Advances in Radiation Oncology Only “Scratch the Surface of Possibility”

“Imaging has spurred remarkable advances in cancer treatment and will continue to play an integral role as treatment becomes more personalized and moves to the molecular level,” according to a leading expert who delivered the Annual Oration in Radiation Oncology Wednesday at the Arise Crown Theater.

After recalling the days when external anatomy and plain X-rays served as the primary guide for radiation therapy and collateral normal tissue damage was a necessary accompaniment of treatment, Paul M. Harari, M.D., professor and chairman of the Department of Human Oncology at the University of Wisconsin School of Medicine and Public Health in Madison, described the “dramatic, seismic changes” that have taken place in the field.

“Radiation delivery has become increasingly precise, enabling us to reduce treatment margins on tumors,” he said. “Now we can shape radiation dose to the exact three-dimensional shape of each tumor and gate dose delivery to account for motion from breathing.”

The revolution in imaging and treatment technology has fostered meaningful gains for patients, Dr. Harari said. While dose traditionally has been limited by normal organ tolerance, modern technology can now provide very sharp dose gradients between tumor and critical normal tissues. The complementary use of CT, MR and PET imaging routinely facilitates improvements in tumor staging, treatment recommendations and outcomes.

“We rely more on imaging in the field of radiation oncology than ever before,” Dr. Harari said during his presentation, “Beneficial Liaisons: Imaging and Therapy.”

Paul M. Harari, M.D.

Dr. Harari, a former RSNA Research & Education (R&E) Grant Scholar, high-lighted technological advances like intensity modulated radiation therapy (IMRT) and image-guided radiation therapy (IGRT) that are now routinely available and contribute to high tumor control rates and improved quality of life for patients. He cited examples from his head and neck

Dunnick is RSNA President

Distinguished radiology leader N. Reed Dunnick, M.D., is RSNA president for 2014. Dr. Dunnick is the Fred Jenner Hodges Professor and chair of the Department of Radiology at the University of Michigan Health System in Ann Arbor.

As president, Dr. Dunnick will help shape and advance RSNA’s vision and strategic goals to advance the radiologic sciences and develop the future of patient-centered practice. “We are proud of our past, but must focus on the future,” he said. “This is a time to reflect on the many advances in our field and how they help us improve the quality of patient care we deliver. How will we translate the continued advances in medical imaging and image-guided therapy into better patient outcomes?

“We are moving from an era of ‘volume-based imaging’ to one of ‘value-based imaging,’” Dr. Dunnick continued. “It will be challenging to make that transition. However, medical imaging has so much to offer, I am confident we can succeed. Today’s research is tomorrow’s practice.”

Dr. Dunnick earned his medical degree from Cornell University Medical College in New York City. Dr. Dunnick was a radiology resident at Stanford University School of Medicine and served as chief resident his last year. Dr. Dunnick began his academic appointments at Stanford as an assistant professor in 1976. Later that year, he moved to the Diagnostic Radiology Department at the National Institutes of Health. At Duke University Medical Center in Durham, N.C., Dr. Dunnick held many posts from 1980 to 1992, including professor of

The RSNA Image Share Network: 20 Month Follow-up Results from a Pilot Site

Are patients really interested in having direct access to their medical images, and do they benefit? The answer to both questions is “yes,” based on a 20-month pilot study of RSNA Image Share, which includes a patient-controlled image-based personal health record.

“Patients are becoming more in tune with their health and they want to control their health records, analyze them and find out what the information means,” said Anand Patel, M.D., senior radiology resident at the University of California at San Francisco and UCSF’s physician coordinator for RSNA Image Share, which allows images, reports, and other types of data to be shared among different vendors’ systems using standard protocols. UCSF is one of five pilot sites where the network is being tested with physicians and patients, along with the University of Maryland, the University of Chicago, the Mayo Clinic, and the Mount Sinai School of Medicine. Dr. Patel presented UCSF’s results to date on Wednesday.

Medicare expenditures on imaging nearly doubled from $6.5 billion in 2000 to $11.7 billion in 2009. At least 10 percent of these costs, and possibly as much as 20 percent, are due to duplicate exams, often because images from prior studies aren’t available. In response RSNA, with funding from the National Institute of Biomedical Imaging and Bioengineering launched RSNA Image Share. Patients gain direct control of their images and interpretations via a cloud-based electronic personal health record and can share access with any provider, regardless of institutional affiliation.

CONTINUED ON PAGE 4A
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Thursday/Friday at a Glance

THURSDAY
7:15–8:15
Controversy and Hot Topic sessions
8:00–9:00
ASRT@RSNA 2013: Moving Toward Best Practice: Developing National Guidelines through a Collaborative Approach
8:30–10:00
Refresher Courses and Workshops
Essentials of Gastrointestinal Imaging
8:30–NOON
Series Courses
Cardiac, Chest, Interventional Radiology, Musculoskeletal, Vascular Imaging
9:20–10:20
ASRT@RSNA 2013: Mastering Digital Radiography: CR and DR Exposures, Techniques and Doses
10:30–NOON
Scientific Paper Sessions
Essentials of Genitourinary Imaging
Informatics Courses
10:40–11:40
ASRT@RSNA 2013: Elbow and Forearm Trauma: Mechanisms of Injury and Patterns of Fractures
12:15–1:15
Scientific Informal (Poster), Quality Storyboard and Education Exhibit Presentations (Lakeside Learning Center and Subspecialty Campuses)
12:30–2:00
Informatics Courses
1:00–2:00
ASRT@RSNA 2013: Normalization of Deviance and Radiology
1:30–2:45
Thursday Plenary Session (Arie Crown Theater)
RSNA/AAPM Symposium (See Page 6)
Imaging in Partnership: With Radiation Therapy
David A. Jaffray, Ph.D.
Imaging in Partnership: With Physics and Quantitative Medicine
James A. Deyo, Ph.D.
1:30–6:00
Interventional Oncology Series: Liver Metastases and Bone
2:20–3:20
ASRT@RSNA 2013: How Do We Make Care Patient-Centered?
3:00–4:00
RSNA Diagnosis Live™: Radiology Potpourri
Hot Topic Sessions
3:40–4:40
ASRT@RSNA 2013: Improving Practice in Pediatric Skeletal Radiography
4:30–6:00
Refresher Courses and Workshops

FRIDAY
8:30–10:00
Refresher Courses and Workshops
8:30–12:00
Series Courses
Interventional Radiology, Musculoskeletal, Vascular Imaging
10:30–12:00
Scientific Paper Sessions
Informatics Course
12:45–3:15
Friday Imaging Symposium: MR Imaging of Common Musculoskeletal Injuries

Radiation Safety Question of the Day
What are the advantages of iterative reconstruction methods in SPECT, compared to conventional filtered back projection?

[Answer on page 8.]

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cancer specialty to demonstrate how precise treatment delivery has helped to preserve important structures that were commonly damaged or destroyed with older methods.

“For example, now we are able to spare major salivary glands and diminish radiation dose to the spinal cord, jawbone and voice box,” he said.

The recent advances only scratch the surface of possibility, according to Dr. Harari, who pointed to molecular imaging and biology as exciting areas of active development.

“The blossoming of molecular biology over the last several decades is now providing opportunities to tailor drug and radiation treatment approaches more specifically for individual patients,” he said.

“Through the blending of modern imaging with molecular drugs and precision radiation, we are poised to further improve cure rates and diminish side effects.”

Along with molecular biology, Dr. Harari expects dramatically improved visualization to have a beneficial impact on treatment by lowering the threshold of cancer detection and enabling the tracking of individual tumor cells.

“Therefore, we can now image the tumor and plan a treatment strategy that allows us to use nanotargeted agents and deliver the therapeutic payload to the tumor.”

This year’s oration was dedicated to the memory of molecular targeted agents with radiation, which were pioneered by Dr. Thomas N. McCausland, who was president of The Mount Sinai Hospital from 1977 to 1980. McCausland was also a pioneer in the use of molecular biology over the last several decades.

More study is needed among physicians, since most UCSF physicians reported not being comfortable reading the findings on their own. However, “We are doing a procedure, radiologists are not the patient’s direct provider and haven’t been following them for years,” Dr. Patel said. “What’s the best way for them to find out that their CT scan shows cancer? We had a couple of patients who asked whether it would be possible for them to get access to their results only after they had talked to their doctors, because they weren’t comfortable reading the findings on their own.”

In the presentation theaters in Mobile Connect, RSNA staff will discuss how to get the most out of RSNA and other mobile apps, and some authors of RSNA presentations with mobile technology topics will also demonstrate their work.

The UCSF study began in August 2011. Patients were enrolled while they were obtaining a CD of their imaging study or waiting to undergo their exam. Patients received a secure log-in through their e-mail for a website, accessible through a computer or mobile device, where they could see their images and radiology reports, download them and share them with their physicians via a secure link. The user interface is simple, like Flickr or Facebook. Users can change the contrast or zoom in to see certain areas of the image.

Patients were surveyed to gauge their RSNA Image Share experience, and a parallel survey was provided to referring physicians. As of March 2013, 892 patients had enrolled and almost 800 surveys had been distributed. (The network is available to about 30 new patients per week, and total enrollment currently tops 1,500.)

The study looked at completed surveys from 252 patients and 81 physicians. In each of those groups, 95 percent expressed the need for a patient-controlled electronic personal health record. Four out of five patients and nine out of ten physicians were satisfied with the network. Two-thirds of the patients agreed or strongly agreed that health record privacy is important, but 90 percent of the patients were comfortable with the amount of privacy provided by RSNA Image Share.

A study of selection bias in the surveyed group, given that more than 90 percent of the patients reporting being online at least weekly for shopping and using social media, and that the San Francisco area is more tech-savvy than average, Dr. Patel said. “The main negative feedback we got was that the site was clunky—not that they didn’t want something like this,” he said.

Having images and radiology reports directly available to patients will sharpen the debate around how health information should be communicated, and by whom. “Unless we’re doing a procedure, radiologists are not the patient’s direct provider and haven’t been following them for years,” Dr. Patel said. “What’s the best way for them to find out that their CT scan shows cancer? We had a couple of patients who asked whether it would be possible for them to get access to their results only after they had talked to their doctors, because they weren’t comfortable reading the findings on their own.”

The RSNA Image Share Network: 20 Month Follow-up Results from a Pilot Site

CONTINUED FROM COVER

Today in Mobile Connect

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<tr>
<th>Time</th>
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<td>- Image Quality Characterization of Handheld Devices for Medical Image Display</td>
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<td>Aldo Badano, PhD</td>
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<td>9:30 A.M.</td>
<td>- University of Colorado Hospital Adult Contrast Reaction Guide Smartphone App</td>
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<td>Theodore B. Jennermann, M.D., Aurora, Colo.</td>
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<td>- When Is Your CTDIvol Too High? Teaching Recognition and Interpretation of CT Scan Parameters Using Web-based Quiz Modules</td>
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<td>Mindy Licourse, M.D., Philadelphia</td>
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Radiation dose can be almost two-fold higher for a patient receiving an identical repeated CT in identical conditions, said Douglas G. Larson, M.D., during his presentation, “CT Dose Variability for Patients Undergoing Repeat Identical CT Scans: A Retrospective Analysis of 2606 Patients Undergoing 12,632 CT Scans.”

“All we know is the average dose number is being brought lower,” said Dr. Larson, an abdominal imaging fellow in the radiation department at Duke University School of Medicine. “Almost nobody is talking about the standard deviation. It turns out there is quite a bit of unpredictability in the CT system.”

Dr. Larson discovered the minimum to maximum variation ratio of radiation dose ranged from 1.56 times to 2.02 times in patients. “We pushed all the same buttons, we did everything the same and one of the scans had double the dose of one of the others without necessarily imparting increased clinical value,” Dr. Larson said.

Patient size, table height, scanner manufacturer and scanner model can all affect dose variability. No variation was seen with patient age or patient gender. “An important step in understanding CT variability is identifying the controllable — the things we can manipulate about the scan and the patient — as well as the intrinsic components of dose variability,” Dr. Larson said.

Dr. Larson retrospectively examined the records of more than 2,000 patients who had undergone more than 12,000 combined repeat CT scans at his institution. He identified colon cancer, rectal cancer lung cancer and renal stone patients who underwent the same CT protocol at least twice between January 2007 and February 2013.

Data collected included study protocol; CT dose index (CTDI) and dose-length product (DLP); table height; pitch, noise index and effective mAs; peak kilovolt (kVp); date; patient age and gender; and patient size.

Other contributing factors likely exist, including particular CT technicians, which were not taken into account during his research, he said.

“As the push for lowering radiation dose moves forward, Dr. Larson said the question involves more than simply reducing the average dose received by patients as a whole. “I feel it’s a real blind spot in all of the work that’s happened to date,” he said. “I fully support everything we’ve done to lower CT dose. But as we try to stretch the limits, it’s time to start looking at some other factors as well.”

Unpredictability of CT Dose Addressed

Knowledge of the intrinsic variability in radiation dose delivered to patients undergoing diagnostic CT imaging would aid efforts to evaluate and lower the radiation patients receive, said a presenter of a study Wednesday at RSNA 2013.

Data collected included study protocol; CT dose index (CTDI) and dose-length product (DLP); table height; pitch, noise index and effective mAs; peak kilovolt (kVp); date; patient age and gender; and patient size.

The researchers also wanted to know the role played by the scanners themselves — the manufacturer, the model and the unique ID of each. They found a significant statistical difference does exist.

“Even if the scanners look identical they don’t actually perform the same,” Dr. Larson said. “Each piece of equipment has its own dose distribution characteristics. If you look at different manufacturers or generations of scanners, everything behaves a little differently.

Diagnosis Live™ Spotlights Chest Cases

Presenter Paul J. Chang, M.D., (left) moderated Monday’s Diagnosis Live Session, the extremely popular audience participation program that always packs the house and gets attendees talking. This year’s session featured a series of interactive case studies meant to challenge radiologists’ diagnostic skills and knowledge. Participants use their personal mobile devices to test their radiology knowledge in a fast-paced session that’s both educational and entertaining.

RSNA/AAPM Symposium

Imaging in Partnership: With Radiation Therapy

—David A. Jaffray, Ph.D.

Dr. Jaffray will discuss how multimodality imaging methods are being used in combination with high-precision radiation therapy delivery techniques to understand fundamental mechanisms of cancer pathogenesis, progression and treatment response. With primary research interests in the development and application of image-guided radiation therapy, Dr. Jaffray has numerous patents issued and several licensed, including kilovoltage cone-beam CT for image-guided radiation therapy.

Dr. Jaffray is a professor in the departments of Radiation Oncology, Medical Biophysics, and Institute for Biomaterials and Biomedical Engineering at the University of Toronto. He serves as the head of radiation physics and a senior scientist within the Ontario Cancer Institute at the Princess Margaret Hospital in Toronto, where he also holds the Orey and Mary Fidani Family Chair in Radiation Physics and is a principal in the STARR Innovation Centre and Guided Therapeutics Group of the University Health Network. Dr. Jaffray is the director of the recently established Institute of Health Technology Development at the University Health Network.

Imaging in Partnership: With Physics and Quantitative Medicine

—James A. Deye, Ph.D.

Dr. Deye will address the challenges and advances associated with quantitative imaging, and how more accurate and quantitative imaging is central to advancing the understanding of major questions in 21st century medicine. Imaging in partnership with medical physics and other technical and clinical disciplines provides a vital tool and multidisciplinary expertise for such advances.

Dr. Deye is a program director in the Extramural Radiation Research Program of the National Cancer Institute. His current portfolio includes grants totaling more than $15 million in areas of advanced technologies and imaging in the planning and delivery of radiotherapy. Dr. Deye’s past appointments include associate director of medical physics at George Washington University Medical Center, with responsibility for the clinical implementation of the Mid-Atlantic Neutron Therapy program, and director of medical physics at Inova Hospital Association in Northern Virginia, where he developed a department of 14 staff covering all areas of medical physics.
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Wednesday's Press Conferences

MR-guided Ultrasound Offers Noninvasive Treatment for Breast Cancer
Using focused ultrasound under MRI guidance to heat and destroy tumors may offer a safe and effective treatment for breast cancer. Researchers assessed the safety and efficacy of MR-guided focused ultrasound (MRgFUS) in 12 patients with invasive ductal breast cancer. They used MRI to confirm the presence and treatable location of cancerous lesions. The patients then underwent single-session MRgFUS treatment. None of the patients experienced significant complications during or immediately after the procedure. In 10 of the 12 patients, MRI showed no enhancement in the treatment area after the procedure. Post-surgery histological evaluation confirmed the absence of residual disease.

Blood Vessels Reorganize after Face Transplantation Surgery
For the first time, researchers have found that the blood vessels in face transplant recipients reorganize themselves, leading to an understanding of the biologic changes that happen after full face transplantation. Researchers used 320-detector row dynamic CT angiography to study the facial allografts of three patients one year after successful transplantation. Results showed that the new blood vessel networks formed in face transplant recipients course posteriorly, in addition to the large arteries and veins that course anteriorly. The findings could potentially improve surgical planning in face transplant patients, shorten the operative time and reduce procedure-associated complications.

Mammography Screening Intervals May Affect Breast Cancer Prognosis
In a study of screening mammography-detected breast cancers, patients who had more frequent screening mammography had a significantly lower rate of lymph node positivity, compared to women who went longer intervals between screening mammography exams. The retrospective study included 332 women with breast cancer identified by screening mammography between 2007 and 2010. The women were divided into groups based on the length of time between their screening mammography exams. Controlling for age, breast density, high-risk status and a family history of breast cancer, the researchers determined that women in the less than 1.5-year interval group had the lowest lymph node positivity rate at 8.7 percent. The rate of lymph node involvement was significantly higher in the 1.5- to three-year and over three-year interval groups at 20.5 percent and 15.4 percent, respectively.

Radiation Safety

Answer

A iterative reconstruction provides more complex modeling of the detector system, scatter, and image noise. Improved spatial resolution or less statistical noise is possible. It may allow reduction of administered activity or shorter imaging times while maintaining image quality.

Q&A courtesy of AAPM.

Lilian Wang, M.D.
Alessandro Napoli, M.D., Ph.D.
Frank J. Rybicki, M.D., Ph.D., and Kanako K. Kumamaru, M.D., Ph.D.

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**Radiologists Balance Quality and Safety with MR Contrast Agents**

Concerns over the safety of gadolinium-based contrast agents (GBCAs) may be adversely affecting quality of care, according to presenters at a Wednesday session.

"**The key question is, in an effort to avoid any adverse reactions from gadolinium-based MRI, have we compromised the quality of MR scans?**" said Jeffrey C. Weinreb, M.D., of the Yale University School of Medicine in New Haven, Conn. GBCAs improve MR image quality and increase diagnostic accuracy, but have been associated with nephrogenic systemic fibrosis (NSF), a disease that involves progressive, severe fibrosis of the skin and other organs, in patients with compromised kidney function. Since the first cases of NSF began appearing in 2006, screening for kidney function before MR imaging has become the standard of care, even though gadolinium-related NSF is extremely rare and not all types of GBCAs have been linked with the disease.

"Since the emergence of NSF and concerns over U.S. Food and Drug Administration warnings, the pendulum has probably swung too much in the direction of hypersensitivity to risk," said session moderator Thomas M. Grist, M.D., of the University of Wisconsin School of Medicine and Public Health in Madison. During the session, “MRI Contrast Use: Have Quality and Safety Collided?”, Dr. Weinreb and Martin R. Prince, M.D., Ph.D., professor of radiology at Cornell and Columbia Universities in New York City, discussed and debated the best approaches in five clinical cases that involved GBCAs.

In a case involving a kidney transplant patient, Dr. Prince raised the possibility of using non-contrast renal MR imaging, while Dr. Weinreb questioned the rationale of doing so many imaging studies with diminishing returns. The case of a patient with a history of allergic reaction to a GBCA provoked a discussion of premedicating patients. Dr. Prince noted that the specific contrast-related allergic reactions that benefit from premedication are minor, and urged radiologists to pay attention to the contraindications listed in the contrast agent package inserts. For patients with a history of reaction to iodinated contrast agents, Dr. Prince recommended leaving in an IV line to speed delivery of medication in case of a reaction.

Both radiologists agreed that patients with cirrhosis and other liver diseases are largely safe to study with contrast-enhanced MR imaging, provided that their kidney function is sufficient. "There is fairly compelling data that liver disease does not increase NSF risk, but liver disease does increase the risk of kidney disease, which has been associated with NSF," Dr. Weinreb said.

The two radiologists also debated the association between NSF and pro-inflammatory conditions. Dr. Prince’s facility uses the presence of pro-inflammatory conditions as one of four risk factors considered in the decision making process, but Dr. Weinreb argued that people getting imaged are likely to be sick and in a pro-inflammatory state.

"In our practice it’s not something we screen for and not something that would prevent us from using GBCAs," he said.

Late in the session, Dr. Prince asked Dr. Weinreb, "Why not pick an agent not associated with NSF and skip the screening?"

There are a number of reasons, Dr. Weinreb said. "For one, we don’t know the patient’s prior history," he said, adding that skipping the screening may become an FDA-supported option in the future.

In the end, the presenters emphasized the pivotal role of radiologists in keeping patients safe while providing them with optimal care. "With appropriate use of contrast agents and understanding of patient parameters, radiologists can reduce the likelihood of NSF," Dr. Grist concluded.

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Radiologists Embrace ACR Guidelines on Incidental Findings

About one-third of radiologists have read an American College of Radiology (ACR) white paper on managing incidental findings on abdominal CT and nearly 90 percent of them are applying it in practice, according to the results of a survey presented during a Wednesday session.

The 2010 white paper covering renal, adrenal, pancreatic and liver incidental findings filled an important niche as a guidance tool for radiologists, according to Lincoln Berland, M.D., of the University of Alabama Birmingham, one of the authors of the white paper.

Also presenting at the session were William W. Mayo-Smith M.D., professor of diagnostic imaging at Brown University, Gary M. Israel, M.D., professor of diagnostic radiology and of surgery at Yale School of Medicine, and Genevieve L. Bennett, M.D., assistant professor of radiology at Langone NYU Medical Center, who respectively discussed adrenal, renal, and adnexal incidental findings.

Dr. Mayo-Smith and Israel were also co-authors of the 2010 white paper.

“There has been a marked increase in the frequency of incidental findings in the last decade and beyond,” Dr. Berland said. “The problem has been that there was no guidance or body of knowledge providing specific recommendations for handling incidental findings in these environments, so they have been handled inconsistently.”

Guidelines Impact Additional Imaging Tests

After the white paper was published, the next step was to determine whether the information was being used, and, if not, to develop ways to increase usage.

To that end, more than 14,000 radiologists were contacted for the survey, with about 20 percent (2,892) responding. About 1,100 survey participants reported they had read the paper, with 89 percent of those radiologists reporting that they used the white paper content in clinical practice.

“It’s part of an ongoing effort to make this information more accessible and better utilized by the radiology public,” Dr. Berland said.

The survey also demonstrates the clinical impact of the white paper, Dr. Berland said. One of the suppositions for creating the document, he said, was that physicians were making too many recommendations for additional imaging tests based on incidental findings.

“We wanted to see whether people were making fewer recommendations based on whether they read the paper,” Dr. Berland said. “Indeed, we found that on average, people made fewer recommendations when they had this for guidance.”

In fact, according to the survey, the white paper led 560 radiologists (51 percent of those who read it) to recommend additional imaging less often and just 33 radiologists (3 percent) to recommend imaging more often.

“The impression from the survey is that the white paper is having a positive effect on how people make specific recommendations in specific circumstances, and that they are making fewer recommendations in instances that have no clinical significance.”

To increase usage, Dr. Berland would like to see a broader effort to improve access to appropriateness guidelines in general. For example, at his institution, the incidental findings white paper is available online for physician reference and printed copies are available at individual workstations.

Dr. Mayo-Smith and Bennett said they are using similar systems at their institutions. At Brown University, the information is available on the Intranet so that it can be easily pulled up on computers next to a PACS workstation, Dr. Mayo-Smith said. “We use it all the time,” he said.

A good practice for radiologists regarding adrenal incidental findings would be— in consensus with gynecologists at their institutions—to develop management algorithms to help make reporting and recommendations more consistent, Dr. Bennett said. “That is something we’ve done at our institution,” she said. “We’ve taken these various recommendations and adapted them to come up with strategies that please everyone.”

RSNA 2014 Abstract Deadline is April 9

The deadline for submitting abstracts for consideration for presentation at RSNA 2014 is 12:00 p.m. Central Time on April 9, 2014.

The online abstract submission program will be activated in mid-January at RSNA.org/abstracts. Abstracts are required for scientific presentations, education exhibits, applied science exhibits and quality storyboards.

For more information about the abstract submission process, contact the RSNA Program Services Department at 1-877-776-2227 within the U.S. or 1-630-590-7774 outside the U.S.
MR T2-mapping Aids in Follow-up of Osteoarthritis Therapy

Arthritic knees may be successfully treated with stem cell therapy, and the success of the treatment can be measured with MR T2-mapping, according to a pilot study presented Wednesday morning.

**THE RESULTS** suggest that treatment with mesenchymal stem cells (MSCs) decreases pain, improves function and quality of life, and in some cases delays or even reverses cartilage damage. MSCs can differentiate into chondrocytes after injection. Osteoarthritis is the most prevalent chronic joint disease, responsible for 2 percent of direct public health expenditures with much larger indirect costs due to disability and loss of productivity. Short of replacing the joint, no treatment today has succeeded in restoring cartilage. Typical treatments include anti-inflammatory drugs, analgesics and local corticosteroid injections.

The study represents a proof of concept for both stem cell therapy and the correlation of T2-mapping with clinical assessments. “We wanted to find out if MRI T2-mapping could be a useful technique for the follow-up of [stem cell] treatment,” said Joan C. Vilanova, M.D., associate professor of medicine at the University of Girona, Spain, who presented the results. He noted that most newer MR equipment is capable of performing T2-mapping, which can detect changes in water content in cartilage, as well as other biochemical and biophysical changes.

**We wanted to find out if MRI T2-mapping could be a useful technique for the follow-up of [stem cell] treatment.** Joan C. Vilanova, M.D.

Twelve patients with clinical and radiologic diagnosis of osteoarthritis of the knee were treated with autologous mesenchymal stem cells (MSCs) by intra-articular injection. There was an equal number of male and female patients and left and right knees. The average patient age was 49, and all 12 patients had failed to respond to conventional treatments.

After an initial clinical and MR assessment, patients had MSCs harvested from their bone marrow, cultured and injected into their knees. There were no serious adverse events from the injections, and post-implantation pain, reported by half the patients, responded well to ibuprofen and resolved within one to six days. Clinical outcomes, including assessments of pain, disability, and quality of life, were followed for a year. Cartilage assessment was performed using MR T2-mapping, at 88 pre-determined anatomic regions, before treatment and at 6 months and 12 months after treatment. T2 relaxation values were determined in each region of the knee. T2 relaxation time is sensitive to both changes in cartilage hydration and orientation of collagen fibrils. T2 relaxation time increases with osteoarthrits.

Participating patients had a 65 to 78 percent reduction in their level of pain, and smaller but still significant improvements in knee function and quality of life. Pain reduction during sports activity was even greater than pain reduction at rest. Analysis of the T2-mapping images showed consistent decreases in T2 relaxation values.

The study is ongoing and has expanded to 70 patients, Dr. Vilanova said. He expects additional results to be available sometime in 2014. He cited two areas that need further study: the standardization of MRI T2-mapping techniques, and exactly how the MSCs work once they’re injected. “We have not proved the mechanism of the benefit,” he said. “We need to study more joints over a longer follow-up period.”

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**Baron Named Board Chair**

Richard L. Baron, M.D., is chairman of the RSNA Board of Directors for 2013. Dr. Baron is a professor of radiology at the University of Chicago Medical Center, where he has been since 2002, serving as chair of the Department of Radiology from 2002 to 2011 and dean for clinical practice from 2011 to 2013.

As chairman, Dr. Baron will support RSNA’s missions and core values by placing a priority on evaluating how RSNA’s educational offerings are organized and accessed, given that lifelong learning and continuous, real-time education are now so essential to the radiology community.

“RSNA members and contributors produce a broad array of scientific and educational content that collectively provides an unmatched resource for the imaging community,” he said. “We want to optimize how we capitalize on that resource to most effectively meet our members’ needs.”

Dr. Baron also believes it is important to reach out to international members to foster valuable interaction amongst members of the radiology community worldwide.

“The world of radiology has become truly one interconnected group, and our membership, annual meeting and journal participation reflect this global community,” he said. “I’d like to help the RSNA continue to provide meaningful opportunities for our international members to interact with our North American members in a comprehensive way.”

Dr. Baron graduated cum laude from Yale University and earned his medical degree at the Washington University School of Medicine in St. Louis, Mo., where he was elected to Alpha Omega Alpha Honor Medical Society. An internship in internal medicine at Yale University was followed by his radiology residency and abdominal radiology fellowship at the Mallinckrodt Institute of Radiology at Washington University.

Dr. Baron has been an active member of several medical societies and organizations, including the American College of Radiology, Washington State Radiology Society, and the American Roentgen Ray Society (ARRS).

The RSNA has presented Dr. Baron with two Magna Cum Laude Awards, and the ARRS awarded him gold and silver medals for educational exhibits.

Dr. Baron has served on RSNA committees including the Scientific Program Committee, Public Information Advisors Network, Finance Committee and the Education Exhibits Committee, of which he served as chairman from 2006 to 2009. In 2008, he was elected to the RSNA Board of Directors and served as the Liaison for Education. He currently serves as Liaison for International Affairs.

**Dunnick is RSNA President**

Dr. Dunnick’s service to RSNA includes the Scientific Program Committee, Research Development Committee, Research & Education Foundation Board of Trustees, Education Council and the Grants Program Committee. In 2006, he was elected to the RSNA Board of Directors and served as the Liaison for Publications and Communications from 2006 to 2007. In 2007, he became the Liaison for Science and served as Chairman from 2011 to 2012, and President-Elect from 2012 to 2013.

**Coming Next Year: RSNA Centennial**

A highlight of the presidency of N. Reed Dunnick, M.D., is the kickoff of the celebration of RSNA’s centennial.

RSNA will celebrate its centennial throughout 2014 and 2015. Dr. Dunnick and RSNA President-elect Ronald L. Arenson, M.D., co-chair the volunteer committee overseeing the celebration.

Watch issues of Radiology, RadioGraphics and RSNA News and RSNA.org for commemorative content and information about special RSNA Centennial activities at RSNA 2014.
Promise of PET/MR in Gynecologic Imaging Explored

While PET/MR shows promise in detecting and staging women’s pelvic cancers, more research is required to take full advantage of its capabilities, said presenters of scientific papers on Wednesday at RSNA 2013.

Patrick Veit-Haibach, M.D., of the Department of Medical Imaging at University Hospital Zurich, assessed and compared the diagnostic accuracy of PET/CT and PET/MR imaging for primary gynecological malignancies. “PET/MR imaging for advanced tumors works,” he said. “It provided several pieces of useful information concerning the local tumor status. However, the overall detection rate for local and distant metastases was not different from PET/CT.”

PET/MR imaging provided localized information, while PET/CT was obtained on the whole body to provide information on the distant metastases, Dr. Veit-Haibach said.

The study involved included 26 patients with 18 suspected primary cancers and eight with suspected recurrence. The two imaging procedures were performed within a single session, with a “shuttle” table facilitating the transition from the MR table to the PET/CT table. Following F18-fluorodeoxyglucose (18F)FDG contrast administration, the patients underwent PET/MR imaging of the abdomen and pelvis and then standard unenhanced PET/CT with a field of view from the mid-thigh to the vertex of the skull.

“For primary tumor detection, PET/MR was superior in 14 cases and equal in 10,” Dr. Veit-Haibach said. “But PET/CT provided advantages concerning distant metastases.” PET/CT overall showed additional relevant additional information in nine cases, mainly concerning distant metastases, while PET/MR showed relevant additional information in three cases concerning the primary tumor, he added.

PET/MR imaging might be one of the future clinical routine indications for evaluating gynecologic tumors, Dr. Veit-Haibach said. “However, in advanced stages, whole-body imaging is needed. We have to figure out efficient whole body protocols which adequately cover the pelvis but also the rest of the body for evaluation of distant metastases, but not having the patient too long in the scanner. Otherwise it will be a very expensive staging tool.”

Future research will also go into multi-parametric PET/MR imaging with advanced MR techniques to better characterize the tumor itself, Dr. Veit-Haibach said.

Presenting the results of separate study, Karsten Beiderwellen, M.D., of the Department of Diagnostic and Interventional Radiology at University Hospital Essen in Germany, said PET/MR imaging as a whole-body technique combines two powerful modalities, Dr. Beiderwellen continued. “First, MR imaging, offering an excellent soft tissue contrast, allows for visualization of the local tumor extent and possible tumor infiltration. Second, FDG-PET allows for detection of small distant metastases as well as information on metabolic activity of suspect lesions.”

Study results indicated that PET/MR imaging when compared to MR imaging alone leads to a higher detection rate of metastatic lesions, a higher lesion conspicuity and a higher diagnostic confidence in the assessment of metastatic lesions. The study included 20 patients with ovarian or cervical cancer who underwent a whole-body MR protocol using an integrated scanner. The researchers detected metastatic lesions in 17 patients. “Based on PET/MR, there was correct identification of all 17 disease-positive patients, and based on MR alone there was correct identification of 15 patients,” Dr. Beiderwellen said. He noted that PET/MR provided significantly higher lesion conspicuity and significantly higher diagnostic confidence.

“Today, pelvic MR imaging as well as whole-body PET—or, rather, PET/CT—are already part of the restaging procedure in patients with recurrent pelvic malignancies,” Dr. Beiderwellen said. “However, these examinations are usually performed independently, on different days. Administering independent exams means that, due to different patient positioning and differences in the state of bladder fullness, lesions characterized in one modality might not be comparable or present in the other modality, Dr. Beiderwellen said. “There is also the matter of radiation exposure. Nowadays, PET is usually performed as combined PET/CT. The added CT leads to an additional radiation exposure that can be avoided in PET/MR imaging.”

While the study included a small patient cohort and lacked histopathological correlation for all lesions, the results are still promising, Dr. Beiderwellen said. “PET/MR might be a valuable alternative to MR and PET/CT in re-staging of patients with recurrent pelvic malignancies,” he concluded.
New Angiography Platform Reduces Dose, Maintains Quality

A new angiographic imaging platform can reduce radiation dose by 83 percent without compromising image quality, according to a study presented Wednesday.

“OVER THE PAST 10 YEARS WE HAVE seen a large increase in the use of radiation for medical imaging,” said Marco J. Van Strijen, M.D. of the Department of Radiology, St. Antonius Ziekenhuis in Nieuwegein, the Netherlands. “Minimal invasive innovative therapies in interventional radiology and cardiology rely on high-quality imaging, but also lead to longer procedure times and often in younger patient groups.”

A further hindrance, Dr. Van Strijen said, is the fact that many patients undergoing interventional procedures are obese, which “poses an additional problem to the dose we are using for getting optimal image quality,” and that procedures are getting more complex and at closer range, which also contributes to larger dose exposure.

Therefore research in this area has been necessary to find new techniques to reduce dose for both individual patients and staff during these procedures, and to verify claims of particular vendors regarding the ability of their devices to reduce dose, he said.

According to Dr. Van Strijen, the availability of increased computer power has led to the development of real-time imaging reconstruction algorithms that combined with technical improvements in imaging equipment are capable of reducing the needed radiation dose while maintaining image quality.

The platform his group studied—a system from Philips Healthcare called AlluraClarity—can adjust more than 500 system parameters in real time, thereby reducing the radiation dose necessary for adequate imaging during interventional procedures.

“The important part of the system is the flexible digital imaging pipeline,” Dr. Van Strijen said, adding that it enables the operator to make adjustments in functions such as pixel shifting, image enhancement or noise correction depending on the anatomical area of interest, and all in real time.

In this study, the researchers acquired two angiographic runs for each of 50 patients scheduled for iliac interventions. One run was acquired using a conventional imaging platform while the other was acquired using the new platform. Air kerma (kinetic energy released per unit mass) and dose area product values were recorded in all acquisitions and at the end of the procedure. “As the definition of ‘adequate imaging’ is difficult to describe we asked several non-affiliated interventional radiologists across Europe to compare the results in a blinded way,” Dr. Van Strijen said.

The researchers found that the radiation dose in all procedures showed a mean reduction of radiation dose of 83 percent. The imaging technology was used in the entire procedure for all 50 patients since the image quality was considered to be sufficient for performing the intervention.

In addition, the qualitative image assessment by the non-affiliated interventional radiologists found that the run using the low-dose platform was usually of equivalent or better image quality as compared to the conventional imaging platform. According to Dr. Van Strijen, the blinded review comparison found that lower dose technique provided better image quality in 14 cases, similar image quality in 32 cases, and worse image quality in two cases.

The results suggest that the technology will provide “enormous” future radiation dose reduction benefits for both patients and staff during interventional procedures, Dr. Van Strijen said.
3D Printing Generates Physical Models of 3D Images

3D printing is an emerging technology that can aid surgeons in pre-operative planning for surgery. It can be used as an educational tool for radiologists and help patients better understand radiology procedures, said the presenter of a study on Wednesday at RSNA 2013.

“If you have a 2D model on your screen and after printing you have the same model, but can hold it in your hand, it is a slightly different experience,” said Zbigniew Starosolski, Ph.D., a research scientist at Texas Children’s Hospital. “It’s much easier to analyze 3D data in your hand.”

In his research, “3D Printing in the Pre-operative Assessment of Subtalar Coalitions Compared to 2D and 3D CT Datasets,” Dr. Starosolski focused on CT images from 12 patients ages 8 to 17 who had been previously diagnosed with subtalar coalition using traditional 2D-CT imaging. The images were used to segment the calcaneus and talus for 3D printing.

To compare the findings from the 3D model with the 2D images, researchers estimated the area of coalition in four ways: a radiologist reading of CT data; the curved multiplanar reconstruction (MPR) segmentation of the coalition; an orthopedic surgeon visually examining the 3D print; and breaking apart the 3D print and physically measuring the area.

Coalition areas were classified as greater than or less than 50 percent, or as needing further assessment. Using Cohen’s Kappa statistic, researchers estimated the correlation between the methods after two experts reviewed the anonymous data sets. The Kappa statistic indicated substantial agreement (0.64) between manual reads and the 3D print. It also indicated moderate agreement among the manual reads (0.4).

Dr. Starosolski said his study did have some drawbacks, notably a limited number of cases. “We could expand the cohorts for the study, but I’m not expecting to have very different results,” he said.

While the 3D model would aid in a surgeon’s decision-making process regarding potential surgery, the model cannot be solely relied upon for the decision, Dr. Starosolski said.

For patients, the 3D model can be used as an educational tool with great value. Most patients do not understand the technical terms, or the images they are shown, Dr. Starosolski said. The model provides a strong visual element that helps lay people understand images and also aids in terms of scale.

“If the screen you can scale your objects a different way,” he said. “For the brain it’s quite difficult to imagine the dimension. But when you have a real object in your hand, you can learn very quickly.”

For the brain it’s quite difficult to imagine the dimension. But when you have a real object in your hand, you can learn very quickly.

Zbigniew Starosolski, Ph.D.

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