elected to the Policy Board are expected to be highly motivated, concerned individuals who will complete those tasks necessary for the SMRT to have ongoing success. Face to face meetings are rare, because members of any given committee may be from a variety of countries. Communication among Policy Board and committee members is generally conducted through electronic mail, which is both efficient and economical. It is a tribute to those many volunteers who have already completed terms on the Policy Board as well as those being considered for election, that the SMRT continues to evolve into a recognized professional organization for MR technologists around the world. By carefully selecting your choices, you will ensure the SMRT will thrive for years to come.

You will also be asked to select a recipient of the Crues-Kressel Award. This award was established in honor of Drs. John Crues and Herb Kressel for their support in establishment of the SMRT. The person nominated to receive this award is someone who is recognized "for outstanding contributions to the education of magnetic resonance technologists." For a listing of those who have received this award in previous years please check the SMRT Website.

Included with the ballot are brief biographical histories for all the candidates. Please review them and mark your choices. As a reminder, only those voting members in good standing, with annual dues paid, are eligible to vote. Follow the directions carefully to sign and mail your ballot or it may not be counted. Ballots will be mailed 15 October 2002. The postmark deadline is **1 December 2002** and the ballots must be received no later than 9 December 2002. The ballots will be counted and the results announced in a future issue of *Signals*. If you have any questions about the election procedure or your eligibility to vote, please contact me at: heidi.berns@mercyic.org, or the SMRT office at: +1 510 841 1899. ●

Editor's Note: Following is an excerpt from the August 1, 2002 press release of The American Registry of Radiologic Technologists (ARRT)

News for ARRT Registered Members

The *Continuing Education Requirements for Renewal of Registration* are revised to specify what is and is *not* approved for CE, and new "should" language is introduced regarding choice of CE topics by Registered Technologists. See below for more detail.

CE Changes

ARRT's Board of Trustees changed the CE requirements to reflect their true intent regarding CE topic selection by R.T.s. ARRT has always expected that technologists rely on their professional judgment to select continuing education topics that update their knowledge and skills in their specific area of practice. To re-affirm that position, the requirements document now states: "All technologists should select CE topics that are related to their area of practice and that will address the needs of the patient and of the Registered Technologist."

The CE document updates also reflect the following changes:

- ARRT's recent decision to award CE credits for NMTCB's new examination in nuclear cardiology.
- Recognition of the CE evaluation mechanism administered by the Texas Society of Radiologic Technologists on behalf of the Texas Department of Health. (This change adds Texas to the states of Florida, Illinois, Iowa, Kentucky, Massachusetts, New Mexico, and Oregon that also have ARRT recognition.)
- Acceptance of CPR certification procedures of the American Safety and Health Institute.
- No longer accepting for ARRT Category A credit any courses approved through the American Medical Association or the American Nurses Credentialing Center – unless they are also approved by a RCEEM (Recognized Continuing Education Evaluation Mechanism) or a recognized state licensing agency. AMA/ANCC courses may still be used for Category B, and up to half of a biennium's 24 credits may be Category B.

If you have questions about ARRT's requirements for R.T. continuing education, check the www.arrt.org website for more information, or contact the CE department at (651) 687-0048, ext. 540.

The updated governing documents appear on ARRT's web site and will be published in next year's certification handbooks and *Annual Report to Registered Technologists*.

ARRT, the American Registry of Radiologic Technologists, recognizes individuals qualified in the use of ionizing and non-ionizing radiation to promote high standards of patient care in diagnostic medical imaging, interventional procedures and therapeutic treatment. Headquartered in St. Paul, Minnesota, USA, it tests, certifies and annually registers more than 226,000 radiologic technologists across the United States. ●

2002 2nd Place Proffered Paper–
Clinical Oral Presentation

The Effect of Peripheral Arterial Occlusive Disease on Venous Filling in Gadolinium-Enhanced MRA of the Distal Aorta and Lower Extremities

Frank Londy R.T. (R), William J. Weadock M.D., Hero K. Hussain M.D., Joseph J. Gemmete M.D., and Stefan S. Schoenberg M.D.*Department of Radiology, University of Michigan, Ann Arbor, Michigan
*Department of Radiology, Ludwig-Maximilians-Universitaet, Munich, Germany

Purpose

Gadolinium-enhanced multi station MRA (MSMRA) examination of the aorta and lower extremities is becoming more common. The advantages of this noninvasive, iodine free, high-resolution examination are making this procedure a necessary component of today's MR department. The goal of an MSMRA study is to define the arterial bed from the aorta to at least the level of the ankle, free of venous overlay however the timing of contrast arrival in the calves may be altered by different disease states. The purpose of this work is to explore the relationship between the amount of venous overlay of the MSMRA, the degree of peripheral arterial occlusive disease (PAOD), and the length of scan time.

Method

After receiving Internal Review Board approval, MSMRA images of 57 consecutive patients were retrospectively reviewed and the venous contamination (VC) of the distal (calf) station was scored on a 3-point scale. (1 = arterial study without or with very little venous contamination, 2 = diagnostic arterial study with mild to moderate venous contamination, 3 = failed exam, non-diagnostic arterial study secondary to extensive venous contamination). Three board certified radiologists, experienced in interpreting MSMRA exams, performed the scoring. All 57 patients' medical records were reviewed and assigned a PAOD value of 0 through 4: (1 = asymptomatic with diagnosis made coincidentally during other diagnostic procedures, 2 = intermittent claudication, 3 = constant pain even at rest, 4 = necrosis or ulcers with or without rest pain). The additional score of 0 was added to the normal grading criteria to indicate those patients that underwent MSMRA but were asymptomatic and without suspicion of PAOD. All readers were blinded to the PAOD scores of the patients. Only the leg with the highest PAOD score was included in this study. In those cases when both legs received the same PAOD score, the leg with the worst scan result was recorded. The scan times of the abdominal (1st) and thigh (2nd) stations were recorded as well as any history of diabetes. All 57 patients received a biphasic contrast injection of 40cc gadolinium consisting of a contrast bolus followed by saline flush. All injections were completed during the scanning of the 2nd station. Contrast arrival detection software and automatic table movement were used. Table movement added approximately 8 seconds per move between stations 1-2 and 2-3. A 12-element phased array coil was used for all patients. Elliptic centric K-space filling was used on all calf stations.

Results

PAOD score vs. Venous Contamination: There was a strong correlation between PAOD score and venous contamination. All 17 cases with VC significant enough to make the case non-diagnostic had a PAOD score of 2 or above. The percentage of failed cases increased along with increasing PAOD score. (Table #1)

Table 1.

PAOD Score	VC Score 1	2	3	% Failed
0	14	4	0	0
1	2	1	0	0
2	8	6	6	30
3	2	1	4	57
4	1	1	7	77

Diabetes: Of the 57 patients, 14 patients had diabetes mellitus. Of these, 8 had a VC score of 1 (arterial study without or with very little venous contamination,, while 6 had a VC score of 3 (non-diagnostic arterial study secondary to extensive venous contamination).

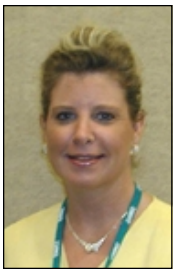
Age: The average VC score of the age 20 to 49 year old group (N=13) was 1.7, the age 50 to 69 year old group (N=21) was 2.1 and the 70 year old and over group (N=23) was 1.7. None of these differences were statistically significant.

Scan Time vs. Result: The average scan times (1st & 2nd stations) of the VC group 1 (with no or little VC) was 35.8 seconds, VC group 2 (some VC) was 37.6 and the VC group 3 (failed exam) was 33.5. None of these differences were statistically significant.

Scan Time vs. PAOD Score: The average scan time (1st & 2nd stations) of the PAOD score 0 and 1 group (patients without claudication) was 36.7 seconds and the average scan time of PAOD groups 2, 3 and 4 (patients with claudication or ulcers) was 37.8 seconds. None of these differences were statistically significant.

Conclusions

Due to the likelihood of venous contamination, patients with a PAOD score of 2 or above should not receive the traditional 3-station MSMRA exam. Rather, these patients may benefit from a separate injection for the calf station prior to the abdominal and thigh stations. Within the limits of our study, total scan time, diabetes, and patient age were not statistically significant predictors of venous contamination. ●



2002 2nd Place Proffered Paper–
Research Oral Presentation

Coronary Magnetic Resonance Angiography: New Non-Contrast Technique

C. Callahan,* R. Niemczura, J.P. Finn, V. Deshpande, S. Shea, D. Li, R. McCarthy, and J. Carr
Advanced MRI Consulting, Inc. Evergreen Park, Illinois, USA, Northwestern University, Chicago, Illinois, USA

Purpose

Coronary artery disease (CAD) is responsible for an estimated one million deaths a year.[1] This compelling statistic is the driving force behind improving Coronary Magnetic Resonance Angiography (CMRA) for detection of disease. In order to characterize coronary anatomy, CMRA requires high performance gradient capabilities and advanced software to handle the intrinsic physiological and artifact challenges. These technical requirements and diagnostic obstacles combined with current contrast enhanced (CE) techniques render MRI a very difficult and under-utilized modality for clinical coronary imaging.[1-3] The purpose of this study was to explore a new non-contrast CMRA technique and assess its diagnostic contributions to coronary artery examination.

Methods

Informed consent was obtained on 12 adult subjects with suspected CAD. Procedures were performed on a Magnetom Sonata, 1.5 Tesla MR System, Siemens Medical Solutions (Iselin, New Jersey, USA). ECG electrodes were placed for cardiac triggering and patients given specific breath-hold (BH) instructions for consistency of anatomical localization. The protocol consisted of a series of 3-5 localization sequences. The non-contrast CMRA technique was as follows: 3D magnetization-prepared True FISP, TE: 1.6-2.0 ms, TR: 3-4 ms, (126-143) x 512 matrix, 12 partitions, 18-24 mm slab thickness, (166-190) x 380 mm^2 FOV, fat saturation, 20 dummy scans and preparation pulses for artifact minimization were implemented prior to acquisition and adjusted for diastolic cycle. 3D True FISP data was acquired in axial oblique orientation to include left main (LM) and left anterior descending (LAD) arteries and acquired in sagittal oblique orientation to include right coronary artery (RCA) (Figure 1a & 1b). Volume data was evaluated using standard MPR and MIP software for vessel delineation, artifacts, signal/noise ratios (SNR) and contrast/noise ratios (CNR). All data was compared to prior 3D Flash CE CMRA images.

Results

The data resulted in the optimal combination of improved vascular conspicuity and artifact reduction. The True FISP data demonstrated a high SNR and CNR, in both axial and sagittal oblique volumes. Patient preparation techniques allowed for successful localization of coronary anatomy. When compared to 3D Flash CE images, True FISP showed a marked improvement in anatomical visualization of coronary arteries and significant artifact reduction in respiratory motion, cardiac pulsation and gradient susceptibility. SNR for True FISP measured 17.7 (59% increase compared to Flash at 11.1). The CNR for True FISP measured 6.8 (172% increase compared to Flash at 2.5) (Figure 2.a & 2.b).

Conclusions

Based on these results there are considerable advantages to the 3D True FISP technique. Compared to the CE Flash sequence, this non-contrast technique offers a substantial improvement in SNR, CNR, and artifact reduction. This technique demonstrates a promising non-invasive alternative for evaluating coronary arteries. With ongoing advancements in technology, CMRA will continue to gain recognition as a diagnostic tool in detection of CAD. ●

References

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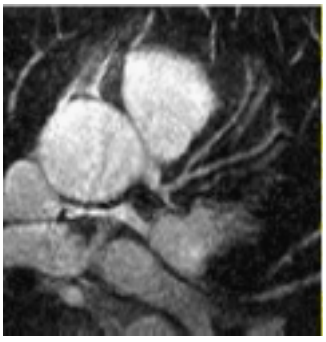

Figure 1a. *True FISP LM, LAD.*

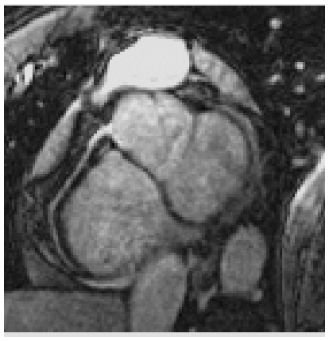

Figure 1b. *True FISP RCA.*

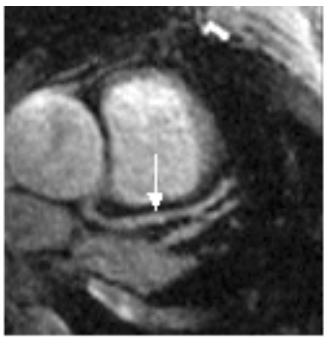

Figure 2a. *True FISP LCA.*

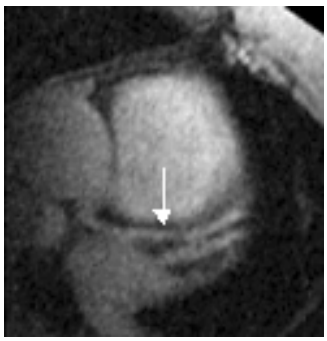

Figure 2b. *True FLASH LCA.*

**2002 2nd Place Proffered Paper–
Clinical Poster**

MRI Breast Needle Localization

R. Walcarius, C.A. Piron, D.B. Plewes, R. Shumak, and P. Causer
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Sunnybrook and Women's College Health Science Center, Toronto, Ontario, Canada**

Purpose

A high risk breast imaging study utilizing mammography, ultrasound, and MRI is currently being run at our site.[1] This has created a need for tissue sampling of suspicious lesions detected only on MRI. The method used for this is a pre-operative needle-wire localization using MRI guidance. The purpose of this study is to describe the MRI stereotactic system we use which enables medial and lateral approaches to the breast, provides access to lesions near the chest wall, and utilizes a phased array coil configuration during the entire procedure.

Method

All scans are performed on a closed 1.5 Tesla GE signa CVMR system. A retrofit frame and tabletop is placed on the GE patient bed (see Figure 1b). The patient is placed in a prone position with the breast to be localized compressed between medial and lateral plates (see Figure 1a). The other breast rests on a flexible bridge compressing it against the chest wall. This bridge allows for medial approach to the breast being localized if necessary. Phased array coils are attached to the compression plates, one medial and the other lateral. Fiducial markers are embedded into the compression plates both horizontally and vertically to help calculate needle position and depth.

Axial and coronal localizing scans are used to not only localize the breast but to determine the positions of the fiducial markers. The lesion is then identified using a dynamic contrast enhanced sagittal 2D SPGR sequence with fat suppression (TR = 150, TE = 4.2, flip = 40 degrees, slice thickness = 5.0 mm, FOV = 18 cc, matrix = 256 X 128, 13 slices, and an injection of 0.2 cc/kg gadolinium). The desired approach (lateral or medial), plus the lesion and fiducial marker coordinates are entered into a computer program to calculate needle position and depth. With the patient removed from the bore of the magnet, the Radiologist inserts an MRI compatible, titanium localizing needle hook-wire into the breast, according to the 3-dimensional coordinates. The needle is guided through a fenestrated plug with 2 mm spaced boreholes. The needle position is then verified in the superior-inferior, anterior-posterior and medial-lateral directions using sagittal and axial 2D SPGR (SPoiled GRadient echo) sequences without contrast. Once needle placement has been verified, the patient is again removed from the magnet bore. The wire is deployed and the needle is removed. A final ax 2D SPGR is performed to verify wire position.

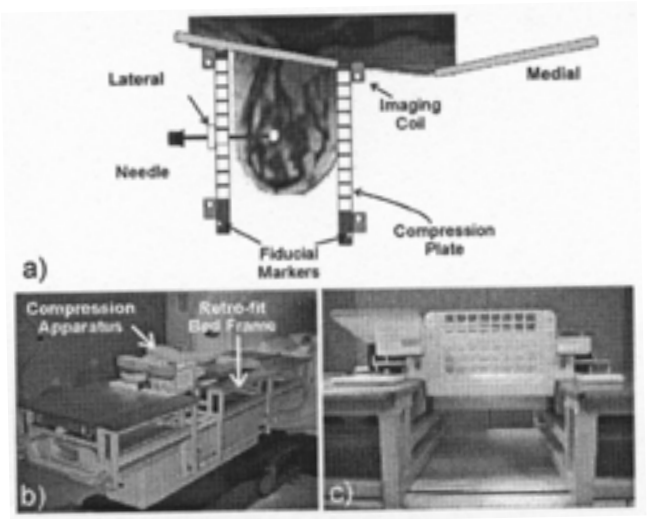

Figure 1a. *Schematic of the localization system. The design permits access to the breast from medial, or lateral approach.*
Figure 1b. *System with retrofit frame on standard GE bed.*
Figure 1c. *Lateral view of system, with coil detached.*

Results

Ten MRI guided breast needle localizations have been performed at our site. Six lateral and four medial approaches. The average size of the lesions was 8.0 mm. The procedure, including set up takes about 1 hour. The time from localizing the lesion with contrast to verfication of needle placement was on average 4 minutes. All needle placements were within the bounds of the lesion.

Conclusions

This stereotactic breast needle localization device has allowed for efficient localization of breast lesions in both medial and lateral approaches using a closed 1.5 tesla magnet. This allows for breast lesions seen only on MRI to be sampled for pathologies. ●

References

1. Warner, E., Plewes, D., et al, *J. Clin. Oncol.*, 19, 3524-3531, 2001

2002 2nd Place Proffered Paper–Research Poster

Diagnostic MRI of Zoo Animals

Julia B. Lowe, B.S.R.T. (R)(MR), Mark J. Lowe, Ph.D., Micheal D. Phillips, M.D., Jan C. Ramer, D.V.M., and Jeffry S. Proudfoot, D.V.M.
Indiana University School of Medicine, Radiology and the Indianapolis Zoo, Indianapolis, Indiana, USA

Purpose

Over the past four years, veterinarians from the Indianapolis Zoo and researchers from the Indiana University School of Medicine (IUSOM) have collaborated in multiple attempts to obtain diagnostic imaging information on certain animals whose diagnosis was not possible with the standard imaging equipment available even to a large urban zoo hospital such as the Indianapolis Zoo. As with humans, MRI technology can provide images with good soft tissue contrast that can be advantageous in diagnosing illnesses in animals that other imaging equipment cannot. We report here the results of four such studies that were done on animals with symptoms indicating neurologic illness. Our goal is to illustrate that MRI can be used to provide diagnostic information that may lead to improved treatment options for valuable zoologic animals.

Methods

The lions were transported from the zoo under gas anesthesia and upon arrival at the MRI suite were switched to an MRI-compatible anesthesia unit. Other animals were transported awake and were anesthetized on site. All imaging was performed on a 1.5 Tesla GE Echospeed scanner (GE Medical Systems, Waukesha, Wisconsin, USA).

Case 1: An African Lion cub presented with blindness and disorientation. Blood and spinal fluid analysis indicated a possibility of canine distemper, which in a zoologic setting is typically managed through euthanasia. A thorough neurologic examination led the veterinarians to believe that the central nervous system was involved. They were anxious to rule out stroke or other neurologic disorder before deciding on a course of action.

Imaging: The lions were imaged using the standard GE head coil. FLAIR, FSE T2, FSE T1, MPGR, and DWI sequences were obtained in the axial plane as well as a high resolution FSE T2 in the sagittal plane. The asymptomatic sibling of the lion cub was scanned as a comparison for normal anatomy.

Case 2: An adult African Lion presented with neurologic symptoms including blindness, disorientation, and ataxia. Blood and spinal fluid analyses were negative. Veterinarians asked for an MRI to rule out stroke or another neurologic event.

Imaging: The lion was imaged using the body RF coil, since its head was too large to fit in the standard head coil. FLAIR, FSE T2, and T1 sequences were obtained axially as well as a high resolution FSE T2 in the sagittal plane. The lion was intravenously injected with Magnevist (Berlex Laboratories Inc., New Jersey, USA), a paramagnetic contrast agent, and a T1 scan was obtained.

Case 3: A Rock Hopper Penguin presented with recurring seizures. X-ray screening and blood work revealed no abnormalities. Veterinarians requested an MRI to rule out pathology so that the penguin could be treated with anti-seizure medication.

Imaging: The penguin was imaged using a Medrad (Indianola, PA) phased array knee coil to attempt to match the volume of the scan region to a coil of appropriate dimension. T2, FLAIR, and 3D SPGR T1-weighted images were obtained.

Case 4: An Emerald Tree Boa presented with sensory coordination problems. Due to the animal's inability to strike his prey, the veterinarians speculated that the problem was with the animal's vision and thermal sensing ability to locate nearby prey.

Imaging: A 3-inch diameter surface coil was used for imaging the brain of the snake. T2-weighted, FLAIR, 3D SPGR T1-weighted, and Spin Echo T1-weighted images were obtained.

Results

Case 1: The African Lion cub was scanned on two different occasions. She was scanned soon after the sudden onset of her symptoms. The first brain MRI scan was negative. A follow-up scan was done weeks later revealing focal areas of white matter T2 abnormality which suggested a demyelinating or ischemic process. The lab results from blood draws suggested canine distemper because of a four-fold increase in the titer. Because her symptoms never improved she was euthanized. Canine distemper was suggested by autopsy.

Case 2: The adult lion's MRI was negative. After returning to the zoo she recovered from the anesthesia and was alert but still suffered from severe motor impairment (unable to stand) and therefore was euthanized. During the autopsy retinal lesions were visualized explaining her blindness. Her lab results were unremarkable and her motor illness remains a mystery.

Case 3: The MRI scan for the penguin was negative, which helped the veterinarians make a presumed diagnosis of idiopathic epilepsy. The animal is now treated daily by placing anti-seizure medication inside of fish that is fed to the penguin. The penguin's seizures are now under control and he is able to live normally in the zoo habitat.

Case 4: The MRI scan of the Emerald Tree Boa's brain was negative. Although there was no evidence of pathology the brain measured only 8 x 9 mm and was difficult to image. Eventually the snake regained his neuro-sensory skills and is now able to successfully strike his prey.

Conclusion

With slight modifications, it is possible to use a whole-body clinical MRI scanner to obtain useful diagnostic information on a variety of zoologic animals. This information was used by the IUSOM and the Indianapolis Zoo to manage the illness of several animals whose diagnosis was incomplete without the usage of MRI. ●

SMRT Regional News

Report on the SMRT Northeast Regional Seminar

Mark Spooner, B.P.S., R.T. (R)(MR)(CT), Regional Seminar Coordinator, Utica, New York, USA

The SMRT Northeast Regional Seminar was held in Utica, New York, USA, on 22 June 2002. Over 50 technologists from New York, Pennsylvania, Connecticut, New Hampshire, New Jersey, and Ontario, Canada gathered at the St. Luke's Home for a variety of MRI lectures. The seminar provided the attendees with eight ECE credits.

After welcoming our guests, the meeting started with a lecture by Carolyn Kaut Roth, R.T. (R)(MR)(CT)(M)(CV), from the University of Pennsylvania Medical Center. Candi covered both *Abdominal* and *Pelvic MRI*. She did an excellent job of providing the attendees with useful and practical information.

After a break, Nikolaus M. Szeverenyi, Ph.D., covered *Functional MRI*. He started with a basic introduction to functional imaging, and described the different types of research being performed at SUNY Upstate Medical University, in Syracuse, New York.

John Ferriter, R.T. (R)(MR)(CT), a Medrad Applications Specialist, gave a lecture describing Concepts and Applications for *Contrast Enhanced Angiography*. John provided some tips for everyone to take back to their sites.

After lunch, Cindy Comeau, B.S. R.T. (N)(MR), presented an informative lecture on the *Essentials of Vascular MRA for Technologists*. Her lecture complimented John's and provided additional information from a working technologists' perspective.

Jason Miller, R.T. (R), from Hitachi Medical Systems America, Inc., described the latest Advances in *Open MRI*.

The last two lectures of the day were given by James J. Stuppino, B.S., R.T. (R)(MR). James' lectures entitled *Obesity and Other Difficult Imaging Challenges: Tips and Advice* and *ACR MRI Accreditation: The Technologists and Administrators Role.*

I would like to thank the St. Luke's Home for providing the lecture hall for the seminar. I would also like to thank my employer, Cooperative Magnetic Imaging, in Utica, New York, for providing the refreshments and lunch. I would especially like to thank Berlex Imaging, Medrad, Inc., and Hitachi Medical Systems America, Inc., for their support.

Nikolaus Szeverenyi and Carolyn Kaut Roth giving their presentations at the podium.

John Ferriter, Medrad Applications Specialist, answering a few of the attendees questions following his presentation.

Cindy Comeau helping James Stuppino set up prior to his presentation.

Upcoming SMRT Regional Seminars–

Southeast Regional Educational Seminar

Saturday, 21 September 2002

Saint Joseph's Hospital Atlanta, Georgia, USA

Donna O'Brien, R.T. (R)(MR)(CT), Co-Chair
Carolyn Brown, R.T. (R)(MR), Co-Chair
Bobbie Burrow, R.T. (R)(CT)(MR), Co-Chair

PROGRAM 07:55 – 16:45

07:00 Registration and Continental Breakfast

07:55 Welcome and Announcements

08:00-08:50 Contrast Enhanced MRA
Carolyn Kaut Roth, R.T. (R)(MR)(CT)(M)(CV)
University of Pennsylvania Medical Center,
Philadelphia, Pennsylvania, USA

08:55-09:45 **Cardiac Imaging**
Stephen Frohwein, M.D.
St. Joseph's Hospital, Atlanta, Georgia, USA

09:45-10:00 Break

10:00-10:50 **Fetal Imaging**
Rita Clemons, R.T. (R)MR)
Baylor University, Dallas, Texas, USA

10:55-11:45 **Spectroscopy 101**
Robin Greene-Avison, C.N.M.T., R.T. (N)(MR)
The University of Kentucky, Lexington, Kentucky, USA

11:45-12:45 Lunch

12:45-13:40 **Abdominal Imaging**
Carolyn Kaut Roth, R.T. (R)(MR)(CT)(M)(CV)
University of Pennsylvania Medical Center,
Philadelphia, Pennsylvania, USA

13:45-14:40 **Open MRI: Physics and Protocols**
James J. Stuppino, B.S., R.T. (R)(MR)
Valley Advanced Imaging & MRI,
Bethlehem, Pennsylvania, USA

14:45-15:00 Break and Dessert

15:00-15:50 **Surface Coil Technology**
Kevin Bolen, IGC/Medical Advances, Milwaukee, Wisconsin, USA
Rick Cloud, MRI Devices, Waukesha, Wisconsin, USA

15:55-16:45 **ACR Accreditation Update**
James J. Stuppino, B.S., R.T. (R)(MR)
Valley Advanced Imaging & MRI
Bethlehem, Pennsylvania, USA

16:45 Adjournment

Eastern Canada Regional Educational Seminar

Saturday, 28 September 2002

Jeanne Timmins Amphitheatre, Montreal Neurological Hospital Montreal, Quebec, Canada

Laurian Rohoman, A.C.R., R.T. (R)(MR), Local Coordinator
Louise Gaudreau, R.T. (R), R.D.M.S., Co-Chair
Marian Stern, R.T. (R), B.F.A., Co-Chair

PROGRAM 07:55 – 17:30

07:00 Registration and Continental Breakfast

07:55 Welcome and Announcements

08:00 **Advances in MR Imaging of Multiple Sclerosis**
Pierre Bourgouin, M.D.
Centre Hospitalier de l'Université de Montréal
Montreal, Canada

09:00 **Advantages of MRI over CT in Head Trauma and Meningeal Carcinomatosis**
Raquel del Carpio-O'Donovan, M.D.
McGill University Health Centre
Montreal General Hospital, Montreal, Canada

10:00 Break

10:15 **Functional Imaging of the Brain**
Pierre Bourgouin, M.D.
Centre Hospitalier de l'Université de Montréal
Montreal, Canada

11:15 **Cardiovascular Imaging and Techniques**
Naeem Merchant, M.D.
Mount Sinai and University Health Centre,
Toronto, Ontario, Canada

12:15 Lunch

13:15 **MRI-Guided Focused Ultrasound Surgery of Breast Cancer**
David Gianfelice, M.D.
Centre Hospitalier de l'Université de Montréal
Hôpital St. Luc, Montreal, Canada

14:15 **Essentials of Vascular MRA for Technologists**
Cindy Comeau, B.S., R.T. (N)(MR)
Manager Cardiovascular MRI,
New York, New York, USA

15:15 Break

15:30 **MR Imaging of the Biliary Tree and Pancreas**
Caroline Reinhold, M.D.
McGill University Health Centre
Montreal General Hospital, Montreal, Canada

16:30 **Common Pathologies in the Musculoskeletal System**
Adel Assaf, M.D.
McGill University Health Centre
Montreal General Hospital, Montreal, Canada

17:30 Closing Remarks

PRECESSING IN A VERTICAL FIELD

"We're go'na get an OPEN MRI"

William Faulkner, B.S., R.T. (R)(MR)(CT)

This article represents the views of its author only and does not reflect those of the International Society for Magnetic Resonance in Medicine and are not made with its authority or approval.

Any time I hear someone say that I cringe. It makes me wonder why they are doing it. Is it because they want a second system and they are looking at operating costs? Is it because they are afraid they are losing referrals to an OPEN MR system across town or down the street? Is it because they want to serve the more generous sized patients? Is it because the hospital administrator decided to buy one and now meets with the radiologists to "bring them on board with our plan?"

Whatever the reason, I'm really liking the term "OPEN MRI" less and less. I'm afraid it causes people to buy them and/or want to be scanned on them for the wrong reasons. I have a friend who, upon installing their vertical-field (better terminology) scanner, framed a very nice poster provided for them by the vendor. The poster showed a small child sitting on the end of the table holding a teddy bear and smiling. They hung this in their main waiting room but soon had to take it down. It seemed patients expected to be scanned while sitting on the end of the table (the teddy bear was not necessarily a requirement).

Many of the vertical-field systems are lower field (a classification that now seems up for debate). By lower field, I mean less than 0.5 T. Lower field systems have several advantages over higher field systems. As field strength increases, the following increases: magnetic susceptibility artifact, flow artifact, chemical shift artifact, and T1-relaxation times, just to name the top ones that come to mind. Unfortunately, SNR decreases with field strength. But, as the great philosopher Huey Lewis once said, "There ain't no living in a perfect world." We can, however overcome some of the SNR losses by well-designed surface/local coils and the use lower receiver bandwidths. At lower fields, we have the luxury of using a lower receiver bandwidth due to the much lower chemical shift artifact. I'm not going to go further with that topic since Linda Varnis did an excellent job with it in a previous issue (thanks again Linda).

I'd like to show you a neat example of one of the benefits of scanning at a lower field compliments of Dr. Larry Tannenbaum (yes – Dr. High-Field himself). The images on the left were acquired at 0.2T. The T1 is a conventional SE while the PD and T2 are Fast Spin Echoes (FSE). The PD and T2 were acquired as two separate acquisitions. You will notice the metal artifact from the surgical screws or rods is less on the T2 than on the PD or T1. That is primarily because the T2 utilizes a higher Echo Train Length (ETL) than the PD and certainly the T1. You will remember that the purpose of the 180-degree refocusing pulse is to re-focus spins that have dephased due to inhomogeneities and chemical shift. The greater the number of 180-degree pulses utilized in a given pulse sequence, the greater the "clean-up" so-to-speak. That is why we like to use FSE (whether at low- or high-field) in the presence of metal to reduce the artifact.

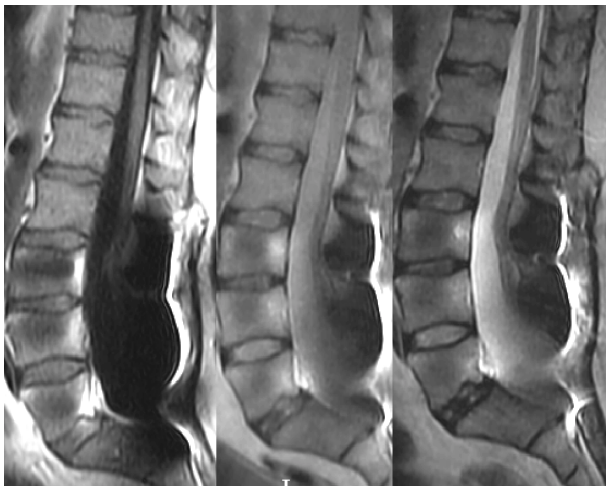

Figure 1. *Images acquired at 0.2 T.*

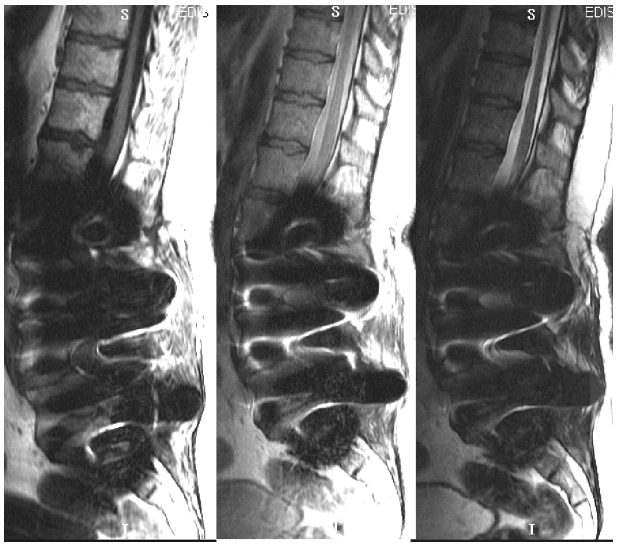

Figure 2. *Same patient scanned at 1.5 T.*

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What's interesting in this case is the image on the right. It is the same patient scanned at 1.5 T. As you can see, regardless of the pulse sequence, the inhomogeneities caused by the presence of the metal, result in a totally non-diagnostic study. This is not the case for the study performed at 0.2 T.

The reason I like this example is that it shows there are reasons to scan someone on a low-field system other than they are "claustrophobic" or "too big to fit in the big magnet." I've spoken with a number of technologists that say their radiologists tell them to use the OPEN scanner only on those patients who can't fit into the high field. The main problem with this is that now every image that comes off their vertical-field will be in all likelihood be sub-optimal in image quality.

The physics of a vertical magnet require the receiving coils to be solenoid in design, meaning they have to encompass the patient. If the patient is rather large, then unfortunately the coil is equally as large. The largest coil on our 0.2 T system is 72 inches when unfurled. Using a large coil, while very necessary, will result in low SNR. I usually use the following analogy. Imagine doing a thoracic spine on your 1.5 T whole-body system using the body coil. You wouldn't expect the SNR to be very good especially considering the spatial resolution parameters you selected. Now if you don't expect that scenario to produce a high quality, "picture-perfect" study, why would you expect it at 0.2 T?

I'm not saying we shouldn't use our vertical-field MR systems for the larger patients; they are certainly the only hope some of these patients have of getting an MR study. I'm just saying let's have a little reality check here. There are things we have to leave outside of the MR environment; our brains aren't one of them. ●

For more information on safety related issues, please visit:

MRIsafety.com

This website was created and is maintained by Frank G. Shellock, Ph.D.

MRI SAFETY

Medical Devices and Accessories Developed for Use in the MR Environment and Interventional MRI Procedures

Frank G. Shellock, Ph.D., Adjunct Clinical Professor of Radiology, University of Southern California, Founder, Institute for Magnetic Resonance Safety, Education, and Research, Los Angeles, California, USA www.MRIsafety.com www.IMRSER.org

This article represents the views of its author only and does not reflect those of the International Society for Magnetic Resonance in Medicine and are not made with its authority or approval.

The increasing capabilities of magnetic resonance (MR) studies to impact medical diagnosis and prognosis has dramatically increased the number of MR procedures performed worldwide. Many more patients, especially those in high-risk or special population groups, are undergoing MR examinations for an ever-widening spectrum of medical indications.

Additionally, as Jolesz, et al., have stated, continuous progress has been made to expand the use of MRI beyond diagnosis into intervention. This has resulted in the development and performance of innovative procedures that include percutaneous biopsy (e.g., breast, bone, brain, abdominal), endoscopic surgery of the abdomen, spine, and sinuses, open brain surgery, and MR-guided monitoring of thermal therapies (i.e., laser-induced, RF-induced, and cryomediated procedures).

Various vendors and manufacturers, prompted by recommendations and requests from MR healthcare professionals, have recognized the need for developing specialized medical devices, equipment, accessories, and instruments necessary for use in the MR environment and for interventional MRI procedures. Accordingly, there are now numerous patient support devices and accessories that have been developed and which have undergone thorough evaluation to assess and verify appropriate use in the MR environment or during interventional MRI procedures.

In consideration of the many devices and accessories that are commercially-available for safe use during MRI procedures, it is surprising that incidents and accidents related to ferromagnetic projectiles, excessive heating of devices, and other problems continue to occur. These have resulted in at least one fatality, several injuries, substantial damage to MR systems, and down-time (i.e., loss of revenue) for MRI centers.

Therefore, the intent of this article is to review the various devices and accessories that are specifically designed for use in the MR environment or for interventional MRI procedures, with the hope that this information will help prompt MR healthcare professionals to recognize the many products that exist which are essential to ensure patient safety. In addition, these devices and accessories may help to create a more efficient or more profitable MR center.

Non-Magnetic Oxygen & Gas Cylinders. According to Chaljub, et al., accidents related to ferromagnetic oxygen tanks and other gas cylinders that become projectiles may be increasing. Therefore, MR facilities should devise an appropriate policy for delivery of oxygen or other gases to patients undergoing MR procedures. The use of

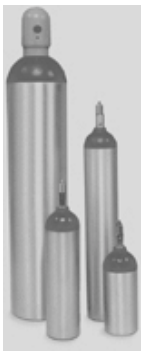

***Figure 1.** Non-magnetic oxygen tanks of various sizes (Magmedix, Gardner, Massachusetts, USA).*

Continued on page 14

non-magnetic (usually aluminum) oxygen and other gas cylinders is one means of maintaining a risk free MR environment with regard to this equipment (Figure 1). It should be noted that nonmagnetic tanks *must be prominently labeled* to avoid confusion with magnetic cylinders. Furthermore, all healthcare workers that work in and around the MR environment must be informed regarding the fact that only nonmagnetic oxygen and other gas cylinders are allowed into the MR system room.

Nonmagnetic oxygen regulators, flow meters, cylinder carts, cylinder stands, cylinder holders for wheelchairs, and suction devices are also commercially available to provide safe respiratory support of patients in the MR environment.

Patient Comfort Devices. Certain patients who undergo MRI procedures experience emotional distress that can range from mild anxiety to a full-blown panic attack. Patient distress contributes to adverse outcomes for the MRI procedure that includes unintentional exacerbation of patient anxiety, a compromise in the quality and, thus, the diagnostic power of the imaging study, and decreased efficiency of the imaging facility due to delayed, cancelled or prematurely terminated studies.

Fortunately, there are a variety of techniques that can help minimize these problems for patients. For example, special systems can be used during MRI procedures to manage the anxious patient such as MR-compatible headphones to provide music to the patient (which also reduce gradient magnetic field-induced noise) and MR-compatible video systems that provide a visual distraction to the patient (Table 1). There is even a virtual reality environment system that provides audio and visual distraction to the patient (Figure 2). A similar device is designed for use in fMRI procedures.

Monitoring Equipment. In general, monitoring during an MRI examination is indicated whenever a patient requires observations of vital physiologic parameters due to an underlying health problem or whenever a patient is unable to respond or alert the MRI technologist or other healthcare worker regarding pain, respiratory problem, cardiac distress, or other difficulty that might arise during the examination. In addition, a patient should be monitored if there is a greater potential for a change in physiologic status during the MR procedure.

In 1992, the Safety Committee of the Society for Magnetic Resonance Imaging published guidelines and recommendations concerning the monitoring of patients during MR procedures. This information indicates that all patients undergoing MR procedures should, at the very least, be visually and/or verbally (e.g., intercom system) monitored, and that patients who are sedated, anesthetized, or are unable to communicate should be physiologically monitored and supported by the appropriate means. Of note is that guidelines issued by the Joint Commission on Accreditation of

Table 1. Examples of companies that provide devices and accessories for use in the MR environment or for interventional MRI procedures (for a comprehensive listing of companies, please refer to Shellock FG. Reference Manual for Magnetic Resonance Safety: 2002 Edition. Amirsys, Inc., Salt Lake City, Utah, 2002 USA).

Company	Products
AESCULAP, INC. 3773 Executive Center Parkway Center Valley, Pennsylvania 18034 USA +1 800 282 9000 www.aesculap.com	MRI Surgical instruments
DRAEGER MEDICAL , INC. 3135 Quarry Road Telford, Pennsylvania 18969 USA +1 800 437 2437 www.draeger.com	Anesthesia equipment Ventilator
E-Z-EM, INC. 717 Main Street Westbury, New York 11590 USA +1 800 544 4624 www.ezem.com	Biopsy needles Biopsy guns Biopsy site markers
IN-VIVO RESEARCH 12601 Research Parkway Orlando, Florida 32826 USA +1 800 331 3220 www.invivoresearch.com	Monitoring equipment
MAGMEDIX 158R Main Street Gardner, Massachusetts 01440 USA +1 866 646 3349, +1 978 630 5580 www.Magmedix.com	Nonmagnetic accessories Respiratory equipment MR facility start up kits Monitoring equipment Patient comfort/positioning devices MRI tools and instruments Patient transport equipment Cryogen accessories MRI carts and maintenance devices Signs and site control devices
MALLINCKRODT, INC. 675 McDonnell Boulevard St. Louis, Missouri 63134 USA +1 314 654 3981, +1 314 654 2000 www.mallinckrodt.com	OptiStar MR Contrast Delivery System
MEDRAD One Medrad Drive Indianola, Pennsylvania 15051 USA +1 800 633 7231, +1 412 767 2400 www.Medrad.com	Monitoring equipment Music system Spectris MR Injection System
MRI DEVICES CORPORATION 1515 Paramount Drive Waukesha, Wisconsin 53186 USA +1 800 524 1476 www.mridevices.com	Biopsy needles Biopsy positioning devices Biopsy localition systems
RESONANCE TECHNOLOGY, INC. 18121 Parthenia Street Northridge, California 91325 USA +1 818 882 1997 www.fmri.com, www.mrivideo.com	MRI audio/video systems fMRI products Custom built devices

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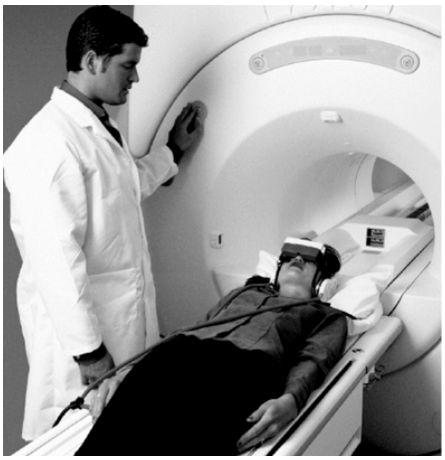

Figure 2. *Specialized equipment used to provide virtual reality environment and for fMRI studies (Resonance Technology, Inc., Northridge, California, USA).*

Healthcare Organizations (JCAHO) indicate that patients that receive sedatives or anesthetics require monitoring during the administration and recovery from these medications.

Additionally, there must be policies and procedures implemented to continue appropriate physiologic monitoring of the patient by trained personnel after the MRI procedure is performed. This is especially needed for a patient recovering from the effects of a sedative or general anesthesia.

Conventional monitoring equipment and accessories were not designed to operate in the harsh magnetic resonance (MR) environment where static, gradient, and radiofrequency (RF) electromagnetic fields can adversely effect or alter the operation of these devices. However, various physiologic monitors and other patient support devices have been developed or specially-modified to perform properly during MRI procedures (Table 1). Besides patient monitoring, various support devices and accessories may be needed for use in the high-risk patient to ensure safety. Many of these likewise have been modified or designed to be safe to use in the MR environment or during interventional MRI procedures (Table 1).

Emergency-Related Equipment. Emergencies can and do happen in the MR environment. Therefore, the development and regular practice of an emergency plan that addresses and defines the activities, use of equipment, and other pertinent issues pertaining to a medical or other emergency are important for patient safety in the MR setting.

For example, a specific plan needs to be developed for handling a patient if there is the need to perform cardiopulmonary resuscitation in the event of a cardiac or respiratory arrest. This includes having a means to immediately remove the patient from the MR system to a place outside the MR environment to properly conduct CPR, allowing the use of necessary equipment such as a cardiac defibrillator. For this reason, it may be necessary to have a stand-by nonmagnetic stretcher or gurney available that can be used to quickly transfer the patient (especially for MR systems that do not have tables that separate from the MR system or that quickly disengage).

Notably, the healthcare professionals that are members of the Code Blue team, (i.e., responsible for establishing and maintaining the patient's airway, administering drugs, recording events, and conducting other emergency-related duties) must be identified, trained in MR safety, and continuously practiced in the performance of these critical activities relative to the MR environment.

For instances when it may not be possible to remove the patient from the MR system room during an emergency, especially if the patient is experiencing a respiratory or cardiac arrest, it is advisable to have various nonmagnetic devices and accessories readily available including an oxygen cylinder, laryngoscope, suction system, stethoscope, blood pressure manometer, and other similar emergency equipment that is appropriate for the MR environment (Table 1).

MR Contrast Agent Injection Systems. The controlled, power injection of MR contrast agents is gaining in popularity for a variety of clinical applications including examinations of abdominal organs, vascular anatomy, and dynamic MRI studies of the breast. Power injectors must be able to operate in the MR environment without affecting magnet homogeneity, degrading signal-to-noise, or causing artifacts. To date, two devices are available for power delivery of MR contrast agents: the Optistar MR Contrast Delivery System (Mallinckrodt, St. Louis, Missouri, USA) and the Spectris MR Injection System (Medrad, Inc., Indianola, Pennsylvania, USA) (Table 1).

MRI Compatible Ventilators. Devices used for ventilation of patients typically contain mechanical switches, microprocessors, and ferromagnetic components that may be adversely affected by the electromagnetic fields used by MR systems. Ventilators that are activated by high-pressure oxygen and controlled by use of fluidics (i.e., no requirements for electricity) may still have ferromagnetic parts that can malfunction as a result of interference from MR systems.

MR-compatible ventilators have been modified or specially designed for use during MRI procedures that are performed in adult as well as neonatal patients. These devices tend to be constructed from non-ferromagnetic materials and have undergone preclinical evaluations to ensure that they operate properly in the MR environment, without producing artifacts on MR images. There are at least two sources of respirators for patients that require respiratory support in the MR environment (Table 1). These devices have been tested in association with MR systems operating at 1.5-Tesla or less (Figure 3).

Basic Patient Management Accessories and Equipment. All new and existing MR facilities should be prepared to handle patients and everyday situations (e.g., maintenance) in the

Figure 3. *The Omni-Vent Series D Ventilator used for respiratory support of patients in the MR environment (Magmedix, Garner, Massachusetts, USA).*

Continued on page 16

MR environment by obtaining a selection of nonmagnetic or other suitable accessories or equipment. For example, useful items for an out-patient facility include nonmagnetic equipment such as a wheelchair (one or more), stretcher or gurney, step stool, IV pole, laundry cart, stethoscope, blood pressure manometer, storage or utility care, fire extinguisher, and custodial cart (Figures 4 and 5).

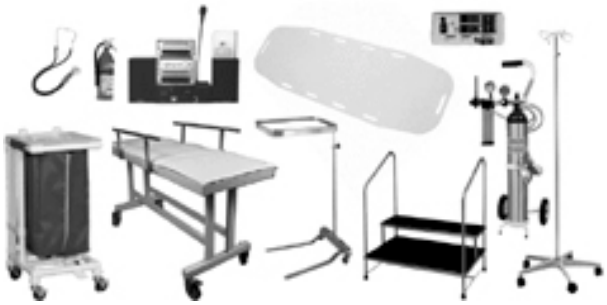

***Figure 4.** Examples of nonmagnetic devices and accessories developed or modified for use in the MR environment.*

***Figure 5.** Non-magnetic custodial cart (the wheels, casters, and bucket handle are all nonmagnetic). A nonmagnetic mop handle and mophead clamp should be used with this equipment.*

MR facilities that handle both outpatients and in-patients should additionally consider obtaining a nonmagnetic patient slider board, physiologic monitoring equipment (e.g., fiber-optic pulse oximeter), nonmagnetic oxygen tank (including nonmagnetic regulator, cart or stand), portable suction, Mayo stand, and other devices and accessories (Table 1).

Of note is that MR centers should have a sufficient number of nonmagnetic oxygen tanks and fire extinguishers in the immediate and general area to prevent responding emergency staff members from introducing ferromagnetic objects into the MR environment. In fact, some hospital-based MR centers have nonmagnetic oxygen tanks and fire extinguishers used throughout their buildings to prevent projectile accidents.

Biopsy Needles, Biopsy Guns, and Tissue Markers. Interventional MRI has been used to guide tissue biopsy and apply markers with encouraging results. Obviously, the performance of these specialized procedures requires tools that are compatible with MR systems. Many conventional biopsy needles, biopsy guns, and tissue markers have been evaluated with respect to compatibility with MR procedures, not only to determine ferromagnetic qualities but also to characterize imaging artifacts. The results have indicated that most of these are not useful for MRI-guided biopsy procedures due to the presence of excessive ferromagnetism and associated imaging artifacts that limit or obscure the area of interest. Fortunately, several biopsy needles and biopsy guns have been constructed out of nonferromagnetic materials specifically for use in interventional MRI procedures. These are now commercially available from various vendors (Table 1).

The placement of a marking clip or wire enables the accurate localization of the surgical excision site and is a useful surrogate target, even if the entire lesion is removed and there is a subsequent need for wire localization prior to surgery. Marking clips and wires have been specially designed for use in interventional MRI procedures (Table 1).

Surgical Instruments. Interventional MRI procedures have evolved into clinically viable techniques for a variety of minimally invasive surgical and therapeutic applications. Besides the typical MRI safety concerns, there are possible hazards in the interventional MRI environment related to the instrumentation and accessory equipment that must be addressed to ensure the safety of MR healthcare practitioners and patients. Surgical instruments are an obvious necessity for interventional MRI procedures. However, many of these instruments are made from metallic materials that can create substantial problems in association with interventional MRI procedures.

The interventional MRI safety issues that exist for a surgical instrument include unwanted movement caused by magnetic field interactions (e.g., the missile effect, translational attraction, torque), heating generated by RF power deposition, and artifacts

***Figure 6.** MR-compatible surgical instruments (Aesculap, Center Valley, Pennsylvania, USA).*

associated with the use of the instrument, if it is in the imaging area of interest during its intended use. To address these various problems, surgical instruments have been developed that do not present a hazard or additional risk to the MR healthcare practitioner or patient in the interventional MRI environment (Table 1, Figure 6). ●

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Editor's Note: SMRT member, Jim Hamilton, shares his understanding of a technical area of Magnetic Resonance Imaging based on his experience with a GE Signa1.5T scanning system.

Gradient Echo Imaging Contrast Phenomenology

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It can be argued that within the huge arsenal of MR pulse sequences available on scanners today, gradient refocused echoes (GRE) are the least used or understood. Part of the problem lies within how to manipulate the contrast of a GRE sequence and understand why the contrast is different from radio frequency (RF) refocused spin echoes. This article attempts to shed light on both answers since gradient echoes are staging a strong comeback in the form of echo planar imaging (EPI).

GRE imaging became clinically available in the mid 1980s and continues to evolve to this day. Initially, sequential 2D, 3D, and multi planar acquired GRE appeared soon followed by more heavily T1- and T2-weighted offerings. The reasons for these new pulse sequences were:

1. Speed: effectiveness of the examination per unit time.
2. Patient comfort.
3. Breath holding capabilities for liver and renal studies.
4. Shorter TEs that increase the number of slices per TR and reduce susceptibility effects.
5. Reduced SAR that again increased the number of slices per TR due to the removal of the180° refocusing pulse.
6. Dynamic imaging: cine cardiac and vascular studies.
7. RF flip angle manipulation to change image contrast.

RF echo formation is familiar and most of us can give fair detail to the how and why of it. What information may not be so widespread is that **any two slice selective RF pulses will cause rephasing.** How can this be? RF pulses are a function of their amplitude and waveform over time and contain elements from 0° to 180°. A 10° RF pulse will move spins from an equilibrium state to the desired transverse magnetization of 10°. Some spins excited by this 10° RF pulse may move as much as 180°. Not many, but some. This is because an RF pulse is optimally tuned to move the majority of spins to the desired flip angle. Even conventional spin echo sequences are hampered by these phenomena and use crusher/spoiler gradients to remove any unwanted nutations. Is a perfectly tuned RF pulse possible, thereby having only the desired elements? Not yet but, it is understood a 90°/180° combination results in optimal spin re-phasing.

RF refocused echo formation is very efficient in compensating for extrinsic dephasing caused by T2′ (T2 prime) effects. As a general classification these effects are called magnetic field inhomogeneities. This is dephasing (signal loss over time) caused by:

1. Main magnetic field inhomogeneities,
2. Magnetic susceptibility effects, and
3. Chemical shift of the second kind (hydrogen frequency differences within the same voxel).

I'll expand on T2′ a little further on. However, keep in mind there are no RF combinations that corrects for true T2 tissue decay.

Now a word about flow effects and RF echo formation. RF echo formation is primarily a slice selective imaging scheme. So when moving blood or CSF feel a 90° RF excitation pulse, it tends to move out of the selected/excited slice before it is phase encoded and refocused by the 180° RF pulse. Meanwhile, blood that was not in the slice is phase encoded, enters the slice during readout and displays miss-mapped signal as flow artifact. You can see signal void, pulsatile flow artifact or bright signal dependent upon the velocity of the moving spins and the timing of the sequence. All of these issues change when we enter the world of gradient recalled echoes.

In GRE formation, refocused signal is dependent on reversed polarity gradients alone (as compared to the 180° RF seen in RF echo formation). Since the 180° RF pulse has been eliminated, several factors affecting the scan will become apparent. First, GRE echoes are not as efficient in refocusing T2′ effects as conventional spin echo (CSE); they only correct for de-phasing caused by other gradients. Second, the applied refocusing gradient affects the acquired slice and all tissues outside the slice as well. Moving spins that enter this slice will generally develop phase correction and display bright signal. This is referred to as non-selective refocusing. Third, it is understood RF echo formation is dependent on:

- Tau; the time between the 90° excitation and 180° refocusing pulses where Tau = one half TE
- RF pulse duration
- Gradient rise time and
- Killer/crusher gradients which take time to play out.

Once the 180° RF pulse is removed we see that gradient echo formation is dependent on gradient reversal and rise time. Removing the 180° RF pulse from our MR experiment looks to benefit scanning until you see how important it is to contrast phenomenology and something we call T2* (T2 star). Depending on TE, TR and flip angle, GRE images display varying degrees of T2* influenced contrast. T2* is the combined signal loss in an image caused by intrinsic tissue T2 decay (irreversible) and extrinsic T2′ effects (which are reversible). T2, T2′ and T2* are all forms of spin phase dispersion; loss of signal in the transverse plane and are affected by the chosen TE value. T2′ effects may not be as familiar as tissue T2 de-phasing. Simply put, T2′ is additional signal loss not seen under CSE conditions. Gradient echo sequences are just not as efficient as CSE in removing T2′ effects. So, let's detail what is signal loss caused by T2′ effects.

T2′ Effects are Caused by:

Main magnetic field (B_0) inhomogeneities (manufacturer dependent). This is a function of how well your particular magnet has been made (linear homogeneity) measured in parts per million (PPM) and the value of the shim it exhibits at any given time. The lower the value of PPM the less magnetic inhomogeneities will adversely affect your images. Problem is, when you place a person in the magnet, human tissues change the homogeneity of B_0. However, in terms of superior image quality no matter what one places in the magnet, it is better to start off with a great shim value than a poor one. Inhomogeneities express them-

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selves as shading, usually seen on image edges. Shorter TE values will de-emphasize this effect since shading is a dephasing phenomenon. Any signal loss seen around metal in a spin echo sequence will "bloom" much larger in a GRE sequence.

Chemical shift of the second kind. This is where the known precessional differences between hydrogen in water molecules and hydrogen in fat molecules exist within the same voxel. This precessional difference is a 3.5 PPM constant occurring out of phase every other 2.1 milliseconds at 1.5 Tesla. Assuming 1.5 Tesla, hydrogen existing in water precess 223 Hz faster than hydrogen existing in fat. How can this be? According to the Larmor equation, where we have created transverse magnetization from an RF pulse, the spins at each location in the sampled volume will precess at a rate determined by the local magnetic field strength. This holds true as long as all spins experience the same magnetic field. The problem is, human tissues are varied in their composition. Our tissues/molecules differ greatly. We agree that hydrogen is found in nearly 99.999% of all human tissues. This is not to say we are 100% free water molecules, instead we are made of both simple and more complex macromolecules and everything in between. Fat triglicerides are said to be a complex carbon chain molecule where hydrogen, oxygen and carbon link up structurally different from our familiar water molecule H_2O. Additionally, hydrogen in the fat molecule forms covalent bonds with atoms of oxygen and carbon and experiences "electron shielding" from it's neighboring atoms and therefore will not feel the same local magnetic field strength as hydrogen in water. It is understood when an RF excitation pulse is applied hydrogen molecules experience phase coherence. Once that pulse is turned off, precessional differences develop between fat and water molecules (very much like the hands of a clock) until their magnetic vectors oppose each other. This opposition occurs at every other 2.1 milliseconds (@1.5T) after excitation causing cancellation of signal within the voxel. This is commonly seen at the tissue boundaries of many internal organs and displays as a "magic marker outlining" of the organ. This effect will not occur unless fat and water molecules exist within the same voxel. On the other hand, phase coherence will occur every other 4.2 milliseconds; the vectors of fat and water will combine to add signal to voxels bordering different tissues.

Magnetic susceptibility effects *(patient tissue induced differences).* This is a form of transverse signal loss (dephasing) characterized by the amount that different human tissues magnetize when exposed to a magnetic field. Human tissues are diamagnetic and will reduce the strength of the applied external magnetic field that the spins "feel." Therefore the magnetic field within a patient is said to be "effective," attributable to whether the substance magnetized is diamagnetic, paramagnetic or ferromagnetic. Tissues magnetize differently by factors of parts per million (PPM) and give rise to intrinsic susceptibility field gradients that form in areas where PPM differences occur such as air tissue interfaces. Gradient echoes do not correct for this as efficiently as 180 degree RF refocused spin echoes.

Steady State Effects

A clear understanding of steady state effects is necessary to control contrast in a gradient echo sequence. Therefore, factors affecting both longitudinal and transverse steady state are listed. Additionally, the words "steady state" should be expanded on so let's get started:

Steady state is a term used in physics describing phenomenology of the very large (cosmology) and the very small (quantum mechanics) and how things are kept in check even though change is occurring. What I prefer is an analogy as applied to nature; the ratio of predators over prey in a given region. Even though rain plays against how much grass and trees exist that feed herbivores that feed carnivores, neither side seems to expand or contract beyond a given range of values at any time. They are said to be in a "steady state" of existence. For that matter, equilibrium is a steady state condition where random spins are held in either a high or low energy state by B_0. So, what does this have to do with gradient echo contrast? A steady state is achieved in GRE where TR values are shorter than T1 and T2 times in tissues. In MRI, steady state has coexistence in both longitudinal and transverse magnetization.

Longitudinal Steady State

In gradient echo imaging four factors affect longitudinal magnetization (Mz):

1. TR.
2. Pulse flip angle (FA).
3. Relative Proton Density (RPD) / Tissue T1.
4. Flow.

TR. Longitudinal steady state exists where TR is less than a tissues' T1 time. Each tissue has it's own T1 value but will lengthen as the main magnetic field strength increases. As a general rule, once TR is less than 100ms, Mz does not recover. So, there will be residual Mxy (transverse steady state) and is converted to Mz at the next alpha pulse. Understand that under GRE conditions, residual Mxy is a function of TR and T2* (which was described earlier). In brief, if you increase TR, you will decrease saturation and decrease longitudinal steady state. Why? Because more spins are allowed to return to equilibrium and are available for excitation to the desired flip angle, be it 90° or any other angle.

Alpha Pulse Flip Angle (FA): Different manufactures use different terminology describing the initial excitation RF pulse of their pulse sequences. If Mz is converted to Mxy, the amount converted can be controlled via the FA (see Figure 1). For low FAs, less RF amplitude or duration time is used to accomplish this and therefore less Mz is converted to Mxy. This in turn decreases the amount of time needed for Mz to recover (equilibrium) as compared with higher FAs. Obviously, higher FAs increase both Mxy and Mz.

Relative Proton Density (RPD)/ Tissue T1: We agree these factors are out of our control since there are only so many protons in a sample of tissue and their T1 value is linked to their environment.

Flow: Flow signal appears bright under gradient echo conditions as described earlier in this article.

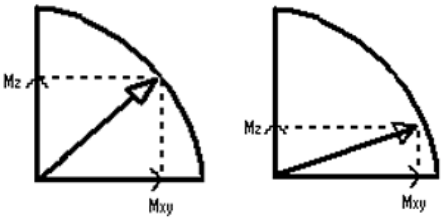

***Figure 1.** Notice how the flip angle determines both Transverse magnetization Mxy and Longitudinal magnetization Mz. We agree that maximum signal is achieved when we have magnetization perpendicular to equilibrium. This implies an inverse relationship between Mz and Mxy: increases in flip angle up to 90° will increase transverse magnetization while decreasing longitudinal magnetization (which maximizes at equilibrium or 180° inversion).*

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Transverse Steady State

It is said that when a pulse sequence's TR is less than four times longer than tissue T2, a transverse steady state or residual transverse magnetization is present. In other words, under CSE T2 conditions, the TR is normally set equal to or greater than 2000ms. Most every tissue is completely de-phased by 300ms and four times that is just 1200ms. Even T1-weighted sequences are immune since we typically use minimum TE values reducing T2 influences as well as using killer gradients after readout.

Non-hybrid GRE sequences use TRs in the range of less than 100ms to about 800ms. This means whatever tissue has a T2 value of 25-200ms will have residual (left over) transverse magnetization at the next TR. This transverse steady state is determined by:

1. How much time between RF excitation (TR).
2. Flip angle.
3. How much T2 decay occurred (TE/T2*).
4. How many protons to begin with (RPD).
5. Use of a rewind or spoiler gradient.

TR: If you decrease TR, you will allow less time for T2/ T2* to decay, thereby increasing transverse steady state. Remember: *It is said that when a pulse sequence's TR is less than four times longer than tissue T2, a transverse steady state or residual transverse magnetization is present.* Increasing TR has the opposite effect.

Flip Angle: If you increase flip angle, you will increase transverse steady state because more Mz is converted to Mxy. Decreasing the flip angle has the opposite effect.

TE: Just like a conventional spin echo, increasing TE will allow more T2/ T2* to decay, therefore decreasing transverse steady state (Of course it does! We just allowed the spins to diphase. Once signal is de-phased you have to wait for TR to hit it with another RF excitation pulse to re-phase it. Refer again to TR above).

T2/ T2*: Obviously, Tissue T2 is not in our control but understand that if tissue T2 is longer, T2 decay will decrease and the transverse steady state will increase.

RPD: The RPD is dependent on the tissue being imaged. The greater the RPD, the greater the transverse steady state.

Re-winder gradient: This type of gradient usage simply applies the law that says, "Whatever you do with a gradient, you have to eventually un-do." This means that where a gradient is turned on, some de-phasing will take place depending on the strength of the gradient and how long it was turned on. This is the foundation of GRE imaging where we use a gradient to refocus our echo instead of a 180° RF pulse. Here we are using a gradient to "wrap-up" spins that have de-phased, making them available as residual transverse magnetization for the next alpha (excitation) pulse.

Spoiler gradient: Here, whatever spins are still in phase, a large "killer crusher spoiler" gradient is engaged to completely de-phase any residual transverse magnetization before the next TR.

Sequence Names and Acronyms

Remember my experience has been with a GE Signa scanner. Following are some of the acronyms used for GRE sequences and a brief description for each.

GRASS (Gradient Recalled Acquisition in a Steady State) is a non-spoiled sequence where slices are acquired sequentially due in part to the relative short TR (<100ms). Grass tends to be T2*/ mixed-weighted in that PD components will always be present.

MPGR (Multi Planar GRASS) is a sequence where all slices are acquired within a single TR (100 - 800ms), mixed-weighted with no transverse steady state spoiling.

SPGR (Spoiled GRASS) is a gradient recalled multi-planar sequence that spoils the transverse component after readout each TR. Very little transverse steady state effects are seen in the image making it less mixed, and more T1-weighted.

SSFP (Steady State Free Precession) is a unique pulse sequence that has seen less usage than other GRE sequences due to it's sensitivity to flow and relative low signal to noise ratio. SSFP is very T2/ T2* weighted but lost favor with the advent of fast spin echo.

What I am driving at is this: be familiar with the sequences on your system. Then extract from your radiologist the contrast he wishes the tissues to exhibit and pick the sequence that delivers this best. ●

Acknowledgments

I would like to thank Bill Faulkner and the following: truly gifted MRI educators: Tom Schrack, Jack O'Blein, Irv Stutzman, Anne Sawyer-Glover, and Dick Prorock of General Electric Medical Systems, for their efforts in helping me understand MRI.

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Awards Committee Update

Heidi Berns, M.S., R.T. (R)(MR), SMRT Past-President, Awards Committee Chair

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Please feel free to e-mail me at heidi.berns@mercyic.org with any suggestions. ●

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