

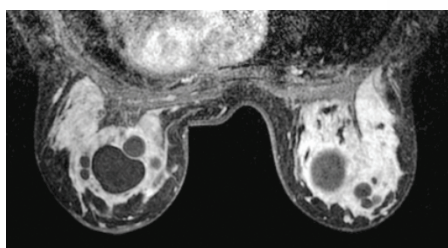
GE Healthcare

# S I G N A pulse

THE MAGAZINE OF MR • SPRING 2007

## Making Your Move into Breast MRI Simple

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Increased Diagnostic Confidence  
with 3.0T MR for Breast Imaging  
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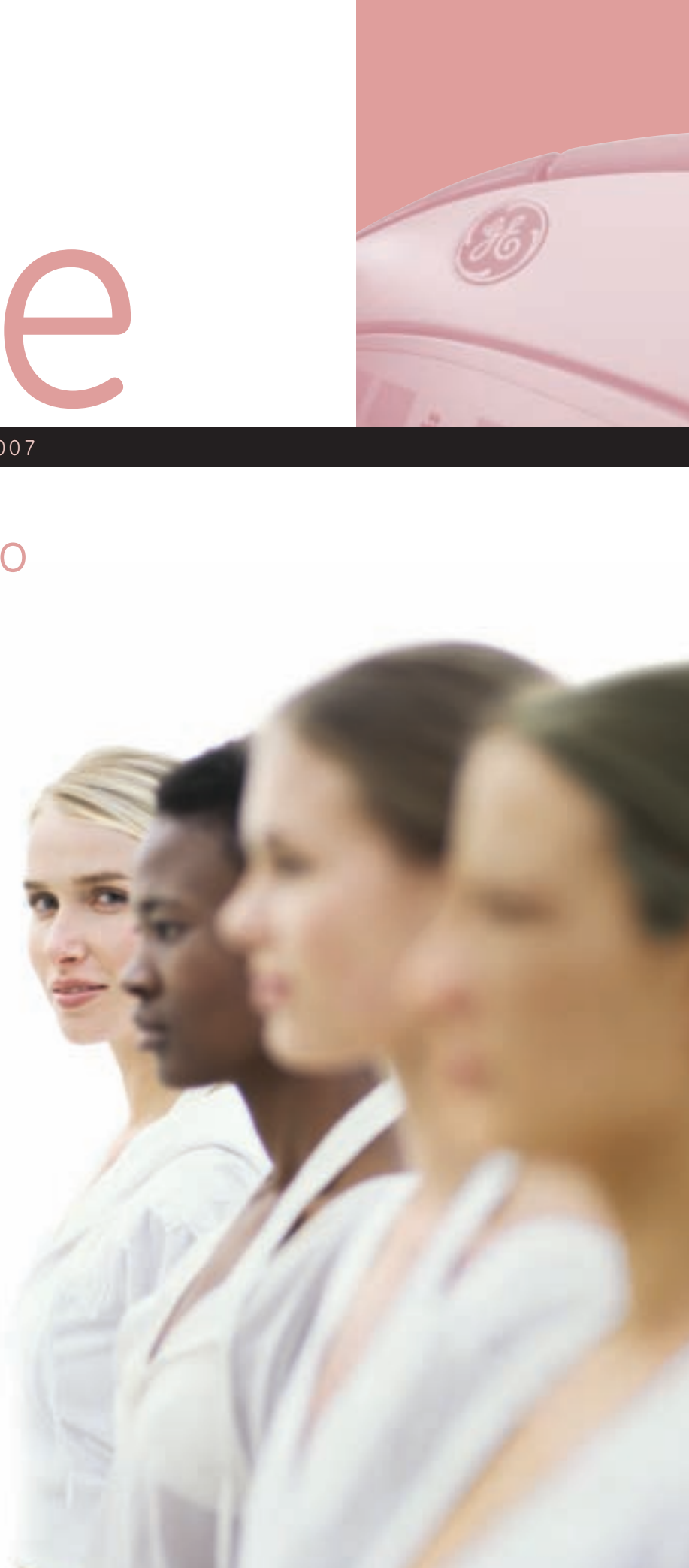
More Efficient Workflow and Accurate  
Diagnosis with Breast MRI CAD  
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imagination at work



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## Technical Innovation

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# Welcome

It is with great pleasure that I join the Global MR business as the new Vice President and General Manager. In many ways, I am returning to my technology and engineering roots – having spent the first seven years of my GE career in engineering and technology organizations.

Over the past six years, I have led several marketing and commercial organizations within GE Healthcare – the past three leading our commercial organization for Diagnostic Imaging. During this time, I have watched the MR modality advance. I have seen exciting technology introduced and new procedures emerge. In fact, as I move to MR, changes are underway that will advance MR in the area of breast imaging.

In March of this year, the American Cancer Society released new guidelines, which recommends MR for high-risk patients. This coincided with the publication of a study in the New England Journal of Medicine showing that in women who have newly diagnosed cancer in one breast, MRI can find tumors in the other breast that mammograms miss. As this news broke, The New York Times ran an article stating, “the new advice could add a million or more women a year to those who need breast magnetic resonance imaging – a demand that radiologists are not yet equipped to meet.”

It is estimated that 80% of MR sites are not equipped to perform Breast MRI today. This creates a unique opportunity to grow your practice, provide excellent patient care and stay at the forefront of this emerging procedure.





James E. Davis

While greater strides have been made in combating breast cancer, statistics remind us that the end is far from near:

- A woman's chance of developing invasive breast cancer at some point in life is 13%, or one in eight<sup>1</sup>
- 32% of all new cancer cases are of the breast, followed by lung/bronchus (12%)<sup>2</sup>
- Women with a BRCA1 or BRCA2 gene mutation have an 80% lifetime risk of developing breast cancer and at a younger age than women without the gene mutation in their cells<sup>3</sup>

There are promising signs. Incidence levels of breast cancer have leveled off; fewer women die from breast cancer (14%) than the next most-often diagnosed cancer, lung and bronchus (27%). Certainly, this is the direct result of mammography screening and continued innovation in multi-modality breast imaging.

Within this publication, Dr. Jeffrey Weinreb, Yale New Haven Hospital, cites three clinical cases where the Signa® HDx 3.0T made a difference, providing fuel for his belief that the future of breast imaging is 3.0T MR (page 12). Two patient cases submitted by Dr. Robert Lavayssiere, IRM Paris Nord, further demonstrate the potential of Breast MRI, leading to a more accurate evaluation and confident diagnosis (page 44-47).

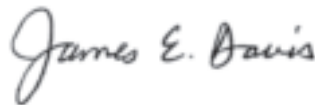
In addition, we've included a story to showcase GE's expansive portfolio of Breast MR technology (page 44), including:

- **VIBRANT™** and **VIBRANT-XV™** – the most widely adopted breast MR application in the industry
- **BREASE™** – an easy to use, breast-specific single-voxel spectroscopy tool for additional lesion characterization and assessment of early treatment response
- **HD 8-channel Breast Array** – best-in-class SNR for improved image resolution and excellent access for intervention

Plus, our partnerships with CADstream and Sentinelle enable GE to offer you the industry's only integrated breast MR CAD and dedicated detachable breast/intervention table, respectively (page 48 and 55).

This issue of *Signa PULSE* will introduce you to a new realm of MR imaging, provide a forum for sharing our customers' vision and a vehicle for providing information to promote early health. Together, we can capture the future of MR imaging today.

Enjoy,



James E. Davis  
Vice President and General Manager, Global MR Business  
GE Healthcare

#### References

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2. *ibid*
3. Society of Gynecologic Oncologists.  
Available at: [http://www.sgo.org/publications/gynecologic\\_cancer.cfm](http://www.sgo.org/publications/gynecologic_cancer.cfm)
4. American Cancer Society. Cancer Facts and Figures 2007  
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# Calendar of Events

## GE Looks Forward to Seeing You at the Following Events

Conference	Dates	Conference Center or Hotel	City and State or Province	Country	Web link
Joint Annual Meeting ISMRM-ESMRMB	May 19-25	International Congress Center	Berlin	Germany	<a href="http://www.ismrm.org/07">www.ismrm.org/07</a>
American Society of Neuroradiology (ASNR) 45th Annual Meeting & NER Foundation Symposium 2007	June 9-14	Hyatt Regency Chicago	Chicago, IL	USA	<a href="http://www.asnr.org">www.asnr.org</a>
Organization for Human Brain Mapping (OHBM) 13th Annual Meeting	June 10- 14	Sheraton Chicago Hotel & Towers	Chicago, IL	USA	<a href="http://www.humanbrainmapping.org">www.humanbrainmapping.org</a>
UK Radiological Congress 2007	June 11-13	G-MEX Centre /MICC	Manchester	Great Britain	<a href="http://www.ukrc.org.uk">www.ukrc.org.uk</a>
The American Orthopaedic Society for Sports Medicine (AOSSM)	July 12-15	Telus Convention Center	Calgary, Alberta	Canada	<a href="http://www.sportsmed.org/education">www.sportsmed.org/education</a>
Current Issues of MRI	Aug. 26-29	Grand Hyatt	San Francisco, CA	USA	<a href="http://www.stollerscourse.com">www.stollerscourse.com</a>
2007 Congress of Neurological Surgeons (CNS)	Sept. 15-20	San Diego Convention Center	San Diego, CA	USA	<a href="http://www.neurosurgeon.org">www.neurosurgeon.org</a>
19th Annual International Conference on Magnetic Resonance Angiography	Oct. 3-6	Crowne Plaza Hotel Istanbul	Istanbul	Turkey	<a href="http://www.mr-angio.org">www.mr-angio.org</a>
North American Society for Cardiac Imaging (NASCI) Annual Meeting	Oct. 4-9	JW Marriott	Washington DC	USA	<a href="http://www.nasci.org">www.nasci.org</a>
6th Annual Breast MRI in Your Facility	Oct. 11-13	Wynn Hotel	Las Vegas, NV	USA	<a href="http://radiologycme.stanford.edu">http://radiologycme.stanford.edu</a>
6th Annual Global Symposium on Clinical High Field MRI	Oct. 14-15	Wynn Hotel	Las Vegas, NV	USA	<a href="http://radiologycme.stanford.edu">http://radiologycme.stanford.edu</a>
ACR: Second Annual Body MRI Update	Oct. 13-14	The Wigwam Gold Resort & Spa	Phoenix, AZ	USA	<a href="http://www.acr.org">www.acr.org</a>
American Heart Association: 2007 Scientific Sessions	Nov. 4-7	Orange County Convention Center	Orlando, FL	USA	<a href="http://www.americanheart.org">www.americanheart.org</a>
Radiological Society of North America Scientific Assembly and Annual Meeting	Nov. 25-30	McCormick Place	Chicago, IL	USA	<a href="http://www.rsna.org">www.rsna.org</a>

# Reports from GE's MR Users Meetings

GE Healthcare is setting the stage for Signa MR users around the world to share and collaborate. As the leader in MR technology, GE's commitment transcends a typical manufacturer-user relationship. As the advantages of 3.0T make it the new standard in MR, GE sees a way to capture the imagination of each user to further advance its clinical utility.



A full house at the 3.0T users meeting at RSNA, Chicago.

## Report from 3.0T Users Meeting at RSNA

Outside the halls of McCormick Place in Chicago last November, GE hosted a Signa 3.0T MR users meeting, more than 150 GE Signa 3.0T users attended from around the world to listen to keynote speakers, share ideas and join in the excitement of 3.0T MR. Technologists, radiologists and administrators listened intently as Bryan Mock, 3.0T MR Global Product Manager, GE Healthcare, highlighted the company's roadmap for product development.

Next, users discussed their experiences. Advancing utility as 3.0T MR migrates from research to clinical practice remains the resounding theme. Tonsok Kim, M.D., Department of Radiology, Osaka University, Graduate School of Medicine, opened the evening with a presentation on abdominal imaging. Dr. Kim shared images that clearly demonstrated the ability of 3.0T MR to provide improved image quality and multi phasic imaging of the liver, kidneys, renals and peripheral arteries. "3.0T MRI will improve abdominal imaging by faster and higher-resolution imaging with a larger reduction factor for parallel imaging," he concluded.

Bruno Kastler, M.D., Professor and Chief of Radiology, University Hospital of Besancon showed examples of his experience with 3.0T cardiac imaging. He explained the benefits of this technology to his practice and has been very pleased with Signa 3.0T MRI.

Patrick Turski, M.D., Neuroradiologist, Department of Radiology, the University of Wisconsin-Madison Hospitals and Clinics, gave his perspective on the importance for expanding 3D image acquisition at 3.0T. He discussed collaborative research with GE on 3D sequences conducted at the University of Wisconsin and further noted specific advantages inherent with 3.0T MR.

GE's advanced applications team was on-hand to answer questions and demonstrate techniques to maximize the power of 3.0T. Attendees were given the opportunity to sign up for a Signa 3.0T MR web community organized by GE for the purpose of providing an online tool for 3.0T users to communicate and share information to improve their practice. Already, a majority of the users signed up as initial members.



Attendees of UK's 3.0T user meeting

### Report from the UK's 3.0T Users Meeting

In mid-February 2007, GE organized the second European MR 3.0T users meeting, hosted by Prof. Gary Green, Director of the Neuroimaging Centre of the University of York. More than 40 Signa 3.0T users attended from 12 European countries to share ideas and facilitate continuous communication. This intensive two-day meeting was primarily focused on neuro applications with a secondary focus on abdominal imaging.

The meeting was very interactive with clinical and technical presentations and group workouts for sharing best practices and discussing ideas for future product advancements.

Dr. Green's closing remarks reminded attendees of the importance of user meetings as an educational symposium. "I've learned a lot and have gained more confidence by my association with (GE's Signa 3.0T users)."

### Report from Japan's Users Meetings

Over the last three years, GE Yokogawa has sponsored more than 117 user meetings attended by more than 3,000 MR technologists. In fiscal year 2006, 52 local meetings were held; each one planned by a user focused on a specific technique or application.

The format of each meeting is geared toward sharing ideas and techniques. Through this forum, GE provides insight into product development, the host user presents their selected topic or technique and attendees review the images and discuss. These half-day meetings are similar to an online community forum, yet more interactive.



Signa Koshien 2006 Winners (left to right): Bronze – Junpei Suzuki;  
Gold – Hitoshi Usuniwa; Silver – Kenya Sato.

At the end of each year, a one-day “championship” meeting is held – the Signa Koshien meeting. Named after Japan’s high school baseball championship event, nine representatives from seven geographic regions compete in the areas of image quality, imagination/creativity and clinical utility/implementation. Twenty-six judges – users – evaluate each 10 minute presentation based on these criteria to select the top three customer presentations.

In December 2006, users attended the 2006 Signa Koshien in the Toshi Center Hotel in Tokyo. Winners of 2006 Signa Koshien awards are:

1. Gold: Hitoshi Usuniwa, RT, Kita Ibaragi Municipal General Hospital: MR Liver Dynamic Scan by using Smart Step
2. Silver: Kenya Sato, RT, Aomori Prefecture Central Hospital: Improvement of Signal Loss on MOTSA-TOF Head MR Angiography
3. Bronze: Junpei Suzuki RT, Sapporo Medical University Hospital: The Advantages of 3D-SPGR for Detecting Brain Meta

### Join GE’s Signa MR Users

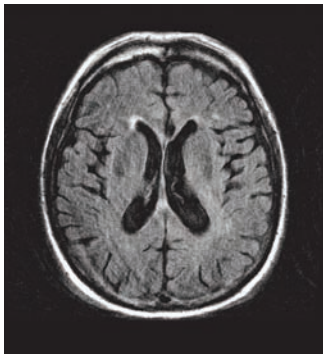
Today, GE’s Signa MR users are active around the world, and the interchange is helping to define future directions of MR.

We look forward to bringing you additional user meeting reports in upcoming issues of *Signa PULSE* magazine. ■

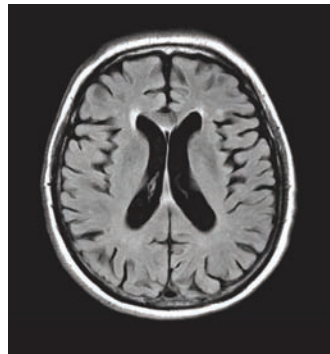
To join GE’s Signa MR users meetings, make sure to complete and return the business reply card found in this issue.

## Propel Neuro Images into a Motionless State

GE Healthcare's Signa® HD system with PROPELLER HD™ technology is the world's first high definition magnetic resonance (MR) system that provides physicians with outstanding image clarity in cases where patients are difficult to image due to movement. These cases include Parkinson's patients who suffer from uncontrollable tremors and restless children who do not respond to sedation.



Without PROPELLER HD



With PROPELLER HD

PROPELLER continues to lead the market with installations – more than 1,700 customers are currently using the application. GE's third generation of the technology, PROPELLER HD, is revolutionizing neurology by effectively "freezing" patient motion. This helps facilitate clear, high-definition, diagnostic-quality images in even the most active patients under the

most challenging circumstances. PROPELLER HD optimizes image resolution, signal-to-noise ratio and tissue contrast without prolonging scan time.

"We have been nothing short of amazed at the motion reduction ability of the PROPELLER sequence," said Emanuel Kanal, Director of Magnetic Resonance Services, University of Pittsburgh Medical Center (UPMC). "Our patients move around a little or a great deal in ways that are not predictable. Everyday in our clinical caseload, as a matter of routine, we see MR images degraded mildly or substantially because of patient motion."

Motion artifacts in brain scanning are a chronic problem. In fact:

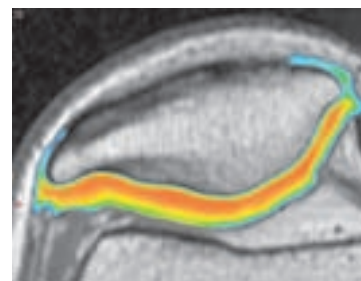
- Approximately four in every 10 brain scans show some type of motion artifact.
- Approximately one in 10 have to be rescanned.
- One in six pediatric patients don't respond adequately to sedation. One in 14 don't respond at all.

PROPELLER HD is available as a new option or upgrade on any Signa HD and HDx 1.5T or 3.0T MR system. ■

## Assess Articular Cartilage Integrity Non-invasively

As an optional application available on the GE Signa® HDx platform, CartiGram™ is a non-invasive imaging method that allows clinicians to visualize collagen fiber degradation to assess articular cartilage integrity. When collagen breaks down, there is increased mobility of water in the cartilage and therefore a prolongation in T2 relaxation times. CartiGram automatically generates color-maps based on a scale of T2 values. The color-map is a tool that allows physicians to see changes in the composition of articular cartilage in some cases before changes in the thickness can be seen.

"CartiGram is an extremely powerful diagnostic tool to non-invasively assess articular cartilage integrity," said Hollis G. Potter, MD, Chief of Magnetic Resonance Imaging, Hospital for Special Surgery. "The quantitative T2 mapping



has allowed us to discern cartilage breakdown prior to alteration in cartilage thickness."

CartiGram is primarily used to detect changes in cartilage composition at earlier stages, often

times resulting in more treatment options for the patient. The ability to non-invasively monitor the progression of changes in cartilage composition helps to optimize the timing of surgical procedures and assess the response to surgical intervention. ■



## Turning the Tables on Breast Imaging

GE Healthcare and Sentinelle Medical Inc. are working together to further advance breast magnetic resonance (MR) with the Vanguard™ system, a dedicated breast imaging and intervention patient table for use with GE Healthcare's Signa® HDx 1.5T MR scanners. Developed and sold by Sentinelle Medical, Inc. (Ontario, Canada), Vanguard can help achieve exemplary image quality, improved access to tissue for intervention and a high level of comfort for patients. The

open architecture design provides complete medial and lateral access to the breast, enabling unimpeded imaging and intervention. Additional access to the breast in the anterior direction enables breast positioning similar to stereotactic mammography.

As a diagnostic tool, Vanguard is suitable for a wide range of indications in breast disease management including, but not limited to:

- Detection of breast lesions
- Evaluation of treatment response
- Surveillance of high-risk patients

GE Healthcare is the only MR manufacturer with a detachable patient table design and Liberty™ docking system, making this advancement in Breast MRI available exclusively on the GE Signa. The detachable table design gives Signa customers exclusive access to this exciting new technology that both Sentinelle Medical and GE Healthcare believe will further advance breast MR imaging and intervention. (For the rest of the story, see page 55.) ■

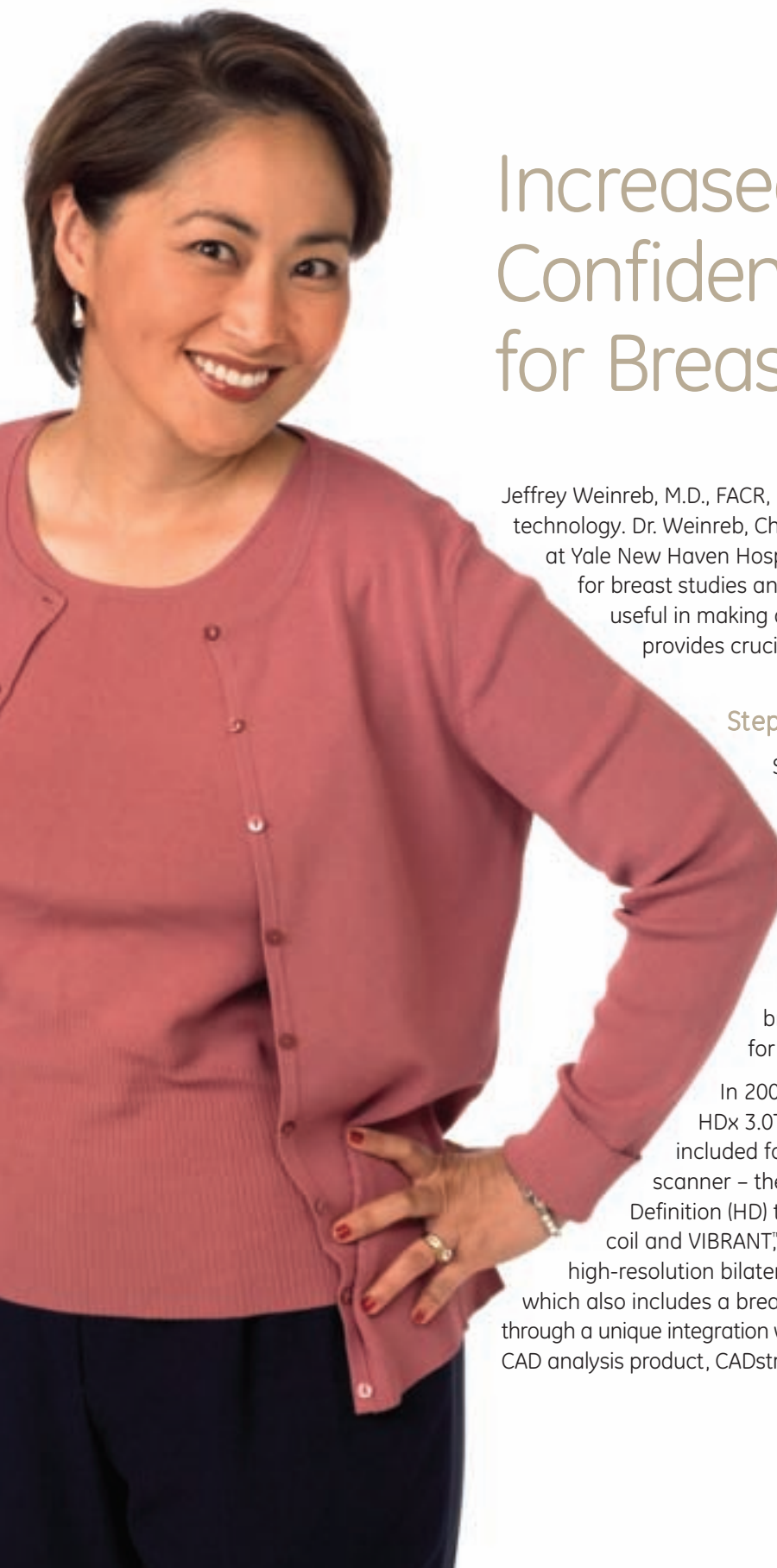
## Non-invasive Uterine Fibroid Treatment Gets FDA Nod for 3.0T

In late February, the U.S. Food and Drug Administration (FDA) approved the use of InSightec's ExAblate® 2000 incisionless surgery system for uterine fibroids with GE Healthcare's Signa® HD 3.0T Magnetic Resonance Imaging (MRI) systems, based on studies conducted at University of California at San Diego (UCSD), Weill Cornell Medical Center and KNI Imaging. ExAblate 2000, which combines Magnetic Resonance Imaging with focused ultrasound waves (MRgFUS) to non-invasively destroy tumors, was previously approved for use with Signa HD 1.5T systems in October 2004.

"This new approval allows physicians the freedom to use ExAblate with either a 1.5T or 3.0T MRI scanner, allowing busy MRI centers greater flexibility in scheduling use of their systems and allowing women greater access to this non-

invasive procedure to destroy their symptomatic uterine fibroids," said William G. Bradley, Jr., M.D., Ph.D., FACR, Chairman of the University of California at San Diego's Department of Radiology and a Professor of Radiology at UCSD School of Medicine. "The 3.0T system also provides a higher level of anatomical detail."

ExAblate 2000 with GE's Signa HD MR is the only MRgFUS system approved by the FDA as a non-invasive, outpatient procedure to treat symptomatic uterine fibroids. Over 2,500 women with the condition have been treated worldwide. ■



# Increased Diagnostic Confidence with 3.0T MR for Breast Imaging

Jeffrey Weinreb, M.D., FACR, believes the future of Breast MRI belongs to 3.0T MR technology. Dr. Weinreb, Chief of MRI and Director of Medical Imaging Services at Yale New Haven Hospital, uses the GE Signa® HDx 3.0T system extensively for breast studies and finds that it sometimes provides information that is useful in making a diagnosis. In some cases, its higher spatial resolution provides crucial information that is not attainable at 1.5T.

## Stepping Up to 3.0T

Since the early 1990s, Dr. Weinreb has collaborated with mammographers and pathologists on diagnoses. He regards MR as a valuable complement to mammography screening and ultrasound examinations that can reveal areas of suspicion.

"We use MR for women who are at high risk because they have a genetic predisposition or a strong family history of breast cancer, have had breast cancer before or received radiation treatment for Hodgkin's disease," said Dr. Weinreb.

In 2005, Yale New Haven Hospital installed the GE Signa HDx 3.0T MR system, adding to a department that already included four Signa 1.5T MR systems. The Signa HDx 3.0T scanner – the latest in MR technology – is equipped with High Definition (HD) technology, such as the GE HD 8-channel breast coil and VIBRANT™, an exclusive GE application that enables fast, high-resolution bilateral breast imaging. GE's complete Breast MRI solution, which also includes a breast-specific spectroscopy application, BREASE™, and through a unique integration with Confirma™, Inc.'s (Kirkland, WA) industry-leading CAD analysis product, CADstream™, is unmatched in the industry.

Bilateral imaging saves patients the inconvenience of having two separate Breast MRI exams. For clinicians, it eliminates the need to choose between scanning for structural detail and scanning rapidly for uptake information. It provides rapid imaging without compromising in-plane resolution. VIBRANT also allows the choice of direct sagittal or axial imaging and automatically optimizes parameters, making it easy for technologists to deliver consistent image quality. Specifically, a strength of VIBRANT is a unique bilateral shim method, which results in homogenous fat suppression over both breasts.

"Having worked in Breast MRI using 1.5T scanners for about 15 years, I had a good idea what the capabilities and limitations were," Dr. Weinreb explained. "With the added signal and other capabilities of 3.0T, I believed we could move Breast MRI to a higher level. We have translated the higher signal strength of 3.0T into higher spatial resolution, which enables us to see finer detail in the images.

"I can't say it increases diagnostic confidence on every single case. But we certainly have had cases where at 1.5T we were not quite sure what we were dealing with, and 3.0T definitely gave us additional confidence."

### Seeing Both Sides in One Exam

Dr. Weinreb prefers bilateral breast studies and finds the VIBRANT application extremely helpful. "In the past, bilateral exams were technically challenging, because it was difficult to get uniform fat suppression over both breasts," he said. With VIBRANT and bilateral shimming, it is no longer a challenge to achieve uniform fat suppression. This has tremendous value versus other breast MR imaging applications in the industry.

VIBRANT is a 3D, fat-suppressed, T1-weighted technique used for dynamic scans. "With VIBRANT, we can get good, uniform fat suppression across the entire field of view," Dr. Weinreb added. "There are two benefits of a bilateral exam. First, we can find suspicious areas in the other breast that were totally unsuspected. Second, we can compare the breasts. Symmetry is very important. We might see something in one breast that looks suspicious, but if we see exactly the same thing in the other breast, our suspicion drops significantly."

The typical protocol for 3.0T breast studies is to perform a T2-weighted, fat-suppressed scan in the sagittal or axial plane, then a series of T1-weighted non-fat-suppressed images. "We do that because, very commonly, there are little enhancing nodules in the breast," Dr. Weinreb explained. "They can enhance very intensely, and we don't know if they're benign or malignant. With the non-fat-suppressed T1-weighted images, if we see bright fat in that nodule, we know it's an intra mammary lymph node and we don't have to worry about it. That has prevented us from recommending unnecessary biopsy in a lot of patients.

"With VIBRANT, we can get good, uniform fat suppression across the entire field of view."

*Dr. Jeffrey Weinreb*



Jeffrey Weinreb, M.D., FACR

Jeffrey C. Weinreb, M.D., FACR, is Professor of Diagnostic Radiology at Yale University School of Medicine and Director of Medical Imaging, Chief of Body Imaging and Chief of Magnetic Resonance Imaging (MRI) at Yale-New Haven Hospital (New Haven, CT). He is a fellow of the American College of Radiology (ACR) and the International Society of Magnetic Resonance in Medicine, President of the Society of Computed Tomography/MR, Vice President of the ACR, and has held various editorial positions for radiology and MRI journals.

Dr. Weinreb specializes in Body MRI and CT with research interests for MR imaging in liver, breast, and prostate. After graduating from the Massachusetts Institute of Technology, he received his medical degree from the Mount Sinai School of Medicine. He completed his postdoctoral training in radiology at Long Island Jewish Medical Center and received fellowship training at the Hospital of the University of Pennsylvania.

### About Yale-New Haven Hospital, New Haven, CT

Yale-New Haven Hospital (YNHH) is a 944-bed tertiary referral center, which includes the 201-bed Yale-New Haven Children's Hospital and the 76-bed Yale-New Haven Psychiatric Hospital. The primary teaching hospital for Yale University School of Medicine (YSM), Yale-New Haven's medical staff is enhanced by 471 supervised house staff physicians (residents) who add around-the-clock coverage and sharp inquisitive minds to patient care.

“We have been performing the bilateral VIBRANT exams in the axial plane which allows us to achieve even higher spatial resolution and facilitates comparisons of the breasts.”

*Dr. Jeffrey Weinreb*

“Our real workhorse sequence is VIBRANT. It’s a fat-suppressed 3D scan, and we do it with a temporal resolution of less than two minutes. Although, with 3.0T technology and higher acceleration factors, we have the flexibility to select temporal resolution as low as 30 seconds while maintaining adequate image quality. However, based on published literature, we favor higher spatial resolution to achieve greater specificity. In our current protocol, we acquire a true isotropic voxel of 1mm, meaning there is no interpolation, with a temporal resolution of 90 seconds. For the dynamic scan, we generate datasets prior to and three times after uptake. We used to do this in the sagittal plane, followed by a delayed high resolution axial scan with VIBRANT. More recently, we have been performing the bilateral VIBRANT exams in the axial plane which allows us to achieve even higher spatial resolution and facilitates comparisons of the breasts.”

An automatic subtraction feature provides a valuable aid to diagnosis: It makes it easier to identify subtle or small areas of enhancement. “The first thing we look at is the first set of subtracted images,” Dr. Weinreb said. “Then we go back to the other images just to validate what is enhancing, and also to look at other characteristics.”

## Cases in Point

Dr. Weinreb cites three cases in which the GE Signa HDx 3.0T made a difference in diagnosis.

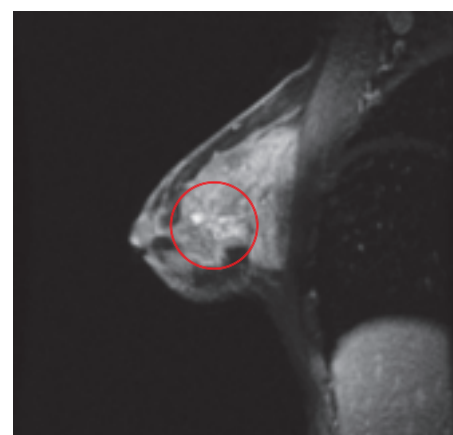
### Case 1

#### Non-mass Enhancement: Comparison 3.0T/1.5T

A 54-year-old patient whose mammogram showed a focal asymmetric density was imaged at 1.5T. The images (right) showed a small, slightly irregular enhancing mass, and posterior to that an abnormal area of non-mass enhancement. “The findings were non-specific,” Dr. Weinreb noted. A follow-up 3.0T scan using VIBRANT, six months later, shows clustered ring enhancement, a finding that is highly suggestive of DCIS.



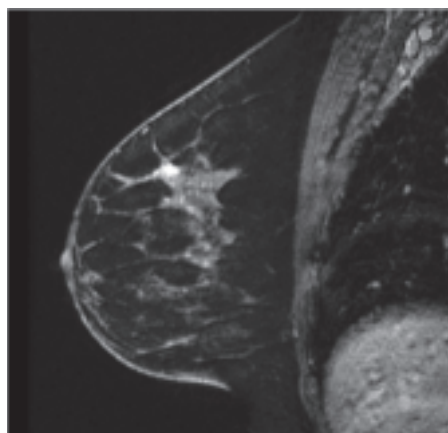
3.0T  
2.0mm sl th  
256 x 256 FOV 18  
Voxel 2.0 x .7 x .7



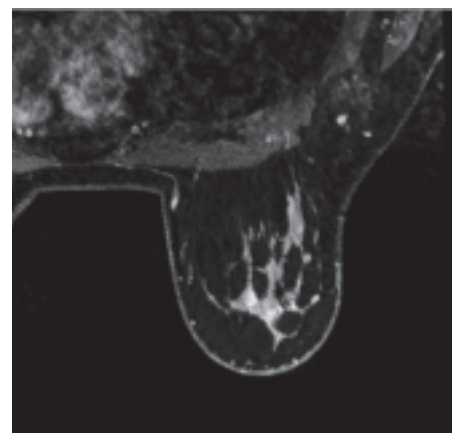
1.5T  
3mm sl th  
256 x 160 FOV 18  
Voxel 3 x 1.1 x .7

**Case 2****Benign Fibroadenoma: Comparison 3.0T/1.5T**

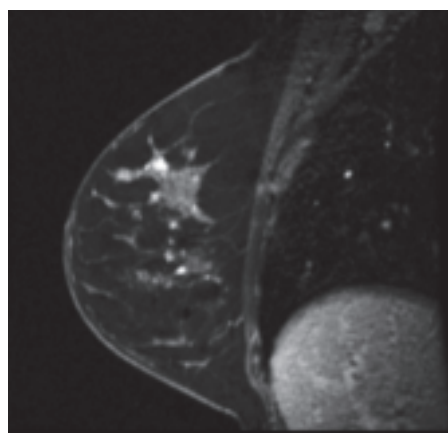
An MR study was performed for a 42-year-old patient who had a mastectomy on the left side for breast cancer and so was at high risk for the disease. Images from an exam at 1.5T show a bright area of enhancement that cannot be clearly evaluated. Dynamic images from a 3.0T scan using VIBRANT with higher spatial resolution show that the growth has smooth lobulated margins and an internal non-enhancing septation, a finding highly suggestive of benign fibroadenoma.



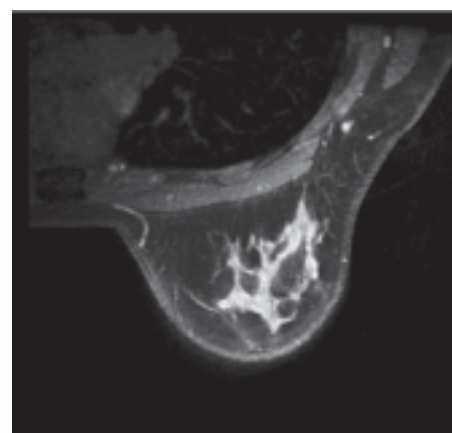
3.0T



1.0mm sl th



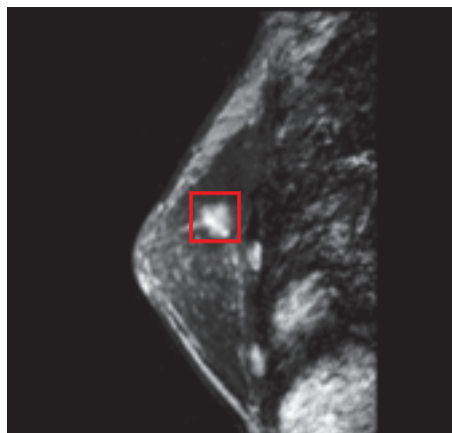
1.5T



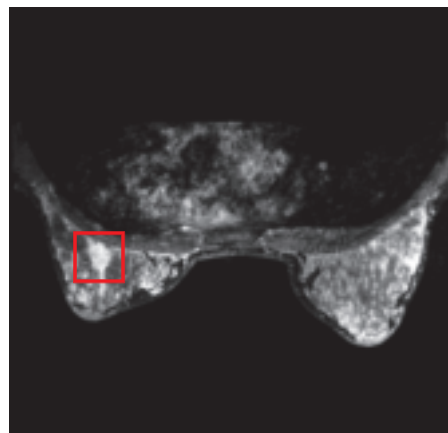
1.5mm sl th

**Case 3****DCIS: 3.0T BREASE Exam Showing a Choline Peak**

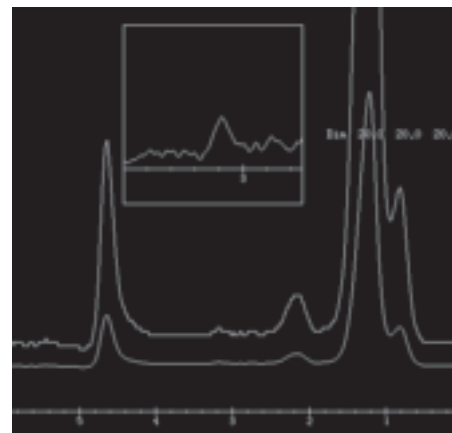
BREASE is a breast-specific spectroscopy application that is designed to enhance diagnostic confidence. It is a proton spectroscopy application optimized specifically for the breast that uses a signal detection technique to show elevated concentrations of choline. BREASE is a TE-averaged, PRESS spectroscopy acquisition compatible with a 4-, 7-, or 8-channel breast coil. ■



Sagittal VIBRANT



Axial VIBRANT



BREASE  
Spectrum Showing a Choline Peak  
Voxel 20mm x 20mm x 20mm  
Scantime: Approx. 5 min.

# Phase Contrast Flow Accuracy

By S. Gay Luebchow, RT (R)(MR) Advanced Cardiac Applications, GE Healthcare and  
Cindy R. Comeau, BS, RT (N)(MR), Advanced Cardiovascular Imaging, New York, NY

MRI offers unique advantages as an accurate, reproducible, and non-invasive modality for the quantification of flow. At Advanced Cardiovascular Imaging (New York, NY) cardiac gated phase contrast sequences are acquired on a GE Signa® 1.5T and the data is analyzed utilizing ReportCARD™ 3.0 (GE Healthcare), resulting in flow direction, volume, and velocity information.

However, as is typical with MRI, flow results are often compromised due to inhomogeneities found in the magnetic field environment, called short term eddy currents. Present in all magnet field environments, these phase offset errors are a common challenge. Even relatively small velocity offsets can have a large effect on flow results; therefore, it is imperative to correctly compensate for the inherent phase-offset errors to provide accurate flow measurements for clinical diagnosis. These errors can potentially overestimate or underestimate flow.

Using a Venc of 200 cm/s for example:

**Venc 200 cm/s**

**1% Velocity Error = 2 cm/s**

**For a 10 cm<sup>2</sup> vessel:**

**Flow Error = 2\*10 = 20 ml/beat**

**For a patient with an 80 ml stroke volume,  
this represents a 25% error in flow.**

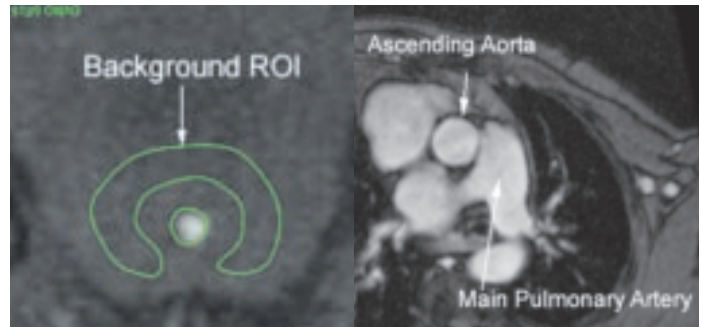
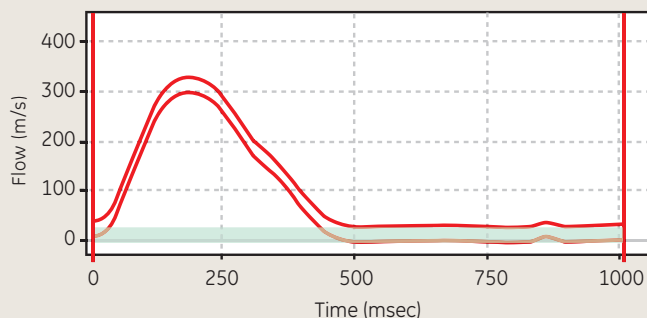


Figure 1

Figure 2

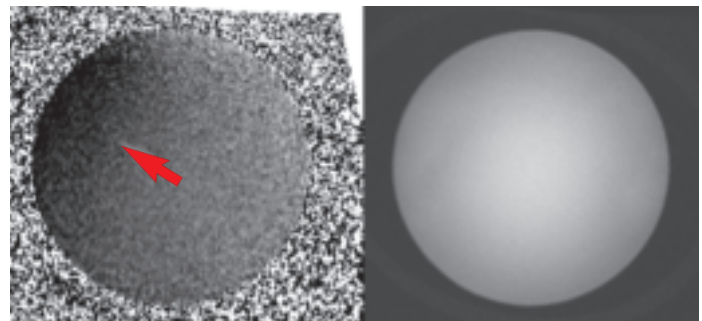


Figure 3a

Figure 3b

To compensate, it is necessary to place an additional background region of interest (ROI) in an area on the image. It is recommended to place the background ROI in stationary tissue that is located as close to the original ROI as possible. This is easily performed when analyzing cerebrospinal fluid (CSF) flow data, as the surrounding brain tissue is stationary (Figure 1).

Flow analysis in areas of the heart and chest are more challenging since there is no stationary tissue located near the vessels to be analyzed. The most commonly measured flow areas in the chest are within the ascending aorta and the main pulmonary artery, both of which are located centrally in the chest (Figure 2). Using stationary tissue in either the spine or shoulder as a zero baseline is not recommended. ROIs placed in these regions have differing phase offsets compared to the vessel that is being analyzed.

ReportCARD 3.0 automatically adjusts final flow results eliminating phase-offset errors caused by the eddy currents.

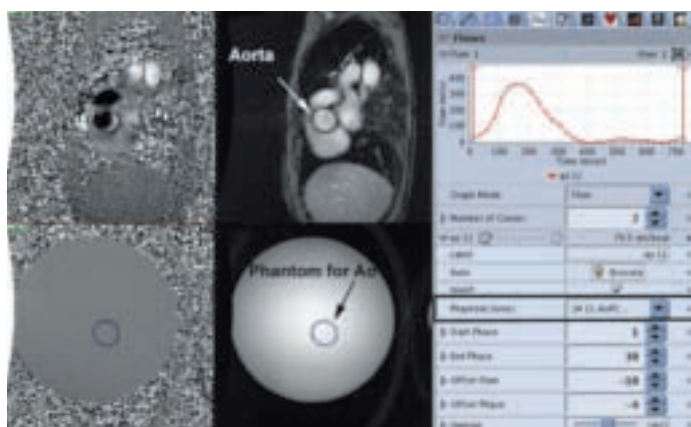


Figure 4

By adjusting the window/level in a phase contrast image from a stationary phantom acquisition (Figures 3a and 3b), the black pixels (red arrow) show the phase error due to eddy currents. Since there is no real flow in the field of view, the measured flow is the phase-offset error result. Phase offset error seen on a phantom may be missed if the background correction ROI is located in the area of shoulder or muscle tissue.

Phantom images are acquired to provide zero flow baseline measurements. ReportCARD 3.0 automatically adjusts final flow results by this factor, eliminating phase-offset errors caused by the eddy currents.

ReportCARD 3.0 quantifies flow volume (milliliter per beat) and velocity (centimeter per second) of blood or CSF. To obtain these values, a ROI is placed surrounding the vessel of interest and clicking "Execute" to generate a flow curve. Selecting the "Phantom Series" option from the flow tab will automatically propagate this ROI to all phases of the cardiac cycle on the phantom acquisition. The phase-offset error is automatically calculated and applied to the original flow curve (Figure 4). ReportCARD checks for the same scan plane position and velocity encoding (VENC) prior to applying this correction. Further details on the workflow for performing the phantom acquisition can be found in the ReportCARD 3.0 operator manual. ReportCARD 3.0 flow analysis also generates Pixel-Wise Velocity Curves, Peak Absolute Velocity, and Peak Velocity Envelope information. Other valuable software features include Flow Summary and Velocity Tables all of which can be printed in the report.

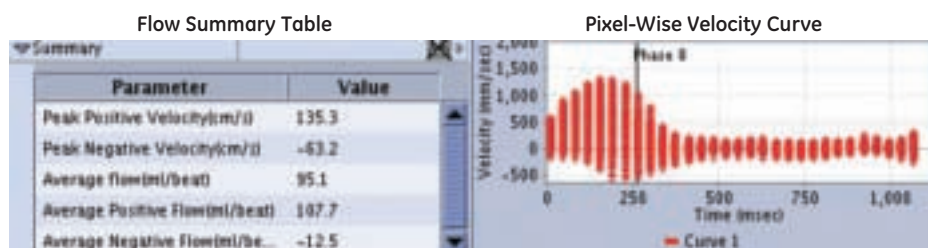


Figure 5

## Conclusion

By automatically calculating the phase offset error from a phantom acquisition, ReportCARD flow analysis improves the accuracy of reporting flow in clinical cardiac MRI patient exams. ■



S. Gay Luebchow, RT

S. Gay Luebchow, RT (MR), is an Advanced MR Cardiovascular Applications Specialist for GE Healthcare, dedicated to training 1.5T and 3.0T users on cardiovascular MRI. Previously Gay was an MR Field Applications specialist for 4 years based in the SE sector of the USA. She has extensive cardiac MR experience with years of clinical experience as an MRI technologist at Wake Forest University Baptist Medical Center, North Carolina. Gay has assisted in the development of cardiovascular training programs, and has globally trained physicians, applications specialist and technologists in the area of cardiovascular MRI.



Cindy R. Comeau, BS, RT

Cindy R. Comeau BS, RT (N)(MR), is the Chief Technologist at Advanced Cardiovascular Imaging, New York, NY. With extensive clinical cardiovascular MRI experience she has published training material, book chapters, authored publications, abstracts and has given numerous presentations at educational meetings for both MRI technologists and physicians. Cindy is an active member of the Society for Magnetic Resonance Technologists (SMRT) and currently serves as the 2006-2007 SMRT President.

# 3.0T: A Vascular Powerhouse

## Edison Imaging Finds Major Advantages in Vascular and Neurological Imaging with a 3.0T MRI Scanner

In 1989, the Edison Radiology Group opened Edison Imaging Associates (Edison, NJ) to offer the best available diagnostic imaging services to patients and referring physicians. Today, Edison Imaging is a full-service outpatient center offering MRI, 64-channel CT, nuclear medicine, ultrasound, mammography and a wide range of specialized diagnostic exams.

The MRI equipment at Edison Imaging includes a GE Signa® 3.0T system with advanced imaging applications that include TRICKS™ time-resolved imaging for angiography studies. “We chose a 3.0T system for two distinct reasons,” said Lawrence N. Tanenbaum, M.D., Section Chief of MR, CT and Neuroradiology at Edison Imaging and Solaris Health Systems. “First, we sought to maintain our status as a center of excellence and quality practice, and we saw 3.0T MRI as providing a significant boost in quality over 1.5T for virtually all applications.

“Second, since we are affiliated with NJ Neuroscience Institute, we have ample opportunity to make use of unique imaging benefits provided by 3.0T for neurosurgery, neurology and neuro-oncology.”

### Excellent Vascular Images

Edison Imaging performs about 65 percent vascular and neurological studies, 25 percent musculoskeletal exams and 10 percent body studies. Dr. Tanenbaum crafts all the MR exam protocols and takes part in scanning on some challenging cases.

Among key benefits of GE Signa technology, Dr. Tanenbaum cites, “very powerful gradients that deliver the shortest TR and TE, superb 8-plus-channel surface coils that synergize with the inherently higher signal-to-noise ratio of 3.0T and enhanced parallel imaging capability to deliver superb whole body imaging studies.”

“TRICKS provides better spatial resolution than we would be able to obtain with a time-resolved approach by creatively oversampling the center of K-space.”

*Dr. Lawrence Tanenbaum*

Edison Imaging also has been able to consistently deliver spectacular time-resolved imaging, or single-phase high-definition imaging, depending on the clinical need. "The Signa 3.0T MR is really a vascular powerhouse," Dr. Tanenbaum added.

Many vascular surgeons prefer MRA to other modalities for studies such as lower extremity vascular runoff exams. Dr. Tanenbaum noted, "Time resolved MRA offers significant benefits in diabetic patients where dynamic information – collateral flow and retrograde flow – is important and we expect calcifications in smaller blood vessels below the knees." For these patients and other angiography studies, Dr. Tanenbaum uses TRICKS time-resolved imaging, an advanced GE application. All MRA studies are complete within a standard 30-minute exam slot.



Subclavian stenosis

### Exquisite Image Quality

Dr. Tanenbaum cites the case of a patient with decreased upper-extremity blood pressure on the left side. "We needed an MRA to evaluate for any stenosis of the blood vessels going to that limb.

Instead of doing a single high-resolution pass, we chose to do a time-resolved exam with TRICKS. Time-resolved imaging brings two distinct benefits. One, it removes the variability from the acquisition process. Since we get multiple snapshots, we are not likely to miss the ideal enhanced contrast phase.

Second, we get the same physiologic information that we would traditionally get from conventional angiography in the way the contrast arrives, distributes in the target vessels and departs. That can help in determining the significance of a stenotic lesion."

This particular exam gives Edison Imaging not only exquisite image quality but also very high spatial resolution. "TRICKS provides better spatial resolution than we would be able to obtain with a time-resolved approach by creatively oversampling the center of K-space. The study combined the benefits of parallel imaging with the four-time acceleration that comes from TRICKS to give us eight times the temporal resolution that we would ordinarily get for this degree of spatial resolution and coverage." ■



Lawrence N. Tanenbaum, M.D., FACR

Lawrence N. Tanenbaum, M.D., is Chief of MR, CT and Neuroradiology at Edison Imaging and Solaris Health Systems. For over 30 years, the radiologists of Edison Imaging Associates have led the way in providing the medical communities of central New Jersey with a full range of imaging services, utilizing the latest, most advanced technologies, including GE's Signa HDx 3.0T and 1.5T MR scanners.

*"The Signa 3.0T MR is really a vascular powerhouse."*

*Dr. Lawrence Tanenbaum*

# Imaging at 3.0T

## University of Wisconsin Sees Key Benefits for Cardiac and Angiography Applications

Scott Reeder, M.D., Ph.D., and Division Chief of MRI at the University of Wisconsin-Madison Hospital and Clinics, sees clear advantages for 3.0T MR imaging in a wide range of clinical studies. As a specialist in cardiac imaging and MR angiography (MRA), Dr. Reeder sees improvement over 1.5T imaging in procedures such as cardiac studies, renal artery angiography and peripheral vascular studies.

### Stepping Up to 3.0T

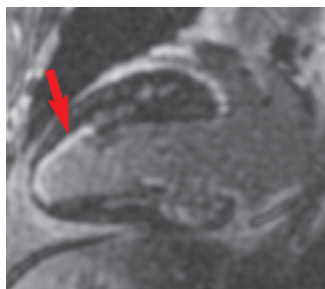
The hospital acquired a GE Signa® 3.0T MR scanner in January 2005 and uses it extensively for MRA and cardiac studies. Dr. Reeder and his colleagues found an easy transition to 3.0T imaging from GE Signa 1.5T systems. "If you know how to use one magnet, you can use the other quite easily," he said. "The interfaces are identical."

Certain MR studies are essential to cardiologists and cardiac surgeons evaluating whether to perform revascularization surgery. "Before opening someone's chest, they need to know if what they're about to do will help the patient or not, and MR can do that," Dr. Reeder said. "With the knowledge we gain from a high-quality MR scan, we can completely change the management of revascularization in patients with ischemic heart disease."

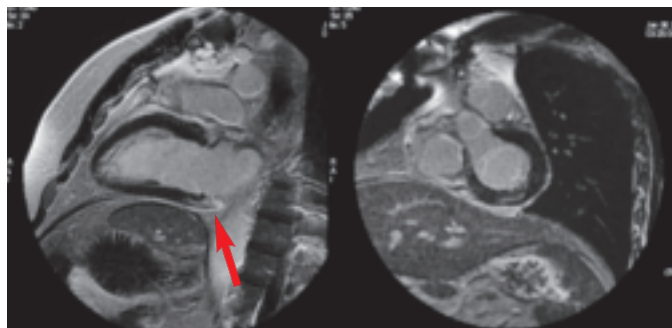
A 3.0T MR scan made a big difference for a middle-aged man who came to the hospital emergency department with chest pain. His EKG was normal, a blood test showed only slightly elevated troponin and he had no obvious risk factors.

"It was clinically ambiguous whether this was a true myocardial infarction," Dr. Reeder recalled. "Instead of doing a catheterization, this was an opportunity to see with MR if there was any damage to the heart. The MR study showed that he had a very small infarction that would have been almost undetectable by any other means. We saw it as clear as day because of the image quality of this scanner. It explained the patient's symptoms and we solved the problem."

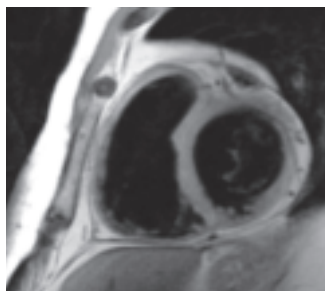




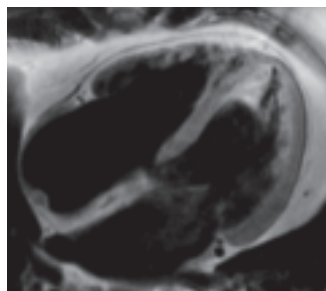
2D MDE image of left ventricle in long axis 2 chamber view. Arrow displays non-transmural infarct. T1 time = 240 ms with 1 R-R imaging.



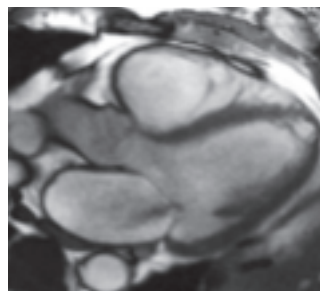
2D MDE image of left ventricle in long axis 2 chamber view with 8mm slice showing delayed hyper enhancement at inferior base (arrow). With higher SNR at 3.0T, short axis images through base were performed with 5mm slice thickness.



2D Double Inversion Recovery in short axis at 3.0T displays excellent blood suppression.



2D Double Inversion Recovery in 4 chamber orientation exhibits excellent anatomical detail.



SSPF (FIESTA) imaging at 3.0T has become a routine part of every cardiac MR exam. Exquisite mitral valve detail is displayed in a functional, dynamic study.

Dr. Reeder's team has used the 3.0T MR system to look for coronary lesions in patients sent from emergency with acute chest pain and make challenging diagnoses, such as arrhythmogenic right ventricular dysplasia (ARVD), a condition in young patients that leads to sudden death.

"This diagnosis requires high-quality, high-resolution images," Dr. Reeder added.

"There are three things you need to see with ARVD: wall motion abnormalities, structural abnormalities, and fibro-fatty infiltrations. With MR, you get the structure, the function and good tissue characterization for looking at fibro-fatty infiltration of the right ventricle."



Scott Reeder, M.D., Ph.D.

Scott Reeder, M.D., Ph.D., is Division Chief of MRI, University of Wisconsin-Madison Hospitals and Clinics.

#### About University of Wisconsin-Madison

UW Health, the academic health system for the University of Wisconsin, offers more than 60 locations throughout the state, including the renowned University of Wisconsin Hospital and Clinics and University of Wisconsin Children's Hospital in Madison. This comprehensive system of healthcare providers serves patients at more than 60 clinical locations throughout the state.

University of Wisconsin Hospital and Clinics is a 471-bed facility that ranks among the finest academic medical centers in the United States. Frequently cited in publications listing the nation's best healthcare providers, University of Wisconsin Hospital and Clinics is recognized as a national leader in fields such as cancer treatment, pediatrics, ophthalmology, surgical specialties and organ transplantation.

The University of Wisconsin Hospital and Clinics offers more than 800 active medical staff and more than 80 outpatient clinics. The hospital has six intensive care units (trauma and life support, pediatric, cardiac, cardiothoracic, burn, neurosurgery) with 74 total beds, and is one of only two organizations in Wisconsin with designated Level One adult and pediatric trauma centers.

## Improving Angiography

In angiography studies, Dr. Reeder and his colleagues take advantage of high image quality and advanced applications of the GE Signa scanner, such as TRICKS™ time-resolved imaging.

“For imaging renal arteries, there is a lot of data to show that MR is the gold standard, rather than digital subtraction angiography,” Dr. Reeder said. “The advantage of MR is that you can evaluate the renal arteries very well, but while using contrast that is not nephrotoxic and without using radiation.”

In peripheral vascular studies, MR avoids the blooming artifact seen when using CT in small blood vessels with calcification. “Patients with peripheral vascular disease from diabetes are almost by default non-diagnostic on CT, but are almost always diagnostic on MR,” Dr. Reeder added.

TRICKS is especially helpful in peripheral vascular studies. Many patients with peripheral vascular disease have differential flow between the feet. “You simply cannot time an optimal arterial phase in both feet at the same time,” Reeder says. “In a normal patient you can, but not in a patient with disease. You’ll get the timing right in one leg, but you will be early or late in the other leg.

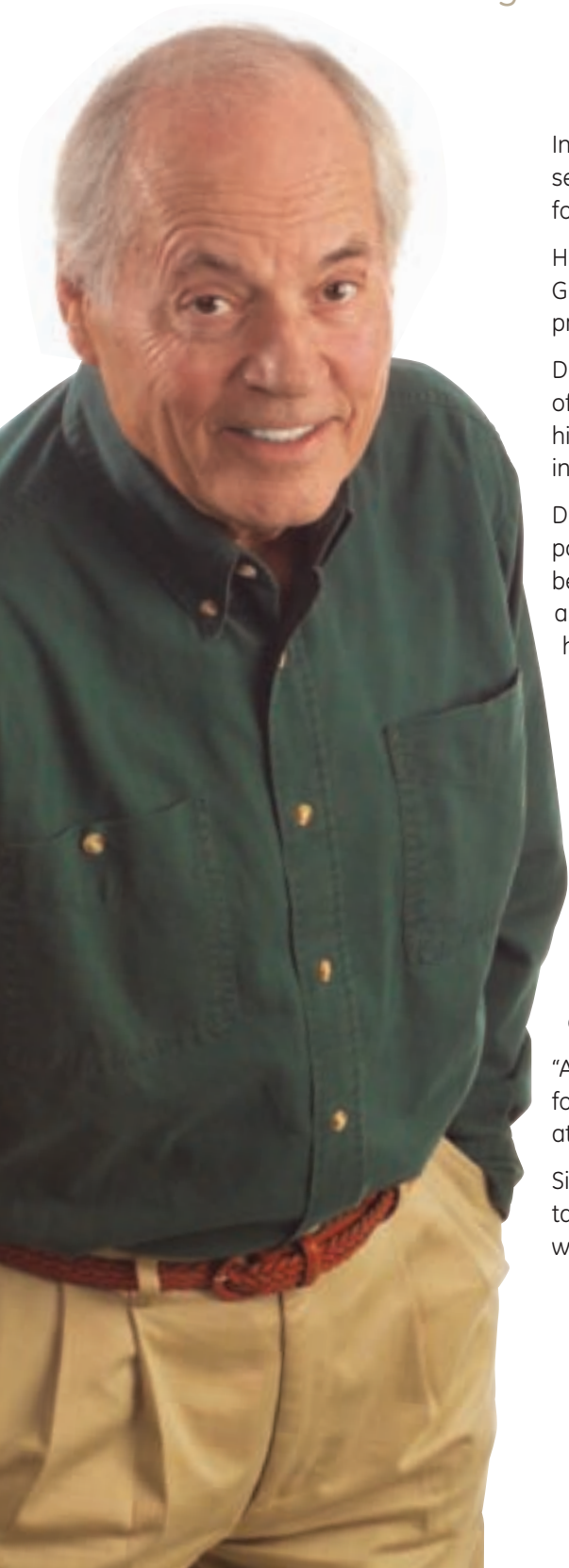
“Time-resolved imaging is essential for patients who have asymmetric flow in their legs. There are a number of reasons why they may have asymmetric flow; and you will miss the contrast bolus if you don’t do the exam with time resolved imaging.”

Dr. Reeder and his colleagues also use TRICKS in other areas of the body to look for direction of blood flow and to understand collateralization. “With conventional MRA, you just get a single shot of where the contrast was at the time,” Dr. Reeder explained. “You miss the information about the direction of flow that TRICKS offers you.” ■

In angiography studies, Dr. Reeder and his colleagues take advantage of high image quality and advanced applications of the GE Signa scanner, such as TRICKS™ time-resolved imaging.

# At the Heart of the Problem

## Advanced MR Applications Enhance Diagnostic Power in Visualizing Diseases of the Heart and Blood Vessels



In 20 years of work in magnetic resonance imaging, Steven Wolff, M.D., Ph.D., has seen huge advances. Today, he regards MR as the most powerful tool available for diagnosing diseases of the heart and blood vessels.

His practice, Advanced Cardiovascular Imaging in New York, NY, uses a GE Signa® 1.5T MR scanner, advanced applications and specialized coils to provide high-quality diagnostic images in even the most challenging cases.

Dr. Wolff and his colleagues use the MR Echo™ application for detailed studies of cardiac function and blood flow, and TRICKS™ time-resolved imaging with a high-density 32 element peripheral vascular coil for fast, reliable run-off studies in the lower extremities.

Dr. Wolff sees the need for MR imaging increasing rapidly as the United States population ages and with growing incidence of obesity and diabetes. He also believes MR has meaningful advantages over other modalities in cardiovascular application. "At some point in the future, I can envision many cardiac patients having a cardiac MR exam as part of their routine care," he said.

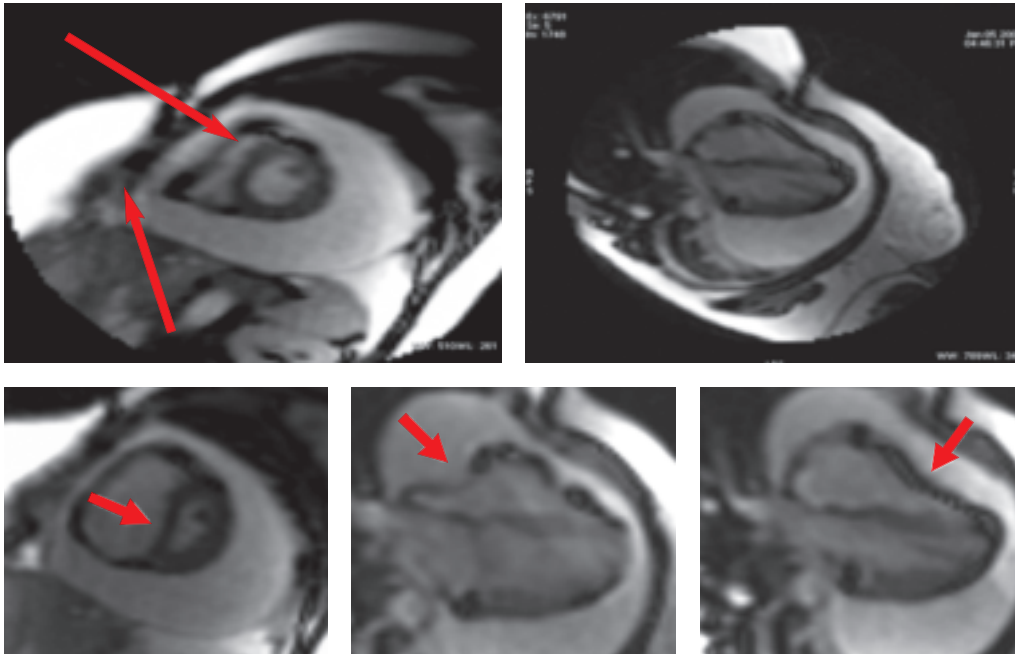
### Focused Specialty

As a radiologist and former Director of Cardiovascular MRI at the National Institutes of Health, Dr. Wolff opened his private practice five years ago. He also serves as Director of Cardiovascular MRI with the Cardiovascular Research Foundation and as Chief of Cardiovascular MRI at Lenox Hill Hospital.

The 1.5T MR system at Advanced Cardiovascular Imaging is used almost exclusively for cardiac and vascular cases. Cardiac exams include stress tests, function and flow studies. Vascular exams include studies of the chest, abdomen, carotid arteries and lower extremities.

"A number of our studies are combination cases where the referring physician asks for a cardiac MRI as well as an MRI of the aorta, neck or lower extremities – because atherosclerotic disease is not limited to just one artery," Dr. Wolff explained.

Since the staff is highly experienced in cardiac studies, Dr. Wolff reports the exams take as little as 23 minutes. "That includes a comprehensive cardiac exam, which we've done faster than we've done knee examinations."



62-year-old woman with SOB

## MR Echo: A Valuable Tool

Dr. Wolff regards the MR Echo application from GE as “clearly the best available for studying the heart.” It enables clinicians to acquire real-time images of the heart. “Until we had real-time imaging, we would have to make images of the heart by averaging a number of heartbeats,” Dr. Wolff said.

“For good image quality, that would require each heartbeat to be identical. But an enormous number of people have arrhythmias, which made it almost impossible to get good-quality cardiac MR images. With MR Echo, it doesn’t matter what cardiac rhythm the patient is in. I can see the heart just as nicely as if it were in normal sinus rhythm.

“The other advantage is that it requires no patient cooperation. Patients who are too sick to breath hold don’t need to hold their breath. It’s an extremely robust technique, and it’s convenient and easy to use.”

Dr. Wolff used MR Echo for a 62-year-old woman sent for evaluation because she had a pericardial effusion. “The referring physician wanted to make sure there wasn’t a cardiac mass causing the fluid buildup,” Dr. Wolff said. “We acquired images in real-time, while the patient was breathing, with no need for ECG gating.

“We observed a pattern of cardiac motion that physicians view with great alarm: collapse of the various heart chambers. We saw collapse of the right atrium and right ventricle, as well as paradoxical septal motion. In the presence of pericardial effusion, these are signs of cardiac tamponade.

“We got the images in a matter of minutes; when we saw them we took her out of the scanner and she received critical care. We could not have made that diagnosis without real-time imaging.”

## Imaging the Arteries

On the vascular side, the 1.5T MR system helps diagnose disease throughout the body: atherosclerosis, dissection, aneurysms, arterio-venous malformations and vein disorders. “People once considered MR angiography to be a very difficult test,” Dr. Wolff noted. “Today’s technology makes it easier and faster. We perform MRAs in 15 to 20 minutes and runoffs in less than 30 minutes.”

One reason for the greater speed and quality is TRICKS time-resolved imaging, which delivers reproducible, high-quality images of the leg arteries. Another is ASSET parallel imaging, which can be used to speed up image acquisition or to increase the imaging volume.

“With MR Echo, it doesn’t matter what cardiac rhythm the patient is in. I can see the heart just as nicely as if it were in normal sinus rhythm.”

*Dr. Steven. D. Wolff*

“Another thing that I consider important is the GE high density 32-element peripheral vascular coil for evaluating the arteries below the knees,” Dr. Wolff added. “It gives us 15 times greater signal-to-noise than the body coil. It’s critical to have good images not just of the arteries below the knees in general but specifically the arteries in the feet. Those frequently were cut off in the past because there was no coil to cover the foot. The combination of TRICKS and the coil has dramatically improved the quality of our runoffs.”

The challenge in peripheral vascular studies has been timing. In patients with compromised circulation, the legs may fill at different rates, making it extremely difficult to time the acquisition. TRICKS solves that problem, eliminating timing and triggering considerations. It is essentially a point-and-shoot application.

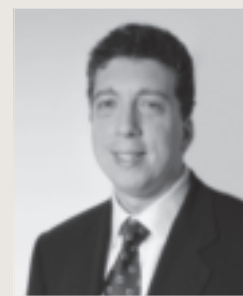
## Changing the Game

Dr. Wolff used TRICKS to examine a young woman who had an arterial-venous malformation just above the knee. “In AVMs, there is a fast rush of blood flow through the legs,” Dr. Wolff said. “If you don’t get the timing right, you may not see the arteries because the veins will appear very quickly and cover them up.

“With a single image, you lose that flow information. You may have a feeding artery, but you can’t tell how much that feeding artery contributes to the lesion. With TRICKS, we can do that in a time-resolved fashion.

“Our images gave the interventionalist a roadmap, showing him the feeding arteries much better than typically seen on an X-ray angiogram. Our 3D images clearly showed three abnormal feeding vessels coming into the AVM. You could actually see the blush of signal and the shunting of blood from the arteries to the veins along with the early draining veins.

“This is the kind of information that’s essential for accurately treating these patients. If this woman hadn’t undergone the MRA, the interventionalist might not have found all the feeding vessels, might not have known which ones were more important and therefore might have spent a longer time looking using X-ray angiography, which may result in more dye and radiation. This interventionalist said we changed the way he practices medicine based on the quality of our MRA studies.” ■



Steven. D. Wolff, M.D., Ph.D.

Steven. D. Wolff, M.D., Ph.D., is the Director of Cardiovascular MRI at the Cardiovascular Research Foundation in New York. He is also the Director of Cardiovascular MRI at Advanced Cardiovascular Imaging, a private practice in Manhattan. His research interests focus on developing new MRI techniques that will have immediate applications to clinical practice.

He is the inventor of several patents in MRI including the original patent on magnetization transfer. Dr. Wolff attended Duke University Medical School for his medical and doctoral studies. His doctoral work was based on research he performed as a Howard Hughes Medical Institute – National Institutes of Health (NIH) Research Scholar. Dr. Wolff completed his radiology residency at Johns Hopkins Hospital in 1994.

### About CRF New York, NY

The Cardiovascular Research Foundation (CRF) is a global leader in bringing together three elements that define modern medicine: research, education and patient care. Founded in 1991, CRF has played a key role in the development of nonsurgical and drug-based treatments of heart and vascular disease.

CRF’s MRI program, directed by Steven D. Wolff, M.D., Ph.D., was established in May 2000 to perform research and education in cardiovascular MRI. Research and education are closely aligned with the Clinical Cardiovascular MRI program at Advanced Cardiovascular Imaging.

# Exploring Frontiers in Neurological Imaging

## 3.0T MR Brings New Capabilities and Abundant Potential for University of Wisconsin-Madison Hospitals and Clinics

Patrick Turski, M.D., has worked on the forefront of MR imaging since its emergence in clinical practice. Today, he sees significant benefits and a highly promising future in neurological imaging with the latest 3.0T MR imaging platform.

As a neuroradiologist in the Department of Radiology with the University of Wisconsin-Madison Hospitals and Clinics, Dr. Turski has worked with GE Signa® 3.0T MR systems since late 2004.

Among its benefits, Dr. Turski and his colleagues note the higher signal strength of 3.0T enhances visualization of small structures in the brain, improve time-of-flight MRA studies and differentiation of the meninges and ventricular linings. The technology also facilitates the use of parallel imaging to acquire 3D brain images, which enable highly detailed brain analyses.

### From the Beginning

Dr. Turski's experience with GE MR technology goes back more than 20 years. In late 2004, University of Wisconsin-Madison Hospitals and Clinics installed two 3.0T systems – one at the main hospital campus in Madison, primarily for neurology, and a second at an affiliated sports medicine center, mainly for musculoskeletal studies.

"For neurological applications, there are some definite advantages to 3.0T as compared to 1.5T," Dr. Turski said. "There is a significant increase in signal-to-noise ratio (SNR), and we're able to take advantage of that by either imaging at a higher resolution or by speeding up acquisitions to reduce imaging time" (Figure 1).

The higher resolution also enables better detection of some common brain disorders. "3.0T is a very good platform for neurological imaging in general," Dr. Turski noted. "We like to have the highest-resolution imaging possible for certain diseases, such as epilepsy patients who have abnormalities of the temporal lobe.

"Some structures in the temporal lobe are quite small. The hippocampal formation, for example, is difficult to image at 1.5T. It's still a challenge to image at 3.0T, but the additional signal-to-noise helps us to push the resolution and enables us to see the hippocampal structures a little better."

## Improving Applications

Dr. Turski finds 3.0T MR beneficial for a variety of imaging procedures and protocols.

**MR angiography (MRA):** 3.0T speeds up acquisitions and the advanced TRICKS™ angiography application enables greater arterial information through faster frame rate. “We like to see arterial structures in great detail,” Turski said. “By having more arterial frames, we can capture the peak of the contrast bolus. That gives us information about the dynamics of flow through the arterial system. We can see if the flow is faster in one artery and slower in another, and if so, that usually indicates some disease involving that blood vessel.”

**Time-of-flight imaging:** “For some applications, such as 3D time-of-flight MRA, 3.0T is a favorable field strength,” Dr. Turski noted. “It prolongs the T1 times and that makes the background signal intensity a little lower. So we’ve seen a significant improvement in 3D time-of-flight imaging – and that has been substantiated at other sites and reported in the literature.”

**3D imaging:** The 3.0T technology helps overcome the signal-to-noise penalty inherent in ASSET parallel imaging, Turski observed. “The combination of higher field and parallel imaging is one reason we bought a 3.0T system,” he explained. “We can do 3D imaging four times faster and with signal-to-noise equivalent to or better than at 1.5T. As a result, we have thinner sections and we can post-process the information to perform volumetric measurements. We can then slice the brain in any direction and sub-segment parts of the brain to look at them in detail. We can also co-register the MR images with PET exams or 3D CT exams.”

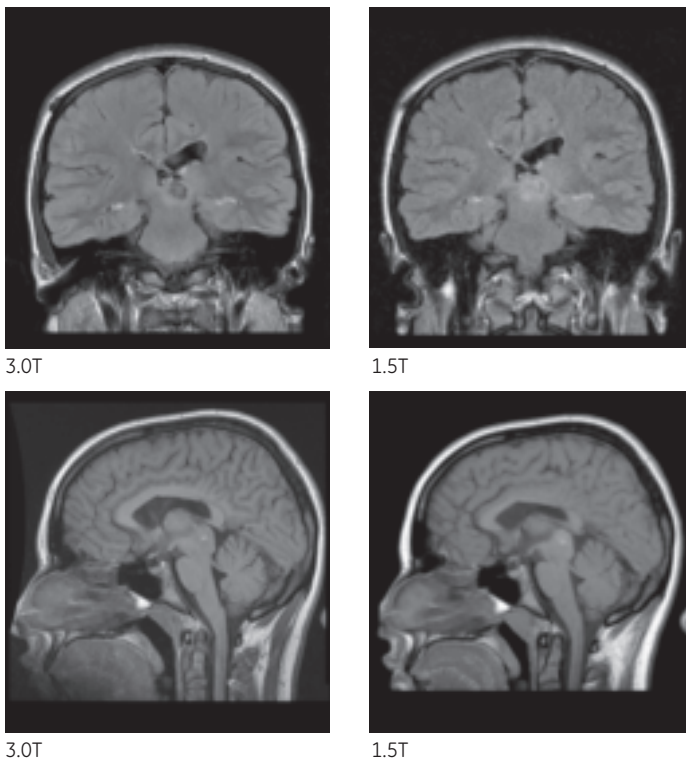


Figure 1. A 16-year-old patient presenting with double vision on upward gaze. Note that the 3.0T images have improved resolution and increased SNR. Diagnosis: Tectal Glioma



Patrick Turski, M.D.

Patrick Turski, M.D., is a Neuroradiologist, Department of Radiology, at the University of Wisconsin-Madison Hospitals and Clinics.

### About the University of Wisconsin-Madison

UW Health, the academic health system for the University of Wisconsin, offers more than 60 locations throughout the state, including the renowned University of Wisconsin Hospital and Clinics and University of Wisconsin Children's Hospital in Madison. This comprehensive system of health-care providers serves patients at more than 60 clinical locations throughout the state.

University of Wisconsin Hospital and Clinics is a 471-bed facility that ranks among the finest academic medical centers in the United States. Frequently cited in publications listing the nation's best healthcare providers, University of Wisconsin Hospital and Clinics is recognized as a national leader in fields such as cancer treatment, pediatrics, ophthalmology, surgical specialties and organ transplantation.

The University of Wisconsin Hospital and Clinics offers more than 800 active medical staff and more than 80 outpatient clinics. The hospital has six intensive care units (trauma and life support, pediatric, cardiac, cardio-thoracic, burn, neurosurgery) with 74 total beds, and is one of only two organizations in Wisconsin with designated Level One adult and pediatric trauma centers.

“FLAIR is extremely useful in neurological diseases. This is one area where we see a marked difference between a 3.0T platform and 1.5T.”

*Dr. Patrick Turski*

**Diffusion-weighted imaging:** Dr. Turski and colleagues use diffusion-weighted imaging (DWI) routinely and find it valuable for studying a variety of neurological conditions.

**FLAIR imaging:** “FLAIR is extremely useful in neurological diseases,” Dr. Turski said. “This is one area where we see a marked difference between a 3.0T and 1.5T platform. FLAIR imaging provides very good contrast between a large variety of pathologies, the brain tissue and the spinal fluid.

“In FLAIR, the signal from the cerebrospinal fluid is suppressed, and so we have a very dark background for observing diseases that involve the edges of the ventricles, such as ventriculitis. We also get a very good look at the meninges. These areas, although visible on T1-weighted images with contrast, are much more distinctive in FLAIR images. That means we can pick up diseases at an earlier stage and diagnose with greater confidence.

“T1 FLAIR images on 3.0T are spectacular. We get excellent gray-white differentiation, which enables us to see whether an area of the brain is atrophic or whether there has been some loss of brain volume. In the hippocampal region, we use T1 weighting extensively to see the morphology of that formation.”

Dr. Turski also finds T2 FLAIR imaging with contrast is “extremely useful” for visualizing tumors and edema in cancer patients (Figure 2).

### Looking Ahead

In Dr. Turski’s view, 3.0T technology provides a competitive edge over other MR scanners. “If you are able to show benefits to referring physicians, such as higher-resolution images of the temporal lobe and better time-of-flight imaging when compared to 1.5T, that does give you an advantage.”

He expects 3.0T technology to become more prevalent as new coils and applications begin to harness its full potential. He notes perfusion and functional MRI studies in the brain, as well as spinal and musculoskeletal imaging are key areas to watch for major advances. ■

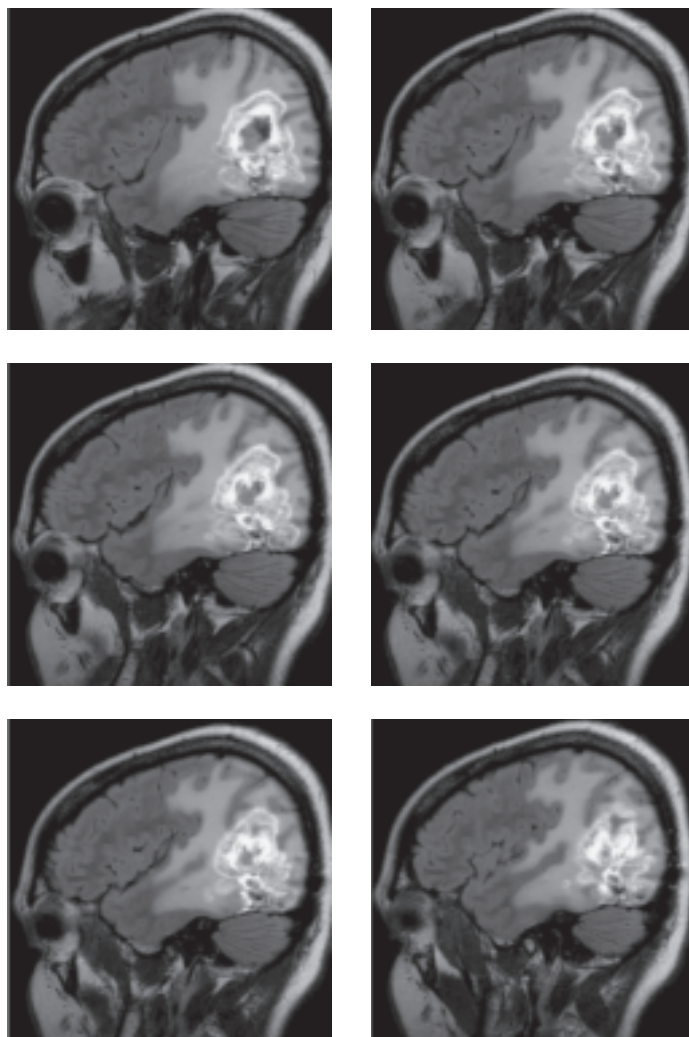


Figure 2. The 3D XETA FLAIR images were obtained using parallel imaging (ACR). Six images from a 128 images acquisition are displayed. The voxels are isotropic and the image information can be reformatted into any plane, co-registered to other 3D datasets and used for volumetric measurements or representations of the surface anatomy.

# Imaging of the Lungs with Time-resolved 3D MRA

By Virna Zampa, M.D., Department of Diagnostic and Interventional Radiology, University of Pisa, Italy

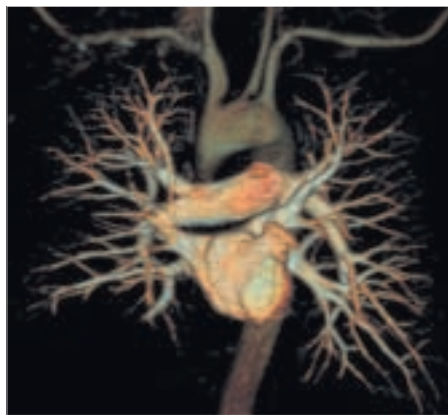
## Abstract

Advances in MRI technology have greatly impacted vascular MR applications. Improvements in the image acquisition technique take advantage of combining high temporal resolution with spatial resolution imaging.

A time-resolved 3D MR angiography (MRA) technique, TRICKS™ (Time Resolved Imaging Contrast KineticS) has been proposed as an alternative method for patients with pulmonary disease. TRICKS is a modified 3D fast GRE pulse sequence that combines high temporal and spatial resolution. Compared to conventional MRA, it improves arterial-venous discrimination, reduces sensitivity to motion artifacts and often gives additional information.

MRI is being increasingly applied in the study of pulmonary vascular anatomy and pathology. The introduction of TRICKS has overcome the limitation of conventional MRA techniques offering the simultaneous assessment of vessels and parenchymal perfusion. Various clinical applications of TRICKS of the chest

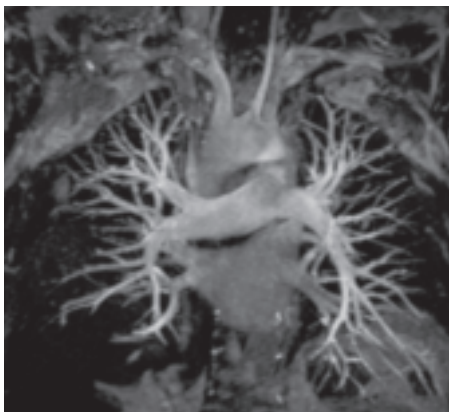
Figure 1. Patient A: 58-year-old male



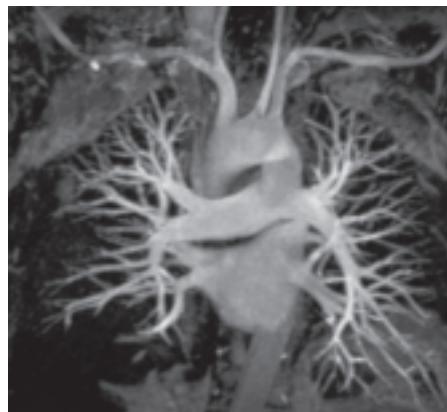
3D volume rendering anterior view



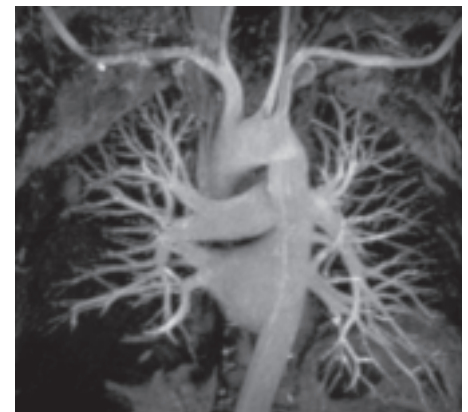
3D volume rendering posterior view



1st phase



2nd phase



3rd phase

can be proposed. Although CT is a popular clinical modality for pulmonary embolism (PE), it has been shown that MRI is able to assess acute PE with high diagnostic accuracy.

In addition, versatility of MR makes it a superior clinical imaging solution for the evaluation of pulmonary transit time in patients with pulmonary hypertension and heart failure.

### Clinical Cases

The MR system being used is a GE Healthcare Signa® HDx 1.5T with an 8-channel cardiac phased array coil.

Patients A and B (Figures 1 and 2), were examined to evaluate the anatomy of the left atrium before performing a radiofrequency thermal ablation procedure. The TRICKS 3D data set was then merged with an electroanatomical map obtained by the intracardiac potentials recorded using the catheter during the cardioablation procedure.

In the case of Patient A (Figure 1), an example of normal pulmonary artery studied with TRICKS is shown.

Patient C (Figure 3), has an acute pulmonary embolism. The embolus is in the right inferior pulmonary artery, and it is well depicted on 3D FIESTA Fat Sat and on TRICKS images.

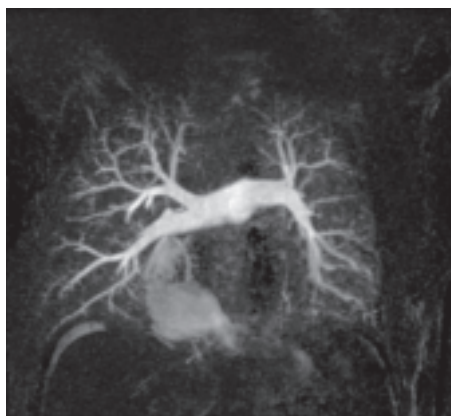
### Technique

The patient is positioned supine with a 20-gauge intravenous cannula in the antecubital vein connected to a dedicated MR injector; breath instruction is given before the examination. After a tri-plane scout, a TRICKS sequence is implemented in the coronal plane using the following parameters: TE/TR 1.4/3.5 ms, BW 83 kHz, FOV 43 x 38 cm, matrix 320 x 224, 0.75 NEX, slice thickness 3 mm (overlap 1.5), number of output temporal phases 10, temporal resolution 3.4 s, acquisition time 1.10 min. A mask is acquired before the intravenous contrast injection.

The TRICKS sequence is the first acquisition technique combining K-space segmentation and the elliptic centric view ordering. High temporal resolution is achieved by dividing the K-space into a number of segments from the center of K-space out. Views are acquired in an elliptic centric order and the rate of sampling is varied, so that the center of K-space is sampled more often than the outer regions and the time period from one phase to the next is shortened.

The start of the acquisition coincides with the start of a bolus injection of 10 ml of paramagnetic contrast media at a flow 2 ml/s. Data was processed obtaining pulmonary arteriograms and venograms.

Figure 2. Patient B: 48-year-old male



Pulmonary arteries

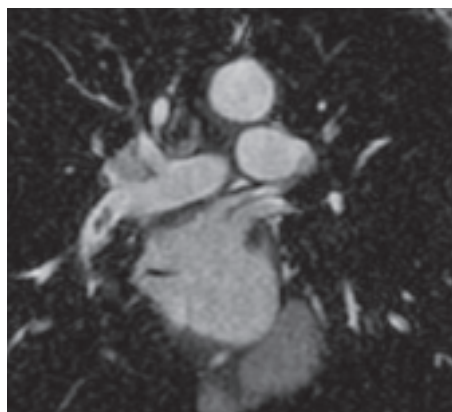


Pulmonary veins

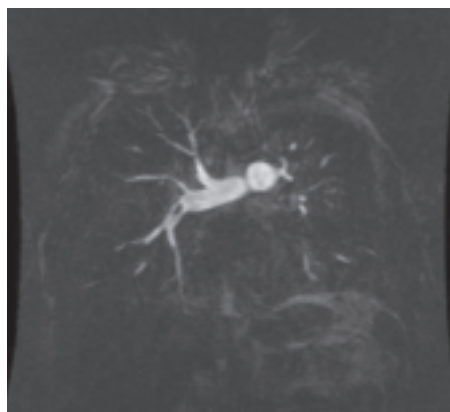


Pulmonary arteries and parenchyma

Figure 3. Patient C: 47-year-old female



Coronal 3D FIESTA Fat Sat



TRICKS acquisition: embolus in the right inferior pulmonary artery



TRICKS acquisition:  
oblique reconstruction



TRICKS acquisition:  
oblique reconstruction

## Findings

The different phases of TRICKS MRA clearly delineate vascular and cardiac structures due to the high temporal resolution, while optimized spatial resolution allows to appreciate the anatomic details.

## Conclusion

Using the TRICKS technique, a good visualization of the pulmonary artery can be obtained. Despite the widespread use of CT for studying the pulmonary artery, the availability of the time-resolved technique makes MRI an alternative and fascinating tool in the evaluation of this anatomic region. ■

### About the University of Pisa, Italy

The Department of Interventional and Diagnostic Radiology, chaired by Professor Carlo Bartolozzi, is an academic department of the University of Pisa, Italy. Equipped with the latest technology, the department provides services at Pisa's Cisanello and Santa Chiara teaching hospitals.

With nearly 100,000 imaging examinations performed annually, there is a broad array of diagnostic imaging and interventions that offer an excellent foundation for graduate medical education. The Department is built upon a system of competence, teamwork, innovation and service as a major referral and teaching center for diagnostic and interventional radiology within Tuscany, Italy and beyond.

Our commitment is to provide excellence in medical imaging, responsive service and the responsible use of our resources in clinical care, education and research.

# Spectroscopy Helps Detect, Localize Suspicious Prostate Lesions

Prostate Cancer is the most common non-skin cancer in the U.S. and one of the most common cancers in Europe with increasing incidence. According to the Prostate Cancer Foundation, in 2006 over 232,000 American men will be diagnosed with prostate cancer and over 30,000 men will die from the disease. Every year, 70,000 men require treatment due to prostate cancer recurrence.

Prostate specific antigen (PSA) and digital rectal examination (DRE) are currently the basic diagnostic tests in the early diagnosis of prostate cancer. DRE is a specific test with low sensitivity for the diagnostic and staging of prostate cancer, with a low correlation with localization and extension of prostate cancer.

The use of transrectal ultrasound to diagnose prostate cancer relies on the fact that the majority of cancers are shown as hypoechoic lesions; however, only 20 percent of hypoechoic lesions are malignant. Moreover, transrectal ultrasound fails to detect eight to 30 percent of palpable lesions.<sup>1</sup>

In the last few years, endorectal MRI has been increasingly used for patients diagnosed with clinically localized prostate cancer. Proton MR spectroscopic imaging can further help detect and localize prostate cancer. Proton MR spectra of prostate cancer tissue reveal a reduced or depleted citrate level and an increased choline level compared with the levels of these substances in healthy or benign tissue.

PROSE (PROstate Spectroscopy and imaging Exam) is an image guided, MR clinical imaging and spectroscopy package from GE Healthcare. It acquires high resolution anatomical images – with analytical coil correction – and volume localized, water/lipid suppressed hydrogen spectra and/or multi-voxel spectroscopic images of the prostate gland using an endorectal coil with phased-array coils. Automated acquisition setup, including the adjustment of homogeneity, is a standard feature of the application. PROSE spectra provides information about the relative concentrations of in vivo metabolites in a non-invasive manner.

## Clinical Case:

A 57 year-old patient, presenting an elevated level of PSA (5.3), a nycturia and a dysuria, showed indication for a prostatectomy.

The transrectal ultrasound exam did not reveal anything particular, and the results of the biopsies were all negative.

## MR Image Acquisition Protocol

The MR images and spectra were obtained with a Signa® 1.5T system (GE Healthcare, Milwaukee, USA) by using a combination of an endorectal coil and a torso phased array coil.

The protocol consisted of axial T1 and T2 FSE acquisitions in 3mm thickness, in the orientation of the prostate gland, 3D-CSI Prostate spectroscopy, followed by a 3D dynamic contrast-enhanced T1 sequences after injection of Gadolinium contrast agent.

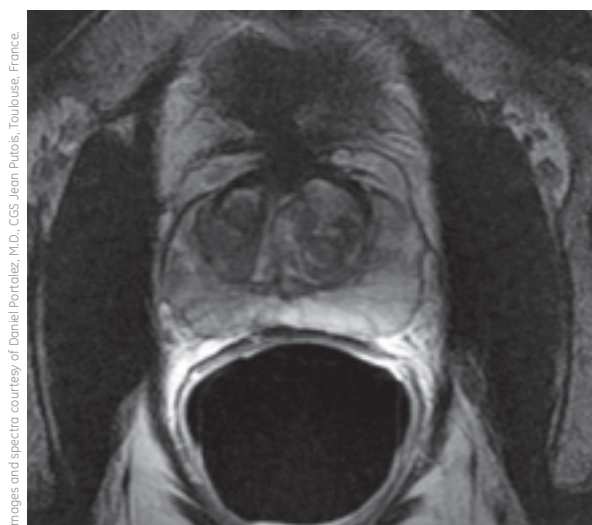
## Conclusion

The axial T2 images showed a large hyposignal in the base and central part of the right side of the prostate, without any other abnormality on the left side. The dynamic contrast-enhanced sequence did not show any pathologic enhancement or asymmetry.

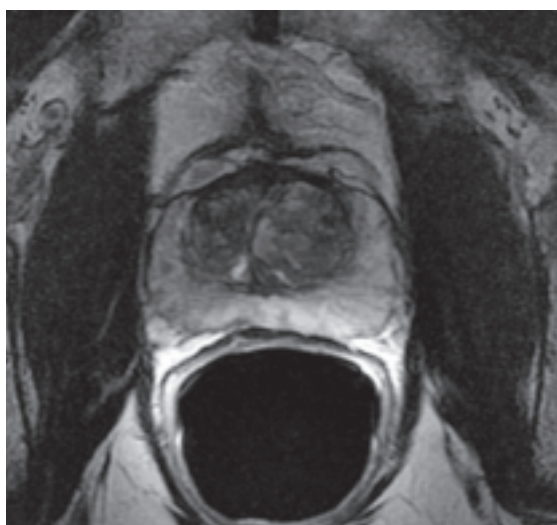
The result of the spectroscopy acquisition showed a reduced level of all the metabolites (choline, creatine and citrate), not significantly pathological (atrophy, prostatitis), and had been confirmed by the anatomopathological results of the prostate resection. ■

## Reference:

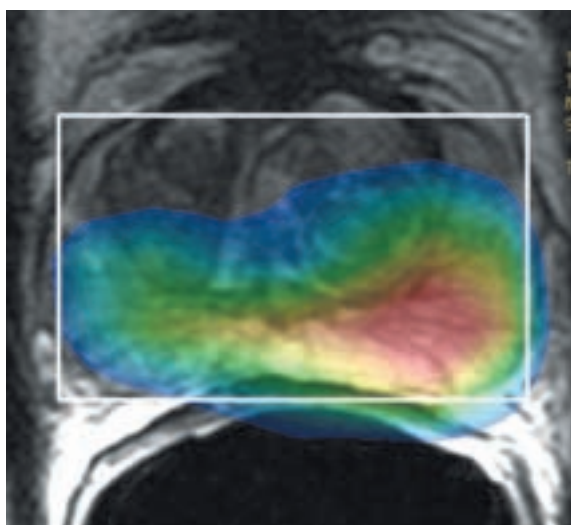
1. Comet-Battle J., Vilanova-Busquets J.C., Saladie-Roig, J.M., et al. The Value of Endorectal MRI in the Early Diagnosis of Prostate Cancer. *European Urology* 2003;44:201-208.



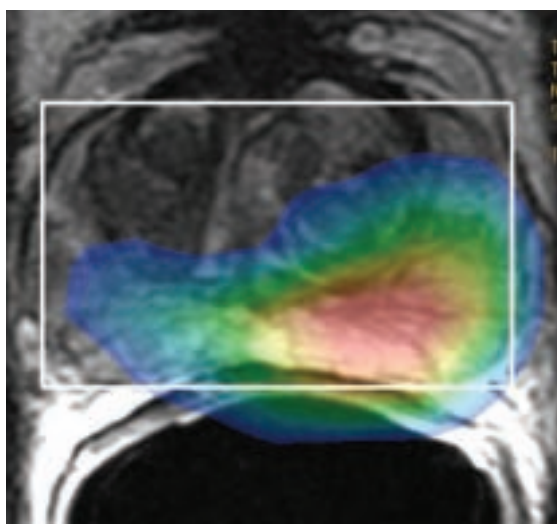
Axial T2 image



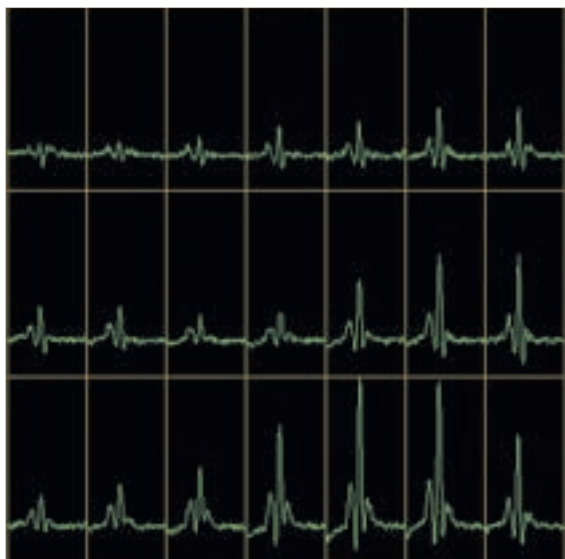
Axial T2 image



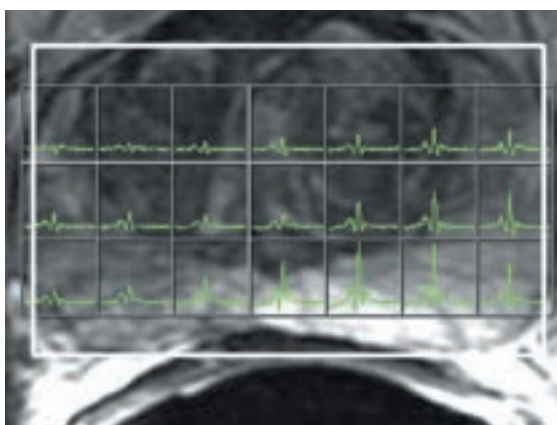
Spectroscopy: Color-coded choline map



Spectroscopy: Color-coded citrate map



Grid of spectra



Zoomed view of grid of spectra, superimposed onto the T2 images, showing the decreased level of metabolites in the atrophy area of the prostate gland.



# The Utility of MR for Whole Body Imaging

*By Trevor La Folie, M.D., Radiology Department, Laveran Military Hospital, Marseille, France*

## Introduction

Recent clinical results underline the usefulness of whole body MRI as an accurate alternative to conventional multi-modality evaluation. A whole body protocol using T1 and STIR weighted sequences has already shown its superiority versus conventional modalities like bone scintigraphy. Adding a diffusion-weighted imaging (DWI) acquisition allows a comprehensive exam in less than 40 minutes and drives MRI towards new horizons.

## Technique

Laveran Military Hospital uses three sequences to image the whole-body with a GE Healthcare Signa® HD 1.5T 8-channel platform: coronal T1 fast spin echo (FSE), coronal STIR and axial DWI EPI.

The scan parameters are:

- 1) FSE T1: TR/TE 385/10 ms, ETL 2, BW 50 kHz, 8 mm slice thickness with 1 mm gaps, matrix of 320 x 160, field-of-view (FOV) 44 cm<sup>2</sup>
- 2) STIR: TR/TE 8400/30 ms, T1 145 ms, ETL 20, BW 62.5 kHz, 8 mm slices with 1 mm gaps, matrix of 320 x 224, FOV 44 cm<sup>2</sup>
- 3) DWI EPI: TR/TE of 7100 /85 ms, matrix of 80 x 128, FOV 36 cm<sup>2</sup>, b=600 s/mm<sup>2</sup>

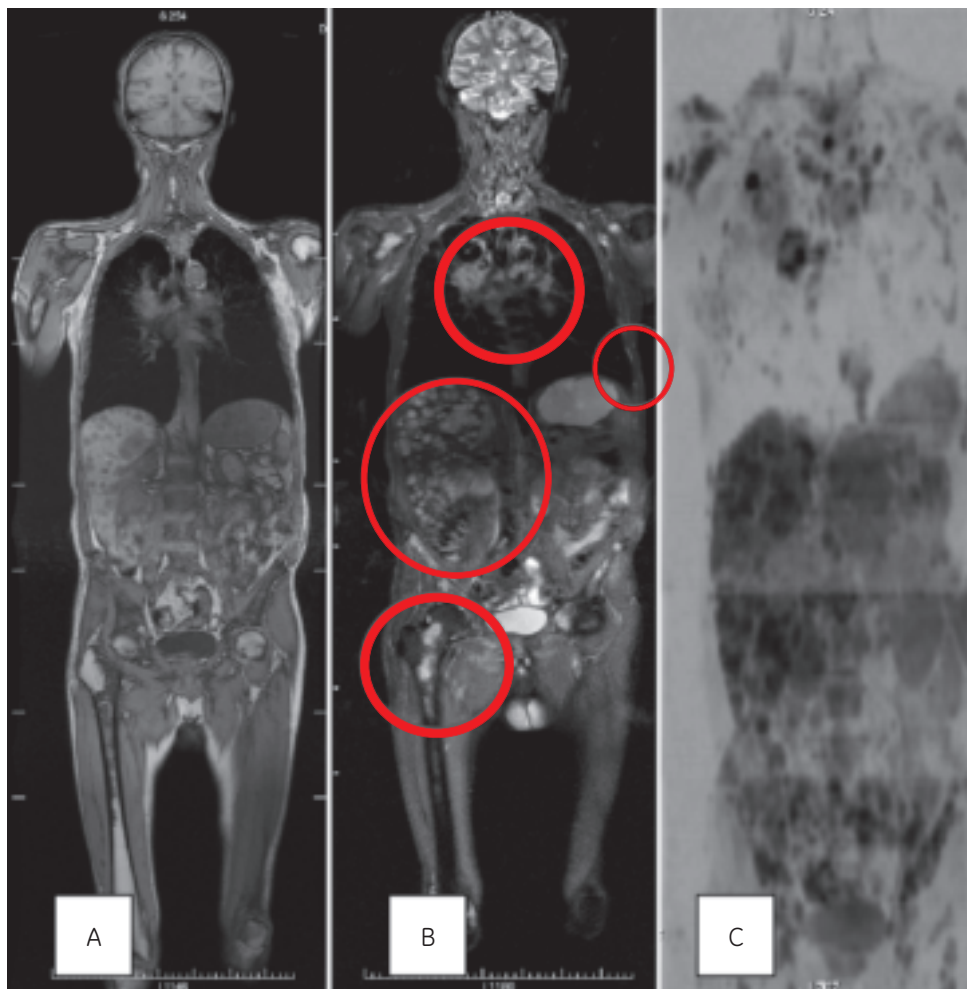
To image the body in total, a four or five station protocol (depending on patient size) is acquired with an overlap between stations. An integrated body coil is used except at the thoracic-abdominal level where the 8-channel body array coil is utilized to realize breath-hold acquisition with parallel imaging techniques.

## Visualization

All T1 acquisitions are pasted together and allow analysis from head to toes (same procedure for STIR images). To review DWI images, an inverse grayscale intensity scale is applied on 20 mm coronal MIP to obtain a "PET-like" image. This static coronal projection allows direct comparison with other modalities, such as a bone scan.

## Case 1

Patient is a 54-year-old male with small cell neuroendocrine carcinoma (tumor stage T2N2) of the right superior lobe of the lung.



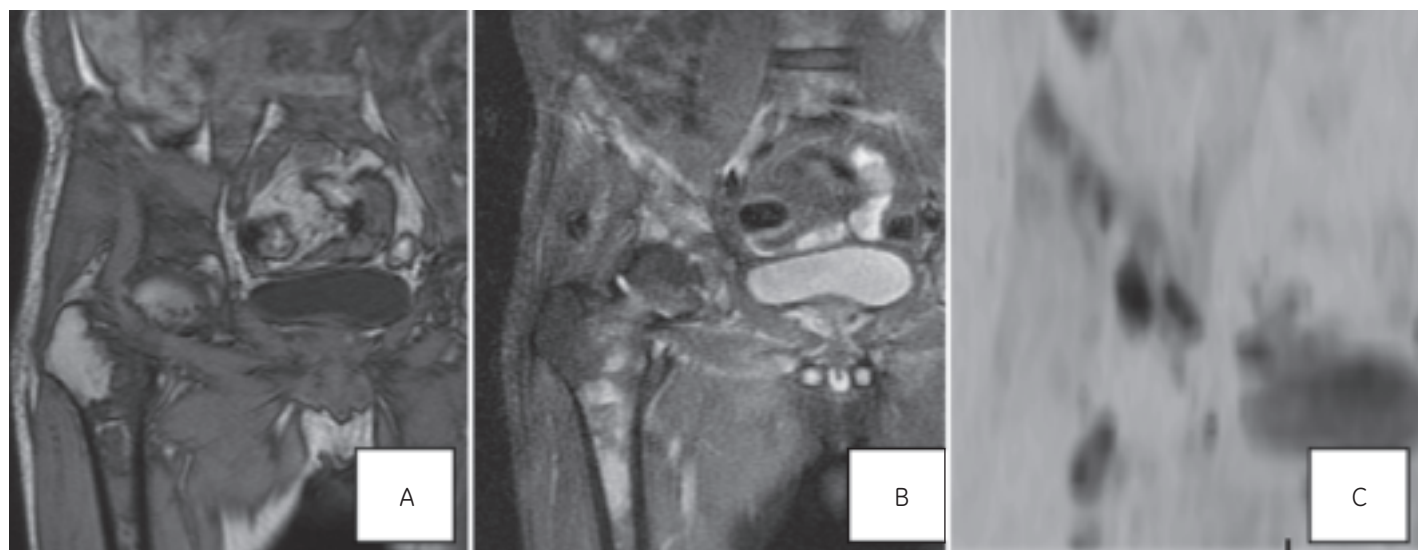
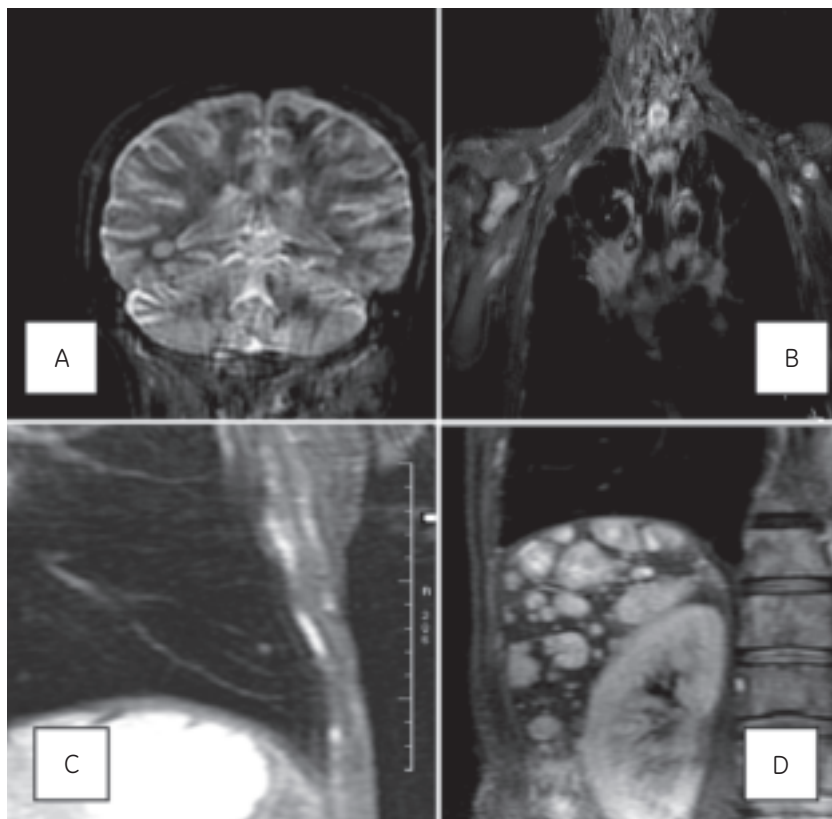
(A) Coronal T1 acquisition using out of phase TE  
(B) Coronal STIR acquisition  
(C) Axial DWI acquisition

Trevor La Folie, M.D., is the lead for MRI Oncology imaging in the radiology department under the direction of Professor J.F. Briant.

### About the Laveran Hospital Marseille, France

The Laveran Hospital is a military institution of 316 beds built in 1963. It bears the name of the army medical officer Charles Louis Alphonse Laveran, who discovered the parasite of paludism in 1880 in Algeria. The hospital is a multi-specialty facility, although it traditionally specialized in Tropical Medicine. The MR system was initially installed by GE in 2001 as a Signa 1.5T MR and was recently upgraded to the Signa HDx platform.

## Case 1 (continued)

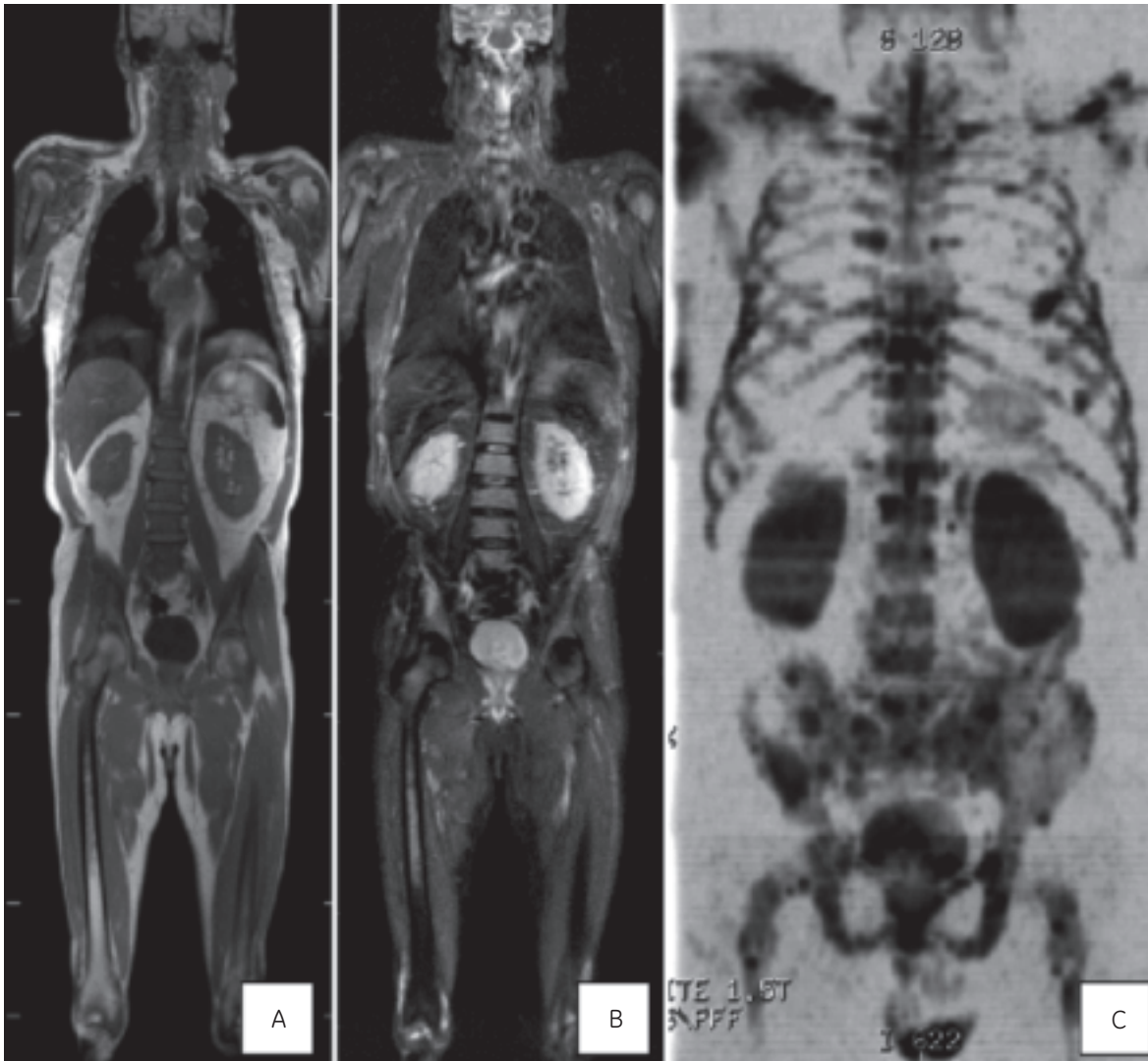


Femoral and iliac bone metastases

- (A) T1 hyposignal
- (B) STIR: hypersignal
- (C) DWI: hypersignal

## Case 2

Patient is a 69-year-old male with Stage III multiple myeloma.



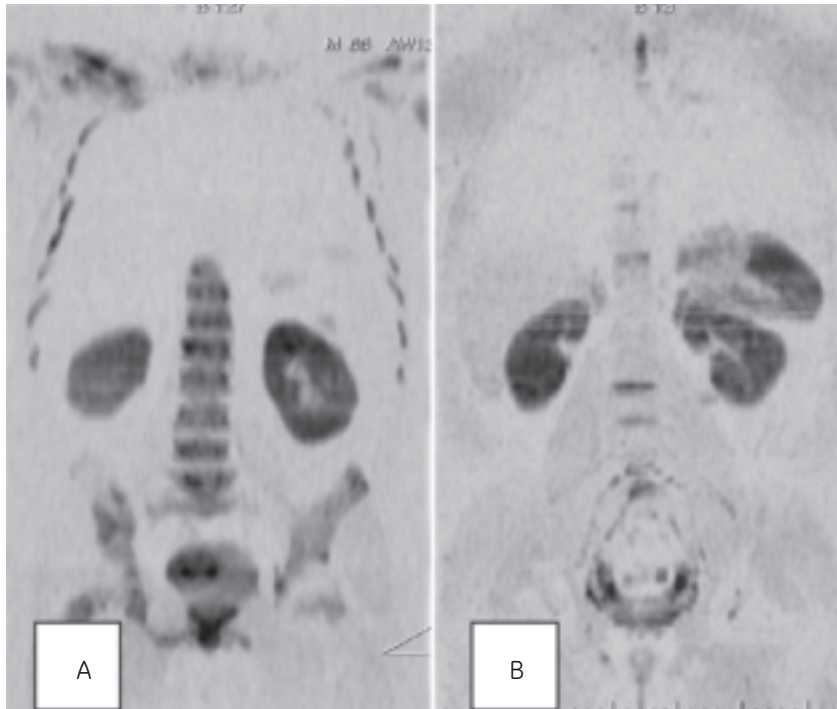
(A) Coronal T1

(B) Coronal STIR

(C) MIP coronal projection of an axial DWI acquisition

...MRI findings impacted the therapeutic strategy as N-staging was reclassified as a Stage III and not II as originally reported based on PET/CT scans.

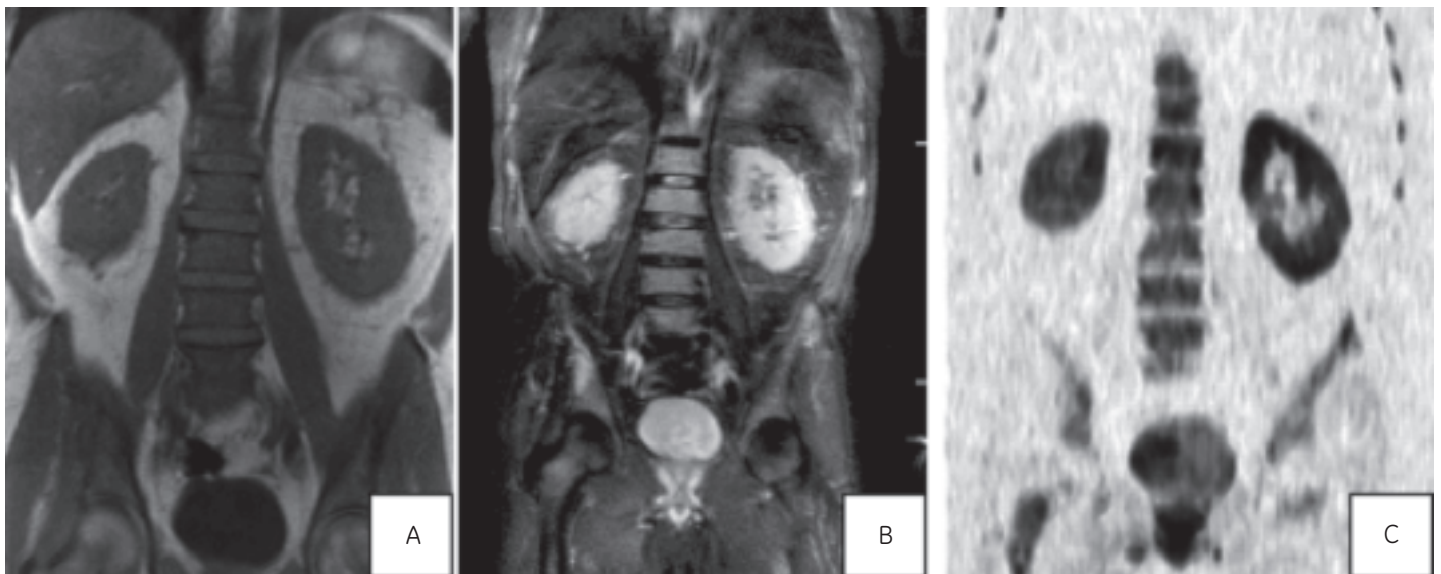
## Case 2 (continued)



DWI acquisition using a b-value of 600 s/mm<sup>2</sup>

(A) Diffuse tumoral bone marrow infiltration with hyper-signal intensities in the axial skeleton, pelvis, the ribs and femoral heads.

(B) Normal subject with normal appearance (iso-signal intensity) of the axial skeleton and hyper-signal intensity of the vertebral discs and organs with large water components.



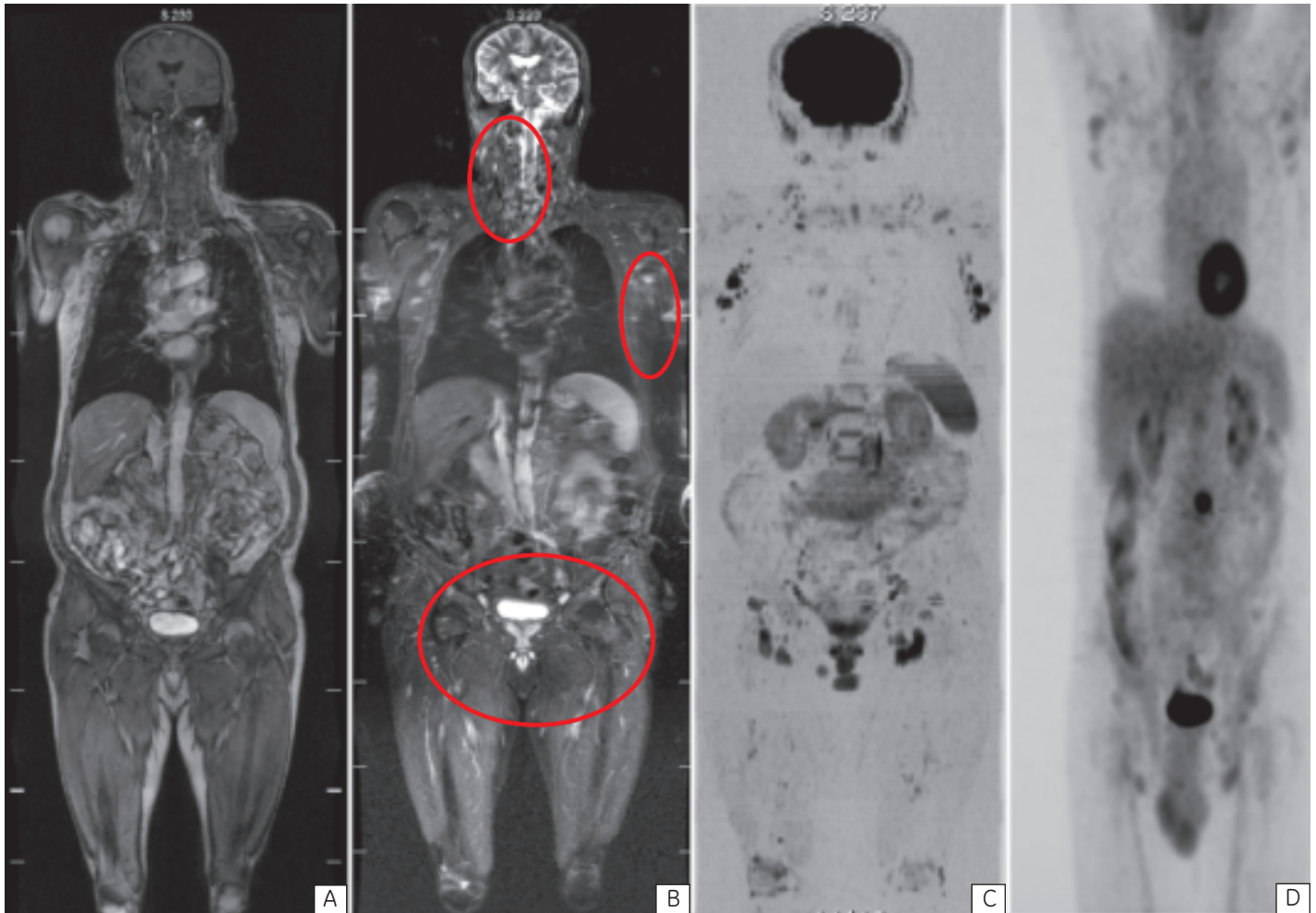
(A) Hypo-signal intensity in T1 imaging

(B) Hyper-signal intensity in STIR

(C) DWI acquisition of the vertebral bodies due to tumoral bone marrow infiltration

### Case 3

Patient is a 61-year-old male with Non-Hodgkin's mantle cell lymphoma, assessed Stage II by PET/CT.



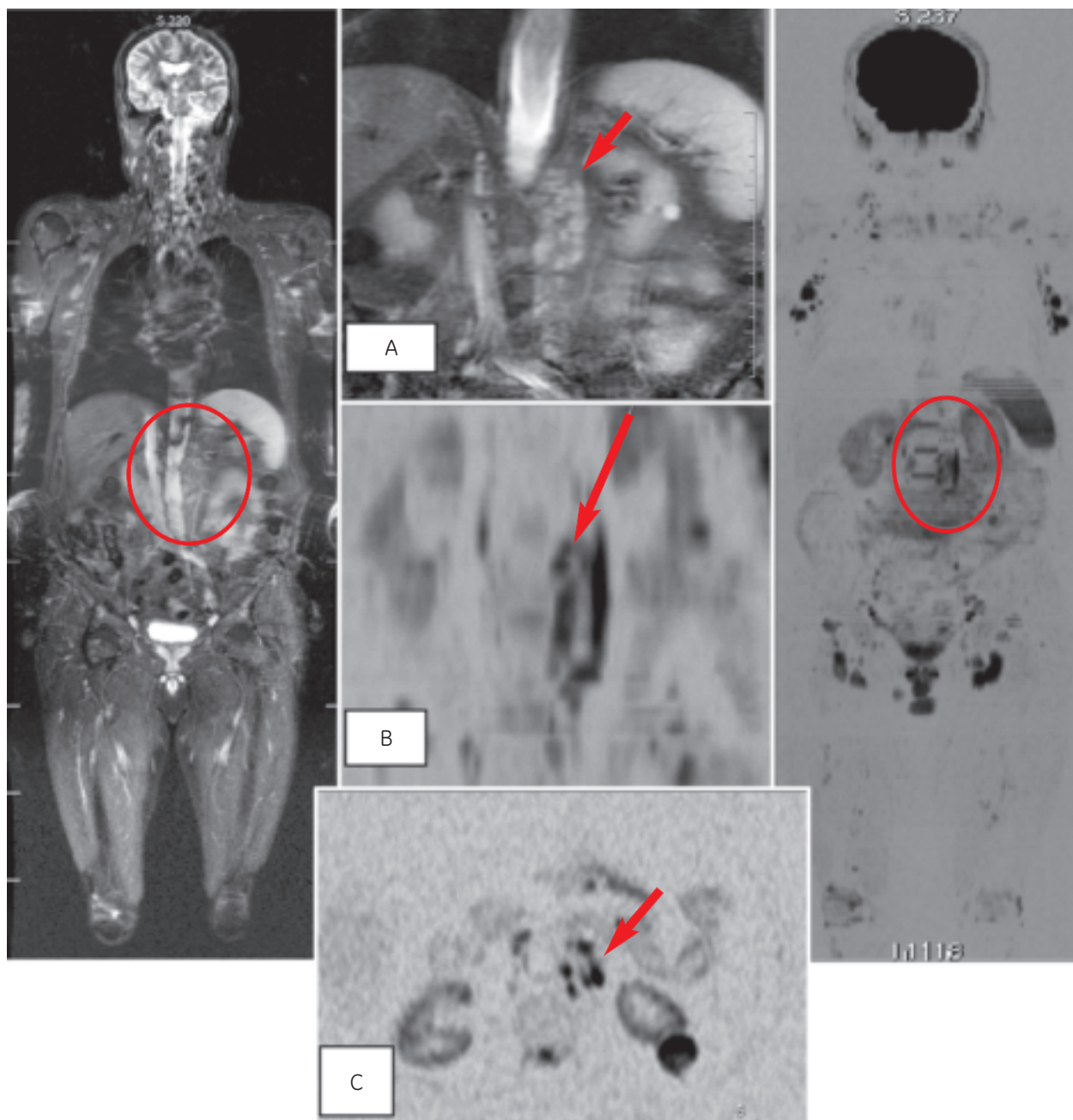
(A) Coronal 3D LAVA acquisition after gadolinium administration

(B) Coronal STIR acquisition

(C) Axial DWI acquisition

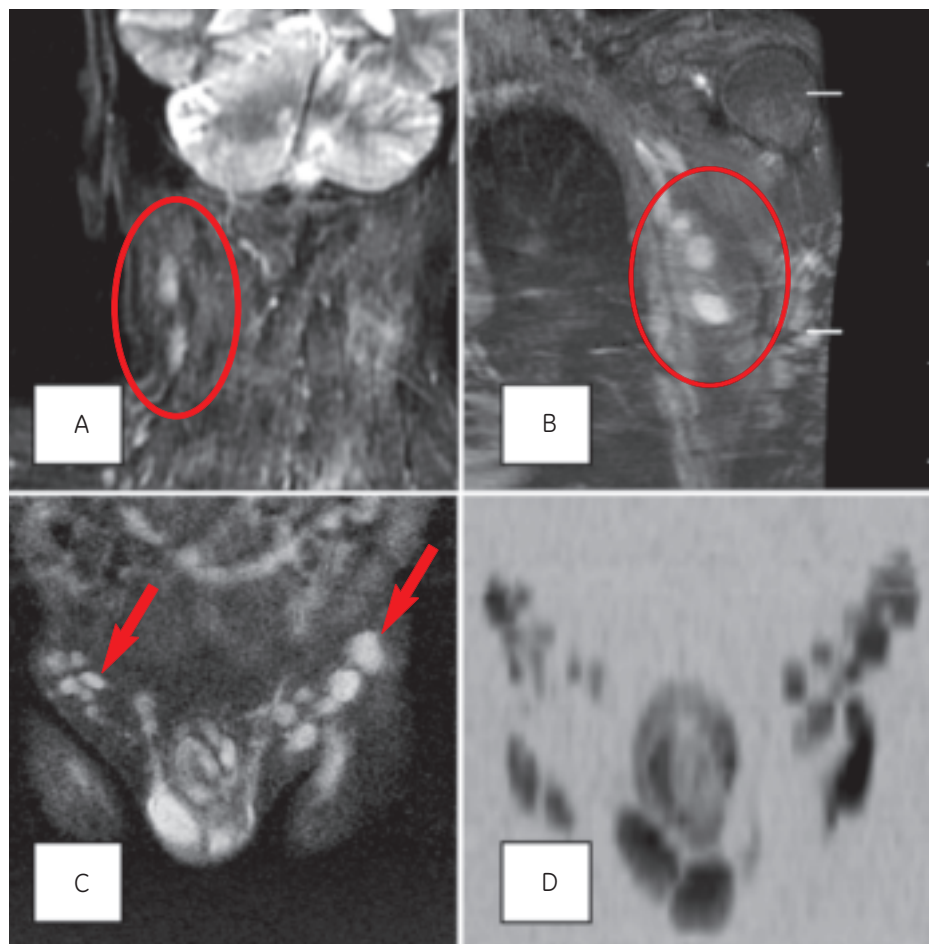
(D) PET/CT

### Case 3 (continued)



- (A) STIR
- (B) DWI: Suspicious signal intensity of retroperitoneal lymph nodes of normal size
- (C) DWI: The axial view (native acquisition plan) avoids partial volume and allows the right location of the lesions using kidneys, vertebral bodies and aorta as anatomical references. Lymph nodes are clearly identified as para-aortic lesions.

### Case 3 (continued)



DWI acquisition using a b-value of 600 s/mm<sup>2</sup>

(A) STIR: Hyper-signal intensities demonstrating right cervical (jugular) lymph nodes

(B) STIR: Left axillary lymph nodes

(C) STIR

(D) DWI: Bilateral inguinal lymph nodes of variable size in hyper-signal

### Discussion

MRI found more suspicious lymph nodes (retroperitoneal and inguinal) compared to PET/CT. The malignancy of the entire left inguinal lymph group (missed by PET/CT) was confirmed by biopsy.

In this examination, MRI findings impacted the therapeutic strategy as N-staging was reclassified as a Stage III and not II as originally reported based on PET/CT scans.

### Conclusion

Despite these findings, DWI should still be considered an emerging technique for this type of examination and will require further validation. The team at The Military Hospital of Laveran systematically include a DWI acquisition for all protocols in a patient's cancer examination. ■

# Imaging a Horizontal Heart – No Problem

*By Leena Mammen, M.D., Advanced Radiology Services, PC*

With (MR Echo), we were able to get the standard cardiac imaging planes, which would have either not been obtainable by conventional methods or would have taken an extensive amount of time by acquiring multiple oblique scan planes.

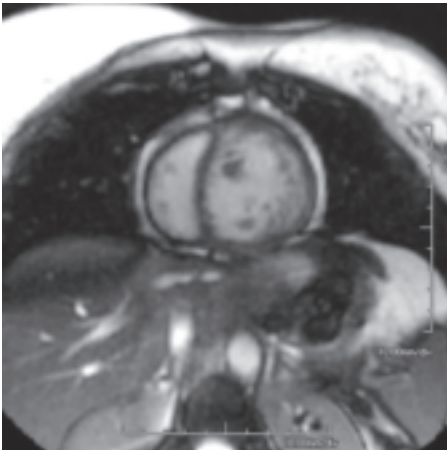
The following case study illustrates the unique clinical utility of MR Echo™, a GE Healthcare cardiac MR application, in the diagnosis of an unusual cardiac structural abnormality. The cardiac MR examination was performed on the GE Signa® HDx 1.5T MRI system with an 8-channel cardiac coil.

## Clinical Case

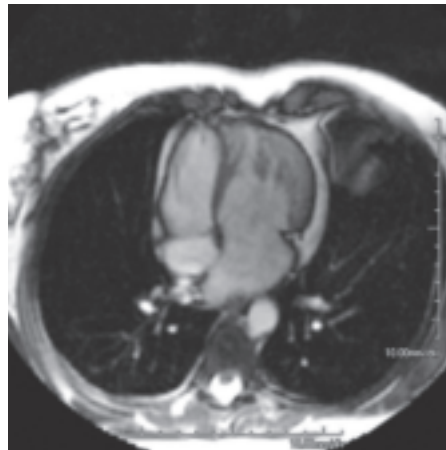
A 39-year-old female was found to have multiple nonspecific ECG abnormalities during a routine physical examination. She was then referred to a cardiologist for analysis of her ECG. An echocardiogram was attempted in the cardiologist's office but diagnostic images were not obtainable. Despite the patient's small stature, all attempted echocardiographic windows failed to produce identifiable cardiac anatomy. She was then referred for a cardiac MR examination for evaluation of cardiac anatomy and function.

The preliminary images of the heart revealed altered anatomy with a horizontally positioned, midline heart. The heart was entirely substernal, which explained why she had no echocardiographic windows. The typical scan plans – 4 chamber, 3 chamber and short axis views of the heart – were not effective in this patient. However, the new MR Echo real-time imaging application allowed us to interactively change scan planes on the fly. With this new imaging sequence, we were able to get the standard cardiac imaging planes, which would have either not been obtainable by conventional methods or would have taken an extensive amount of time by acquiring multiple oblique scan planes. This cardiac MR examination conclusively diagnosed the patient with the complex cardiac condition known as congenitally corrected transposition of the great vessels.

Congenitally corrected transposition of the great vessels is a rare cardiac defect, present in less than one percent of those with congenital heart disease. It is associated with conduction system abnormalities and other structural cardiac defects. The aortic outflow tract is anterior and to the left of the pulmonary artery outflow tract. The ventricles are transposed with the morphologic right ventricle on the left and the morphologic left ventricle on the right. Venous blood from the body enters the right atrium, traverses the mitral valve, enters the morphologic left ventricle and then exits through the pulmonary valve and pulmonary arteries to the lungs. The pulmonary venous blood then returns to the left atrium, passes through the tricuspid valve and enters the morphologic right ventricle. The blood then goes through the aortic valve to the aorta.



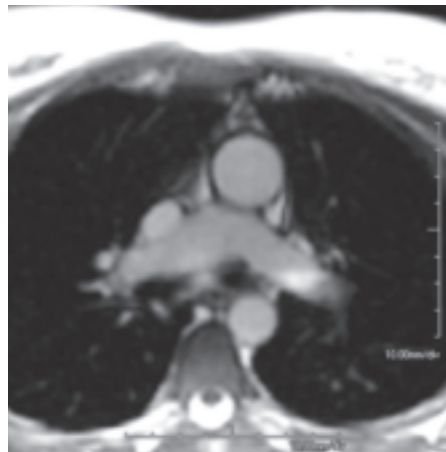
Short axis view of the heart obtained after MR Echo.



4 Chamber view showing a horizontally oriented heart, entirely substernal.



3 Chamber view showing the aorta arising from the LV in an anterior location.



Axial view of the upper thorax shows the aorta anterior to the main pulmonary artery.

## MR Echo

MR Echo is part of the GE Healthcare advanced cardiovascular suite of applications and coil phase arrays. Beyond its advantage as a time-saving sequence, MR Echo also allows the operator to image the heart in any scan plane or orientation, even with non-breath-hold acquisitions if needed.

## Conclusion

As the only real-time sequence available, MR Echo is useful for obtaining unconventional scan planes and for use in patients with variant cardiac anatomy who may be difficult to image with traditional oblique plane imaging. We currently use the application on all cardiac MR cases since it provides the best scan plans in the heart. In this particular case, MR Echo assisted us in imaging and diagnosing this patient's unusual heart and great vessel anatomy. ■



Leena Mammen, M.D.

Dr. Leena Mammen is a radiologist specializing in cardiac and abdominal imaging for Advanced Radiology Services, PC, which serves seven healthcare systems including Spectrum Health.

### About Advanced Radiology Services, P.C., Grand Rapids, MI

With nearly 100 radiologists, Advanced Radiology Services PC, is one of the largest subspecialty radiology practices in Michigan. The group provides diagnostic and interventional radiology services to multiple healthcare systems. All of the radiologists at Advanced Radiology Services are board-certified and many have completed a Fellowship and/or have obtained a Certificate of Added Qualification in their respective subspecialty, further ensuring delivery of the region's highest level of specialized radiology services.

### About Spectrum Health Hospitals Grand Rapids, MI

Spectrum Health is one of the nation's top integrated healthcare delivery systems, earning 40 national awards since it was founded in 1997. As a regional leader in quality performance and increasing patient safety, Spectrum is dedicated to delivering personalized care at each of its seven nationally-accredited hospitals.

Spectrum operates six different GE MR scanners – five 1.5T and one open 0.7T – and performs over 2,900 MR cases per month, of which 30 cases are cardiac exams conducted at Butterworth Hospital. The MR scanner used in this case was originally a Horizon LX 1.5T that underwent a software upgrade to HDx software. All five 1.5T scanners were upgraded with new software and hardware to the GE Signa HDx platform in 2006.

# Making Your Move into Breast MRI Simple



Breast MRI is a growing clinical imaging modality, particularly for those women who are determined to be at high risk. On March 28, the American Cancer Society (ACS) released new recommendations for the use of MRI for women at increased risk for breast cancer. This was a result of an expert panel organized by ACS that reviewed additional evidence since it last convened in 2003. The new recommendations for annual MRI screening, in addition to mammography, apply to women who:<sup>1</sup>

- have a BRCA 1 or 2 mutation
- have a first-degree relative with a BRCA 1 or 2 mutation that are untested
- have a lifetime risk of breast cancer of 20 to 25 percent or more using standard risk assessment models
- received radiation treatment to the chest between ages 10 and 30, such as Hodgkin Disease
- carry or have a first-degree relative who carries a genetic mutation in the TP53 or PTEN genes (Li-Fraumeni syndrome and Cowden and Bannayan-Riley-Ruvalcaba syndromes).

For some women, however, the jury is still out on whether MRI screening is beneficial, even though they have conditions that do give them a higher-than-average risk of breast cancer. The guideline says there still isn't enough evidence to recommend for or against MRI screening in women who have:

- a 15%-20% lifetime risk of breast cancer, based on one of several accepted risk assessment tools that look at family history and other factors
- lobular carcinoma in situ (LCIS) or atypical lobular hyperplasia (ALH)

- atypical ductal hyperplasia (ADH)
- very dense breasts or unevenly dense breasts (when viewed on a mammogram)
- already had breast cancer, including ductal carcinoma in situ (DCIS)
- Screening MRIs are not recommended for women with a lifetime risk of breast cancer below 15%.

Several risk subgroups were also identified; however, data is insufficient to either recommend for or against MR screening. These subgroups are: women with a personal history of breast cancer; carcinoma in situ, atypical hyperplasia; and extremely dense breasts on mammography.

The clinical requirements for breast MR include higher spatial resolution for improved morphology, temporal resolution for contrast uptake curves to aid specificity, increased diagnostic confidence and simplified post-processing and visualization. To address this growing need, GE Healthcare has developed a complete portfolio for breast MRI, including VIBRANT™, a high-density 8-channel surface coil, BREASE™ for spectroscopy and an integrated CAD analysis package from Confirma™ (Kirkland, WA). The entire family of GE Healthcare's Signa® 1.5T and 3.0T MR systems offer advanced applications for breast imaging.

With **VIBRANT** and **VIBRANT XV**, clinicians no longer must choose between scanning for structural detail and scanning rapidly for contrast uptake information – critical to breast imaging. VIBRANT also allows clinicians to acquire bilateral breast images in the sagittal or axial plane with the same high resolution as a unilateral MRI breast exam. The application

“Immediately you notice that the images obtained using the Signa 3.0T HDx and the new HD 8-channel breast array coil are striking.”

*Dr. Robert Lavayssiere*

also uses a breast-specific spectral inversion technique, a unique bilateral shim method and an automated image subtraction technique for reliable fat elimination.

The benefits of VIBRANT-XV include isotropic dynamic imaging – the ability to visualize data in any plane with no loss of detail; enhanced depiction of lesion boundary with a 1024 matrix; and the highest clinically useful acceleration available today.

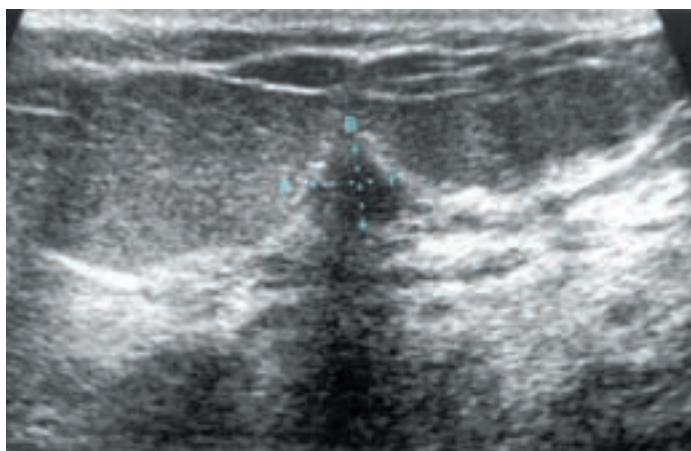
**BREASE** is a breast specific single-voxel spectroscopy application that increases specificity by providing additional lesion characterization and assessment of early treatment response. It is a proton spectroscopy application optimized

specifically for the breast that uses a signal detection technique to show elevated concentrations of choline. BREASE is a TE-averaged, PRESS spectroscopy acquisition compatible with a 4-, 7-, or 8-channel breast coil.

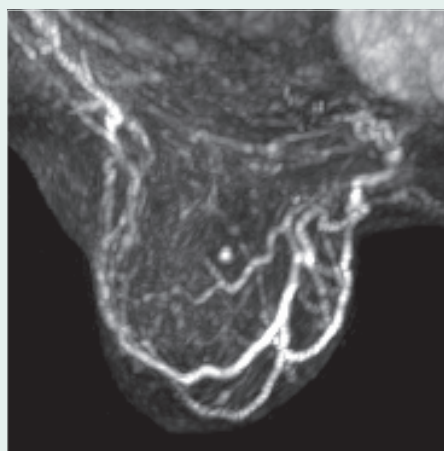
GE's **High-Density (HD) 8-channel Breast Array**, the newest addition to GE's comprehensive Breast MRI portfolio, provides best-in-class signal-to-noise ratio and uniform coverage of the breast and axillary tissue. The coil can be used for bilateral or unilateral imaging and is optimized for ASSET (can achieve an ASSET factor of 3) and VIBRANT (enables an acceleration factor of 4 with VIBRANT-XV) applications.

## Case 1

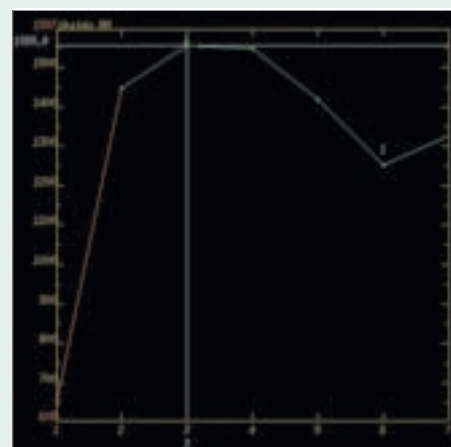
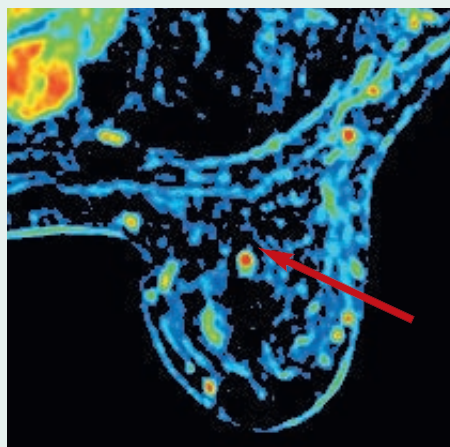
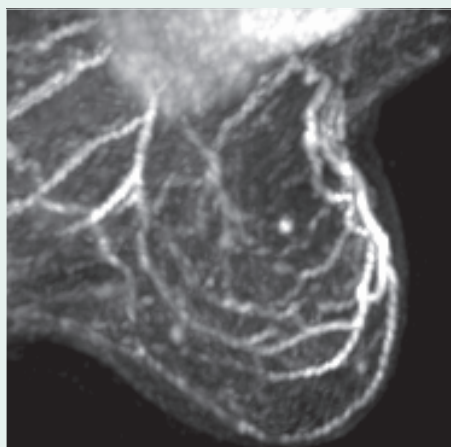
56-year-old woman: follow-up after surgery of a lobular cancer in 2000.

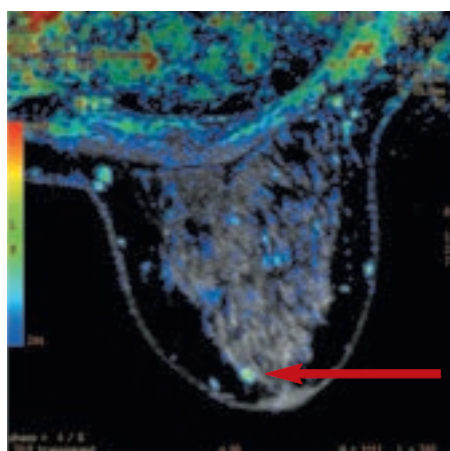
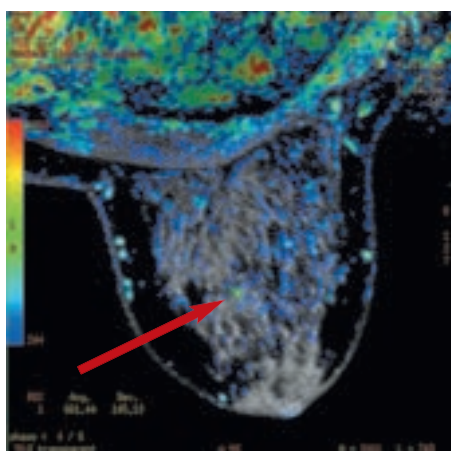
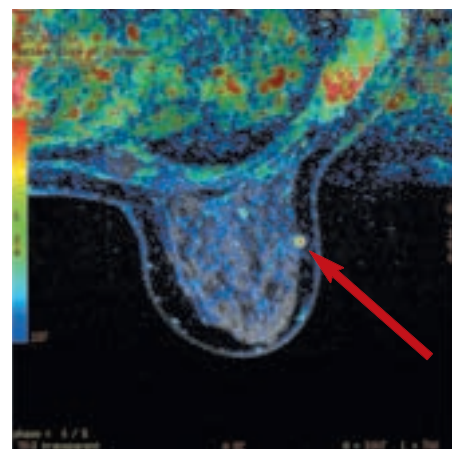
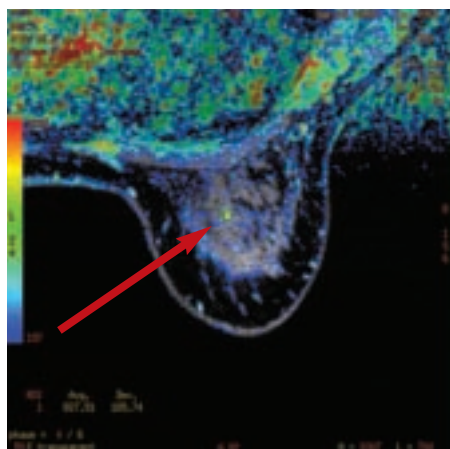
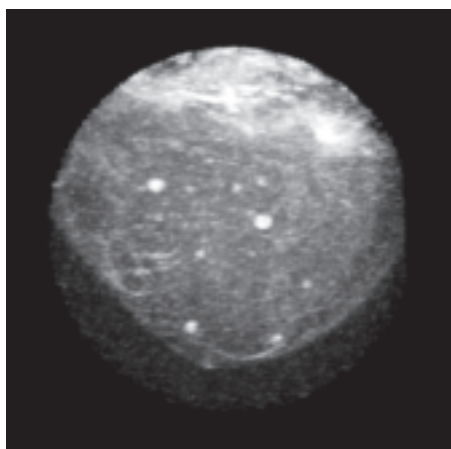


Ultrasound showed only one lesion.



1.5T MR exam done one week before also showed only one lesion.





3.0T MR exam with VIBRANT-XV sequence revealed four lesions.

## An Urgent Health Issue

Breast cancer remains a leading cause of premature death in women. The American Cancer Society (ACS) reports that breast cancer is the most common cancer among women, other than skin cancer, and is the second leading cause of cancer death in women, after lung cancer.

Approximately 178,480 women in the United States will be found to have invasive breast cancer in 2007, the ACS estimates. At present, slightly more than two million women living in the United States have been treated for breast cancer.

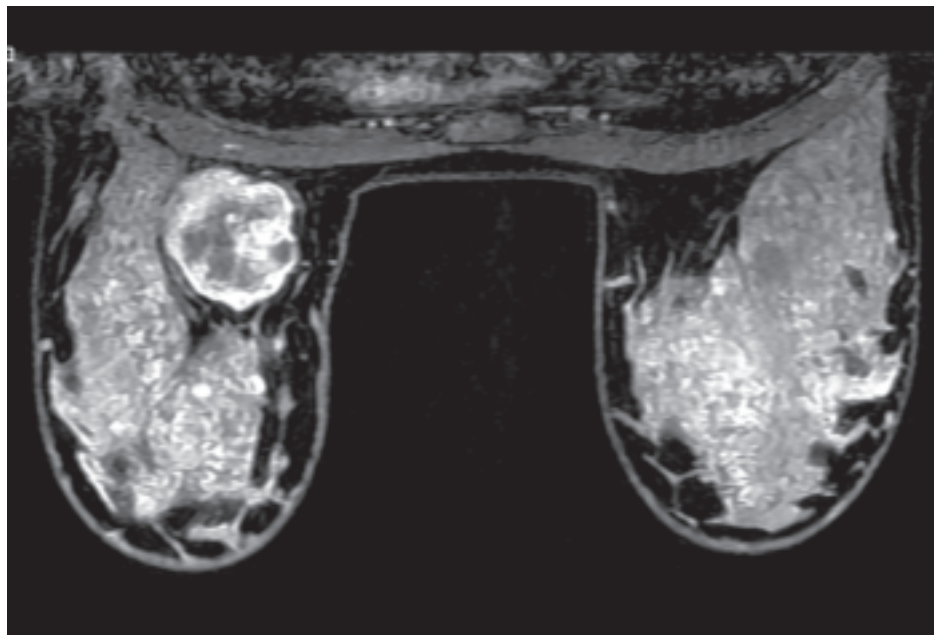
The chance of a woman having invasive breast cancer at some time during her life is about 1 in 8. The chance of dying from breast cancer is about 1 in 33. Breast cancer death rates are going down. The decline is probably the result of finding the cancer earlier and improved treatment.

## Imaging Challenges

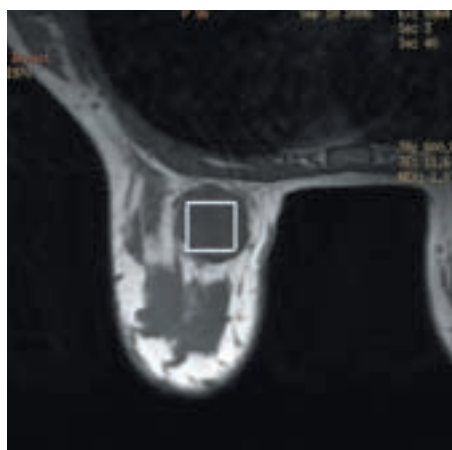
- 1 in 3 breast cancer patients has undiagnosed multi-focal disease.
- 1 in 20 breast cancer patients has undiagnosed bilateral disease.

## Case 2

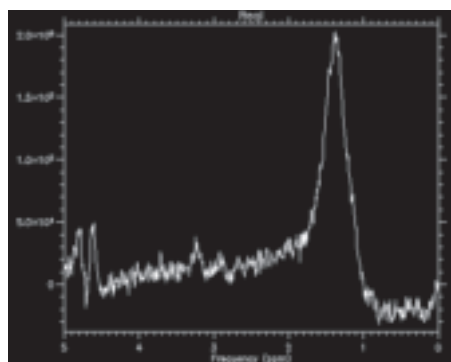
36-year-old woman: Grade III carcinoma.



VIBRANT-XV  
TR 10.5/TE 4.3/TI 26  
Matrix 756 x 288  
BW 83, 0.74 nex  
1.5 mm slice thickness  
1 min 44/phase  
Acceleration factor 2.37



Spectroscopy voxel location onto the reference image.



Resulting spectrum showing a choline peak within suspected lesion.

"Immediately you notice that the images obtained using the Signa 3.0T HDx and the new HD 8-channel breast array coil are striking," said Dr. Robert Lavayssiere, IRM Paris Nord (Sarcelles, France). All 3.0T images were obtained at CHNO des Quinze-Vingts Hospital (Paris, France). "They are high-quality artifact-free images with very good contrast due to very efficient fat saturation and good signal-to-noise ratio despite small slice thickness. The 3D MIP reconstructions from subtracted images are very good and moreover very useful for spatial localization and clinical display.

"The potentials of 3.0T breast imaging include better dynamic acquisition for a higher spatial resolution and better spectroscopic resolution, leading to more accurate evaluation and diagnosis," added Dr. Lavayssiere. ■

#### Reference:

1. American Cancer Society Guidelines for Breast Screening with MRI as an Adjunct to Mammography. CA Cancer J Clin 2007;57:75-89. Press release also available at: [www.cancer.org](http://www.cancer.org).

# More Efficient Workflow and Accurate Diagnosis with Breast MRI CAD

As clinical indications for Breast MRI studies continue to expand, so too does the amount of data produced for each exam. Computer-aided detection (CAD) can facilitate more rapid interpretation of the MR study in a standardized and efficient manner. GE has partnered with Confirma™ (Kirkland, WA) to offer CADstream™, the first CAD application designed exclusively for MRI, to users of the GE Signa® MR family.

CADstream's automated processing of MRI studies helps standardize the way studies are analyzed and reported, further enhancing clinical efficiency. Automated processing includes detection and removal of cardiac artifact, image registration to correct for patient movement, subtraction images, multiplanar reformats, Angiogenesis maps and curves, maximum intensity projections (MIPs) and volume summaries.

Lesion(s) of interest selected by the radiologist are automatically placed into a report with reference images, size and location information and radiologist-assigned Bi-RADS® Atlas classification for each lesion.

## More Efficient, Accurate Breast Imaging

For Michael Fisher, M.D., St. Francis Hospital in Indianapolis, the integration of CADstream with a GE Signa MR has resulted in the ability to increase the volume of breast MR studies. "Once we integrated CADstream with our GE MRI equipment, our Breast MRI program became faster and more efficient and accurate," Dr. Fisher said. "CADstream enables more thorough, higher quality image analysis and a standardized process for image interpretation."



St. Francis now performs four to five Breast MRI studies each week, up from one study every three months prior to implementing CADstream. “I really feel that without CAD, Breast MRI is an extremely difficult study,” Dr. Fisher added. “CADstream makes Breast MRI more accessible to patients who can dramatically benefit from this important study.”

### Case in Point

A 49-year-old patient was found to have calcifications in the left breast and underwent stereotactic biopsy, demonstrating Ductal Carcinoma In Situ (DCIS). She then had a surgical lumpectomy showing invasive lobular carcinoma with micrometastasis to two lymph nodes.

A Breast MRI examination processed with CAD found a one centimeter enhancing mass in the left breast away from the lumpectomy site and a large two to three centimeter enhancing mass in the right breast. “A second-look ultrasound exam was negative at these two sites,” Dr. Fisher said. “We then did bilateral MR-guided needle localization and both sites were determined to be malignant. Even with the wires in place after the localization, on mammography we still could not see the lesions in the dense breasts.” The patient subsequently underwent bilateral mastectomy.

### Breast MRI with CAD Creates Time Savings

Hackensack Radiology Group operates two GE Signa 1.5T MR scanners at its outpatient imaging center. “GE is our preferred MR vendor because of the superior image quality of the scanners as well as the robust pulse sequence, VIBRANT, for breast exams,” said Andrew Osiason, M.D., radiologist. Since 2004, the group began using CADstream for all of its Breast MRI cases – from 50 to 100 exams each month.

As a result of the partnership between CADstream and GE, Dr. Osiason notes a unique advantage between MR and CAD vendors. “Because of the relationship between these companies, the two systems work seamlessly together. The CAD sits on the MR console – I don’t know of any other MR system that offers a CAD integrated quite as well as this.”

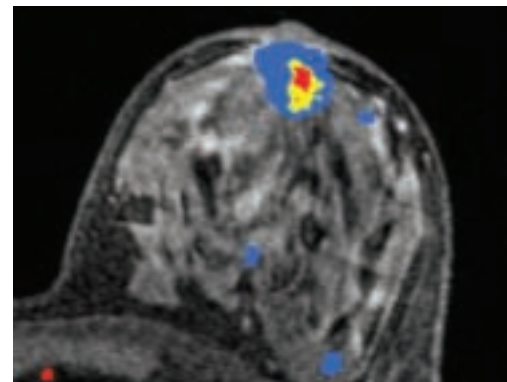
“Once we integrated CADstream with our GE MRI equipment, our Breast MRI program became faster and more efficient and accurate.”

*Dr. Michael Fisher*

#### About St. Francis Hospital Indianapolis, IN

St. Francis Hospital & Health Centers is one of the largest healthcare systems in Indiana with three main facilities in Indianapolis, Beech Grove and Mooresville. The St. Francis Hospital campus in Indianapolis continues to lead the area’s healthcare providers as the only teaching hospital in Indiana to receive the HealthGrades Distinguished Hospital Award for Clinical Excellence for three consecutive years. HealthGrades also ranks the hospital among the top five percent of all hospitals nationwide for overall clinical performance.

As Indianapolis’ newest hospital built in 1995, St. Francis boasts a state-of-the-art facility utilizing the latest medical technology with a strong emphasis on convenient access for both inpatient and outpatient services. The hospital is the only site among the healthcare systems’ 12 sites to offer open, closed and Breast MRI services.

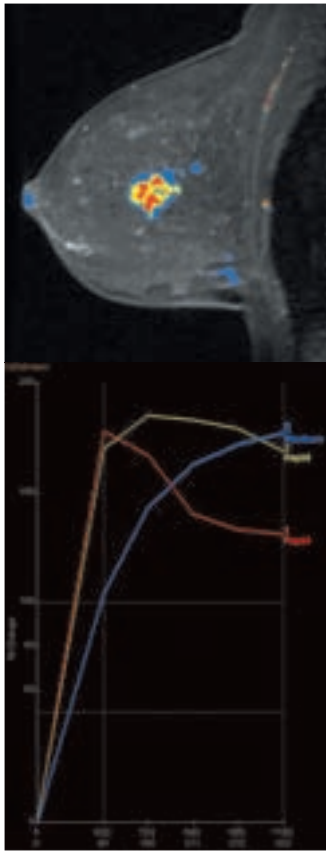


CADstream automates image processing functions and corrects for patient movement during the study.

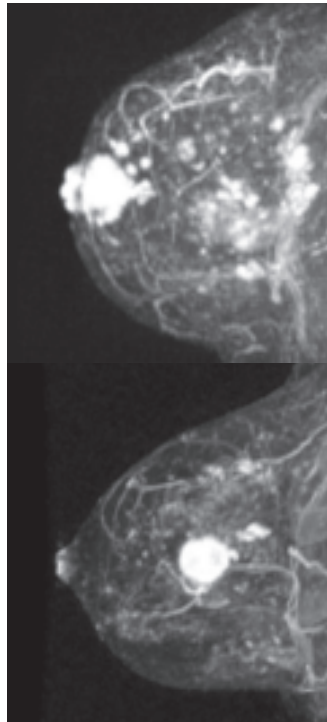
#### About Hackensack Radiology Group Hackensack, NJ

Hackensack Radiology Group (HRG) provides comprehensive radiology imaging and services to Hackensack University Medical Center and the surrounding area. With a rich history of service dating nearly 50 years, HRG is comprised of the region’s leading imaging specialists in all areas of radiology, including neuroradiology, body and vascular imaging, orthopedic imaging and mammography. Two outpatient sites – Newman Street Imaging Center and New Century Imaging Center – offer a full range of imaging services: CT, MRI, ultrasound, nuclear medicine, mammography, bone densitometry, general X-ray and fluoroscopy. HRG has offered Breast MRI with CAD services since 2004.

## TECHNICAL INNOVATION BREAST – CADSTREAM



Developed in accordance with the BI-RADS Atlas, CADstream's Angiogenesis Maps and curves promote standardization that is achieved through consistent thresholds.



CADstream can automatically create MIPs for the entire study or for left or right breast only.

There is no question that the utilization of CAD with Breast MRI has significantly reduced reading time for these studies at Hackensack Radiology Group. "CADstream enables us to review breast MR exams in a concise, consolidated fashion with all the functionality we need to manipulate the image," Dr. Osiason said. While he acknowledges that most CAD will streamline the image review process, it is his opinion that CADstream is the most intuitive and user-friendly breast MR CAD solution on the market today. "CADstream is particularly tuned to how the radiologists evaluate breast MR images," Dr. Osiason explained. "It is the better CAD system to use."

The most significant impact on workflow is the removal of manual post processing. "This alone has increased efficiency and workflow in every step of the process – from the technologist to the report," he added. Data is sent directly from the MR imager to the CADstream server where, after correcting for patient movement, the system automatically creates subtraction images, region of interest summary series and interactive real-time dynamic contrast curves.

With the integrated GE Signa MR and CADstream, Hackensack Radiology Group has been able to maximize return on investment by using the solution to read more Breast MRI cases. "If a facility is at its limit in terms of reading breast MR studies, then CADstream can be used to alter that capacity by helping clinicians read at a faster pace without compromising accuracy." ■

"Because of the relationship between (GE and CADstream), the two systems work seamlessly together. The CAD sits on the MR console – I don't know of any other MR system that offers a CAD integrated quite as well as this."

*Dr. Andrew Osiason*

GE Healthcare



How do you capture  
difficult images?



imagination at work

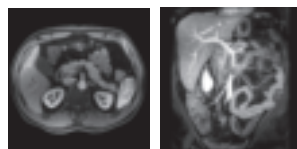
GE Healthcare

# Start by capturing the imagination.

There have always been patients who have been difficult to image. But through the eyes of GE's Signa® High Definition MR, you get a new view of your patients. Clearer and more accurate. So you can diagnose quickly and with more certainty.

## **Applications that make it easy.**

You've never scanned with such ease or confidence. LAVA-XV lets you scan your patient's entire abdomen with one injection. One scan. One breath-hold.



LAVA-XV

Exceptional contrast differentiates between the liver and spleen, revealing the subtle details you need to make the best diagnosis. PROPELLER™ HD helps eliminate the effects of motion. Whether a Parkinson's patient or fidgety child, you get a quality image without sedation or anesthesia.

MR Echo produces high-definition cardiac images in even the sickest patients without breath-holding or ECG gating. VIBRANT lets you examine both breasts at the same time without compromising resolution or scan time. And TRICKS gives you a whole new level of accuracy in timing for vascular imaging with four times the acceleration of traditional MR angiography.



#### **Technology that sets the pace.**

Signa HD systems keep up with the way you work. Their parallel imaging algorithms and reconstruction computing power

give you all the data-intensive images you need with no waiting. Plus, our broad portfolio of simple-to-use Signa HD high-density coils, like the integrated head, neck and spine array, provide the highest signal-to-noise ratio with the highest element count. So you get quality images every time.



#### **More innovative. More friendly.**

The speed of our Signa HD machines makes it easy to scan more patients every day. The user interface is so simple and intuitive it is easy to quickly become a power user. Whether a technologist is using a 1.5T scanner or a 3.0T, scanning is just a click away. Our detachable dual tables are an

innovation in patient care. Prep one patient while you scan another. Quickly move a patient in the event of an emergency. And easily integrate upgrades like focused ultrasound ablation technology.

## GE Healthcare

### An MR for every facility and every body.

#### **3.0T – Signa HDx 3.0T, Signa HD 3.0T.**

Signa is the 3.0T leader, with the most 3.0T systems installed worldwide. Capture detail you couldn't see before. High-performance, high-definition imaging capabilities help you diagnose your most challenging cases.



#### **1.5T – Signa HDx 1.5T, Signa HD 1.5T, Signa HDe 1.5T.**

Powerful, high-definition MR delivers a more definitive image and a full complement of applications. Choose the highest performance Signa HDx, the 16-channel Signa HD or the smaller and simpler Signa HDe that takes up 30% less space.

#### **Open – Signa OpenSpeed, Signa Ovation, Signa Profile.**

The open experience of our Open MR family helps reduce patient anxiety while the remarkable resolution and high-performance applications give you more access, more image quality and more peace of mind.

#### **MR Guided Focused Ultrasound.**

Treat uterine fibroids non-invasively without an incision. All GE Signa MR systems are exclusively compatible with InSightec™ technology that helps you expand your spectrum of care.

#### **Service to keep you up and scanning.**

GE offers more worldwide support than any other MR available today. We have more service engineers. More application specialists worldwide. More parts distribution centers. You also get more physician training options. Even a remote diagnostic and solutions network for real-time, on-line support.

#### **The GE Continuum.™**

##### **Designed for what's next.**

Every GE MR system is designed with the future in mind. That's the Signa Continuum. Easy upgrades keep your technology current and competitive. And make your investment last.

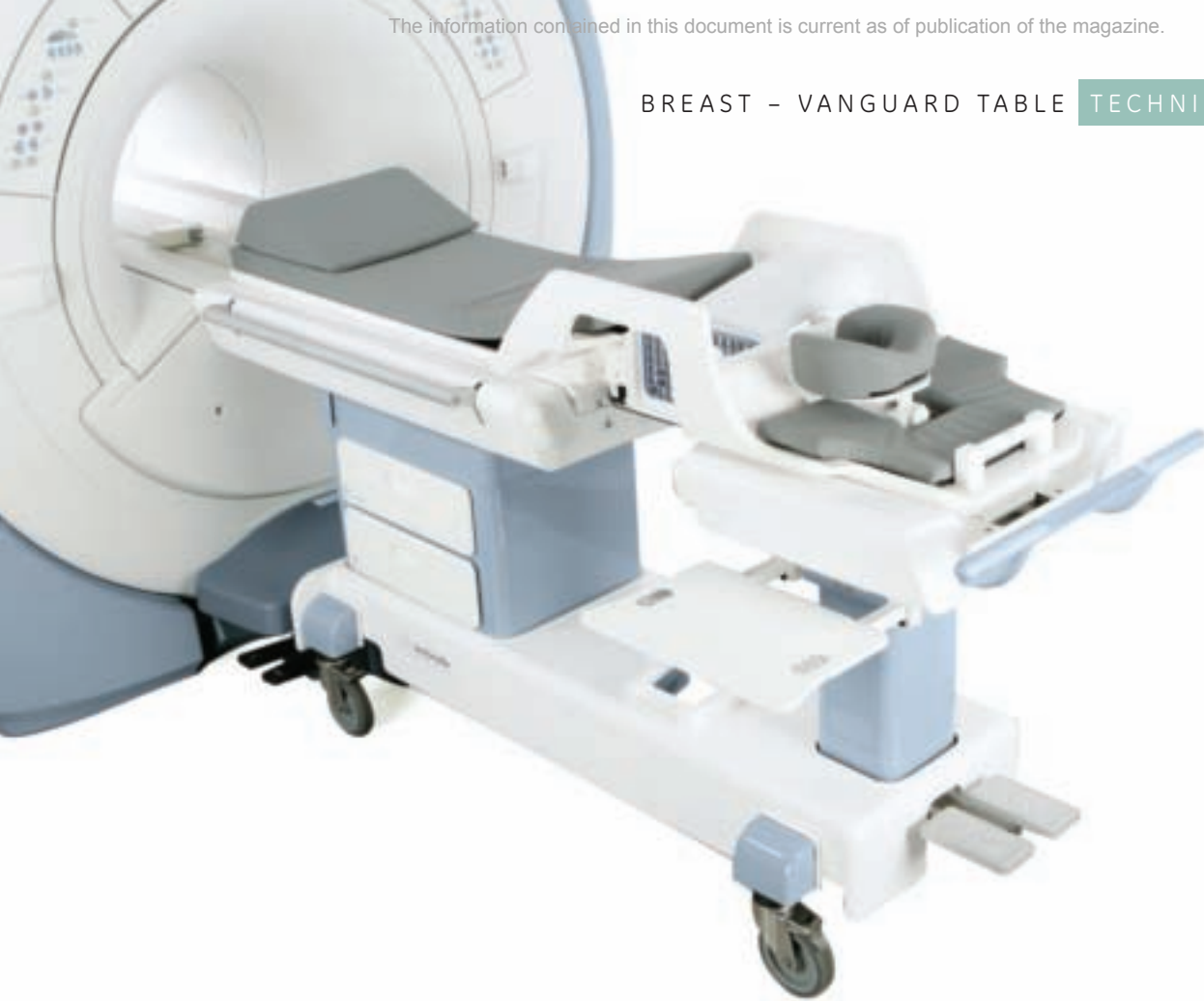
Capturing images you could once only capture in your imagination.

##### **MR Re-imagined.**

To learn more visit [www.gehealthcare.com/re-imagine](http://www.gehealthcare.com/re-imagine)



imagination at work



## Detachable Table Plugs Your Practice into Breast MRI

The unique detachable table design of the Signa® family of MR systems enables access to exciting technological advances that can improve patient care. GE Healthcare recently announced collaboration with Sentinelle Medical Inc. (Ontario, Canada) for the exclusive use of its Vanguard™ system.

Developed and sold by Sentinelle, Vanguard can transform a GE Signa® HDx 1.5T MRI into a dedicated breast imaging and interventional system. Unique to this system is Variable Coil Geometry (VCG) – an innovative departure from the fixed coil geometry found with other MR breast coils. VCG allows the technologist to position the coils directly against the breast. When used in conjunction with a Signa HDx 1.5T MR system, Vanguard provides exceptional signal-to-noise ratio for Breast MRI and, therefore, superb image quality.



With a large grid and complete and open medial and lateral access, clinicians can perform interventions on lesions in all quadrants of the breast, including lesions in difficult positions such as the upper-inner quadrant. A patented patient support design, positioning system and surgical grade padding ensures comfort for all patients regardless of size. The unique dedicated table design allows patient exam preparation outside of the MR suite to further maximize patient throughput.

The Vanguard detachable table is available for purchase directly from Sentinelle Medical, and gives Signa customers exclusive access to this exciting new technology to further advance breast MR imaging and intervention.



## TECHNICAL INNOVATION BREAST – VANGUARD TABLE

### About Sunnybrook Health Sciences Centre Toronto, Canada

Sunnybrook opened its doors in 1948 as the largest veterans' hospital in Canada. As the need for public hospital services increased, Sunnybrook became affiliated with the University of Toronto as a teaching hospital in 1966 and began providing patient care services to the general public. By the early 1990s, the facility had established six major program priorities: Aging, Cancer, Community Health, Heart and Circulation, Mental Health and Trauma. With over 1,200 beds and a staff of 11,000, physicians, volunteers and students, residents throughout the province of Ontario rely upon the expertise of one of Canada's premier academic health sciences centres. During 2005 and 2006, over 123,000 MR studies were performed on two GE Signa HDx 1.5T MR scanners. Dr. Causer and Joan Glazier are part of the Clinical Breast Imaging Research Team at Sunnybrook Health Sciences Centre and have published several articles on breast MR imaging and intervention. Most recently, Dr. Causer was one of the investigators who contributed to the newly-released ACS guidelines for Breast MRI screening. Dr. Causer has collaborated with clinical and scientific colleagues as co-investigator on several research studies using Breast MRI and ultrasound for the screening of women at high risk for breast cancer. She is currently researching co-registration of these imaging modalities for guided interventions for tumor localizations and biopsies.

### Dedicated Breast MR Solution Optimizes Workflow, Increases Patient Throughput at Sunnybrook

Sunnybrook Health Sciences Centre, a Center of Excellence in Toronto, Canada, realized several years ago that there was a need to optimize their breast MR imaging and intervention program for high-risk patients. The facility now uses the Sentinelle Medical Vanguard system with its GE Signa 1.5T MR systems. With the Vanguard's unique VCG, they are able to obtain higher signal-to-noise ratios translating to faster scan times that optimizes workflow and increases patient throughput.

The number of patients receiving MRI-guided biopsies has quadrupled since 2001, claims Dr. Petrina Causer, Radiologist and Associate Scientist at Sunnybrook. "We are biopsying smaller and smaller lesions and require the necessary setup, imaging protocols and biopsy systems to allow us to get these lesions."

When routinely targeting three and four millimeter lesions, Dr. Causer requires solid compression and a large grid for accessing all quadrants of the breast. "The Vanguard allows us to target lesions in the upper outer and upper inner quadrants of the breast," noted Dr. Causer.

Joan Glazier, technologist at Sunnybrook, has been integral in optimizing the breast MR interventions. She believes that one of the most important aspects of MR-guided biopsies is patient preparation. "We have the ability to prepare our patients in a room outside of the MR suite," stated Glazier. "It is easier and faster to set the patients up when they are not being intimidated by the sights and sounds of an MR scanner." This means a total reduction of time in the MR Suite by 15-20 minutes.

The Vanguard resembles a stereotactic breast biopsy table that allows the technologist to pull breast tissue away from the chest wall. The interventional grids can move medially and laterally, as well as anteriorly and posteriorly. Glazier uses one hand to hold the breast and the other hand to move the grids and lock them into place. "We can have absolutely no movement of the breast or the interventional grid during our procedures," said Glazier. "This system is extremely sturdy so we have never had an issue of the grids moving during our procedures." ■



Vanguard™ is a trademark of Sentinelle Medical Inc.  
It is manufactured and distributed directly by Sentinelle.

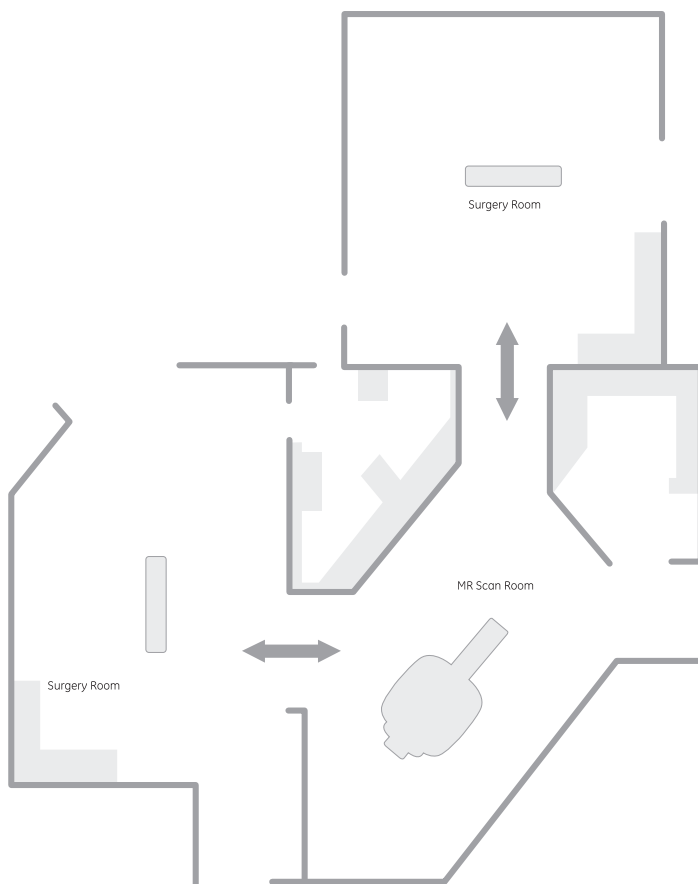
# The Next Big Idea: MR-Guided Neurosurgical Suite

An ambitious program by GE Healthcare and Barrow Neurological Institute (BNI) at St. Joseph's Hospital and Medical Center is implementing the next generation of MR-guided intra-operative surgical solutions. This new concept includes the world's most comprehensive portfolio of neuro-imaging solutions, such as GE Signa® 3.0T High Definition MR and 3D imaging to plan, navigate and validate treatments to help increase both the accuracy and speed of interventions.

At BNI, the GE MR Surgical Suite is comprised of a standard Operating Room (OR) interconnected to an adjoining MR room, providing the capability for multiple OR intra-operative imaging interconnectivity. At BNI 11 ORs have intra-operative imaging capability through either direct or remote connectivity utilizing a sterile corridor. Surgery is conducted on a an ALPHAMAQUET 1150 (GETINGE AB, Solna, Sweden) surgical table modified with a GE exclusive MR/X-ray compatible interchangeable docking and transfer board technology in either a mobile or fixed column base. The suite can interconnect three or more standard ORs and facilitates patient transfer with GE's industry-exclusive detachable MR table design with the Liberty™ docking system.



## TECHNICAL INNOVATION INTERVENTIONAL – MR SURGICAL SUITE



Example of an MR-guided neurosurgical suite floor plan showing two surgery rooms interconnected to an adjoining MR scan room.

MR/X-ray compatible OR table system and real-time imaging is performed on the GE Signa® HD 3.0T MR scanner. Uniting the MR system and multiple ORs is a state-of-the-art transport system that enables patients to be moved quickly and safely from MR to OR – and vice versa – during surgical, minimally-invasive or therapy procedures. The patient is positioned on the transfer board and remains on it during the entire patient care process. Maintaining the patient on the transfer board simplifies the patient care process by eliminating lifting and repositioning by OR staff.

“Pre-operative imaging detects and defines tumors, but during surgery the anatomy can be distorted and the degree of tumor resection may be difficult to estimate,” said Robert Spetzler, M.D., Neurosurgeon and Medical Director of Barrow Neurological Institute. “This technology will allow us to reevaluate and update our information allowing safer and more complete tumor resection. This improves our ability to get maximum tumor resection while reducing the rate of complications. I am excited by the ability of utilizing our 3.0T intraoperative MRI scanner to improve the outcomes of our patients.”

### Exclusive Technology Sweetens the Concept

The MR Surgical Suite concept provides high-resolution image capabilities for surgical planning and intra-operative imaging in a near real-time surgical setting. Key to the neurosurgeon is providing intra-operative MR imaging, and flexible, open architecture to meet future clinical needs without compromising the way they perform surgery today. Integrated into the design is a two-room concept and transfer process. GE Healthcare and Maquet collaborated to develop an exclusive MR and X-ray compatible transfer board

“As a surgeon, the ability to take any table top which is fully functional in any one of our 11 operating rooms and transfer the table top and dock it to the 3.0T MRI scanner during surgery provides us with impressive versatility.”

*Dr. Robert Spetzler*

solution that integrates with GE's detachable MR Signa table. All of the table platforms are docked interchangeably to allow the patient transfer board to easily transition between them. Two surgical table configurations are available. The dual pedestal on rails is designed for customers who want a single OR interconnect and very controlled automated patient transfer. The 1150 surgical table enables two or more ORs to be interconnected for intraoperative imaging.

"As a surgeon, the ability to take any table top which is fully functional in any one of our 11 operating rooms and transfer the table top and dock it to the 3.0T MRI scanner during surgery provides us with impressive versatility. Cases in which an intraoperative scan may or may not be needed will still be allowed to be scanned as needed without otherwise tying up a single dedicated MRI OR. Thus the full functionality of an OR with its non-MRI-compatible hardware can still be used to its full advantage," noted Dr. Spetzler. "Finally the location of the intraoperative MRI scanner allows the scanning of patients as they leave the operating room or patients located in the recovery room. It can even accommodate patients in nearby ICUs if the scanner is sitting idle making the financial investment more viable."

GE partnered with Integra™ Mayfield® (Plainsboro, NJ), who developed an exclusive design for a fully-functional skull clamp that is Signa 1.5T and 3.0T MR and X-ray compatible. A three-point fixation and six degrees of freedom give the surgeon complete flexibility for proper patient approach positioning for both adults and pediatrics. Quick detachable navigation arms are integrated into the surgical clamp for an open architecture, which allows integration of multiple manufacturer's navigation systems.

Surgical head coils for both 1.5T and 3.0T systems are another GE exclusive in the MR Surgical Suite solution. The 6-channel RF Flex coils are designed to work seamlessly with the skull clamp and OR equipment. Quick connectors built into the table provide safety in an easy to use configuration. ■

#### About the Barrow Neurological Institute, Phoenix, AZ

The Barrow Neurological Institute at St. Joseph's Hospital and Medical Center is an internationally recognized center of excellence involved in research, education and caring for patients from around the world. The hospital actively participates in ongoing clinical and basic neuroscience research to further the prevention and treatment of brain, nerve and spinal cord diseases and injuries. The new Barrow Neuroscience Tower houses eleven state-of-the-art neurosurgical operating rooms, the largest neurosurgical facility in the country, and is the setting of the 3.0T MRI intraoperative suite.



Fully-functional skull clamp, a GE-exclusive design developed by Integra Mayfield.

ALPHAMAQUET 1150 is manufactured by MAQUET a subsidiary of GETINGE AB (Solna, Sweden).

Mayfield® is a registered trademark and Integra™ is a trademark of Integra Life Sciences (Plainsboro, NJ).



## When Good Cartilage Goes Bad

“These images provide us with quantitative information about the cartilage ultrastructure. In this case (Case 1), it may aid in timing patellar realignment procedures.”

*Scott A. Rodeo, M.D.  
Orthopedic Surgeon  
Director, Sports Medicine  
Hospital for Special Surgery*

“The quantitative T2 mapping has allowed us to discern cartilage breakdown prior to alteration in cartilage thickness. Note the blister formation over the lateral facet, where the cartilage appears relatively normal on the FSE sequence.”

*Hollis G. Potter, M.D.  
Chief, Magnetic Resonance Imaging  
Hospital for Special Surgery*

## MR Musculoskeletal Imaging

The suite of musculoskeletal imaging solutions from GE Healthcare includes high-resolution imaging capabilities and clinical applications that aim to provide the physician with the appropriate tools to increase diagnostic confidence. One such application, CartiGram™, is a non-invasive imaging method that is ideal for the early evaluation and assessment of cartilage breakdown, particularly to assess articular cartilage integrity. It allows better visualization of collagen fiber network loss or degradation that translates into focal T2 increase. CartiGram provides the radiologist with increased diagnostic confidence and the orthopedic surgeon with the information needed to determine course of treatment, possibly to optimize the timing of a surgical procedure. It also helps with monitoring the effectiveness of treatment non-invasively, potentially eliminating a “second-look” biopsy.

As the collagen component of articular cartilage breaks down, water in the cartilage becomes more mobile and results in a prolongation of T2 relaxation times. CartiGram (T2 relaxation time mapping) is a validated, non-invasive tool to visualize changes in the composition of cartilage, in some cases before changes in thickness can be seen.

## Clinical Utility of CartiGram T2 Mapping

Early detection of cartilage degeneration before the onset of physical symptoms can potentially offer more treatment options for the patient, particularly for those afflicted with osteoarthritis. The application is also useful to assess surgical outcomes by providing a measure of tissue characterization of the repaired tissue. ■

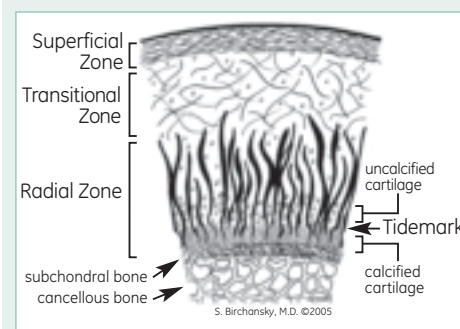
### Articular Cartilage Ultrastructure

#### Components of Articular Cartilage Extracellular Matrix:

1. Proteoglycan
2. Collagen

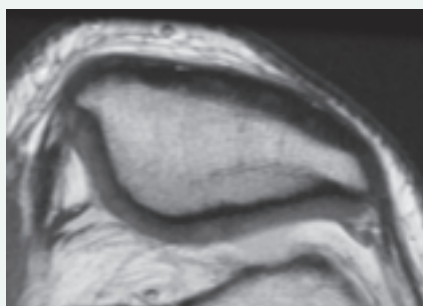
#### Characteristics of Normal Collagen Orientation:

1. Superficial zone (<10%): parallel to surface (beyond resolution of clinical MRI)
2. Transitional zone (20-30%): more random collagen orientation – less angular dependence and longer T2 relaxation times
3. Deep radial zone (40-60%): collagen oriented perpendicular to subchondral zone – strong angular dependence: vertical striations evident and short T2 relaxation times

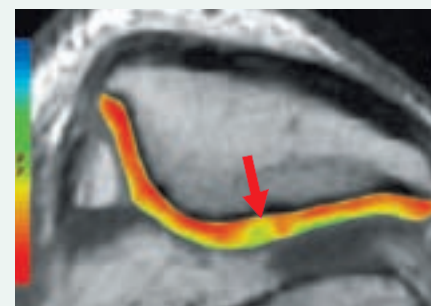


### Case 1

31-year-old man with chronic patellofemoral pain and normal radiographs.



Axial cartilage sensitive FSE demonstrates uniform thickness of cartilage.



CartiGram image demonstrates prolongation of T2 values focally over the lateral facet (arrow), indicating abnormal collagen orientation.

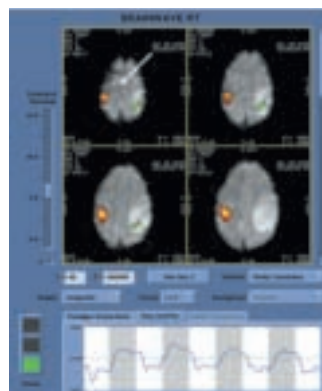
# fMRI Removes the Gray Between Research and Clinical Practice

## 2007 Activation of Reimbursement Codes Will Drive Increases in Patient Studies, New Applications

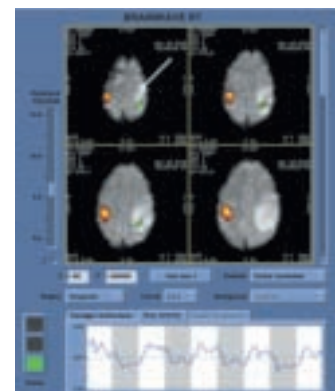
Functional MRI (fMRI) measures metabolic changes that occur in the brain. While it is generally known which areas of the brain control language, cognitive motoric or other functions, exact locations vary for each person. Therefore, while conventional MR provides images of the brain anatomy, fMRI is a powerful, non-invasive tool for mapping the exact positions of the activation areas in the brain.

GE Healthcare's signature application for performing fMRI is the BrainWave™ for Signa® HDx MR scanners. BrainWave is an integrated set of tools for acquiring and processing fMRI exams. It is comprised of several components:

- 1) **BrainWave RT** provides real-time color activation maps during the scan to ensure patient compliance with the task. It also will show any patient motion. A color data quality indicator is green during normal operation, but turns yellow and then red if the source images become degraded for any reason. This tells the operator to apply a correction for additional processing.
- 2) **BrainWave PA** provides post-processing capabilities for the images acquired with BrainWave RT. This feature performs automated motion correction and spatial smoothing, then aligns the fMRI with a 3D T1 (FSPGR, BRAVO, etc). Processing takes less than three minutes, after which time the fused color maps are displayed in 3D, or in a typical "light-box" view. All data can be saved to the image database for sending to PACS or surgical workstation.
- 3) **BRAVO** is an isotropic 3D T1 sequence that employs parallel imaging. This entire scan takes less than three minutes and provides a high definition brain anatomy data set.



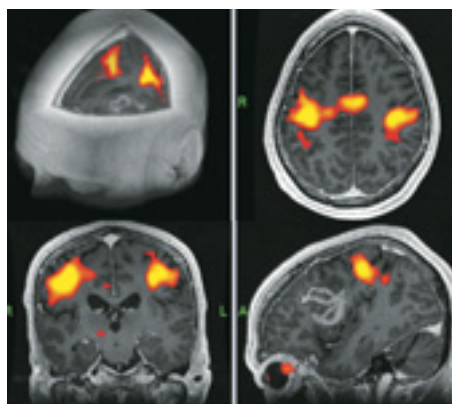
Alternating right hand open and close/left hand open and close.



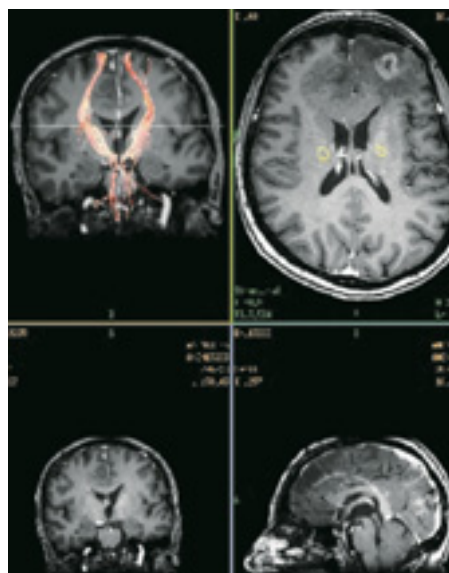
BrainWave RT shows negative Z-score to visualize activation from the opposite hand.

- 4) **FiberTrak** is GE's Diffusion Tensor Imaging (DTI) application for assessing the white matter in fMRI images. The solution provides 150 diffusion directions for improved white matter definition and auto-processes DTI images into ADC, FA, and/or isotropic combined images (Apparent Diffusion Co-efficient, Fractional Anisotropy, and Combined images, respectively) or processes DTI images into 2D color directional maps and 3D fiber maps.
- 5) **BrainWave Fusion 2.0** combines the fMRI activation with DTI FiberTrak and co-registers the data into a single 3D dataset for a complete neurofunctional assessment of gray matter (fMRI) and white matter (DTI Fibers) in a single view. The application enables high definition 3D visualization of anatomy, neurological function brain maps, white matter tracts and lesions. Neoplasm is visualized in relation to key neurofunctional centers. The information extracted from BrainWave Fusion 2.0 can be used for pre-surgical planning as well as intra-operative assessment. ■

Images courtesy of Dr. Keith Thulborn, University of Illinois, Chicago



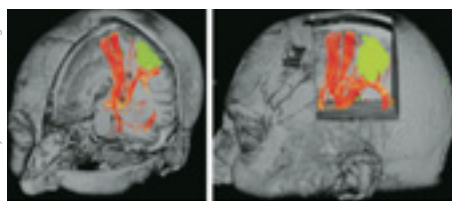
Automated fusion with 3D anatomical data set and retro motion correction.



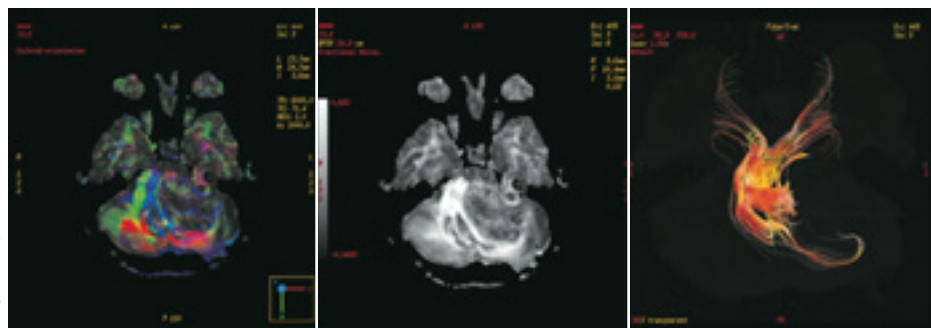
Define ROI on 2D image.



Co-registered fMRI and FiberTrak.



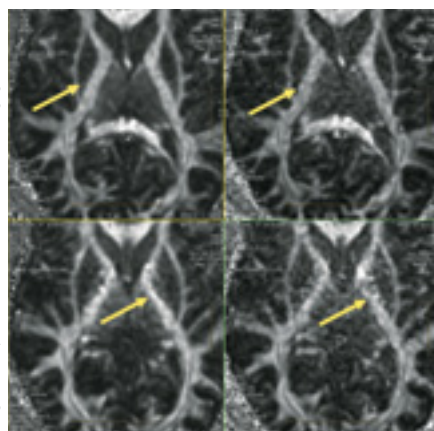
Multi-channel cut planes allow flexible display options.



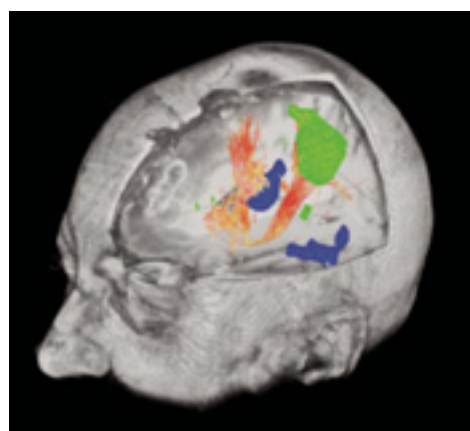
Color directional map

Fractional Anisotropy map

FiberTrack



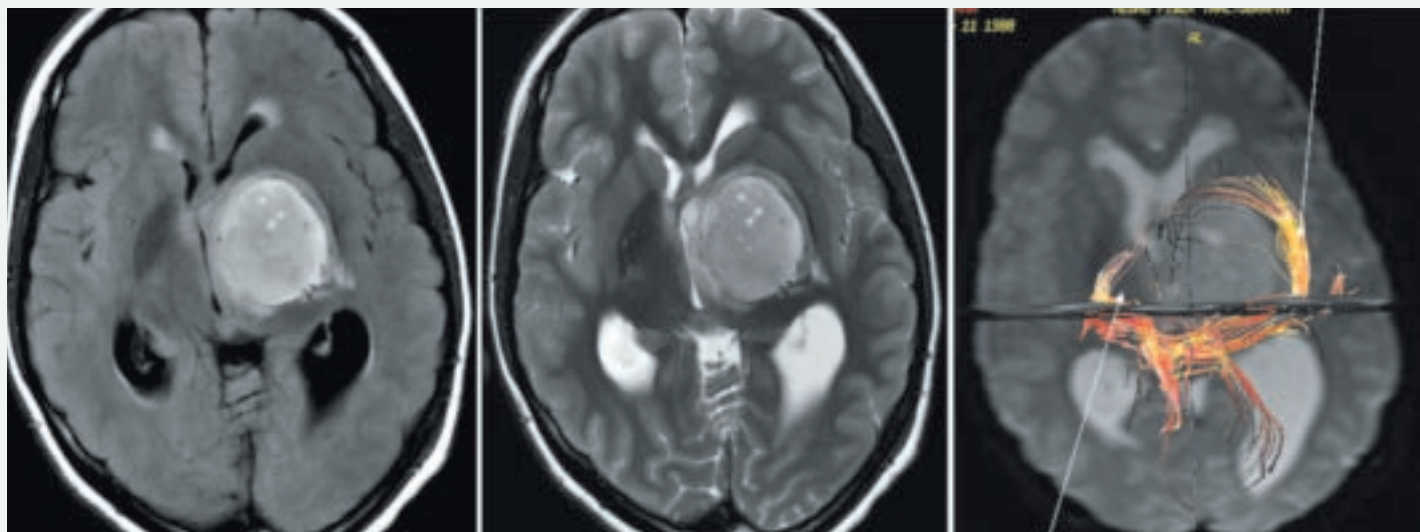
DTI provides improved white matter definition.



Signa HDx 3.0T

## Clinical Case

13-year-old patient with deep brain neoplasm



PROPELLER HD T2 FLAIR

PROPELLER HD T2

3D Tractography

(Images courtesy of Dr. Lawrence Tanenbaum, Edison Imaging)

### fMRI Reimbursement Codes

New reimbursement codes for functional MRI (fMRI) imaging mark the transition of this advanced neuroimaging technique from predominantly a research application to clinical practice. Three new CPT codes for MR imaging and Functional Brain Mapping became effective January 1, 2007.

#### The New Codes are:

- 70554 fMRI brain by tech (APC 00336)
- 70555 fMRI brain by physician/psychologist (APC 00336)
- 96020 functional brain mapping (APC 00373)
- APC 00336 New Description: Magnetic Resonance Imaging and Magnetic Resonance Angiography without Contrast

Source: CMS Manual System. Pub 100-04 Medicare Claims Processing; Transmittal 1155, dated January 12, 2007

# HD Head-Neck-Spine Array Changes Everything in Neurology Imaging Except the Coil



8 Channel Spine Coil



12 Channel Head Coil



16 Channel NV Coil

The first two clinical sites to use the new GE Signa® HD Head-Neck-Spine (HNS) array are reporting positive changes in workflow, productivity and anatomical coverage. Both sites have discovered that the HNS array also produces uncompromised high definition images while streamlining neurological studies.

Seattle Radiologists, a full-service outpatient imaging center in Seattle, WA, acquired the HNS array in early 2006 and uses it for a full range of neurological studies. "We have many multiple sclerosis patients who require double exams, such as spine/head," says Jason Wu, Technical Coordinator, MRI. "Previously we changed for those exams.

Now with the integrated coil, we eliminate those coil changes and save our patients a significant amount of discomfort in the process."

Wu notes that while changing coils is not difficult, being able to set the patient up once and simply continue the exam saves at least 10 minutes of scan time. "Over the course of the day, those minutes add up to the ability to scan an extra patient or two. Of course this improves service to our clinicians, and it also adds to our bottom line," said Wu. "As for image quality, the head and spine images are comparable to what we acquired using individual coils while the neck images are somewhat better."

## TECHNICAL INNOVATION NEURO – HNS ARRAY

### About Edison Imaging Associates Edison, NJ

For over 30 years, the radiologists of Edison Imaging Associates have led the way in providing the medical communities of central New Jersey with a full range of imaging services, utilizing the latest, most advanced technologies, including GE's Signa HDx 3.0T and 1.5T MR scanners.

### About Seattle Radiologists Seattle, WA

Over the last 40 years, Seattle Radiologists has earned a reputation as the Puget Sound's leader in diagnostic imaging. Today, thousands of medical professionals and area hospitals rely on Seattle Radiologists' 20 board-certified, subspecialty trained radiologists. The group utilizes the most advanced imaging equipment in state-of-the-art facilities, including one GE Signa 3.0T and two GE Signa 1.5T MRI scanners, and GE's latest CT and PET/CT technology. Seattle Radiologists provide imaging expertise in sports medicine, cardiovascular, oncology, women's health and breast imaging and offer the latest advances in interventional radiology (vascular and neuro-vascular), uterine fibroid embolization, interventional spine procedures including vertebroplasty and tumor ablation.

Lawrence N. Tanenbaum, M.D., FACR, and colleagues at Edison Imaging Associates use the HNS array extensively for neurological imaging. Dr. Tanenbaum cites the "8-plus-channel surface coils that leverage the inherent higher signal-to-noise ratio of 3.0T," as a key advantage.

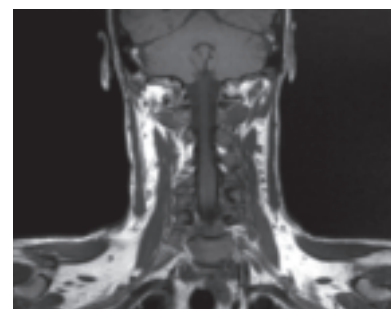
As a dedicated GE MR Scanner user since 1989, he states, "They have consistently delivered state-of-the-art imaging techniques that have assisted me in my clinical practice and consistently provide the highest quality image and most refined diagnosis. With each new generation, there are new capabilities and improved efficiency."

By using a single array for virtually all applications, Edison Imaging avoids the need to change coils in many circumstances. Tanenbaum notes, "The power of the high-density coil segments provides gold-standard image quality for the brain, spine and neurovascular tree. It also brings synergistic benefits in border zone areas like the brachial plexus and paraspinal regions. The seamless cephalocaudal coverage and superb fat suppression of this coil contribute significant image-quality benefits."

Edison Imaging completes approximately 350 cases each month on the HNS array, totaling well over 2,000 patients scanned with it. Tanenbaum noted, "We are very pleased with the results." ■

### Integrated HNS Array

By utilizing industry-leading radio frequency technology coupled with an advanced patient and user-friendly design, the GE Signa HD HNS array places the highest number of clinically optimized coil elements directly within the imaging field to maximize image quality and streamline neurology scanning. It combines a 12-channel head coil and a 16-channel neurovascular coil with an 8-channel spine coil. With 29 elements and 16 channel outputs, the array covers the patient's entire upper body with a single coil, providing high-definition signals that directly contribute to optimal and uniform image quality in brain, neck and spine images. The phased array technology provides higher signal-to-noise (SNR) ratio and capability for parallel imaging, which speeds up scanning. With the HNS array, users can perform a series of exams on one patient without changing coils, increasing patient comfort and effectively shortening procedure time without compromising image quality.





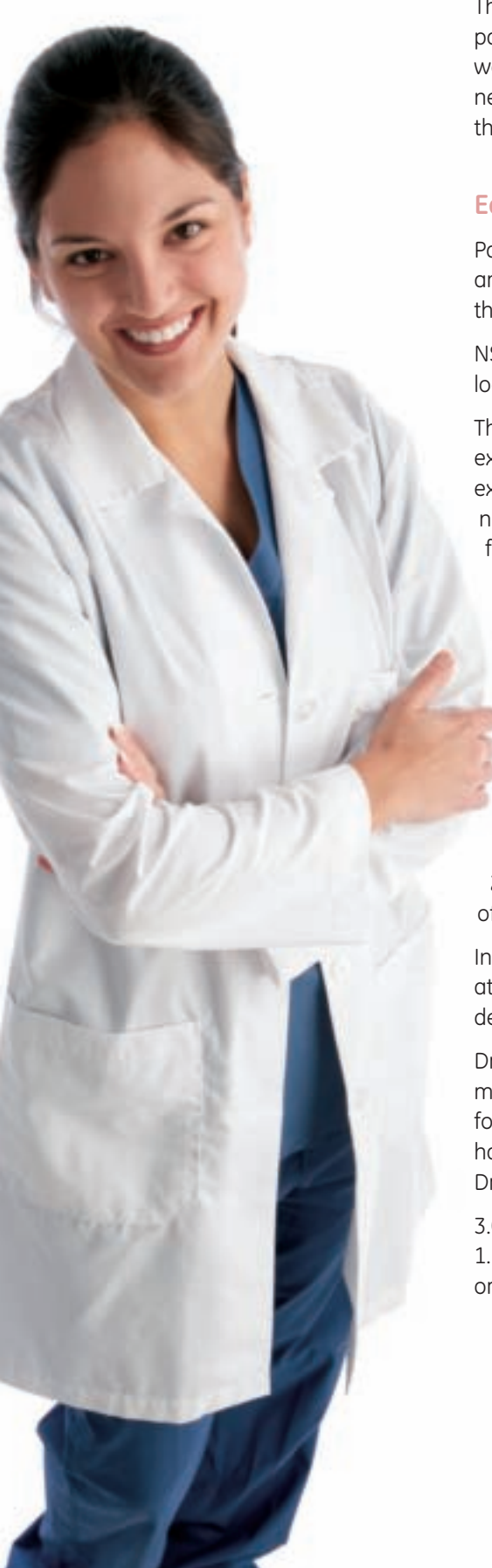
# 3.0T: A World of Difference

## Leader in Neurological MR Imaging Finds New Advantages of Latest 3.0T Platform

NeuroSkeletal Imaging Institute (NSI) Winter Park (FL), scans more than 30 patients each day on its GE Signa® 3.0T MR scanner while achieving superior image quality. For Marc Shapiro, M.D., President and Chief of Neuroradiology, that is a testament to the value of 3.0T imaging when compared to even the best 1.5T technology.

NSI Winter Park specializes in neurological and musculoskeletal (MSK) studies but also provides abdomen, pelvic, heart and vasculature exams. "We have scanned as many as 38 patients in one day and in 2006, we completed 7,600 MR procedures with our 3.0T MR system," Dr. Shapiro said. "Many of these are not routine cases. We do some of the most advanced neurological and orthopedic work in Central Florida."

The center schedules studies in 30-minute blocks, although some cervical spine and thoracic spine cases are 20-minute slots. "The great thing about 3.0T is that exams are more detailed with superior image quality," Dr. Shapiro noted. "Because of the extra signal-to-noise we get with 3.0T, we're able to produce thinner sections and higher matrices than with a 1.5T."



That fact is readily acknowledged by the sophisticated physicians who send their patients to the center. "Because we're able to maximize the power of 3.0T imaging, we have relationships with the leading multiple sclerosis specialists, epileptologists, neuro-oncologists and others in our area. We get referrals from doctors who want the best imaging possible for their patients," Dr. Shapiro added.

### Early Adopters

Patients take center stage in the comfortable environment at NSI Winter Park. "The ambience of our facilities is unique," Dr. Shapiro said. "We have an incredible staff that takes great care of patients. We try to treat all our patients as if they were family."

NSI Winter Park installed a Signa 3.0T MR scanner in late 2004 at its Winter Park location and immediately noticed the increase in imaging detail and quality.

The technology especially shines in neuro, spine and MSK applications. The center examines more than 20 brains each day, most of which are not simple cases. Shapiro explained, "With 3.0T, we are able to use ultra-thin sections. We examine a large number of seizure patients and by using 3.0T we can perform MR spectroscopy, fMRI and diffusion tensor imaging on patients with brain tumors. 3.0T has the capability to produce and visualize small structures. For example, 3.0T allows us to produce images of the inner ear with much more detail than possible with 1.5T MR."

### Making it Definitive

3.0T imaging also helps detect small lesions. One patient with a seizure disorder had been scanned on a 1.5T system using 5 mm pulse sequences. Clinicians were unable to locate any lesions. NSI Winter Park examined the patient using the 3.0T system with 1 mm to 3 mm slices. "We were able to see two lesions smaller than 2 mm that the 1.5T exam missed. As a result, we were able to give a correct diagnosis of tuberous sclerosis," Dr. Shapiro said.

In the evaluation of brain tumors, the added SNR, chemical shift and susceptibility at 3.0T is beneficial for Diffusion Tensor Imaging (DTI), 3D spectroscopy and the detection of increased cerebral blood volume with perfusion imaging.

Dr. Shapiro uses the advanced PROPELLER™ application, which corrects for patient motion and delivers diagnostic-quality images even in patients unable to hold still for their exams. "The combination of specific FLAIR sequences with PROPELLER has exceeded my greatest expectations in diagnosing white matter diseases," Dr. Shapiro said.

3.0T is helpful for detecting aneurysms that were not seen or were equivocal in 1.5T studies. "With 3.0T, we can now say definitively in those cases that there is or there is not an aneurysm," he noted.

In one case, a patient had been scanned at a hospital on a 1.5T system. The chief of neurosurgery and the neuroradiologist thought an aneurysm might be present but could not be certain. "They told the patient he would need an arteriogram to confirm the diagnosis," Shapiro explained. "He came to us for a 3.0T cerebral MRA and we were able to tell him, 'You don't need an invasive, diagnostic arteriogram.'" Dr. Shapiro was able to visualize a 1.5 mm aneurysm using his 3.0T scanner.

## Beyond Neuroradiology

Dr. Shapiro sees the benefits of 3.0T extending to MSK, body and breast imaging. In orthopedics, the technology has enhanced the ability to visualize cartilage abnormalities.

"Experts used to say that with 1.5T imaging, in 10 percent of patients it was not possible to distinguish a meniscal tear from myxoid degeneration, which doesn't require an arthroscopy," he said. "That is no longer the case. The added signal-to-noise in 3.0T, along with increased matrices and thinner slices, allows us to make the distinction in more than 99 percent of the cases."

For body imaging, Dr. Shapiro sees demand for 3.0T studies in cases involving renal artery stenosis.

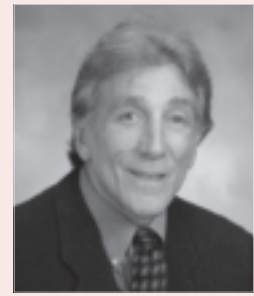
In late 2006, NSI Winter Park launched a complete breast imaging program to take advantage of the greater diagnostic power of 3.0T technology. "Breast MRI is very effective at 1.5T, but it is even better and more diagnostic at 3.0T," Dr. Shapiro said.

"The higher signal-to-noise enables us to see more detail than with 1.5T," he added. "Those are the two qualities you really need to make an accurate diagnosis in Breast MRI." The breast imaging program includes the GE VIBRANT™ application, which enables high-speed, high-quality bi-lateral breast studies.

## Competitive Edge

Strictly in terms of clinical quality, 3.0T is the technology of choice for MR imaging in Dr. Shapiro's view. "The reality is that if someone wants to do the best thing for patients, they will do 3.0T imaging," he said. "In time, all large hospitals and academic institutions will be at 3.0T."

The technology has also helped NSI Winter Park better market its services. Dr. Shapiro explained, "When working with doctors who are sophisticated in their fields, particularly in neurology, orthopedics and neurosurgery, having a 3.0T system is a major advantage." ■



Marc Shapiro, M.D.

Dr. Shapiro is President and Chief of Neuroradiology at NeuroSkeletal Imaging Institute (NSI).

### About NSI Winter Park Winter Park, FL

NSI Winter Park is an imaging facility dedicated to providing neuroskeletal imaging to Central Florida. As a strategic collaborator with GE on new, breakthrough imaging technologies, NSI Winter Park provides patients and referring physicians with access to some of the most advanced MRI technology in the world. The center operates from 7 am to 11 pm Monday through Friday and from 7 am to 2 pm on Saturday.

"The combination of specific FLAIR sequences with PROPELLER has exceeded my greatest expectations in diagnosing white matter diseases."

*Dr. Marc Shapiro*

# Detachable Table Design Unlocks MR Potential



“With all new GE systems purchased, we order a second table. This is to improve our MRI cycle time and patient throughput.”

*Ann Hester,  
Florida Hospital,  
MRI Systems Modality Manager*

GE's Liberty™  
docking system



Unique to the Signa® family of MR systems is the detachable MR table design. GE Healthcare pioneered this innovative concept puts you at liberty to deliver greater patient safety, productivity and growth in the MR suite.

GE offers wide range of tables to enable flexibility and accessibility to new and emerging MR applications. Different procedure tables easily and safely dock to the Signa MR scanner via GE's Liberty™ docking system. Choices include: the Signa table for general imaging; Signa lite; Vanguard system for dedicated breast imaging; ExAblate® 2000 MR-guided Focused Ultrasound; Signa OR-compatible table; and, there are more in development.

## Safety

Critically ill patients often undergo MR scans. With the Signa detachable table, the technologist can quickly and easily release the table and coils in an emergency and have the patient outside the scan room in seconds. This enables the emergency team to access the patient outside the MR scanner's ferromagnetic field – safely and quickly.

“We're able to quickly pull the patient out of the scanner, ...undock the table and pull the patient completely out of the room, close the door, so we can handle the patient in a safe environment without the code team going into the magnetic field,” said Tuan Luu, Technologist and Applications Specialist, Brigham & Women's Hospital (Boston, MA).

## Productivity

The detachable table also facilitates patient loading to further drive MR suite productivity and patient throughput. By bringing the table to the patient, users can reduce unnecessary patient transfers – the patient is placed directly onto the MR detachable table. With two or more Signa tables, one patient can be prepped while another is scanned.

“With all new GE systems purchased we order a second table. This is to improve our MRI cycle time and patient throughput. We want to decrease our ‘empty table time.’ This is especially important to our facilities because 50 percent of our volume is inpatients,” noted Ann Hester, MRI System Modality Manager, Florida Hospital (Orlando, FL).

## Growth

Facilities can also expand their business by offering new procedures or improving the speed and quality of existing exams with the detachable table. Two GE-exclusive technologies – MR-guided Focused Ultrasound (MRgFUS) and the new Sentinelle Medical Vanguard™ breast imaging and intervention table – are compatible only with Signa.

“These women are really doing their internet research and finding out about MR-guided Focused Ultrasound (MRgFUS). A lot of them are calling us asking about it. They're willing to actually fly here to get the procedure done.” Mindy McKinnon, MRI Technologist, Seattle Radiologists (Seattle, WA). ■

Vanguard™ is a trademark of Sentinelle Medical Inc.  
It is manufactured and distributed directly by Sentinelle.  
ExAblate® is a registered trademark of InSightec, Ltd.

# Learn From the Experts with GE Healthcare's MR Masters Series

## Masters Series Courses for MR

### Featured Course – Cardiovascular MRI

MRI offers superior clinical properties for cardiovascular imaging and is the only modality versatile enough to allow the assessment of anatomy, structure, function, stress, flow, and time course in one exam.

Yet, the adoption rate for cardiovascular MR (CVMR) has been slow. According to Arlington Medical Resources (AMR), a market research firm in Malvern, PA, only one percent of all MR procedures today are cardiac. The availability of clinicians and technologists with an understanding and skill of MR technology as well as cardiac imaging is one of the barriers slowing down wider adoption.

This offers an outstanding opportunity for radiology departments to differentiate themselves in their community by becoming proficient in cardiovascular MRI.

GE Healthcare is committed to providing educational opportunities by offering a series of MR Masters Series courses. Designed to give physicians an avenue to learn clinical applications or the latest MR techniques, the Masters Series courses offer increased levels of specialized education to help physicians fully utilize their GE MR equipment.

At a network of GE MR training centers located throughout the United States, the world's top radiologists train physicians from around the globe on how to maximize the clinical benefits of the most advanced MR techniques.

### Course Profile

#### Cardiovascular MRI

*With Steven D. Wolff, M.D., Ph.D., New York, NY*

#### Dates:

June 8-10

October 12-14

#### Location:

Advanced Cardiovascular Imaging

62 East 88th Street

New York, NY USA 10128

This three-day weekend course on cardiac MRI and vascular MRA is intended for clinicians who want to incorporate these technologies into their daily practice. Attendees will acquire an understanding of the basic principles and become familiar with clinical indication of cardiac MRI and CT.

The course includes didactic lectures and an opportunity for participants to review clinical cases from an extensive library collection. Instruction is provided on workstations showing how to analyze cardiac and vascular cases. Participants have the opportunity to scan normal volunteers and choose from a number of cardiovascular studies including: cardiac morphology and function, myocardial perfusion, tissue viability, coronary artery imaging, and MR angiography of the carotids, aorta, renals and lower extremities.



Steven D. Wolff, M.D.

#### About the Faculty:

Dr. Wolff is the Director of the Cardiovascular MRI at the Cardiovascular Research Foundation and at Advanced Cardiovascular Imaging, a private practice on Manhattan's upper east side. He is also Chief of Cardiovascular MRI at Lenox Hill Hospital. He formerly directed cardiovascular MRI at the National Institute of Health. He has been directly involved in the development of many of the software and hardware modifications to the Signa CV/i scanner.

## What Attendees Had to Say

*"I was amazed by the cardiac studies being performed routinely and in such a short exam. The MRI scan information obtained by Dr. Wolff is incredible and begs the question of why isn't a similar "Cardiac MRI" center available in every major city. The presentations were succinct and very informative. The quality of cardiac MRI data and the willingness of Dr. Wolff to so willingly share every aspect of his practice and "how it's done" are inspiring and refreshing. After experiencing this course you will not only be sold on the merits of Dr. Wolff and cardiac MRI; but you will want this available in case you or your family is in need."*

**Steven R. Maxfield, M.D.**  
Banner Baywood Medical Center, Mesa, AZ

*"Thank you very much for the opportunity to attend the Steve Wolff Cardiac MRI course. It was fabulous. I have heard Dr. Wolff speak at many different forums over the years but never have I understood this modality as he explained and demonstrated at his course. The teaching file is awesome. He should publish and sell his teaching files. I know that I would buy a copy. Gay Luebchow (GE) was awesome as well. She is very knowledgeable. We watched her demonstrate her scanning and teaching abilities and I was very impressed. I hope to get her out to in-service our technologists here in Arizona. Thanks again for a wonderful opportunity."*

**Stephen Hu, M.D.**  
Scottsdale, AZ

*"I thought the CMR course was very good. Firstly, Dr. Wolff brings a logical and practical approach to CMRI which cuts through a variety of clinical disciplines and technical issues. The lectures and lecture notes are clear, concise and well thought out. The important literature is reviewed and the state of the art is made clear without embellishment or tedious commercial bias. The lab experience seemed just right for the state of my knowledge. It was the kind of course that I could go to again in a year or two and continue to benefit from."*

**Jeffrey S. Rose, M.D., FACC**  
Providence Everett Medical Center, Everett, WA

*"All phases of this well designed, efficiently run course were critical to my growth in understanding CMR: the lectures, teaching cases, workstation applications, scanner interaction, and interaction with Dr. Wolff and his vast knowledge in this area. I am trying to implement CMR in our practice, and it is more complex than I thought. I have repeatedly referred to his syllabus that has helped answer several of my questions and (also) provide clinically proven GE specific protocols.*

*I may attend his fellowship in the future for more in depth understanding of difficult cases."*

**Joe Hasapes, M.D.**  
Managing Physician CT/MRI, Department of Radiology  
Kelsey-Seybold Clinic, Houston, TX

## Masters Series Courses 2007 Schedule

### Breast MR Imaging

*With Constance D. Lehman, M.D., Ph.D*

**Dates:**

June 14  
August 9

**Location:**

Seattle Cancer Care Alliance  
825 Eastlake Avenue East, G3-100  
Seattle, WA

Dr. Lehman has extensive experience in Breast MRI and MR-guided biopsy and is the Principle Investigator of the multi-center international ACRIN study of the role of MRI in women with a recent diagnosis of breast cancer. This comprehensive, practical and interactive one-day course is devoted to Breast MRI on the 1.5T HD system. The course includes lectures on the technical aspects of performing breast MRI with VIBRANT, clinical indications for Breast MRI, and practical guidelines for interpretation of Breast MRI. In addition to lectures, participants will have hands-on training interpreting clinical Breast MRI cases utilizing MR computer-assisted detection, and performing MR-guided breast biopsy.

### Physics and Clinical Applications

*With William G. Bradley, M.D., Ph.D., FACR*

**Dates:**

July 9-13  
September 17-21

**Location:**

University of California-San Diego  
9500 Gilman Dr.  
La Jolla, CA

Dr. Bradley is a well known author and instructor in MR. He has experience on several vendors' equipment and has developed a course specifically tailored to the language of the GE Signa MRI. This course lasts one week and covers MRI from soup to nuts, including everything from basic physics to diffusion weighted imaging on the GE Signa Infinity 1.5T.

As a result of Dr. Bradley's recent move to UCSD as Chairman of Radiology, attendees benefit from multiple faculty. The Musculoskeletal MRI talks will be given by Don Resnick, M.D. and the Musculoskeletal staff. The MRI body talks will be given by Bob Mattrey, M.D., and staff. John Hesselink, M.D., Rosalind Dietrich, M.D., and Wade Wong, D.O., will be sharing the Neuro talks with Dr. Bradley. The course will be highly interactive, facilitated in part by the small class size.

### Basic MR Physics: Understanding and Applying

*With Emanuel Kanal, M.D., FACR*

**Dates:**

July 16-20 (Residents Course)  
October 15-19

**Location:**

University of Pittsburgh Medical Center  
Pittsburgh, PA

Dr. Kanal is a wizard at teaching MR physics to both the technical and non-technical person. His experience is primarily with GE, although he does read from other manufacturers equipment. This five-day course is designed to give the attendee a deeper understanding of the basic physics and contrast mechanisms underlying the MR imaging process and how to apply them to a busy clinical practice. It also provides a thorough overview of MR angiography, diffusion weighted imaging, perfusion weighted imaging, and literally dozens of other clinical imaging techniques and parameters.

Dr. Kanal also utilizes his custom-developed computer program, Kanal's MR Tutor™, a Macintosh-based MR simulator which is famous throughout the MR education and training community. With this tool, the student can apply "what-if" scenarios to scanning situations and MR images, and observe the effects of parameter changes in real time.

### Musculoskeletal Imaging – Applications, Techniques and Interpretation with Emphasis on Joint Imaging

*With Michael B. Zlatkin, M.D., Weston, FL*

**Dates:** To Be Announced

**Location:**

Weston, FL

Dr. Zlatkin is a well known, highly regarded musculoskeletal radiologist particularly knowledgeable in musculoskeletal MR technique. Dr. Zlatkin has written extensively in the field of musculoskeletal MRI having authored or co-authored two texts, including the well known "MRI of the Shoulder" and the general MRI reference standard, "Clinical MRI." He has a long standing experience with GE MRI systems.

This two-day short but comprehensive course will cover MR Arthrography, injection techniques, applications and interpretation of joints. Teaching files will be available on site for review.

**Clinical fMRI at 1.5T and 3.0T***With Keith Thulborn, M.D., Ph.D.***Date:**

September 8-9

**Location:**

Chicago, IL

Dr. Thulborn is an acknowledged world leader in MRI and a well established educator in his field. This two-day course provides integrated didactic lectures and hands-on training for functional brain imaging on the 1.5T and 3.0T Signa LX scanners.

Emphasis is on functional imaging protocols using diffusion, perfusion and blood oxygenation level dependent (BOLD) contrast. Conventional anatomic and angiographic sequences at each field strength will be compared in clinical applications. Teaching is through discussion of case studies and assumes a basic knowledge of MR physics and imaging on the LX platform. This allows greater time to be used for discussions of data acquisition and interpretation. Quality assurance and patient safety are treated in detail. A syllabus with a basic set of functional MR imaging protocols will be distributed. The course is designed for both 1.5T and 3.0T imaging and will emphasize the similarities and differences between field strengths. Small group and one-on-one hands-on training under the guidance of an experienced MR research technologist will familiarize participant with the operational features of the scanner.

**Advanced High Field MR Practicum: 3.0T – 1.5T***With Lawrence Tanenbaum, M.D., FACP***Date:**

June 1-2

**Location:**

Edison Imaging Center  
Edison, NJ

Dr. Tanenbaum is a master at integrating leading-edge technology and advanced imaging techniques into productive clinical practice. He has designed this practical course for the aggressive Radiologist or lead technologist who wants to maximize image quality and productivity while integrating advanced imaging techniques into his/her practice. The unique challenges and opportunities provided by 3.0T is a particular focus of this course which covers both principles and protocols for whole body imaging at 3.0T and 1.5T.

Neuro imaging techniques including perfusion and spectroscopy at 1.5T and 3.0T are covered in detail. Basic and advanced diffusion techniques (PROPELLER, tensor imaging, and tractography) will be discussed in depth. Musculoskeletal, body and vascular imaging techniques including MRCP, dynamic liver imaging (LAVA), CE-MRA and CVMR will be included exploiting the latest coil technology. The most recent software releases and hardware platforms at 3.0T and 1.5T and 8- and 16-channel systems will be exhaustively surveyed.

This hands-on course is conducted over a two-day weekend.

**Beyond MRI: MR Spectroscopy for the New Millennium***With Brian Ross, M.D. and Alexander Lin, B.S.***Dates:** To Be Announced**Location:**

Huntington Medical Research Institutes  
660 S. Fair Oaks Avenue  
Pasadena, CA

Dr. Brian Ross and his team have five years of experience training radiologists in reading and reporting the newest MR brain exam – MRS. This four-day course provides the fundamental information necessary to use and interpret MRS via expert guest lecturers, hands-on scanner training and small group interpretation sessions. Diagnostic examples describe the clinical utility of MRS and its impact on patients: Alzheimer's disease, stroke prognosis, radiation necrosis, brain tumors, pediatrics, head injury, multiple sclerosis, HIV and organic encephalopathies. ■

For more information and up to the minute course dates, please visit the GE Healthcare website at:

**[www.gehealthcare.com/us/en/mr/education/products/physiciantrain.html](http://www.gehealthcare.com/us/en/mr/education/products/physiciantrain.html)**

# Beyond the DRA: Strategies for Growth and Success

With the Deficit Reduction Act (DRA) Now in Place, Imaging Center Owners and Operators are Faced with Adjusting to a New Business Environment.

To help, GE Healthcare has put together a series of seminars, educational events and webcasts with the goal of helping imaging centers thrive in today's challenging environment. These programs give timely information on effective marketing, managing growth, maintaining a fiscally sound operation, efficient staffing and operations and planning for the future.

Most recently, GE Healthcare hosted "Facing the DRA Together: Fresh Insights on the Deficit Reduction Act." Featured speakers included the American College of Radiology and the Access to Medical Imaging Coalition, as well as imaging experts representing finance, marketing, law, reimbursement, and lobbying efforts on Capitol Hill. You can access archive webcasts at the web address below.

## Coming this July 26-27th

The 2nd Annual GE Healthcare Outpatient Imaging Center Conference, "Beyond the DRA: Strategies for Growth & Success", will be held in Arlington, VA. Over 200 leading OIC executives will convene to share industry leadership insight and futurist projections specifically for outpatient services. Keynote speakers include The Honorable Newt Gingrich, former Speaker of the House and Founding Partner, Center for Healthcare Transformation, and Dr. Regina Herzlinger, Professor, Harvard Business School, and author of "Consumer Driven Healthcare" and "Market Driven Healthcare." ■

Registration for this event and complimentary access to the archive of Outpatient Imaging Center webcasts and resources, are available at [www.gehealthcare.com/registration](http://www.gehealthcare.com/registration).



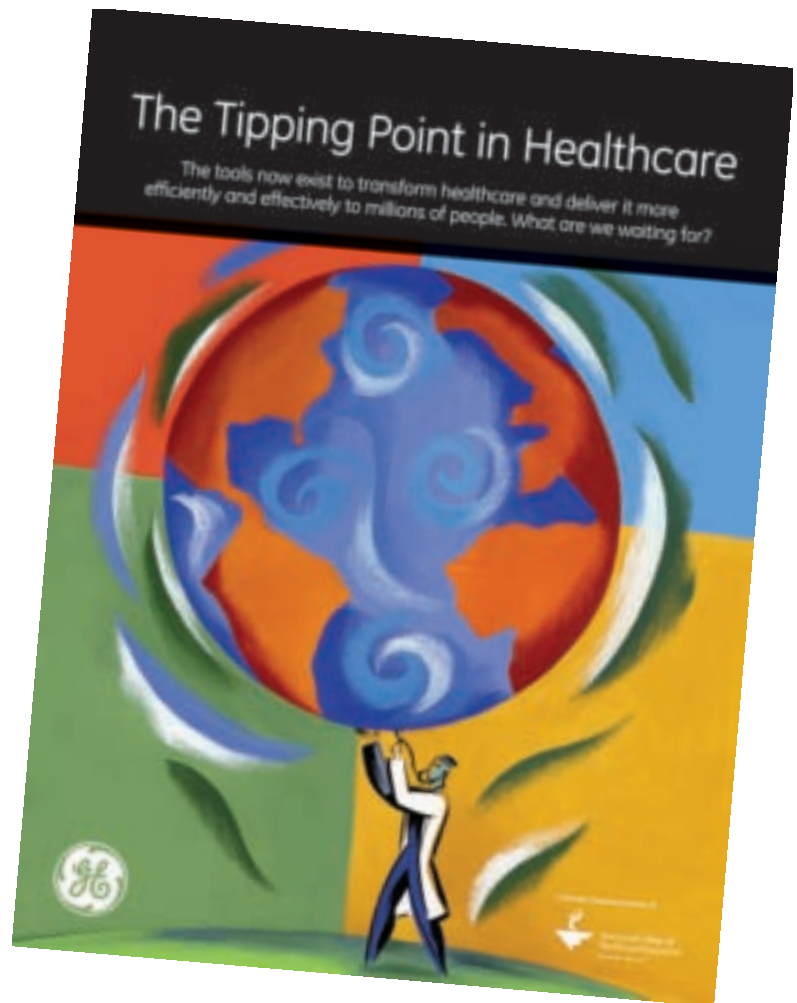
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- Measuring healthspan, not lifespan
- Increasing the transparency of quality and cost
- Committing to equity in healthcare access

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"To take healthcare into the future, we don't have to wait for technologies that will be available in 2025. We need only look at the technologies we have today, and act."

*Joe Hogan  
President and CEO, GE Healthcare*



imagination at work



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Introducing **Signa HDx technology from GE Healthcare**. Parkinson's disease patients. Poor vascularity in patients with diabetes. Women who need bilateral breast scanning in a single visit. Jittery kids. Once they were considered hard-to-scan patients. Now they're simply patients. With high-definition imaging and motion correction technology you can view all your patients exactly how you want. The same. **MR Re-imagined.**

To learn more visit [www.gehealthcare.com/re-imagine](http://www.gehealthcare.com/re-imagine)



imagination at work

