Signals

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President's Letter

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

As you can see, the *Signals* newsletter has changed. If, you're reading this on-line, you are taking advantage of one of the changes we've implemented. In this day and age of electronic communication, the SMRT felt the need to offer the membership an electronic version of *Signals*. Special thanks to **Julie Strandt-Peay**, our *Signals* Editor, and **Sheryl Liebscher** from the SMRT Office for making this a reality.

Plans are well under way for next year's Annual Meeting to be held in Toronto, Ontario, Canada, in May 2003. **Laurian Rohoman**, from Montreal General Hospital, and her committee have been busy evaluating your suggestions and comments from the Honolulu meeting and implementing their ideas into her program for Toronto. For those of you who have not been able to attend the SMRT Annual Meeting, Toronto is your opportunity. It is a great location: easily accessible and a beautiful city. **Laurian** has been diligently working on preparing a fabulous program for the meeting.

The SMRT Regional Seminars have been well attended this year. **Mark Spooner**, from Utica, New York, hosted the first one of the year and had a fabulous meeting. Atlanta held the second Regional Seminar and, as always, it was well attended with over 130 attendees. Montreal was the setting for the SMRT's first Canadian Regional. **Laurian Rohoman** did a great job (perhaps a test run for Toronto?). We were quite impressed to see over 100 technologists at the Eastern Canada Regional. Our fourth Regional this year was held in Pittsburgh, Pennsylvania. I had the opportunity to attend the Atlanta, Montreal, and Pittsburgh Regionals and saw firsthand how well things went.

Heidi Berns, our Past-President and current Chair of the Nominations Committee has a wonderful list of candidates for the Policy Board and President-Elect. Please be sure to read the candidates' bios and cast your vote. The five elected Policy Board members will start serving their three-year term at the Toronto meeting. Also on the ballot will be candidates for the Crues-Kressel Award.

The SMRT is pleased to announce the addition of another local chapter: The Central Virginia Local Chapter, scheduled to start at the end of the year. **Bobbie Burrow**, Local Chapter Chair, encourages all of you to consider organizing a chapter in your area to bring MR education to you and your local technologists. Philadelphia is interested in starting a local chapter as well.

One of the big advantages of being a SMRT member is having access to the *SMRT Educational Seminars* or home studies. We have received rave reviews about the home studies. They give technologists the opportunity to challenge themselves by learning more about MR as well as earning continuing education credits. **Kelly Baron** has done an outstanding job putting these together. **Kelly** reports that next year's home studies will include MRA of the Abdominal and Lower Extremities, Anatomy of the Knee, Soft Tissues of the Neck, and a Cardiac Update.

The SMRT Policy Board will meet again in Chicago during RSNA. I will update you on the activities of the Section in the next issue of *Signals*.

As always, if you have any questions or comments, please feel free to visit our website at www.ismrm.org/smrt or you can e-mail me directly at jak3264@aol.com.

Editor's Letter

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

Greetings.

Even though the calendar year is wrapping up, the SMRT continues to be lively. First, we extend a note of appreciation to **Medrad** for underwriting this issue of *Signals.* It is the goal of the SMRT to obtain more sponsorship as membership dues alone do not support all of the SMRT educational programs. President, **John Koveleski** shares an overview of the SMRT leadership and their current activities. Editor of the *SMRT Educational Seminars,* **Kelly Baron** shares her personal reflections as well as news on the new home study offering. Nomination Committee Chair, **Heidi Berns** reminds us to vote before the rapidly approaching deadline.

Annual Meeting Program Committee Chair, **Laurian Rohoman** and her committee have been diligently working to provide a great educational program. Check out the information-packed program that is shaping up for Toronto. Besides her efforts in planning the annual meeting, Laurian reports on the first SMRT Regional held in Canada which she coordinated. We appreciate her extended efforts this year on behalf of the SMRT. Regional news also comes to us from Atlanta. Southeast Regional Co-Chairs, **Carolyn Brown, Bobbie Burrow** and **Donna O'Brien** report on another successful educational program.

Greetings are extended to us from Policy Board Member, **Muriel Cockburn** and the British Association of MR Radiographers. Also from the European arena we have an article from **Silke Bosk** and her colleagues in Essen, Germany. Be sure to read the techniques involved with state-of-the-art colon imaging.

Regular features in *Signals* include Low- and Mid-field MR Scanning and the MR Safety column. **Bill Faulkner** discusses faster scanning at "low" field by improving patient throughput. **Frank Shellock** shares the latest information on safety screening for MR, including forms that you can use at your site. Included for your information are the 3rd place award winning proffered oral presentations from this past annual meeting. **David Stanley** and **Anne Blankholm** share the clinical and research perspectives of heart imaging.

Don't forget to review the calendar for upcoming SMRT events and if you are attending the RSNA, stop by the SMRT booth located in the Associated Sciences area. ●

Update on

SMRT Educational Seminars

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

By now you should all have *"MRI of the Ankle and Foot"* issue in your hands. I know, I know, you all have already read it and answered all the questions! Just an update, the ASRT has given us 4.0 credits for this issue, not the 3.0 credits printed in the introduction of the issue. If you have already completed it, the office will amend your credits!

Were any of you performing MRIs 10-12 years ago?! Well I was! Yes, I am an oldie (but a goody) and I can remember losing sleep the night prior to doing a breast exam (I am one of those types that looks at the next day's schedule and then proceeds to fret about it for 24 hours). Back in those days imaging a breast was a PROJECT that was grueling for all involved: the patient, technologist, and radiologist. Well, it does not have to be so anymore! Technical advances in MR compatible equipment, coils, pulse sequences, and spectroscopy have made great strides in overcoming the hurdles of the past. The previous issue of the *SMRT Educational Seminars* entitled *"MR Imaging of the Breast"* which provides you with all the latest and greatest ways to evaluate breast implants and disease.

The last issue of the year is *"Diffusion-Weighted MR Imaging in Acute Stroke: Theoretic Considerations and Clinical Applications."* Diffusion weighted imaging (DWI) is providing the means to evaluate stroke patients within the window in which the administration of therapeutic agents are effective. It is important to understand the physical principles and clinical applications of this technique, and this article will help you build a strong foundation of knowledge in this area. My next question is – "Does this mean I have to take a call?"

Thank you for all the comments received at the Annual Meeting. We are glad that the home study program is truly benefiting MR technologists worldwide. Tentatively, the 2003 issues will focus on the following subjects: MRA in the abdomen and lower extremities, anatomy of the knee, imaging of the soft tissue neck, and a cardiac update. We will continue to provide you with twelve approved credits per year in the field of MR. Please feel free to contact me with any suggestions or comments, or if you would like to participate in putting together a home study, e-mail: baron4mri@woh.rr.com. ●

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

"Excellence Through World-Class Education"
Make Plans Now to Attend the SMRT 12th Annual Meeting

Laurian Rohoman, A.C.R., 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 to11 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 advance the education and training for MR technologists worldwide and to promote communication and dissemination of information regarding current and emerging technological advances. The theme of the 2003 meeting is ***"Excellence Through World-Class Education."***

The agenda of the Annual Meeting will be geared towards 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 are based on the comments and feedback received from the attendees of previous annual meetings.

Topics will include: *Functional Imaging, Advanced Pulse Sequences, Parallel Imaging, Breast Imaging, Body Imaging, Pediatrics, Cardiac Imaging, MSK,* and *Female Pelvis.* This educational program will be submitted for 14.5 Category A Continuing Education credits, pending approval by the ASRT and CAMRT. The preliminary program schedule is included for your reference.

The SMRT Annual 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 encourage all technologists to actively participate in the meeting by submitting an oral or poster abstract.

The deadline for abstract submissions will be **17 January 2003.** For the 2003 Annual Meeting, all abstract submissions should be done electronically through the SMRT Website: http//www.ismrm.org/smrt. Paper submission forms may be obtained upon special request by contacting the SMRT Office at: SMRT, 2118 Milvia Street, Suite 201 Berkeley, California 94704 USA.

The SMRT Annual Business Meeting will be held on Saturday, 10 May, providing a chance to participate in the SMRT professional organization. At the end of the Business Meeting, awards will be given for the most outstanding oral and poster abstract presentations.

As requested by the attendees at previous annual meetings, *The Safety Forum* will again be held on Sunday during the lunch hour. This session continues to be a hot topic at the SMRT Annual Meeting and Safety Issues will be discussed along with a question and answer session.

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 beautiful Toronto. ●

Preliminary Program

Saturday, 10 May 2003, 07:45-17:30

07:45-08:00	**Welcome and Announcements**
08:00-09:00	**Basics of Functional Neuro Imaging** *Anne Sawyer-Glover, B.S., R.T.(R)(MR)*
09:00-10:00	**Cardiac Imaging** *Naeem Merchant, M.D.*
10:15-11:15	**Physics: New Pulse Sequences** *William Faulkner, B.S., R.T.(R)(MR)(CT)*
11:15-11:45	Proffered Papers
11:45-13:30	SMRT Business Meeting and Awards Luncheon
13:30-14:30	**Breast Imaging** *Petrina Causer, M.D.*
14:30-15:30	**Pulse Sequences and Protocols in MSK** *Garry Gold, M.D.*
15:45-16:00	Proffered Papers
16:00-17:00	**Pre- and Postnatal Pediatric Neuromaging: How and Why** *Erin Simon, M.D.*
17:00-17:30	**Assessment of Gastrointestinal Disorders** *Silke Bosk, R.T. and Thomas Lauenstein, M.D.*

Sunday, 11 May 2003, 07:45-17:00

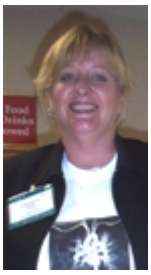
07:45-08:00	**Welcome and Announcements**
08:00-09:00	**Functional MRI: Past, Present, and Future** *Peter Bandettini, Ph.D.*
09:00-10:00	**Stroke Imaging** *Richard Frayne, Ph.D.*
10:15-11:15	**Contrast Enhanced MR of the Abdomen: Contrast Agents, Techniques, and Findings** *Richard Semelka, M.D.*
11:15-13:15	**MRI Safety Forum and Luncheon** *Frank Shellock, Ph.D., Moderator*
13:15-13:45	Proferred Papers
13:45-14:45	**Talking Sense and Non-Sense in Parallel Imaging** *Donald W. McRobbie, Ph.D.*
15:00-16:00	**MRI of the Female Pelvis: Emphasis on Technique** *Eric Outwater, M.D.*
16:00-17:00	**Why 3T?** *David W. Stanley, B.S., R.T. (R)(MR)*
17:00	Adjournment

SMRT Regional News

Report on the SMRT Southeast Regional Seminar

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

The SMRT Atlanta Local Chapter hosted the Southeast Regional Seminar on 21 September 2002, at St. Joseph's Hospital Auditorium. This was our sixth annual local chapter meeting and we were pleased to have over 130 attendees. The seminar featured speakers from across the country sharing dynamic lectures. This year, we were very honored to welcome the current SMRT President, John Koveleski, who encouraged membership in the SMRT.



After welcoming all who attended, our seminar began with Carolyn Kaut Roth, R.T. (R)(MR)(CT)(M) (CV), from the University of Pennsylvania Medical Center. Candi began our meeting with her unique style of lecturing, and gave an excellent presentation of contrast enhanced MR angiography. Following Candi, Dr. Steve Frowein, M.D., a cardiologist from St. Joseph's Hospital, presented very timely information on the latest and most up-to-date techniques used in cardiac imaging.

For a second year, we were again pleased to welcome Rita Clemons, R.T. (R)(MR), from Baylor University, Dallas, Texas. Rita provided enlightening information on fetal imaging with many great images and techniques. Robin Greene-Avison, C.N.M.T, R.T. (N)(MR), from the University of Kentucky, explained the basics for Spectroscopy Imaging. Robin was very instructive on how spectroscopy is used in a clinical setting.

Speaker Robin Greene-Avison.

SMRT President, John Koveleski join co-organizers (l to r) Carolyn Brown, Bobbie Burrow, and Donna O'Brien, in welcoming the SMRT Southeast Regional Seminar participants.

Everyone enjoyed lunch and used this time to network. After lunch, Candi Roth spoke on abdominal imaging. Candi explained the different contrast agents used. Coil vendor representatives from MRI Devices and Medical Advances spoke about the latest technology for surface coils, and presented new advances in their equipment.

Jim Stuppino, B.S., R.T. (R)(MR), from Valley Advanced Imaging & MRI, in Bethlehem, Pennsylvania, presented two very edifying lectures. He explained the physics and protocols for open MRI imaging. The Atlanta area has a large number of open MRI scanners and the information he provided to the group was very instructive. As the last speaker, Jim also presented an ACR accreditation update with his recommendation for the current ACR weekly testing and the accreditation process.

The Atlanta Local Chapter has always had superb support from its local vendors. This year, we would especially like to thank all of our suppliers for their help and contributions. We are grateful and overwhelmed by all of the wonderful door prizes we received. Our attendees were ecstatic about them. I would like to thank all who contributed. We would also like to thank St. Joseph's Hospital for hosting the seminar, and to everyone who was so generous in making the seminar a great success.

Donna O'Brien, Carolyn Brown, and Bobbie Burrow work hard each year to organize the meeting, and all of our efforts are worthwhile when we see such a great response. We appreciate all of our guest speakers, and we enjoyed the cutting-edge lectures. ●

Update from the British Association of MR Radiographers

Muriel Cockburn, D.C., R.B.Sc. (Hons) P.Gd.Cert. MRI, BAMRR President and SMRT Policy Board Member

Dear SMRT Members,

Another update from the United Kingdom and BAMRR. This is my last year as president of the above association and with a mixture of sadness and pleasure I will be handing over to my colleague, Andrew Cooper, who I am sure will be a great president. My time now will allow me to concentrate on my new role as SMRT Policy Board member, a role which I hope to fulfill in the great tradition of SMRT with continuing support for global sharing and learning in the field of MRI. This is one of the great potentials of MR technologists and radiographers. We are all committed to sharing knowledge and expertise globally, and this can only benefit our patients. After all, that is why we are all in employment!

If anyone has any ideas they wish to share or explore, wherever you are in the world, please contact me through SMRT. Take care everyone and I hope you have started booking those flights to Canada. ●

SMRT Regional News

Report on the SMRT Eastern Canada Regional Seminar

Laurian Rohoman, A.C.R., R.T. (R)(MR), Local Coordinator

On September 28th the first ever SMRT Canadian Regional Seminar was held in Montreal, Quebec, Canada. The meeting was hosted by the McGill University Health Centre (Montreal Neurological Hospital Site) and was held in the Jeanne Timmins Amphitheatre. The location was ideal as it was spacious enough for all attendees to gather and socialize. We were pleasantly surprised by the good turnout of over 90 technologists from Quebec, Ontario, the US. And MR technologists even as far as Calgary (Alberta) attended the regional. Bravo!

Dr. Bourgouin started the morning with his talk on *"Advances in MR Imaging of Multiple Sclerosis,"* explaining the appearance of lesions, the role of MR in patients with MS and new techniques. He was followed by Dr. Raquel Del Carpio who spoke on *"Advantages of MRI over CT in Head Trauma and Meningeal Carcinomatosis."* She pointed out in which cases CT is the initial imaging modality and when MR is the preferred imaging modality. After a short break, Dr. Bourgouin gave his second presentation on *"Functional Imaging."*

Dr. Naeem Merchant, from Toronto, ended the morning session with his impressive presentation on *"Cardiovascular Imaging and Techniques,"* showing great images done with the CVMR.

After a nice lunch, the afternoon session started with Dr. David Gianfelice who gave a very interesting presentation on *"MR Imaging-Guided Focused Ultrasound Surgery of Breast Lesions."* There are only four sites in the world that perform this procedure and it is nice to know that St. Luc Hospital, in Montreal, is the largest centre. Cindy Comeau followed with a presentation on the *"Essentials of Vascular MRA for Technologists."* This was a great presentation on "how to" and Cindy had many questions from the audience afterwards. After the break, Dr. Caroline Reinhold gave a very informative talk on *"MR Imaging of the Biliary Tree and the Pancreas,"* discussing technical factors and pathologies. Dr. Adel Assaf ended the day with his presentation on *"Common Pathologies in the Musculoskeletal System,"* giving us a good overview of pathologies of the shoulder, elbow, wrist, hip, knee, and ankle.

Door prizes were given during the day to some lucky attendees. These door prizes were donated by some of our sponsors. During the course of the meeting we received very positive feedback and comments from the attendees, which was very encouraging. Although it was a long day, everyone felt their time was well spent.

On behalf of the SMRT I would like to thank our sponsors for their generous support, Amersham Health, Berlex Canada Inc., GE Medical Systems, and Philips Medical Systems.

I would like to thank my co-chairs Louise Gaudreau and Marian Stern for all their hard work. A special thank you to William Brodie, administrator of the Medical Imaging Department of the Montreal General Hospital for his advice and support. And last but not least to Jennifer Olson and the SMRT staff for all their support, advice, and help in making this meeting a success, thank you all. ●

From the International Community

Magnetic Resonance Colonoscopy (MRC)

Silke Bosk, R.T., Department of Radiology, University Hospital Essen, Essen Germany

Editor's Note: **Silke is a MR Technologist in Essen, Germany, as well as an SMRT Board Member. She shares with us the exciting work being done at her site.**

INTRODUCTION

Colorectal cancer (CRC) remains the second leading cause of cancer mortality in western countries. Approximately 6% of the population will develop CRC during their lifetime.[1] The majority of colon cancers develop from non-malignant adenomas or polyps.[2] Thus, cancer screening programs targeting precancerous polyps with subsequent endoscopic polypectomy could potentially reduce the incidence and thus the mortality of colorectal cancer significantly.

Insufficient diagnostic accuracy and/or poor patient acceptance characterise most available colorectal screening modalities, including testing for occult fecal blood, conventional colonoscopy, or double-contrast barium enema.[3,4] Recently virtual colonography (VC), based on 3D CT or MR data sets has been propagated for colorectal screening. VC has been found to be highly sensitive for detecting colorectal polyps exceeding 8mm in size.[5,6] Despite high diagnostic accuracy, the considerable exposure to ionising radiation casts a shadow over the future of CT colonography as a screening exam for colorectal cancer.[7] Hence, efforts have been focussed on MR colonography (MRC).

To date, MRC has been based upon the administration of a rectal enema containing paramagnetic contrast. On 3D gradient echo data sets only the contrast-containing colonic lumen is bright whereas the surrounding tissues including colonic wall and polyps remain low in signal intensity. Hence the technique has been referred to as 'bright lumen' MRC. Polypoid colonic masses appear as dark filling defects within the bright colonic lumen– an appearance

Continued on page 7

which is difficult to differentiate from residual fecal material and/or small pockets of air. To avoid false positive findings induced by residual stool, patients are required to rigorously cleanse their colon prior to the exam. To compensate for the presence of residual air, the 3D acquisition is performed in both the prone and supine positions.

In this communication we describe our initial experience with a simplified, less costly variation on MR-colonography– MRI of the contrast-enhanced colonic wall. The technique is based on the acquisition of a 3D gradient echo sequence collected after administration of a rectal water-enema and an intravenous injection of paramagnetic contrast. The colonic wall as well as masses arising from it brightly enhance and are thus easily delineated against the background of dark surrounding tissues and a dark colonic lumen– hence 'dark lumen' MRC.

MATERIALS AND METHODS

'Dark lumen' MRC: Technique

Following standard preparation for bowel cleansing (oral ingestion of 4 L Golytely, Braintree Laboratories, Braintree, Massachusetts) MR examinations were performed on a 1.5 T MR system (Magnetom Sonata, Siemens Medical Systems, Erlangen, Germany). A combination of two surface coils were used in conjunction with the built-in spine array coil for signal reception to permit coverage of the entire colon. To minimize bowel peristalsis, 40mg of scopolamine (Buscopan; Boehringer Ingelheim, Germany) were injected intravenously. Following placement of a rectal enema tube (E-Z-Em, Westbury, New York), the colon was filled with 3000ml of warm tap water. To ensure safe and complete filling, the administration of the enema was monitored using a fast 2D TrueFISP sequence (TR/TE/flip 3.2/1.6/70°; slice thickness 5mm) which allowed for the acquisition of one image every three seconds. Once complete filling and distension of the colon was assured, a first 'pre-contrast' T1-weighted 3D gradient echo data set was collected. Data acquisition was performed with the patient in the prone position, only. For the 3D sequence the following parameters were used: TR/TE 1.64 / 0.6 ms, flip angle 15°, field of view (FOV) 450 x 450mm, matrix 512 x 460, effective slice thickness 1.57mm. Subsequently paramagnetic contrast (gadobenate dimeglumine, Gd-BOPTA, Multihance, Bracco, Italy) was administered intravenously at a dosage of 0.2 mmol/kg and a flow rate of 3.5 ml/s. After a delay of 75 s, the 'pre-contrast' 3D acquisition was repeated with identical imaging parameters. The 3D data set was collected breathheld in 23 s.

Patients

MRI of the colonic wall was performed on twelve subjects (eight men, four women, age range 44-76 years, mean age 60.2 years) in whom a colorectal mass was suspected due to positive family history (n = 3) or a positive fecal occult blood test (n = 9). The study was performed in accordance with all guidelines set forth by the local ethical committee and all patients signed informed consent.

In addition to MRI of the colonic wall all patients underwent conventional colonoscopy performed within five to fourteen days following the MR exam. In addition, three subjects agreed to undergo MR-colonography based on the published 'bright lumen' protocol.[8] These exams were performed seven days following the 'dark lumen' MRC, on the same MR system, using identical patient and coil positioning, as well as the same 3D gradient echo sequence for display of the colon. In contrast to the 'dark lumen' MRC protocol, Gd-DTPA was added to the rectal water enema (1:100) and no intravenous contrast agent was applied.

Data Analysis

All MRI exams were evaluated by two experienced radiologists. Analysis was based on individual source images, multiplanar reformations and virtual endoscopic renderings. Signal intensities were measured in Regions-of-Interest (ROIs) positioned within the walls of the ascending, transverse, descending and sigmoid colon as well as within all mass lesions on both unenhanced and enhanced 3D GRE images. Signal-to-Noise Ratios (SNR) were calculated in the usual manner using the following formula: SNR = SI (colonic wall)/noise defined as the standard deviation of an ROI measurement outside the subject. All MR findings were compared to those obtained with conventional endoscopy.

RESULTS

'Dark lumen' MRC, including placement of the rectal tube and colonic filling with warm tap water was well-tolerated by all twelve subjects. All twelve exams were considered diagnostic. The in-room time ranged between 10 and 15 minutes (mean 12 minutes). Image analysis time amounted to 10 ± 4 minutes.

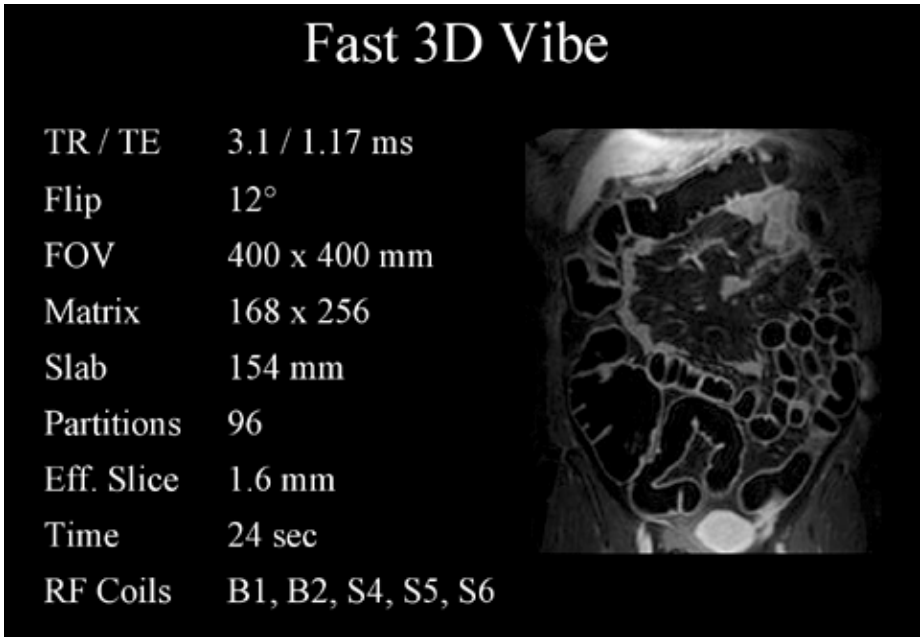


Figure 1.

Continued on page 8

Five polyps ranging in diameter between 7 and 12 mm were detected with 'dark lumen' MRC (Figure 1). All five lesions were confirmed by conventional colonoscopy and subsequent polypectomy was performed. There were no false negative findings.

On 'bright lumen' MRC, performed in addition in only three patients, three polyps were seen in two patients. One lesion corresponded to a polyp seen on 'dark lumen' MRC as well as at colonoscopy. Two lesions identified in one patient did not have a correlate on either 'dark lumen' MRC or conventional colonoscopy. The two false positive findings were retrospectively interpreted as either residual air bubbles or residual stool adherent to the colonic wall.

The intravenous administration of paramagnetic contrast resulted in an average SNR increase within the colonic wall of 170% from 9.2 to 24.8 ± 2.6. This difference was statistically significant ($p < 0.001$). Polyps revealed even more enhancement with signal intensities increasing by 306% from 8.9 ± 1.6 to 36.1 ± 3.9. Lack of contrast enhancement correctly identified three bright "lesions" as residual stool (Figure 2).

In addition, 'dark lumen' contrast-enhanced MRC revealed four extra-intestinal lesions: two renal cysts in two patients, a single hepatic hemangioma in one patient, and an aortic abdominal aneurysm measuring 4 cm in diameter in another patient.

DISCUSSION

The preliminary experience documented in this communication suggests that 'dark lumen' MRC works well. The technique is well tolerated and appears highly accurate regarding the detection of colorectal masses– all 5 polyps were readily identified. Compared to 'bright lumen' MRC which has been extensively evaluated in the past, 'dark lumen' MRC harbors considerable advantages including reduced cost, reduced examination and post-processing times, as well as potentially higher diagnostic accuracy and confidence.

'Bright lumen' MRC, which has been shown to be accurate in detecting colorectal polyps larger than 8 mm in size, requires the administration of a gadolinium-containing rectal enema.[6,8,9] Although most authors suggest a mixture of 1:100,[6] some studies recommend the use of a 1:50 Gd/water dilution.[8] Assuming a colonic volume of 3000 ml, between 30 and 60 ml of costly paramagnetic contrast are needed for the rectal enema alone. In addition, most 'bright lumen' MRC protocols call for the additional administration of paramagnetic contrast in a dose of 0.1 mmol/kg for better assessment of surrounding organs such as the liver. The 'dark lumen' MR-colonography approach on the other hand requires merely a single intravenous injection of less than 30 ml of paramagnetic contrast for a subject weighing 70 kg. No additional injection of contrast is required for concomitant assessment of parenchymal organs.

To compensate for residual air pockets, which obscure the outline of the colonic wall, 'bright lumen' MRC requires the collection of two data sets: one obtained in the prone and a second obtained in the supine patient position. Turning the patient during the exam is cumbersome and can be associated with considerable time delays. Occasionally the patient moves so much that a new landmark is required. In any case, a new localizing sequence is required to assure full coverage of the colon in the subsequent 3D acquisition. During this delay, contrast frequently escapes from the colon into the small bowel. As a result the colon looses distension and the resultant data set is of reduced diagnostic quality. 'Dark blood' MRC obviates the need for a 3D acquisition in a second patient position. Since air is signal-less on all sequences, its appearance on heavily T1-weighted 3D GRE images is identical to water, which is used to distend the colon. The enhancing colonic wall and mass lesions arising from it are easily differentiated. Thus the time for both the actual exam as well as image interpretation is considerably reduced amounting to less than 30 minutes.

The detection of colorectal lesions with 'bright lumen' MRC relies on the visualization of filling defects. Differential considerations for such a filling defect include air bubbles as well as residual fecal material. Collecting two data sets in the prone and supine patient position allows the use of 'motion' as a differentiating criterion. Only those lesions that remain in the same position are considered a true polyp. Unfortunately this differentiating criteria can introduce severe errors, both regarding false negatives and false positives. Thus polyps with a long stalk may move sufficiently to impress as a moving air bubble or more likely residual stool, while stool adherent to the colonic wall may not move at all and thus falsely impress as a polyp. This was the case in one patient examined in the current

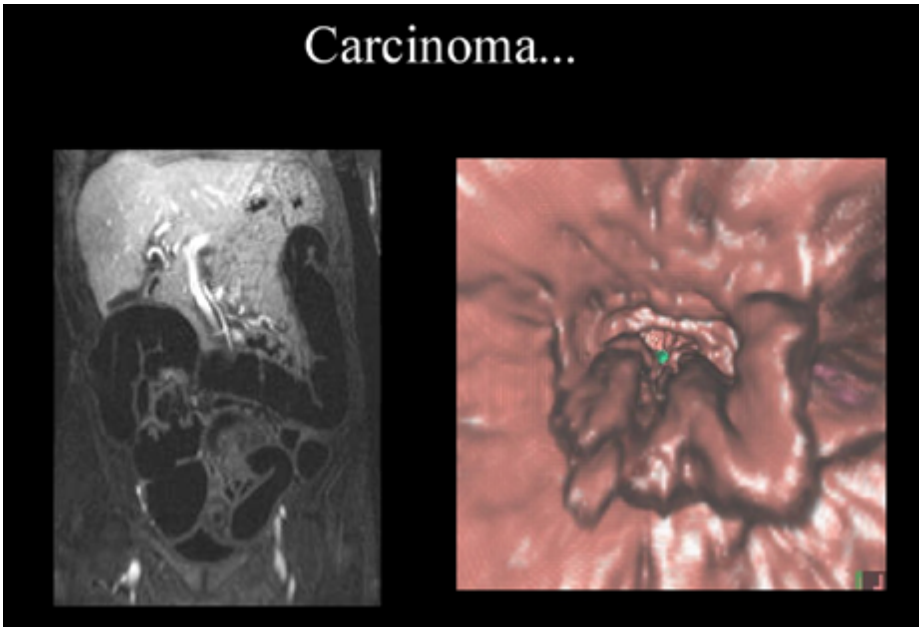


Figure 2.

Continued on page 9

collective– based on the 'bright lumen' technique two small polyps were identified, which had no correlate on either 'dark lumen' MRC or conventional colonoscopy.

All techniques for virtual colonography, regardless whether based on CT or MRI are handicapped by residual stool. The proposed 'dark lumen' technique copes with this problem in a simple manner: if the lesion enhances it is a polyp, if it does not enhance it represents stool. Suspicious appearing lesions are analyzed by comparing signal intensities on the pre- and post-contrast images. Lesions identified in this limited number of patients enhanced in average by more than 300%. Comparing post- to pre-contrast data sets is crucial, as stool can be quite bright on T1-weighted images. The presence of iron and manganese is implicated as the cause for the bright signal within stool. If analysis were limited to the post-contrast data set, bright stool could be misinterpreted as a polyp. Comparison with the pre-contrast images documents the lack of contrast enhancement which assures the correct diagnosis. In the current study, several patients exhibited bright stool which was readily identified as such based on assessment of the pre-contrast images (Figure 2).

Enhancement of colorectal masses following the intravenous administration of contrast has been documented before in conjunction with MR-colonography[10] and CT colonography.[11] The use of intravenously administered contrast material had significantly improved reader confidence in the assessment of bowel wall conspicuity and the ability of CT colonography to depict medium polyps in suboptimally prepared colons. Interestingly, the enhancement observed within polyps exceeded the increase determined within the colonic wall. In view of the very limited number of lesions, the reliability of this observation remains unclear. If proven true, this difference may aid in differentiating even very small polyps from thickened haustral folds.

A further advantage of 'dark lumen' MRC relates to the fact that it permits direct analysis of the bowel wall. This might facilitate the evaluation of inflammatory changes in patients with Crohn's disease. Increased contrast uptake and bowel wall thickening, as documented on contrast-enhanced T1-weighted images has already been shown to correlate well with the degree of inflammation in the small bowel.[12] Hence, the 'dark lumen' approach may indeed amplify the list of indications for MRC in the future to also encompass inflammatory bowel disease.

Finally, the intravenous application of paramagnetic contrast permits a more comprehensive assessment of parenchymal abdominal organs contained within the field of view. By combining pre- and post-contrast T1-weighted imaging, the liver can be accurately evaluated regarding the presence and type of concomitant disease. Accordingly, a hepatic hemangioma was not merely detected but immediately characterized as such on the contrast-enhanced scan. Not only hepatic lesions, but also vascular structures can be interpreted with more confidence. Thus one patient with an abdominal aortic aneurysm was readily identified.

'Dark blood' MRC also offers new perspectives regarding optimization of bowel distention.

Although the administration of water as a rectal enema does not adversely effect patient comfort in most cases, a modified strategy could be based on the application of gas like CO_2.[13] The gas is signalless and would thus easily permit delineation of the contrast-enhanced colonic wall and masses. Eventually, the technique may also offer new perspectives for 'fecal tagging'.[14] If the signal of stool could be reliably nulled, cleansing of the colon prior to the exam would no longer be necessary. Preliminary experiments using various orally applied contrast agents appear promising.[15]

CONCLUSION

'Dark lumen' MR colonography is based on the contrast enhancement of the colonic wall and masses arising from it. Compared to 'bright lumen' MRC, the technique appears to enhance diagnostic accuracy and confidence, while at the same time reducing cost and shortening exam as well as post-processing times. ●

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How to Scan Faster at Low Field

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.

Got your attention with that title? Thought you couldn't scan fast with a low field system? What I want to write about it and not exactly what most people think of when they think of fast scanning. Usually, it conjures up images of sequences that take longer to setup than to scan. I've had many technologists and radiologist complain that the sequences on low field systems (0.2 T to 0.35) can take as long as 7 minutes and at 0.2 T, up to 10 minutes. Reality check time; 0.2 T is 7.5 times less in field strength than a 1.5 T system. Why are they surprised that the scan times are that long? What physics books have they been reading? The scan times are going to be long– get over it.

Now, to the point of this article, if we could scan faster, then we could possibly do a couple more patients in a standard workday. Let's assume that is the goal. Since I can't ramp the magnet up to a higher field strength, then lets examine other issues that keep us from doing those two extra patients per day.

The first thing to consider is how many sequences we run per study. In 1985, I remember when on my 1.5 T system, it took us about 45 minutes to acquire 3 series on a routine brain. The protocol consisted of a sagittal T1-weighted spin echo sequence, which took about 4 to 5 minutes. The second series was a double echo spin echo (PD- and T2-weighted) that took approximately 17.5 minutes. The third sequence was either an axial or coronal T1-weighted sequence, which also took about 5 minutes to acquire. The reason for the 45 minute scan time was that we had to perform manual center frequency tuning before the first sequence and manual prescan adjustments before each series. Additionally, we were not able to prescribe the next series before the previous series was scanned and reconstructed (recon was several seconds per image in those days). If we wanted to add a coronal double echo spin echo sequence, then we really had a long study.

As the software and hardware improved and we upgraded our system, the individual sequences became shorter and we could perform more simultaneous processes (up to a point). Keep in mind that with the first few upgrades, our 17-minute sequence became about 9 minutes. When we finally got it down to 6 minutes, we called it a "fast scan." Do you think that with the reduction in time we were able to get the patient off the table faster? No way! We just added more sequences. They were still on the table for at least 45 minutes. When fast spin echo (FSE) became available, we added more sequences. When MRA and diffusion became more common, we added those. Granted, if we wanted to, we could do a sagittal T1, axial T2 and axial FLAIR in under 10 minutes as some sites do, but more times than not, that is not the case.

Now, when a high field site adds a low field system, the first thing that many radiologists do is insist on the same number of sequences as are acquired on the high field system. Additionally, since we most often don't get as many slices per TR at lower field (primarily due to the use of lower receiver bandwidths), we have to either increase the TR or acquire a double acquisition to maintain the TR for the desired T1 contrast. This often results in total acquisition times of 50 minutes or longer, due to the increased scan times necessary at lower fields. One should keep in mind that if you are going to go for ACR accreditation, they look at your total "tapping time." If it exceeds 50 minutes, you may very well fail. I encourage sites to better tailor their studies on the low field systems in order to keep the number of sequences to a minimum. Don't start with the goal of doing as many series/sequences on the low field as you do on the high field. Remember, you used to get by with less series. This one strategy alone can shave 15 minutes off of some study times.

Lastly, I'd like to address the issue of "other duties as assigned". We used to use that broad term when writing job descriptions some years ago. By this I mean those "paper-work" or administrative tasks that technologists are often required to perform. My pet peeve is "hanging films." Fortunately, now that many sites are reading off of workstations or PACS, we don't have to hang any films for the radiologist to read. I never understood why they couldn't just hang them up, read them, then take them down. The reports never seemed to get out any faster whether or not we hung the films.

But I digress– even if techs don't have to hang films for them, they often have to put the paperwork together so the films can be dictated. My recommendation is to hire a technologist assistant whose job it is to do all the peripheral work related to scanning. Depending on the quality of the individual hired, they can even be well trained to interview the patient and even prepare the room between patients.

I have personally been at sites where the table was empty as long as 30 – 40 minutes between patients. The waiting was usually due to registration, transport or patient prep delays (orbit x-rays and the like). If a site reduced the amount of empty table time by as little as 40 minutes per day, that could translate to one additional patient per day. Put these two suggestions to work and you can easily see how a site scanning with a low field system can increase throughput by two patients per day. If we use a conservative number of $450 per study and 20 scanning days per month, that would mean additional gross revenue of $216,000 per year. Not bad huh? ●

Screening Patients for MR Procedures and Individuals for the MR Environment

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 establishment of thorough and effective screening procedures for patients and other individuals is one of the most critical components of a program that guards the safety of all those preparing to undergo MR procedures or to enter the MR environment. An important aspect of protecting patients and individuals from MR system-related accidents and injuries involves an understanding of the risks associated with the various implants, devices, accessories, and other objects that may cause problems in this setting. This requires constant attention and diligence to obtain information and documentation about these objects in order to provide the safest MR setting possible. In addition, because most MR-related incidents have been due to deficiencies in screening methods and/or a lack of properly controlling access to the MR environment (especially with regard to preventing personal items and other potentially problematic objects into the MR system room), it is crucial to set up procedures and guidelines to prevent such incidents from occurring.

Magnetic Resonance (MR) Procedure Screening for Patients

Certain aspects of screening patients for MR procedures may take place during the scheduling process. This should be conducted by a healthcare worker that is specially trained in MR safety (i.e., this person should be trained to understand the potential hazards and issues associated with the MR environment and MR procedures and be familiar with all of the information contained on the screening forms for patients and individuals). During this time, it may be ascertained if the patient has any implant that may be contraindicated for the MR procedure (e.g., a ferromagnetic aneurysm clip, pacemaker, etc.) or if there is any condition that needs careful consideration (e.g., the patient is pregnant, has a disability, etc.). Preliminary screening helps to prevent scheduling patients that may be inappropriate candidates for MR examinations.

After preliminary screening, every patient must undergo comprehensive screening in preparation for a magnetic resonance (MR) procedure (i.e., MR imaging, MR angiography, functional MRI, MR spectroscopy). Comprehensive patient screening involves the use of a printed form to document the screening procedure, a review of the information on the screening form, and a verbal interview to verify the information on the form and to allow discussion of any question or concern that the patient may have. An MR-safety trained healthcare worker must conduct this aspect of patient screening.

A screening form for patients developed by Sawyer-Glover and Shellock (2000) was recently revised in consideration of new information in the peer-reviewed literature. This two-page form entitled, *Magnetic Resonance (MR) Procedure Screening Form for Patients* (Figure 1), was also created in conjunction with the Medical, Scientific, and Technology Advisory Board and the Corporate Advisory Board of the Institute for Magnetic Resonance Safety, Education, and Research (IMRSER). A "downloadable" version of this form may be obtained from the MR safety web sites, www.IMRSER.org and www.MRIsafety.com.

Page one of this screening form requests general patient-related information (name, age, sex, height, weight, etc.) as well as information regarding the reason for the MR procedure and/or symptoms that may be present. Pertinent information about the patient is required not only to ensure that the medical records are up-to-date, but also in the event that the MR facility needs to contact the referring physician for additional information regarding the examination or to verify the patient's medical condition.

The form requests information regarding a prior surgery or operation to help determine if there may be an implant or device present that could create a problem for the patient. Information is also requested pertaining to prior diagnostic imaging studies that may be helpful to review for assessment of the patient's condition.

Next, important questions are posed in an effort to determine if there are possible problems or issues that should be discussed with the patient prior to permitting entry to the MR environment. For example, information is requested regarding any problem with a previous MR examination, an injury to the eye involving a metallic object, or any injury from a metallic object or foreign body. Questions are posed to obtain information about current or recently taken medications as well as the presence of drug allergies. There are also questions asked to assess past and present medical conditions that may affect the MR procedure or the use of an MRI contrast agent in the patient.

At the bottom of page one, there is a section for female patients that poses questions that may impact MR procedures. For example, questions regarding the date of the last menstrual period, pregnancy or late menstrual period are included. A definite or possible pregnancy must be identified prior to

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permitting the patient into the MR environment so that the risks vs. the benefits of the MR procedure can be considered and discussed with the patient. MR procedures should only be performed in pregnant patients to address important clinical questions. MR facilities should have a clearly defined procedure to follow in the event that the patient has a confirmed or possible pregnancy.

Questions pertaining to the date of the last menstrual period, use of oral contraceptives or hormonal therapy, and fertility medication are necessary for female patients undergoing MR procedures that are performed to evaluate breast disease or for OB/GYN applications, as these may alter the tissue appearance on MR imaging. An inquiry about breastfeeding is included in case the administration of MRI contrast media is being considered for nursing mothers.

The second page of the form has a statement at the top that indicates: **"WARNING:** Certain implants, devices, or objects may be hazardous to you and/or may interfere with the MR procedure (i.e., MRI, MR angiography, functional MRI, MR spectroscopy). *Do not enter* the MR system room or MR environment if you have any question or concern regarding an implant, device, or object. Consult the MRI Technologist or Radiologist BEFORE entering the MR system room. The MR system magnet is ALWAYS on."

Next, there is a section that lists various implants, devices, and objects to identify anything that could be hazardous to the patient undergoing the MR procedure or that may produce an artifact that could interfere with the interpretation of the MR procedure. In general, these items are arranged on the checklist in order of the relative safety hazard (e.g., aneurysm clip, cardiac pacemaker, implantable cardioverter defibrillator, electronic implant, etc.), followed by items that may simply produce imaging artifacts that could be problematic for the interpretation of the MR procedure. Additionally, questions are posed to determine if the patient has a breathing problem, movement disorder, or claustrophobia because these are known to present difficulties for MR procedures.

Figures of the human body are included on the second page of the screening form for the patient as a means of showing the location of any object inside of or on the body. This information is particularly useful so that the patient may indicate the approximate position of any object that may be hazardous or that could interfere with the interpretation of the MR procedure as a result of producing an artifact.

Page 2 of the screening form also has an **Important Instructions** section that states: "Before entering the MR environment or MR system room, you must remove *all* metallic objects including hearing aids, dentures, partial plates, keys, beeper, cell phone, eyeglasses, hair pins, barrettes, jewelry, body piercing jewelry, watch, safety pins, paperclips, money clip, credit cards, bank cards, magnetic strip cards, coins, pens, pocket knife, nail clipper, tools, clothing with metal fasteners, and clothing with metallic threads. Please consult the MRI technologist or radiologist if you have any question or concern BEFORE you enter the MR system room."

Finally, there is a statement on the ***Magnetic Resonance (MR) Procedure Screening Form for Patients*** that indicates hearing protection is "advised or required" to prevent possible problems or hazards related to acoustic noise. In general, this should not be an option for a patient undergoing an MR procedure on a high-field-strength MR system. By comparison, it may not be necessary for the use of hearing protection by patients undergoing MR procedures on low-field-strength MR systems.

It should be noted that undergoing previous MR procedures without incidents does not guarantee a safe subsequent MR examination. Various factors (e.g., the static magnetic field strength of the MR system, the orientation of the patient, the orientation of a metallic implant or object, etc.) can substantially change the scenario. Thus, a written screening form must be completed each time a patient prepares to undergo an MR procedure. This is not an inconsequential matter because a surgical intervention or accident involving a metallic foreign body may have occurred that could impact the safety an MR procedure or of entering the MR environment.

With the use of any type of written questionnaire, limitations exist related to incomplete or incorrect answers provided by the patient. For example, there may be difficulties associated with patients that are impaired with respect to their vision, language fluency, or level of literacy. Therefore, an appropriate accompanying family member or other individual (e.g., referring physician) should be involved in the screening process to verify any information that may impact patient safety. Versions of this form should also be available in other languages, as needed (i.e., specific to the demographics of the MR facility).

In the event that the patient is comatose or unable to communicate, the written screening form should be completed by the most qualified individual (e.g., physician, family member, etc.) that has knowledge about the patient's medical history and present condition. If the screening information is inadequate, it is advisable to look for surgical scars on the patient and/or to obtain plain films of the skull and/or chest to search for implants that are known to be particularly hazardous in the MR environment (e.g., aneurysm clips, cardiac pacemakers, etc.).

Following completion of the *Magnetic Resonance (MR) Procedure Screening Form for Patients,* an MR-safety trained healthcare worker should review the form's content. Next, a verbal interview should be conducted by the MR-safety trained healthcare worker to verify the information on the form and to allow discussion of any question or concern that the patient may have before undergoing the MR procedure. This allows a mechanism for clarification or confirmation of the answers to the questions posed to the patient so that there is no miscommunication regarding important MR safety issues. In addition, because the patient may not be fully aware of the medical terminology used for a particular implant or device, it is imperative that this particular information on the form be discussed during the verbal interview.

After the comprehensive screening procedure is completed, any patient that

Continued on page 16

MAGNETIC RESONANCE (MR) PROCEDURE SCREENING FORM FOR PATIENTS

Date _____/_____/_____ Patient Number _____

Name _____ Age _____ Height _____ Weight _____
Last name First name Middle Initial

Date of Birth _____/_____/_____ Male ❒ Female ❒ Body Part to be Examined _____
month day year

Address _____ Telephone (home) (_____) _____-_____

City _____ Telephone (work) (_____) _____-_____

State _____ Zip Code _____

Reason for MRI and/or Symptoms _____

Referring Physician _____ Telephone (_____) _____-_____

1. Have you had prior surgery or an operation (e.g., arthroscopy, endoscopy, etc.) of any kind? ❒ No ❒ Yes
   If yes, please indicate the date and type of surgery:
   Date _____/_____/_____ Type of surgery _____
   Date _____/_____/_____ Type of surgery _____
2. Have you had a prior diagnostic imaging study or examination (MRI, CT, Ultrasound, X-ray, etc.)? ❒No ❒ Yes

If yes, please list:	Body part	Date	Facility
MRI	_____	_____/_____/_____	_____
CT/CAT Scan	_____	_____/_____/_____	_____
X-Ray	_____	_____/_____/_____	_____
Ultrasound	_____	_____/_____/_____	_____
Nuclear Medicine	_____	_____/_____/_____	_____
Other_____	_____	_____/_____/_____	_____

3. Have you experienced any problem related to a previous MRI examination or MR procedure? ❒ No ❒ Yes
   If yes, please describe: _____
4. Have you had an injury to the eye involving a metallic object or fragment (e.g., metallic slivers, shavings, foreign body, etc.)? ❒ No ❒ Yes
   If yes, please describe: _____
5. Have you ever been injured by a metallic object or foreign body (e.g., BB, bullet, shrapnel, etc.)? ❒ No ❒ Yes
   If yes, please describe: _____
6. Are you currently taking or have you recently taken any medication or drug? ❒ No ❒ Yes
   If yes, please list: _____
7. Are you allergic to any medication? ❒ No ❒ Yes
   If yes, please list: _____
8. Do you have a history of asthma, allergic reaction, respiratory disease, or reaction to a contrast medium or dye used for an MRI, CT, or X-ray examination? ❒ No ❒ Yes
9. Do you have anemia or any disease(s) that affects your blood, a history of renal (kidney) disease, or seizures? ❒ No ❒ Yes
   If yes, please describe: _____

For female patients:

10. Date of last menstrual period:_____/_____/_____ Post menopausal? ❒ No ❒ Yes
11. Are you pregnant or experiencing a late menstrual period? ❒ No ❒ Yes
12. Are you taking oral contraceptives or receiving hormonal treatment? ❒ No ❒ Yes
13. Are you taking any type of fertility medication or having fertility treatments? ❒ No ❒ Yes
    If yes, please describe: _____
14. Are you currently breastfeeding? ❒ No ❒ Yes

Figure 1.

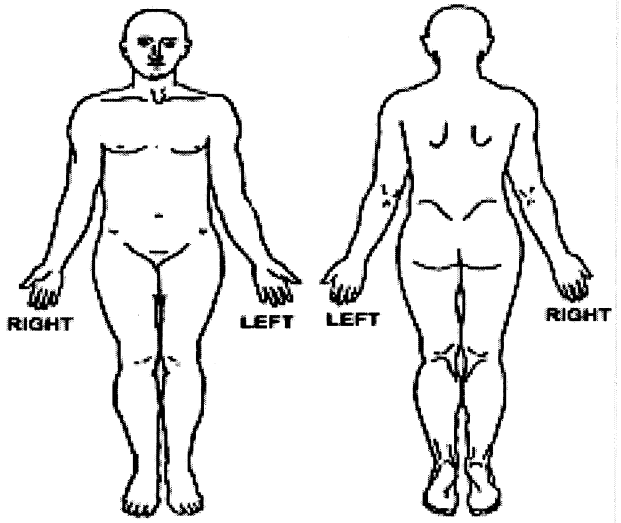
Continued on page 14

WARNING: Certain implants, devices, or objects may be hazardous to you and/or may interfere with the MR procedure (i.e., MRI, MR angiography, functional MRI, MR spectroscopy). **Do not enter** the MR system room or MR environment if you have any question or concern regarding an implant, device, or object. Consult the MRI Technologist or Radiologist BEFORE entering the MR system room. **The MR system magnet is ALWAYS on.**

Please indicate if you have any of the following:

❒ Yes ❒ No Aneurysm clip(s)
❒ Yes ❒ No Cardiac pacemaker
❒ Yes ❒ No Implanted cardioverter defibrillator (ICD)
❒ Yes ❒ No Electronic implant or device
❒ Yes ❒ No Magnetically-activated implant or device
❒ Yes ❒ No Neurostimulation system
❒ Yes ❒ No Spinal cord stimulator
❒ Yes ❒ No Internal electrodes or wires
❒ Yes ❒ No Bone growth/bone fusion stimulator
❒ Yes ❒ No Cochlear, otologic, or other ear implant
❒ Yes ❒ No Insulin or other infusion pump
❒ Yes ❒ No Implanted drug infusion device
❒ Yes ❒ No Any type of prosthesis (eye, penile, etc.)
❒ Yes ❒ No Heart valve prosthesis
❒ Yes ❒ No Eyelid spring or wire
❒ Yes ❒ No Artificial or prosthetic limb
❒ Yes ❒ No Metallic stent, filter, or coil
❒ Yes ❒ No Shunt (spinal or intraventricular)
❒ Yes ❒ No Vascular access port and/or catheter
❒ Yes ❒ No Radiation seeds or implants
❒ Yes ❒ No Swan-Ganz or thermodilution catheter
❒ Yes ❒ No Medication patch (Nicotine, Nitroglycerine)
❒ Yes ❒ No Any metallic fragment or foreign body
❒ Yes ❒ No Wire mesh implant
❒ Yes ❒ No Tissue expander (e.g., breast)
❒ Yes ❒ No Surgical staples, clips, or metallic sutures
❒ Yes ❒ No Joint replacement (hip, knee, etc.)
❒ Yes ❒ No Bone/joint pin, screw, nail, wire, plate, etc.
❒ Yes ❒ No IUD, diaphragm, or pessary
❒ Yes ❒ No Dentures or partial plates
❒ Yes ❒ No Tattoo or permanent makeup
❒ Yes ❒ No Body piercing jewelry
❒ Yes ❒ No Hearing aid
(Remove before entering MR system room)
❒ Yes ❒ No Other implant _____
❒ Yes ❒ No Breathing problem or motion disorder
❒ Yes ❒ No Claustrophobia

Please mark on the figure(s) below the location of any implant or metal inside of or on your body.



IMPORTANT INSTRUCTIONS

Before entering the MR environment or MR system room, you must remove all metallic objects including hearing aids, dentures, partial plates, keys, beeper, cell phone, eyeglasses, hair pins, barrettes, jewelry, body piercing jewelry, watch, safety pins, paperclips, money clip, credit cards, bank cards, magnetic strip cards, coins, pens, pocket knife, nail clipper, tools, clothing with metal fasteners, & clothing with metallic threads.

Please consult the MRI Technologist or Radiologist if you have any question or concern BEFORE you enter the MR system room.

NOTE: You may be advised or required to wear earplugs or other hearing protection during the MR procedure to prevent possible problems or hazards related to acoustic noise.

I attest that the above information is correct to the best of my knowledge. I read and understand the contents of this form and had the opportunity to ask questions regarding the information on this form and regarding the MR procedure that I am about to undergo.

Signature of Person Completing Form: _____ Date ____/____/____
Signature

Form Completed By: ❒ Patient ❒ Relative ❒ Nurse _____ _____
Print name Relationship to patient

Form Information Reviewed By: _____ _____
Print name Signature

❒ MRI Technologist ❒ Nurse ❒ Radiologist ❒ Other_____

MAGNETIC RESONANCE (MR) ENVIRONMENT SCREENING FORM FOR INDIVIDUALS*

The MR system has a very strong magnetic field that may be hazardous to individuals entering the MR environment or MR system room if they have certain metallic, electronic, magnetic, or mechanical implants, devices, or objects. Therefore, all individuals are required to fill out this form BEFORE entering the MR environment or MR system room. **Be advised, the MR system magnet is ALWAYS on.**

***NOTE: If you are a patient preparing to undergo an MR examination, you are required to fill out a different form.**

Date ____/____/____ (month day year) Name _____ (Last Name First Name Middle Initial) Age _____

Address _____ Telephone (home) (____) ____-____

City _____ Telephone (work) (____) ____-____

State _____ Zip Code _____

1. Have you had prior surgery or an operation (e.g., arthroscopy, endoscopy, etc.) of any kind? ❒ No ❒ Yes
   If yes, please indicate date and type of surgery: Date ____/____/____ Type of surgery_____
2. Have you had an injury to the eye involving a metallic object (e.g., metallic slivers, foreign body)? ❒ No ❒ Yes
   If yes, please describe: _____
3. Have you ever been injured by a metallic object or foreign body (e.g., BB, bullet, shrapnel, etc.)? ❒ No ❒ Yes
   If yes, please describe: _____
4. Are you pregnant or suspect that you are pregnant? ❒ No ❒ Yes

WARNING: Certain implants, devices, or objects may be hazardous to you in the MR environment or MR system room. Do not enter the MR environment or MR system room if you have any question or concern regarding an implant, device, or object.

Please indicate if you have any of the following:

❒ Yes ❒ No Aneurysm clip(s)
❒ Yes ❒ No Cardiac pacemaker
❒ Yes ❒ No Implanted cardioverter defibrillator (ICD)
❒ Yes ❒ No Electronic implant or device
❒ Yes ❒ No Magnetically-activated implant or device
❒ Yes ❒ No Neurostimulation system
❒ Yes ❒ No Spinal cord stimulator
❒ Yes ❒ No Cochlear implant or implanted hearing aid
❒ Yes ❒ No Insulin or infusion pump
❒ Yes ❒ No Implanted drug infusion device
❒ Yes ❒ No Any type of prosthesis or implant
❒ Yes ❒ No Artificial or prosthetic limb
❒ Yes ❒ No Any metallic fragment or foreign body
❒ Yes ❒ No Any external or internal metallic object
❒ Yes ❒ No Hearing aid
(Remove before entering the MR system room)
❒ Yes ❒ No Other implant_____

IMPORTANT INSTRUCTIONS

Remove all metallic objects before entering the MR environment or MR system room including hearing aids, beeper, cell phone, keys, eyeglasses, hair pins, barrettes, jewelry (including body piercing jewelry), watch, safety pins, paperclips, money clip, credit cards, bank cards, magnetic strip cards, coins, pens, pocket knife, nail clipper, steel-toed boots/shoes, and tools. Loose metallic objects are especially prohibited in the MR system room and MR environment.

Please consult the MRI Technologist or Radiologist if you have any question or concern BEFORE you enter the MR system room.

I attest that the above information is correct to the best of my knowledge. I have read and understand the entire contents of this form and have had the opportunity to ask questions regarding the information on this form.

Signature of Person Completing Form: _____ (Signature) Date ____/____/____

Form Information Reviewed By: _____ (Print name) _____ (Signature)

❒ MRI Technologist ❒ Radiologist ❒ Other _____

Figure 2.

is transferred by a stretcher, gurney, or wheelchair to the MR system room should be checked thoroughly and systematically for metal objects under the sheets or blankets such as ferromagnetic oxygen tanks, monitors, or other objects that could pose a hazard.

Magnetic Resonance (MR) Environment Screening for Individuals

Before any "non-patient" individual (e.g., MRI technologist, MR support person, patients, family member, visitor, allied health professional, physician, maintenance worker, custodial worker, fire fighter, security officer, etc.) is allowed into the MR environment, he or she must be screened by a MR-safety trained healthcare worker. Proper screening for individuals involves the use of a printed form to document the screening procedure, a review of the information on the form, and a verbal interview to verify the information on the form and to allow discussion of any question or concern that the individual may have before permitting entry to the MR environment.

In general, magnetic resonance (MR) screening forms were developed with patients in mind and, therefore, pose many questions that are inappropriate or confusing to other individuals that may need to enter the MR environment. Therefore, a screening form was recently created specifically for individuals that need to enter the MR environment and/or MR system room. This form, entitled, *Magnetic Resonance (MR) Environment Screening Form for Individuals* (Figure 2), was developed in conjunction with the Medical, Scientific, and Technology Advisory Board and the Corporate Advisory Board of the Institute for Magnetic Resonance Safety, Education, and Research (IMRSER). A "downloadable" version of this form may be obtained from the MR safety web sites, www.IMRSER.org and www.MRIsafety.com.

At the top of this form, the following statement is displayed: "The MR system has a very strong magnetic field that may be hazardous to individuals entering the MR environment or MR system room if they have certain metallic, electronic, magnetic, or mechanical implants, devices, or objects. Therefore, *all* individuals are required to fill out this form BEFORE entering the MR environment or MR system room. Be advised, the MR system magnet is ALWAYS on."

The *Magnetic Resonance (MR) Environment Screening Form for Individuals* requests general information (name, age, address, etc.) and poses important questions to determine if there are possible problems or issues that should be discussed with the individual prior to permitting entry to the MR environment. A warning statement is also provided on the form, as follows: **"WARNING:** Certain implants, devices, or objects may be hazardous to you in the MR environment or MR system room. *Do not enter* the MR environment or MR system room if you have any question or concern regarding an implant, device, or object." In addition, there is a section that lists various implants, devices, and objects to identify the presence of anything that could be hazardous to an individual in the MR environment (e.g., an aneurysm clip, cardiac pacemaker, implantable cardioverter defibrillator (ICD), electronic or magnetically activated device, metallic foreign body, etc).

Finally, there is an **Important Instructions** section on the form that states: "Remove *all* metallic objects before entering the MR environment or MR system room including hearing aids, beeper, cell phone, keys, eyeglasses, hair pins, barrettes, jewelry (including body piercing jewelry), watch, safety pins, paperclips, money clip, credit cards, bank cards, magnetic strip cards, coins, pens, pocket knife, nail clipper, steel-toed boots/shoes, and tools. Loose metallic objects are especially prohibited in the MR system room and MR environment. Please consult the MRI Technologist or Radiologist if you have any question or concern BEFORE you enter the MR system room."

The proper use of this written form along with thorough verbal screening of the individual by an MR-safety trained healthcare worker should prevent accidents and injuries in the MR environment.

Portions of this text were adapted with permission from Sawyer-Glover A, Shellock FG. Pre-Magnetic Resonance Procedure Screening, In: Magnetic Resonance Procedures: Health Effects and Safety, FG Shellock, Editor, CRC Press, LLC, Boca Raton, FL, 2001. The screening forms, Magnetic Resonance (MR) Procedure Screening Form For Patients and Magnetic Resonance (MR) Environment Screening Form for Individuals were developed in conjunction with the Medical, Scientific, and Technology Advisory Board and the Corporate Advisory Board of the Institute for Magnetic Resonance Safety, Education, and Research (IMRSER), 2002.

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2002 3rd Place Proffered Paper–
Clinical Oral Presentation

Alternative Approach to Myocardial Viability Assessment

David Stanley,[1] Thomas Foo,[1] Guang Cao,[1] Wang YI,[2] Cindy Comeau[3]
[1]Applied Science Laboratory, GE Medical Systems; [2]People's Hospital, Beijing, China; [3]Advanced Cardiovascular Imaging, New York, New York, USA.

Purpose

The ability to demonstrate viability in acute or chronic heart disease in a timely and efficient manner is critical in managing patients with heart disease. There have been substantial improvements made in development of Cardiac MRI imaging sequences that assess myocardial viability. A clinical MRI protocol consists of a left ventricular function, myocardial perfusion and myocardial viability series. Ventricular function by cardiac MRI yields important clinical information such as ejection fraction and the evaluation of wall motion abnormalities. Myocardial perfusion imaging demonstrates contrast uptake in the myocardium to evaluate filling defects that could be either ischemic or infarcted myocardial tissue (no contrast uptake). Viability imaging also know as myocardial delayed enhancement (MDE) can further demonstrate areas of the myocardium that are permanently non-viable (bright contrast signal) due to lysed cellular structures.

The purpose of this paper is to evaluate the current 2D MDE sequence used in clinical practice today versus a 3D MDE sequence comparing SNR, contrast, and acquisitions scan time.

Method

The MDE sequence is an IR prepped gated Fast Gradient Echo technique that nulls tissue due to T1 relaxation when the TI is properly selected. The current 2D technique is a single slice acquisition that requires a breath hold for each slice. However, the image contrast can be superb when proper parameters are selected, including scan delay time, and the proper dose of gadolinium contrast used. The 3D MDE acquisition employs a Variable Sampling in Time (VAST) technique and acquires the data in a single breath hold. The VAST acquisition is an interleaved view acquisition order that acquires each slice in 2 heartbeats. Thus a complete exam of 12 cardiac slices can be obtained in a 24 second breath hold, on a patient with a heart rate of 60bpm.

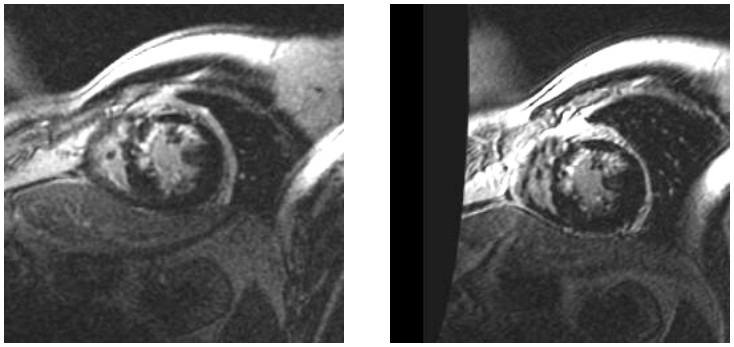

Figure 1. *The image on the left is a 2D MDE acquisition. The image on the right is a 3D MDE acquisition on the same patient. An infarct is present on the anterior/septal wall of the left ventricle.*

The 2D protocol used a TI=200 msec; 256 X160 acquisition matrix; 36-40 cm FOV; 8mm sections; TR/TE/flip= 7.2msec/3.2msec/200; 2 NEX; 24 views per segment; scan time=14 heartbeats. The 3D acquisition utilized a protocol with identical parameters except that 0.5 NEX, 12 8.0mm partitions, TR/TE / flip=4.0 msec/1.5msec/200 were used.

Eleven patients were scanned with known myocardial infarcts with the 2D MDE and 3D MDE protocol. Mean signal from the infracted area, normal myocardium were measured using both techniques. Scan times were recorded.

Results

For the eleven patients studied, the mean contrast for all of the 2D studies was 45.3± 19.5 compared to the 3D value of 81.8±36.7. The mean SNR measurement for 2D studies was 52.9±23.41, compared to 90.1±40.2 for the 3D acquisition. The variation (σ) within the contrast and SNR values was due to the variation in position of the different infarct regions in relation to the phased array coil and delay times of the acquisition after the second injection of contrast. The mean scanning time for the 2D MDE was 2 min, 7 sec. However, the mean total time, including breath hold instructions between each slice, was 6 min 57 sec. The mean total time was 22.45 seconds for the 3D MDE acquisition, following instructions to take a single breath hold.

Conclusions

The 3D MDE using the VAST technique outperformed the 2D MDE by improvements in contrast, SNR and decreased in scan acquisition times. Patients tended to tolerate the single breath hold 3D technique better than a multiple breath hold 2D technique. In cases where there was breathing artifacts on the 3D acquisition, these artifacts were also seen on the 2D acquisition. The 3D MDE VAST technique allows for increase SNR while substantially decreasing scan times.

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Onsite registration fees are $100.00 higher than advance registration fees.

Advance registration information appears in the July issue of *Radiology*. Brochures are also available from your association or from RSNA, 820 Jorie Blvd., Oak Brook, IL 60523-1860.
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Image Fusion: Techniques, Technology and Applications for Oncologic Patients from a Medical Physics Perspective
Charles Pelizzari, PhD
Jeffrey T. Yap, PhD

TUESDAY 10:30 AM – 12:00 NOON
Fusion Imaging: An Introduction to Its Clinical Uses and the Education Challenges It Presents
Robert E. Henkin, MD, FACNP, FACR
Betty G. Wilson, MEd, RT(R) (CT), RDMS

WEDNESDAY 10:30 AM – 12:00 NOON
Fusion Imaging and Issues of Reimbursement
Frances Keech, MBA, RT (N)

AAPM/RSNA Basic Physics Lecture for the Radiologic Technologist: ACR Magnetic Resonance Imaging Accreditation Program
Tuesday, 1:00 – 2:15 PM
Geoffrey D. Clarke, PhD
Michael C. Steckner, PhD, MBA

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SUNDAY RC 124
Workforce Crisis: Strategies for Management
Becky Kruse, RT(R), (ASRT) Moderator
Salvatore Martino, EdD, RT(R) (ASRT)
Lynne Roy, MBA, CNMT, FSNMTS (SNM-TS)

MONDAY RC 224
Digital Technology for Diagnostic Imaging
Elaine Dever, ACR, (CAMRT) Coordinator
A) PACS – John Landry, (ASRT)
B) Digital Radiography – Joseph Popovitch, (CAMRT)
C) Computed Radiography – Charles B. Burns, MSPH, RT(R) (ASERS)

TUESDAY RC 324
Transforming the Organization: eCommerce and its Influence on the Modern Radiology Facility
Terri Fauber, EdD, RT,(R)(M), (AERS) Moderator
Jeffrey H. Kleck, PhD, (AERS) (RBMA) (AHRA)
Kevin Tracy, (AERS) (RBMA) (AHRA)

TUESDAY RC 424
Continuity of Care
Kate Little, RN, (ARNA) Moderator
Janet Roe, BS, RDMS, RVT RT(R) (SDMS)
Carolyn K. Roth, RT, (R), (MR) (SMRT)
Debra Gordon, RN, MS (ARNA)

WEDNESDAY RC 524
HIPAA and Radiology: The Operational Impact
Kathryn J. Canny, (RBMA) Coordinator
Patricia Kroken, FACMPE, (RBMA)
Susan J. Gregg, CMPE, (RBMA)

THURSDAY RC 624
The Digital Department: Its Architecture and Design
Morris A. Stein, AIA, FACHA, (AIA-AAH), Coordinator
Bill Rostenberg, FAIA, FACHA, (AIA-AAH)
Steven C. Horii, MD, FACR, (AIA-AAH)

THURSDAY RC 724
How to Effectively Manage the Capital Asset Cycle: From Acquisition Planning to Maintenance and Replacement Strategies
Ed Mercado, MBA, CMPE, (SROA) Coordinator
Michael A. Franklin, (SROA)
Sheila M. Sferrella, MAS, RT(R), FAHRA (AHRA)

FRIDAY RC 824
The Process of Managing Outcomes
Kate Little, RN, (ARNA) Moderator
Julie Peay, RT(R), MR (SMRT)
Sue M. Smith, RT(R), (CV)(M) (AVIR)

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2002 3rd Place Proffered Paper–Research Oral Presentation

3D Virtual Reality of the Heart, Preliminary Results

A.D. Blankholm, R.T. (MR), T.S. Sørensen, M.Sc., E.M. Pedersen, M.D., Ph.D., MR Research Center, Aarhus University Hospital, Denmark.

Aim

Will it be possible to use MRI for the purpose of making a 3D virtual reality model of the heart? The 3D virtual reality would be a useful tool for making diagnosis and for pre operative planning in patients with congenital heart disease.

Method

The system used was a Philips ACS-NT 1.5 Tesla magnet with 6.2.1 software. Twelve pigs with a weight of ca. 5kg were scanned in order to find a robust sequence with high resolution and with sufficient image quality to create the 3D model. 6 patients were scanned with the abovementioned equipment and after an upgrade to Philips Intera with release 8.1 software two patients were scanned.

The cardiac synergy coil or the Neck quad. coil were used.

The sequences used were:

a) 3D BFFE (True Fisp) with ECG triggering, TR/ TE = 5.1/1.2ms, 1.3mm slice thickness, in-plane resolution: 1.6 x 1.3mm and total scan time of approximately 9 min.

b) 2D double inversion, black blood TSE sequence with ECG triggering, TR/TE = 545/25ms, 1.3mm slice thickness, in-plane resolution: 1.4 x 1.6mm and total scan time approximately 10 min.

c) 3D contrast enhanced MRA sequence was a T1 enhanced FFE (spoiled gradient echo) with TR/TE = 4.9/ 1.4ms with two dynamic scans and a total scan time of 29sec. The slice thickness was 1.0mm.

Post processing of the data was done with dedicated software.

Results

After post processing the surgeon has the possibility of viewing the images on either a stereoscopic display or on a regular monitor. The surgeon is equipped with two joysticks and is hereby given the opportunity to examine the 3D MR volume interactively The viewer can rotate the heart in any direction and open the heart and "take a walk" inside the heart and the large vessels.

In the present cases it was possible to inspect the heart, to see the chambers of the heart, septal defects, normal and abnormal vessels. (Figure 1)

Conclusion

Virtual reality images of the heart obtained with the use of MRI and MRA images show very promising results. The method is far superior to viewing the volume slice by slice, and may be the way to view cardiac MRI in the future both as still images and as cine imaging. ●

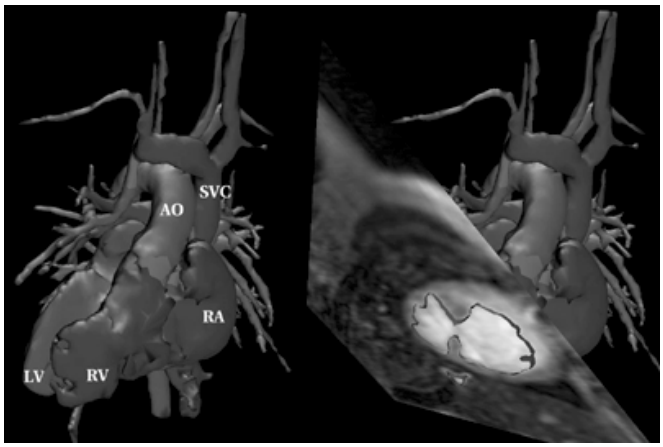

Figure 1. *Exploring a 3D virtual cardiac model (situs invertus). The reconstructed heart is seen to the left, to the right a slice through the underlying MR volume is inserted in the model. The model is seen peeking through the slice, which highlights a septal defect. Abbreviations: LV: left ventricle, RV: right ventricle, RA: right atrium, AO: aorta, and SVC: superior vena.*

Signals

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SMRT 12th Annual Meeting of the Section for Magnetic Resonance Technologists

9-11 May 2003
Metro Toronto Convention Centre
Toronto, Ontario, Canada

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Message from the Awards and Nominations Committees

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

"The ballots are out, please cast your vote!"

Postmark deadline for SMRT ballots: 2 December 2002.

IMRSER
Institute for Magnetic Resonance Safety, Education, and Research

The **Institute for Magnetic Resonance Safety, Education, and Research** (IMRSER) was formed in response to the growing need for information and research on matters pertaining to magnetic resonance (MR) safety. The IMRSER is the first independent, multidisciplinary, professional organization devoted to promoting awareness, understanding, and commun-ication of MR safety issues through education and research.

Advisory Boards

The **Medical, Scientific, and Technology Advisory Board** is comprised of recognized leaders in the field of MR including diagnostic radiologists, clinicians, research scientists, physicists, MRI technologists, MR facility managers, and other allied healthcare professionals involved in MR technology and safety.

The **Medical, Scientific, and Technology Advisory Board** for 2002-2003 consists of an esteemed group of 35 members representing academic, private, research, and institutional MR facilities utilizing MR systems operating at static magnetic field strengths ranging from 0.2-Tesla (including dedicated-extremity and interventional MR systems) to 8.0-Tesla. In addition, the Food and Drug Administration has assigned a Federal Liaison to the IMRSER.

The **Corporate Advisory Board** is comprised of representatives from the MR industry including MR system manufacturers, contrast agent pharmaceutical companies, RF coil manufacturers, MR accessory vendors, medical product manufacturers, and other related corporate organizations.

Functions and Activities

The functions and activities of the ***IMRSER*** involve development of up-to-date MR safety materials and dissemination of this information to the MR community. This is accomplished predominantly through the efforts of the Advisory Boards. Members of the Advisory Boards of the ***Institute for Magnetic Resonance Safety, Education, and Research (IMRSER)*** are charged with creating recommendations, guidelines, position papers, and educational materials pertaining to existing or emerging MR safety issues.

This is achieved by utilizing the pertinent peer-reviewed literature and by relying on each member's extensive clinical, research, or other appropriate experience. Notably, documents developed by the ***IMRSER*** consider and incorporate MR safety guidelines and recommendations created by the International Society for Magnetic Resonance in Medicine (ISMRM), the American College of Radiology (ACR), the Food and Drug Administration (FDA), the National Electrical Manufacturers Association (NEMA), the Medical Devices Agency (MDA), and the International Electrotechnical Commission (IEC).

The ***IMRSER's*** rigorous development and review process for MR safety documents ensures that authoritative and relevant information is produced in a timely manner for rapid dissemination to the MR community. This MR safety information is provided to MR healthcare professionals and others as hard copy and electronic publications.

Web Site

The web site, www.IMRSER.org, is an important resource for MR safety information, recommendations, and guidelines.

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