NOVEMBER 28, 2017

TUESDAY

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INSIDE TUESDAY

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TODAY
56 High / 36 Low

WEDNESDAY
48 High / 43 Low

A Turbulent Age for Imaging, a Golden Age for Innovation

By Elizabeth Gardner

Radiology began as a discipline of capturing images, and, like photography, has evolved by emulating and improving on how the eye works. But advancements such as compression and image analysis algorithms and artificial intelligence (AI) are quickly transforming radiology into a discipline that instead mirrors how the brain works.

These new developments may someday render radiology images — as we know them today — irrelevant, according to Daniel K. Sodickson, MD, PhD, who on Monday delivered this year's New Horizons Lecture, "A New Light: The Birth, and Rebirth, of Imaging."

"I'm pleased to announce the death of the MR protocol," said Dr. Sodickson, "Not quite yet, because there is lot of work to do and there will always be need for tailored studies to answer a particular question. But MRI is a little like art photography now: Lie still, don't move, hold your breath, and do it again. It's not a very modern paradigm."

Radiologists, on the other hand, will maintain their value, he added.

"We are more than just our images," Dr. Sodickson said.

Dr. Sodickson, chair of the National Institutes of Health study section on biomedical imaging technology, is credited with founding the field of parallel imaging, which allows distributed arrays of detectors to gather MR images at previously inaccessible speeds.

Sodickson

> ***. . . MRI is a little like art photography now: Lie still, don't move, hold your breath, and do it again. It's not a very modern paradigm.***
>
> **Daniel K. Sodickson, MD, PhD**

In his lecture, he predicted that imaging studies will become less like still photography and more like streaming video. Scanners that acquire information from many different angles at the same time will capture patients' data continuously and algorithms will select it as needed to reconstruct images for specific purposes.

"You can see a moving abdomen and the flow of contrast," said Dr. Sodickson, vice chair for research in the Department of Radiology, director of the Bernard and Irene Schwartz Center for Biomedical Imaging, and a professor of radiology, physiology and neuroscience at NYU School of Medicine, in the NYU Langone Health System in New York City. "You can freeze the heart and look at respiratory function, or track the coronary arteries and freeze them at any point you like."

An Alphabet Soup of Algorithms

This revolution in physical modeling is changing the way radiologists interpret image information and connect organ-level maps to underlying cellular architecture and molecular composition.

At the same time, an alphabet soup of AI algorithms are deriving new information from sometimes very low quality image data, and may someday change the way imaging devices are designed, Dr. Sodickson said. In fact, recent implementations of AI for image reconstruction have begun to resemble the neural processing of complex, continuous sensory data streams.

CONTINUED ON PAGE 17

New Horizons Lecture Dedicated to Mansfield

The 2017 New Horizons Lecture was dedicated to the memory of MRI pioneer and Nobel laureate Sir Peter Mansfield, PhD, who died in February. Dr. Mansfield was awarded the Nobel Prize in Physiology or Medicine in 2003 for his work developing MRI, a technique that changed the face of modern medicine.

Dr. Mansfield, a physicist, shared the Nobel Prize with Paul C. Lauterbur, PhD, a chemist from the University of Illinois, Urbana, who died in 2007. Dr. Lauterbur is credited with inventing the MRI technique as part of Dr. Mansfield's team at the University of Nottingham in England in the 1970s.

Mansfield

Dr. Mansfield, an emeritus professor of physics at Nottingham since 1994, further developed MRI with his invention of echo-planar imaging, which dramatically reduced scan times. In 1978, Dr. Mansfield became the first person to step inside a whole-body MRI scanner so it could be tested on a human subject.

Born Oct. 9, 1933, in London, Dr. Mansfield left school at 15 to become a printer's assistant. Eventually, he returned to school and obtained a physics degree and his doctorate from Queen Mary College, University of London.

Dr. Mansfield began his professional career in 1962 as an appointed research assistant in the physics department at the University of Illinois, the same institution where Dr. Lauterbur worked, though 20 years apart. Dr. Mansfield joined the University of Nottingham as a physics lecturer in 1964 and remained there until his retirement 30 years ago. The Sir Peter Mansfield Imaging Centre at the university was named in his honor.

Dr. Mansfield was knighted by Queen Elizabeth II in 1993. Among his many other accolades, Dr. Mansfield was awarded gold medals by the Royal Society Wellcome Foundation, the International Society of Magnetic Resonance in Medicine and the European Congress of Radiology.

Tuesday At a Glance

View the full program and add sessions to My Agenda on the RSNA 2017 App or at *Meeting.RSNA.org*.

7:15-8:15

Controversy Session
Combining Immunotherapy and Radiation: Is It All Hype?
(E350)

Hot Topic Session
Abbreviated Abdomen MRI Protocols
(E450A)

RSNA Diagnosis Live™
Keeping Radiology Weird: Spot Diagnoses from the Pacific Northwest (Case-based Competition)
(E451B)

8:30-10:00

Educational Courses

8:30-NOON

Series Courses

10:30-NOON

Plenary Session
(E451B)
RSNA/AAPM Symposium: Machine Learning in Radiology: Why and How? Harnessing Artificial Intelligence
Keith J. Dreyer, DO, PhD
Assistive AI for Cancer Treatment
Antonio Criminisi, PhD

10:30-NOON

Scientific Paper Sessions
BOOST: Bolstering Oncoradiologic and Oncoradiotherapeutic Skills for Tomorrow
Gastrointestinal—Oncology Anatomy
(S103AB)
Lung—Science Session with Keynote
(S103CD)

10:30-NOON

Israel Presents: *Radiology in Israel—Experience from the Land of Innovation*
(E353C)

11:00-1:00

3-D Printing Theater Presentations
(Learning Center)

11:00-2:00

Machine Learning Theater Presentations
(Machine Learning Showcase, North Hall)

12:15-1:15

Poster Discussions
(Learning Center)

1:30-2:45

Plenary Session
(Arie Crown Theater)
Presentation of the RSNA Gold Medal
Annual Oration in Diagnostic Radiology
Strategies for Radiology to Thrive in the Value Era
Jonathan B. Kruskal, MD, PhD

1:30-2:30

BOOST: *Gastrointestinal-Science Session*
(S103AB)
Lung—The Confluence of Diagnostic Radiology and Radiation Oncology in Lung Cancer
(S103CD)

1:30-6:00

Interventional Oncology Series:
Liver Mets and Immuno-Oncology
(S405AB)

2:30-4:00

RSNA Diagnosis Live™ Interactive and Mobile Device Integrated Audience Response:
Tips, Tricks and How to Get Started (Hands-on)
(S401CD)

2:30-4:00

Educational Courses

3:00-4:00

Scientific Paper Sessions

3:00-4:15

BOOST:
Genitourinary—Case-based Review
(S103AB)
Lung—Case-based Review
(S103CD)

4:30-6:00

Educational Courses

4:45-6:00

BOOST: *Genitourinary—eContouring*
(S104AB)

Tickets Not Required for RSNA 2017 Sessions

All sessions at RSNA 2017 are filled on a first-come, first served basis. Please be aware that adding sessions to My Agenda in Meeting Central does not reserve a seat, it is provided to assist you in managing your meeting schedule. Visit any Information Desk for more information.

DailyBulletin

Tuesday

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RECYCLED PAPER · PRINTED WITH SOY INK · RECYCLABLE PAPER

AI Key to Noninvasive Biomarker Development in Lung Cancer

By Richard Dargan

Artificial intelligence (AI) is playing a pivotal role in the development of new imaging biomarkers for lung cancer, according to an expert in the field who spoke Monday at RSNA 2017.

Researcher Hugo Aerts, PhD, from Harvard University in Cambridge, MA, likened the impact of AI on radiology to that of self-driving cars on transportation. Just as self-driving is capable of exceeding human performance in some instances, AI can assist radiologists in areas where they have limitations, such as determining if a lung nodule found on screening is benign or malignant.

"Benign and malignant nodules often look similar to humans," Dr. Aerts said. "By finding very subtle differences in the nodules, AI can go beyond human performance."

Current methods for sampling lung tumors such as invasive needle biopsy have limitations, Dr. Aerts said, as they are often unable to fully capture the spatial state of the tumor. In contrast, radiomics, which represents the quantification of tumor characteristics through medical imaging, is ideally suited to tracking a tumor's physical characteristics before, during and after treatment. Medical imaging offers the additional advantage of being a noninvasive technique that can be performed with minimal risk or inconvenience to the patient. And the use of deep learning (DL), a subset of AI, provides access to an immense amount of data that allows the radiologist to draw more accurate conclusions.

"Through the application of AI in radiology, we can extract more information from the image than meets the eye, improving treatment for the patient," Dr. Aerts said.

Dr. Aerts cited a 2014 study in which he and colleagues performed a radiomic analysis of 440 features quantifying tumor image intensity, shape and texture, extracted from CT data of 1,019 patients with lung or head-and-neck cancer. The results showed that a large number of radiomic features have prognostic power in independent data sets from these patients, many of which were not identified as significant before.

> ***AI will change how radiology is practiced, but will not remove the need for radiologists.***
>
> **Hugo Aerts, PhD**

"You need to know the volume and extent of a tumor for treatment, but it's much more difficult to predict survival," Dr. Aerts said. "Through DL, we can find characteristics that predict if patients will have good outcomes. It is replacing what is already done and improving it."

In a 2017 study of 262 North American and 89 European patients with lung cancer, Dr. Aerts and colleagues identified previously undescribed associations among radiomic imaging features, molecular pathways and clinical factors. A number of imaging features like intra-tumor heterogeneity showed predictive value for specific disease pathways.

Aerts

"Several biomarkers have been discovered in research settings and hopefully will be in the clinic within the next few years," Dr. Aerts said.

Interest in AI is high, as evidenced by the standing-room-only crowd at the 7:15 a.m. session, prompting Dr. Aerts to quip, "the most important part of AI is all of you being here this early in the morning." But he cautioned that the hype around AI might have negative consequences for radiology if it encourages the mistaken notion that machines will eventually take over.

"AI will change how radiology is practiced, but will not remove the need for radiologists," Dr. Aerts said.

Functional MRI Markers Measure Certainty — and Uncertainty — in the Brain of Normal Subjects

By Elizabeth Gardner

It makes sense that the level of uncertainty in a situation would change how a person's brain makes decisions about what to do next. Now researchers can actually see the differences, thanks to functional MRI (fMRI).

On Monday, Danielle Farrar, MA, an MD/PhD candidate in the Boston University Department of Anatomy and Neurobiology, presented research showing that when neurologically normal subjects were certain in advance about the results of a decision, they used the areas of their brain most closely associated with rewards.

However, when they were uncertain, they used areas of their brain that are active during changing conditions, as well as areas associated with increased visual attention and motor control.

The goal of the study, which is part of Farrar's doctoral research, is to establish a baseline for how different decision-making tasks activate the brains of neurologically normal subjects who have not been diagnosed with any mental illness or neurological impairment.

With that baseline, Farrar eventually hopes to study impaired decision-making in such pathological states as schizophrenia, attention deficit/hyperactivity disorder, and obsessive-compulsive disorder. People with these conditions, as well as many other neuropsychological impairments, often have poor executive function, which includes not only decision-making, but the ability to plan, focus attention, remember instructions and follow them correctly, prioritize tasks, and control impulses.

"This work sheds light on the fact that executive function, thought to be a frontal lobe function, really taxes the whole brain during times of uncertainty," illustrating why those times can be so difficult for those with impaired executive function, Farrar said. Her work also seeks to establish how the various parts of the brain function in a network during the tasks studied, rather than simply studying the activity of individual areas.

Farrar

Researchers examined 19 healthy subjects between ages 18 and 35 who each completed a decision-making card-matching task while undergoing an fMRI scan. The subjects were given one card, and asked to match it to one of five other cards. The card they were given matched each of the five cards in one attribute (such as color, number of shapes shown, type of shape shown, or type of border), but not in any of the others.

In the "certain" condition of the card-matching task, the subject chose a rule to apply for matching the first card, and that rule remained in effect for all of the "certain" trials.

In the "uncertain" condition, a program randomly chose the correct rule for each trial and the subject didn't know it in advance, so the likelihood of making an incorrect choice was high.

Each subject received a baseline structural scan and then completed the matching tasks six times, alternating with brief rests to return to baseline, during a 36-minute functional scan. The fMRI scan captured brain function every two seconds. Cards were presented for four seconds and subjects were instructed to respond within that time on a button box held in their right hand. Certain and uncertain conditions alternated. Half the subjects started with the certain condition and the other half started with the uncertain condition. The results showed different networks of functional brain regions for the two conditions.

The areas activated in the "certain" condition — the insula, parietal cortex, temporal cortex, ventromedial cortex, and orbitofrontal cortex — were those generally associated with reward. The "uncertain" condition activated areas usually associated with resolving uncertainty and updating rules (the prefrontal cortex, parietal cortex striatum, thalamus, amygdala and hippocampus), and also activated the occipital cortex and midbrain, areas associated with visual attention and motor control.

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Resident vs. Attending Coverage: What are the Merits?

By Jennifer Allyn

Twenty-four-hour resident coverage in radiology at academic medical centers with faculty oversight has its proponents, but has also come under fire — particularly around the quality of patient care at night and the education of residents.

During Monday's course, "24-Hour Attending Coverage: Has the Time Come?" Michael A. Bruno, MD, from Penn State University in Pennsylvania, PA, laid out the biggest challenges with making this change, while Hani H. Abujudeh, MD, MBA, from Rutgers New Jersey Medical School in Newark, NJ, shared his thoughts on how centers that have already made this change are thriving.

The traditional model for night coverage in teaching hospitals is for an upper-level resident to be responsible for providing real-time, onsite coverage all night. Residents are supervised by attending faculty who are available for consultation by phone at night. The residents' work is reviewed the following morning, often by multiple faculty members of each subspecialty.

When an attending radiologist covers the overnight shift, residents are still present and working, but are more immediately supervised by the attending, who signs off on all types of cases and also provides direct care.

"In study after study, it has been shown that residents are at least as accurate and are typically more accurate for overnight ER radiology reading than attending radiologists," Dr. Bruno said. "In my opinion, faculty are generally subspecialists, whereas the residents are more generalists and are therefore better suited for this type of work."

Michael A. Bruno, MD, Hani H. Abujudeh, MD, MBA, Howard P. Forman, MD, and Jonathan Mezrich, MD, discussed the merits of 24-hour attending coverage during a Monday session.

Dr. Abujudeh disagrees. "Residents who are on their own in the overnight hours are often overworked, especially due to the volume and acuity of the cases, and due to their inexperience," Dr. Abujudeh said. "Having an overnight attending, especially an ER radiologist, provides high value because they can immediately catch errors and are more of a condition specialist, trained for severe or emergency inpatient issues."

Resident training is also an issue affected by a change to 24-hour attending coverage. "When a resident makes an error, there is up to an 8-hour void before an attending catches the error," Dr. Abujudeh said. "Unfortunately, residents often never learn of their error because after an overnight, they head home."

"However, as a resident, knowing that my decisions would be acted upon and would not immediately be second-guessed or rescinded, made me work harder to make sure my decisions were correct," Dr. Bruno said. "Taking that pressure away from residents would drastically undermine the effectiveness of teaching programs."

In closing, both doctors talked about how 24-hour attending coverage can and does affect the quality of patient care. For Dr. Bruno, having 24/7 attending coverage creates different levels of care. "Residents provide a higher level of care, no matter what time of day, and attending coverage eliminates the benefit of double-reading for error mitigation and prevention of patient harms," Dr Bruno said.

For Dr. Abujudeh, patient care definitely improves when attending physicians, particularly ER specialists, read over 24 hours. "Having attending physicians reading images day and night provides a continuity of care for the patient. They can be assured that there will be fewer delays in diagnosis, especially if there is a change to a read in the morning, and that their wait time, especially in the emergency department, will be reduced," Dr. Abujudeh concluded.

Technology Can Aid Healthcare Team Communication

By Lynn Antonopoulos

With continuous advancements in technology, radiologists have access to more tools than ever to combat breakdowns in communication with referring physicians and to ultimately play a greater role in improved patient care.

During a Monday morning educational course, Max Wintermark, MD, MAS, MBA, professor of radiology and chief of neuroradiology at Stanford University, moderated a panel of presenters focused on identifying costly communication gaps between radiologists and referring physicians while broadening awareness of some creative and strategic ways radiologists are leveraging technology to be more active in patient care after imaging.

Often overwhelmed with heavy workloads, radiologists may be hesitant to assume additional responsibilities related to conveying test results and ensuring proper follow-up with patients. Yet those activities can play an important role in not only carefully interpreting images and making recommendations but also acting as a safe, patient-centered back-up system and ensuring that actionable results are not overlooked.

Virtual Connections

Among the creative methods highlighted were a virtual consult application and virtual rounds. Each follow the traditional model of a group of specialists meeting to review patient films and discuss the course of care. However, through these virtual meetings, the teams can use available technologies to overcome the challenge of gathering specialists in one place. Instead, they may teleconference from separate locations and accomplish the same care goals.

> ***Though the patients do not generally see radiologists, radiologists see the patients, and the patients are the center of our concerns — prioritized above all else.***
>
> **Max Wintermark, MD, MAS, MBA**

The virtual consult application is particularly important in the emergency department because it cuts through the problem of accessing help and can deliver an immediate benefit to the patient. "This is also especially useful where experts may not be in the area where patients live. Their access to care is not limited by geographic boundaries," Dr. Wintermark said.

Bridging the Data Divide

As a result of advancements in artificial intelligence, future radiologists will move toward a more data-driven environment with more clinically useful work and less mechanical work related to interpreting and reporting. Data-driven image acquisition, data extraction, data-assisted interpretation and data-oriented reporting are all part of the future of radiology.

Using a wealth of data from a wide variety of sources, radiologists can turn reporting into the optimal tool for advancing patient care. According to the session presenters, the challenge is to bridge the divide between imaging data and clinical data. The answer may be to employ technology to gather rich data from all sources and provide layered reporting that includes details more useful to referring physicians and more understandable to patients, they said.

Annette J. Johnson, MD, MS; Andrew B. Rosenkrantz, MD; Tarik K. Alkasab, MD, PhD; and Max Wintermark, MD, MAS, MBA, participated in a panel to explore communication strategies between radiologists and referring physicians on Monday.

Maintaining a Personal Connection

Although technology can increase communication, it can also be a barrier between radiologists and their clinical colleagues. It has the potential to lead to de-personalization during care. Dr. Wintermark said the key to incorporating technology effectively is striking the right balance, providing the patient access to expertise while retaining a familiar connection with a trusted provider.

"Though the patients do not generally see radiologists, radiologists see the patients, and the patients are the center of our concerns — prioritized above all else," Dr. Wintermark said. "IT tools are used to better serve the patient behind the film."

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RSNA 2017: Explore Sessions in Every Subspecialty

No matter what your area of interest, RSNA 2017 sessions have you covered. Choose from a wide array of educational courses, education exhibits, scientific sessions and posters in a range of subspecialties. View scientific posters and education exhibits in the Learning Center through Friday.

Virtual meeting registrants may also view posters and exhibits by logging on from in or outside McCormick Place.

INFORMATICS

RCB34

RSNA Diagnosis Live™ Interactive and Mobile Device Integrated Audience Response: Tips, Tricks, and How to Get Started (Hands-on)

Tuesday 2:30–4:00 p.m.
Room: S401CD

Attendees will discover the higher receptiveness of interactive content by learners compared with traditional didactic techniques and learn about the basic operational features of the Diagnosis Live audience participation interactive tool.

INTERNATIONAL

RC416

Equipment in the Global Radiology Environment: Why We Fail, How We Could Succeed (Sponsored by the Committee on International Radiology Education [CIRE])

Tuesday, 4:30-6:00 p.m.
Room S014A

Presenters will discuss their experience with the expanding use of digital equipment in resource-limited countries, including data gathered from diverse international departments and from equipment vendors.

HEALTH POLICY AND PRACTICE

RC527

Radiologist Peer-Review and Peer-Learning Options, Best Practices, and Future Directions

Wednesday, 8:30–10:00 a.m.
Room S404AB

Presenters will discuss radiologist peer review history, practices and implementation of a department wide peer review conference, and will review methods of peer review and peer learning through IT improvements, institutional consensus criteria development, and creation of Rad-Path modules.

PHYSICS

SSK18-03

A Personal Organ Dose Archive System for Patient Safety in Radiotherapy

Wednesday, 10:50–11 a.m.
Room S503AB

Researchers developed a personal organ dose (PODA) system that can be used to track and accumulate each patient's organ doses associated with the use of sophisticated treatment technologies and image-guidance procedures in modern radiotherapy.

PEDIATRICS

PD161-ED-WEB7

Understanding Genetics in Pediatric Neuroradiology

Wednesday, 12:45–1:15 p.m.
Pediatric Community, Learning Center

Presenters offer an introduction to genetic and epigenetic mechanisms in neurologic diseases and discuss genotype phenotype correlation in inherited metabolic diseases and the role of MRI as a biomarker. Researchers will discuss using neuroimaging phenotypes to guide genetic analysis in CNS malformations including vascular malformations and posterior fossa malformations.

ONCOLOGIC IMAGING

RC518

Deconstructing Tumors with Imaging

Wednesday, 8:30–10:00 a.m.
Room S104B

Sessions include:

- Imaging of Angiogenesis: What Do Vessels Tell Us about Tumors?
- Multiparametric Imaging of Bone Marrow Metastatic Disease
- Imaging Tumor Metabolism with Hyperpolarized MRI

GENITOURINARY

RC607

Genitourinary Series: Prostate MRI in the PI-RADS Era: Detection, Diagnosis and MRI Guided/Targeted Interventions

Thursday, 8:30 a.m.–12 p.m.
Room E450B

Presenters discuss current issues in prostate cancer care including multiparametric MRI (mpMRI). Attendee will learn how to apply PI-RADS V2 MpMRI quantitative metrics-added value to PI-RADS.

ULTRASOUND

RC623

Evolving Perspectives on Ultrasound Safety

Thursday, 8:30–10:00 a.m.
Room S504AB

Presenters will discuss the physical principles related to ultrasound safety and the potential for biological effects of ultrasound.

Robotic Tracking May Save Time, Reduce Radiation Dose Exposure in CT-Guided Procedures

By Mike Bassett

The use of robotic tracking can save time and reduce radiation dose exposure to both patients and interventional radiologists during CT-guided percutaneous bone procedures, according to research presented Monday at RSNA 2017.

There are several advantages to using robotic systems in CT-guided procedures, according to researcher Simone Quarchioni, MD, of the Department of Biotechnological and Applied Clinical Sciences, University of L'Aquila, Italy.

"First, there is the possibility of reducing radiation dose exposure, which is particularly valuable in case the procedures are performed on young patients," he said. "There is also the possibility of reduced procedure times that will be useful in children and/or uncooperative patients."

Robotic tracking systems can also help interventional radiologists control needle trajectories, thereby avoiding structures near the lesion and possibly reducing side effects, since the technique eliminates the need to change the direction of the needle inside the patient's body.

The system, starting with a CT scan, reconstructs 3-D models of a patient's anatomy. Then, with the use of infrared technology, the system is capable of recognizing the spatial position of microspheres reflecting infrared beams that are positioned on the interventional tool. This allows the interventional radiologist to follow the needle inside the patient's body using real-time navigation.

In this study, Dr. Quarchioni and colleagues performed 38 CT-guided percutaneous bone procedures (18 biopsies, 10 crioablations, and 10 radiofrequency ablations) between January 2015 and December 2016.

Nineteen of the procedures (nine biopsies, five crioablations, and five radiofrequency ablations) were performed using a robotic tracking system, while the other 19 procedures (nine biopsies, five crioablations and five radiofrequency ablations) were performed with the standard "freehand" technique.

The final positioning of the needle was confirmed by CT fluoroscopy in all procedures. The researchers confirmed the robotic tracking system correctly positioned the needle in the patients with a single entry in 95 percent of the cases (18 out of 19 procedures). The one case in which the needle needed to be repositioned was due to an error of 4 millimeters.

The mean execution time for those procedures that were assisted by the robotic system was 16 minutes, compared to 25 minutes for the standard freehand techniques. The mean radiation dose for patients after the first CT scan was performed to detect the lesion was 3.5 mSv ± 1mSv with the traditional freehand technique compared to 0.92 mSv ± 0.78 mSv with the robotic-assisted procedures.

Simone Quarchioni, MD, presented research on the use of robotic tracking systems in CT-guided procedures.

The radiation dose for the interventional radiologists during the robotic-assisted procedure was zero.

The major take-home message from the study is that the robotic tracking system reduces procedure times and radiation dose to both patients and interventional radiologists, Dr. Quarchioni said.

"The system also allows rapid, accurate centering, even of small lesions, reducing side effects and technical failure, with the consequent reduction of the operators' learning curve," he added.

Radiologists Support Tricky Auditory Canal Surgery With 3-D Models

By Jennifer Allyn

Surgery on the inner auditory canal through the middle cranial fossa can be challenging due to the presence of several important anatomic structures in a confined space and the lack of consistent bony anatomic landmarks. Radiologists are assisting with this surgery by providing low-cost, high-precision 3-D printed models to help surgeons simulate the surgery beforehand.

Ghodadra

Stereolithography 3-D printing offers a means to create precise, patient-specific models of the temporal bones so surgeons can visualize and practice, according to Anish Ghodadra, MD, of Yale New Haven Hospital in New Haven, CT.

"The 3-D printed models of the lateral skull base enable otolaryngologists to have a better understanding of a given patient's anatomy and allow them to practice the surgical procedure prior to performing the actual surgery," Dr. Ghodadra said. "The models provide a realistic, patient-specific simulation of drilling of the bone in the skull."

To evaluate the effectiveness of the 3-D models, four cadaver heads were imaged with CT and the bony structures were segmented. 3-D meshes were prepared in modeling software with critical structures that the surgeons want to avoid injuring, such as the facial nerve and the membranous labyrinth, modeled as hollow cavities. These hollow cavities were filled with paint and sealed. If either structure was entered while drilling the model, the paint would leak and provide visual feedback to the surgeon.

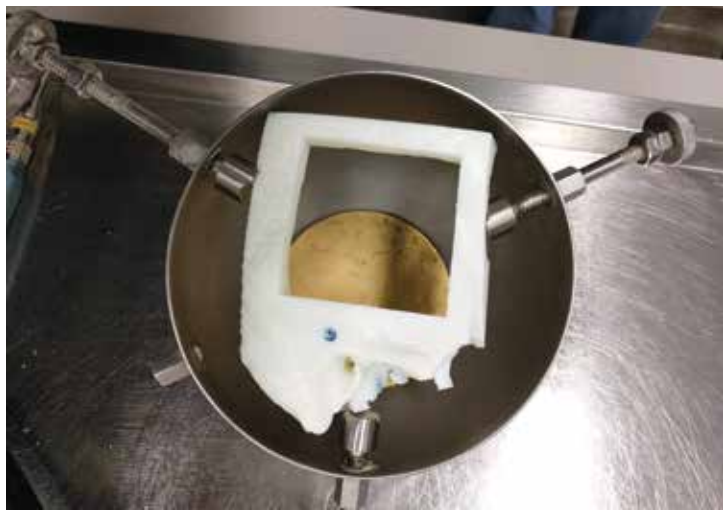
Surgeons then practiced on the 3-D models, followed by the drilling of the corresponding cadaver head. Dr. Ghodadra and his team then measured the accuracy and utility of the model using visual analog scales.

Surgeons reported a median score of 95 out of 100 for the utility of the model in understanding the position of key underlying anatomy in relation to the surface anatomy. As a tool for training residents and fellows on lateral skull base surgery, the score also was 95 out of 100.

"Not only does a 3-D model help simulate this surgery, but it can also serve as a low-cost training tool for residents and fellows, giving them a better perspective of the inner auditory canal and its anatomic structures," Dr. Ghodadra said.

The development of the 3-D models can be time- and labor-intensive, according to Dr. Ghodadra, but should not deter surgeons from this type of pre-operative planning and training. The median time for segmentation of the anatomy and computer-aided design (CAD) modeling was three hours, while the print time was 7.7 hours. The material cost, however, was only $11 per model.

"Any surgery involving the skull in ENT could potentially benefit from these models. We have also created models for performing mastoidectomy and correction of external auditory canal atresia in the pediatric population," Dr. Ghodadra said. "When it comes to applications of these low-cost printing techniques, the sky's the limit."



The 3-D model of the inner auditory canal is finalized for training and the surgeon prepares to practice the procedure, avoiding the facial nerve and membranous labyrinth, which have been hollowed and filled with paint. If the areas are entered while drilling the model, the paint will provide a visual feedback to the surgeon.

Walter H. Backes, PhD, Accepts Alexander R. Margulis Award for Scientific Excellence

Walter H. Backes, PhD, professor of Medical Physics in the Department of Radiology at the Maastricht University Medical Center in Maastricht, the Netherlands, and colleagues have identified a connection between leakage of the blood-brain barrier (BBB) and Alzheimer's disease (AD) pathology, shedding new light on the vascular contribution of dementia.

The research, "Blood-Brain Barrier Leakage in Patients with Early Alzheimer Disease," which was published in the November 2016 issue of *Radiology*, has earned Dr. Backes and his colleagues the sixth annual RSNA Alexander R. Margulis Award for Scientific Excellence.

Richard L. Ehman, MD, (*left*) presented Walter H. Backes, PhD, with the Alexander R. Margulis Award for Scientific Excellence on Monday.

"Our results suggest that BBB impairment may be a contributing factor in the early pathophysiology of AD and might be part of a cascade of events eventually leading to cognitive decline and dementia," Dr. Backes said.

Giving Tuesday

The RSNA Research & Education (R&E) Foundation is participating in #GivingTuesday, a global day dedicated to giving.

Last year, more than 45,000 organizations in 71 countries came together to celebrate #GivingTuesday — a movement to celebrate giving and provide incentives to do so. Since its founding in 2012, #GivingTuesday has inspired giving around the world, resulting in greater donations, volunteer hours, and activities that bring about real change in communities.

Demand for RSNA R&E Foundation grants has increased dramatically. To meet that demand the Foundation launched the Inspire-Innovate-Invest Campaign which will conclude at the end of this year. The Foundation seeks to raise $17.5 million to fund grants in radiologic research and education, bridging gaps in funding for promising investigators and educators.

Celebrate #GivingTuesday and help the Campaign reach its goal by making a donation to the Foundation today at *RSNA.org/Donate* or by visiting the R&E Foundation booth in the Connections Center.

Dosage

Question of the Day

Q A CT protocol uses automatic dose modulation. If the patient is located above scanner isocenter, what will happen to dose compared to a patient at isocenter?

[Answer on page 17A.]

Residents Reception

Following a busy day of learning, residents eagerly networked and mingled at the annual Residents Reception hosted by RSNA and the American College of Radiology (ACR). Residents and their peers from around the world caught up over food and drinks, while making new connections with radiology leaders, including board members from both organizations. There were lively discussions about the hottest topics at the meeting, while many attendees took pictures together for social media and shared emails to keep in touch.

Diagnosis Live™ Meeting Madness Draws Crowd

The first Diagnosis Live™ Meeting Madness session, held Monday morning, brought teams from four residency programs head-to-head. Master of Ceremonies Omar Awan, MD, facilitated the competition. Each of the four participating residency programs — Thomas Jefferson University (TJU), Oregon Health & Science University, University of Cincinnati and University of California, Los Angeles — submitted two Diagnosis Live games with five questions each. The University of Cincinnati defeated TJU in the final round to become the inaugural winner of the competition. Thank you and congratulations to all resident participants!

RSNA 2017 Sessions Geared Toward Residents and Fellows

Highlighted by the annual RSNA Resident and Fellow Symposium, RSNA 2017 offers a full roster of programming geared toward residents and fellows, along with networking opportunities this year. Check out the Resident and Fellow Tweet-up planned for today.

Tuesday, 1:00-4:00 p.m.
Room E451B

MSRP31
RSNA Resident and Fellow Symposium

Provided by the RSNA Resident and Fellow Committee, the symposium offers a wide range of career-related issues beneficial to radiology trainees. Sessions are:

- What RSNA Offers Members in Training (1:00-1:15 p.m.)
- Panel Discussion: Academic, Private Practice, Hybrid Model, Telerad, Interventionalist (1:15-1:30 p.m.)
- Session 2: Landing the Job You Want (1:50-2:55 p.m.)
- Interview to Win — How to Land the Job You Want (1:50-2:30 p.m.)

- Contract Negotiation (2:30-2:55 p.m.)
- Session 3: Tips for a Successful Career (2:55-4:00 p.m.)
- Tips for Successful Leadership: What I Wish I Knew Back Then (3:20-3:45 p.m.)
- Q&A (3:45-4:00 p.m.)

Residents and Fellows Share Favorite Apps for Learning

The Daily Bulletin *stopped by the Residents Lounge on Monday to ask doctors the question: "What radiology apps do you use in work and for studying?" Several of our responders had to pause and think for a moment before answering, while others immediately grabbed their phones to show us their favorites.*

Christoph Berliner, MD, *final-year resident and first-year attending trainee at University Hospital in Hamburg Eppendorf, Hamburg, Germany said, "I like Radiology Assistant, Dose Calculator and QX Calculate for formulas or staging, and Arznei aktuelle, which is an app useful for looking up drug dosing and comparable drugs."*

Nisanard Pisuchpen, MD, *a fellow at Chulalongkorn University in Bangkok, Thailand said, "They're not specifically radiology apps, but I use eAnatomy for reference and Notability for taking notes."*

"I don't use one for studying specifically," said ***Sangoh Lee, MD,*** *fifth-year resident at University Hospitals of Leicester. "I use Radiology 4U, and I used to use Radiology Assistant, but stopped because they added a payment system. Now I look it up online for free."*

"I use Radiopaedia for reference articles and to check image findings. I also use RSNA because the RadioGraphics *articles are very good for specific topics," said* ***Lucas Gikonyo, MD,*** *third-year resident at University of Nairobi.*

"I don't normally use apps other than Epocrates," said ***Anish Ghodadia, MD,*** *interventional radiology fellow at Yale New Haven Hospital, Connecticut.*

Erica Lopata, MD, *is a second-year resident at Rush University Medical Center in Chicago. She said, "I use Devices, which shows medical devices on x-ray and Radiopaedia. But mostly I look online."*

Santiago Osorio, MD, *a third-year resident at CES University in Antioquia, Columbia, said, "I used to use Rad Anatomy, Radiology and Differentiations, but now I usually look online."*

"I use Radiopaedia, Learning Radiology, Radiology Assistant and Aunt Minnie," said fourth-year resident ***Ilaria Capretti, MD,*** *of University of L'Aquila in Italy.*

Tuesday, 12:30-2:00 p.m.
Room S501ABC
RCC33
Technologies for Creating Educational Content and Teaching Files

Sessions include:

- Podcasting and Screencasting for Teaching
- ePublishing
- Incorporating the iPad in Resident Education: Using Mobile Technology to Improve the Way We Teach

Tuesday, 4:30-6:00 p.m.
Room E260
RC402
What's New from the Radiology Residency Review Committee

Presenters will provide updates from the Review Committee for Diagnostic Radiology and on Accreditation Council for Graduate Medical Education (ACGME's) Next Accreditation System.

All Day | Digital Education Exhibit
HP126-ED-X
Between Mini-Fellowships to the Job Search: How Trainees Might Approach Recent Changes from the American Board of Radiology (ABR)

Presenters will summarize recent curricular and certification changes from the ABR and present preliminary survey results pertaining to "mini-fellowships," fellowship training, and the job search.

All Day — Digital Education Exhibit
VI163-ED-X
What Every Resident Should Know About PAD: Workup, Clinical Evaluation and Treatment

Presenters will review anatomy of the lower extremities with emphasis in atherosclerotic disease processes and discuss the clinical workup and diagnostic tests for patients with lower extremity arterial disease and how these tests will guide treatment options and outcomes.

All Day — Digital Education Exhibit
NR255-ED-X
Midnight Radiology: A Primer on Emergent Head CT Findings for the On-Call Resident

Presenters will review non-contrast appearance of emergent head CT findings, discuss radiological signs on head CT and their pitfalls and highlight trouble spots for radiologists, particularly residents, on the non-contrast head CT.

Explore Other Resident and Fellow Offerings:

Residents Lounge

RSNA members-in-training and non-member residents are offered a place to relax and network while enjoying complimentary refreshments. The lounge is open Sunday through Thursday, 8 a.m. – 6 p.m.

Trainee Tweet Up

Get some face-to-face time with radiology residents and fellows you've conversed with on Twitter at this IRL (in real life) networking event for trainees. The Tweet Up will be held in the Residents Lounge from 4:30 – 5:30 p.m., Tuesday, Nov. 28.

Combined Radiotherapies Prove Effective for Base of Tongue Cancer

The combination of brachytherapy and external beam radiation therapy (EBRT) to treat base of tongue (BOT) cancer increased overall survival rates compared to each of the two therapies alone, according to research presented Monday.

By Mike Bassett

The most recent cancer statistics show that about 17,000 new cases of oropharyngeal cancer are reported in the U.S. each year, with over 3,000 deaths. And it is believed the overall incidence of this cancer has increased because of the rise in human papillomavirus-positive oropharyngeal-(HPV) associated oropharyngeal cancers. BOT cancer accounts for about 30 percent of those cases.


Silva

Although brachytherapy can deliver higher doses of radiation close to the tumor while sparing normal tissue, it has not yet been evaluated in Phase III prospective randomized trials in terms of treating BOT cancer, said researcher Scott Silva, MD, of Loyola University Medical Center, Chicago.

"Our hypothesis was that, in some patients — particularly those with large tumors — we are not able to deliver enough radiation safely to completely eliminate the tumor," Dr. Silva said. "We can do that with brachytherapy, and we thought that combining it with external bream radiation therapy would increase overall survival compared to just external beam therapy or brachytherapy alone."

In order to test that hypothesis, Dr. Silva and colleagues performed an analysis of the National Cancer Database (NCDB) to evaluate overall survival in BOT patients treated with brachytherapy.

From 2004-2013, 27,954 patients with BOT were treated with EBRT, 209 were treated with a combination of EBRT and brachytherapy and 154 were treated with brachytherapy alone, according to the NCDB. Median follow-up times were 35.6 months, 59.2 months and 40.6 months for patients treated with EBRT, EBRT plus brachytherapy and brachytherapy alone, respectively.

"We found a statistically significant increase in the overall survival in patients treated with the combination of external beam radiation therapy plus brachytherapy," Dr. Silva said.

Specifically, researchers found that at three years, the overall survival was 69.6 percent for patients treated with EBRT, 63 percent for patients treated with brachytherapy alone and 77.1 percent for those threated with the combination of EBRT and brachytherapy.

A multivariate analysis including age, sex, tumor size, treatment with and without chemotherapy and type of radiation therapy found that even after adjusting for these variables, there was still a trend towards improved survival in the patients that received the combination of external beam radiation therapy and brachytherapy, Dr. Silva said.

In addition, patients with large tumors (>4 cm in diameter) had a significant overall survival benefit when treated with the combination of EBRT and brachytherapy (78.4 percent) compared to EBRT (64.6 percent) and brachytherapy (58.4 percent) alone.

> ***We found a statistically significant increase in the overall survival in patients treated with the combination of external beam radiation therapy plus brachytherapy.***
>
> **Scott Silva, MD**

"There was no significant difference in overall survival in those patients who had tumors 4 cm or less in diameter," Dr. Silva said.

Dr. Silva and his colleagues concluded that although not widely used, brachytherapy offers the distinct advantage of providing highly localized doses of radiation directly to the tumor while sparing adjacent structures, and that patients with larger BOT tumors have increased survival rates when treated both with brachytherapy and EBRT.

"We realize this is a database study and not a prospective randomized trial," Dr. Silva said. "Given that we do see significant differences in overall survival, I think the results call for future prospective clinical trials comparing external beam radiation therapy to the combination with brachytherapy."

This research was awarded the 2017 RSNA Trainee Research Prize – Resident.

Brain MRI, Deep Learning Aid in Gender Differentiation

A deep learning (DL) algorithm applied to brain MRI findings helps accurately distinguish between genders, according to research presented Monday.

By Richard Dargan

Hormonal abnormalities and certain diseases can make gender identification challenging. An individual may have the genotype, or genetic makeup, of one gender and the phenotype, or observable traits, of the other. For instance, a person with androgen insensitivity syndrome appears genetically male but has female genitalia.

In ambiguous cases, gender differentiation is typically accomplished through clinical examination and blood tests. An accurate imaging tool to differentiate gender would be a useful adjunct for clinicians, patients and their families, but such a test currently doesn't exist.

"Men and women have differences in their brains, but to date, no specific anatomic landmark seen by the human eye has been identified to properly distinguish between genders in sectional images," said study co-author Felipe C. Kitamura, MD, from the Federal University of São Paulo.

Kitamura

Dr. Kitamura and colleagues recently tested an automated method to distinguish genders using head MRI and a DL algorithm.

"The major application of this approach is to see if we can develop a different kind of biomarker using an algorithm that is capable of seeing something we are not able to see with our eyes," he said.

The researchers reviewed a total of 7,120 images from 356 patients using a convolutional neural network, a type of neural network that produces a hypothetical mathematical representation in a computer of the way the brain works. They used some of the subjects to train the algorithm, others to validate it and the rest to test it out.

When the researchers correlated the neural network findings with the subjects' genders, they found that the algorithm was 95 percent accurate at gender differentiation. Dr. Kitamura said the results show the power of DL, a subset of machine learning that provides a more in-depth analysis of data.

"With deep learning, you don't have to tell the algorithm what to look for," he said. "You give examples and it does it itself."

Despite the 95 percent accuracy of the algorithm, Dr. Kitamura said that more research is needed before it is ready for clinical use. If the results hold up over larger study groups, it could eventually have applications in the clinic.

"This approach can give us one more biomarker that will aid in the diagnosis of all those diseases that may affect gender differentiation," he said. "This could be particularly important in those cases where diseases lead to genotype/phenotype gender mismatches."

> ***"This approach can give us one more biomarker that will aid in the diagnosis of all those diseases that may affect gender differentiation. This could be particularly important in those cases where diseases lead to genotype/phenotype gender mismatches. "***
>
> **Felipe C. Kitamura, MD**

The researchers intend to look at images acquired from different MRI scanners to see if the algorithm is able to maintain its predictive power across different equipment and operators.

Technology

American Association of Physicists in Medicine

Tip of the Day

Power Doppler does not exhibit aliasing artifacts because it relies on the intensity of the Doppler spectrum without velocity or frequency information.

Attribution: Zaiyang Long, PhD

Exploring the Connection between Blast Injuries and Pulmonary Hypertension

By Nick Klenske

For soldiers deployed in combat missions, blast injuries are an unfortunate, but all-too-common, cause of injury and death.

Lichtenberger

An explosion causes a sudden release of energy, which forms what are called blast waves. As these waves interact with the body, stress and shear waves are formed – injuring the locations that are spatially separated from the site of the displacement of the body wall. As blast pressure waves primarily exert force at the air-tissue interfaces within the body, pulmonary, gastrointestinal and auditory systems are at the highest risk for injury.

> ***We recognized that when a soldier experiences a blast, such as from an improvised explosive device, or IED, something happens that makes it difficult for blood to travel through their lungs***
>
> **John P. Lichtenberger, MD**

While reviewing non-combat and war-zone CT scans of soldiers who had suffered a blast injury to the lungs, John P. Lichtenberger, MD, and colleagues at the Walter Reed National Military Medical Center noted an interesting pattern: In addition to their blast-related injuries, many soldiers also showed signs of pulmonary hypertension.

"We recognized that when a soldier experiences a blast, such as from an improvised explosive device, or IED, something happens that makes it difficult for blood to travel through their lungs," said Dr. Lichtenberger, speaking from the RSNA Learning Center on Monday. "What we wanted to know was whether or not there is a correlation between the blast injury and the presence of pulmonary hypertension."

A Previously Unrecognized Complication of Blast Injuries

Dr. Lichtenberger and colleagues conducted a study to determine the incidence of main pulmonary artery (MPA) dilation (which correlates with pulmonary hypertension) in blast injury patients with and without pulmonary artery occlusion from emboli or thrombosis.

Focusing on combat wounded military service members ages 19 to 56, researchers reviewed 565 (562 male, 3 female) polytrauma CT scans. Of these, 63 patients demonstrated an MPA diameter greater than 2.9 cm, while 68 had an MPA/ascending thoracic aorta ratio greater than one. Combined, 28.5 percent of the patients studied had CT evidence of pulmonary hypertension.

"As this number is much higher than what is expected in otherwise healthy patients, it suggests that pulmonary hypertension is a previously unrecognized complication of blast injury," Dr. Lichtenberger said.

Dr. Lichtenberger said this is the first study to describe this possible association between a blast injury to the lungs and pulmonary hypertension.

"However, before we can improve the long-term treatment of this injury, we need to learn more, such as whether this is a temporary or permanent condition," he said.

Nevertheless, Dr. Lichtenberger believes the study's initial findings can already have a significant impact on therapy and treatment.

"Now that we are aware of the pulmonary hypertension problem, we can start to change our approach to therapy," he said. "This starts in the combat theater where, following a blast, medical providers can immediately begin looking for pulmonary hypertension."

For instance, as subtle pulmonary findings are better seen on CT compared to chest radiography, Dr. Lichtenberger encourages the use of CT for patients showing persistent blast lung symptoms with negative chest radiographs.

The study also has potential implications for civilian populations. "Whether from a terrorist attack or an industrial accident, blast injuries, and presumably pulmonary hypertension, happen to civilians too," said Dr. Lichtenberger.

Now that we are aware of the pulmonary hypertension problem, we can start to change our approach to therapy.

Annual Oration in Diagnostic Radiology Presented Today

Strategies for Radiology to Thrive in the Value Era

In the current value-driven population healthcare environment, radiology must play a key role in both understanding and defining value for providers and their patients.

Yet radiology faces challenges in defining the term "value" in the context of medical imaging and finding metrics with relevance to both the patient and the radiologist, said Jonathan B. Kruskal, MD, PhD, who will present today's Annual Oration in Diagnostic Radiology, "Strategies for Radiology to Thrive in the Value Era."

As an essential first step, radiology must create a roadmap for providing the evidence-based, outcomes-focused, appropriate and effective clinical care that each patient deserves, he said.

"To thrive in the world that only rewards value contributions, we need to reassess and reorganize our roles in effectively managing health imaging information and become realistic about how we currently measure and manage our performance in healthcare delivery," Dr. Kruskal said.


Kruskal

Dr. Kruskal received his medical degrees (MB, ChB) from the University of Cape Town (UCT) in South Africa in 1982. After completing an internship in medicine and surgery at Groote Schuur Hospital, he joined the South African Liver Research Center at UCT as a research scholar, where he earned a PhD degree in hepatic molecular physiology and developed an assay for the newly identified protein D-dimer. After a post-doctoral fellowship at Vanderbilt University, Dr. Kruskal completed his radiology residency at Harvard Medical School's New England Deaconess Hospital in Boston in 1994.

With the support of a 1998 GE Healthcare/RSNA Research Scholar Grant, Dr. Kruskal developed intravital optical methodology for imaging gene expression, angiogenesis and metastatic pathways in a solid tumor mouse model.

Dr. Kruskal joined the faculty specializing in abdominal imaging, and in 2001, he was appointed chief of abdominal imaging, then rose to radiology chair at Beth Israel Deaconess Medical Center and professor of radiology at Harvard Medical School in 2008, positions he still holds today.

As an expert on quality improvement in medical imaging, Dr. Kruskal serves as deputy editor of *RadioGraphics*, editing the Practice, Policy and Quality Initiatives section.

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RSNA 2017 Press Releases

Press releases are distributed to the media throughout the week highlighting research presented at RSNA 2017. Several studies have been featured in consumer news outlets, including *WebMD, Newsweek, CBS News, BBC News, Boston Globe, United Press International*. RSNA's media outreach helps the public gain a greater understanding of radiology and its role in personal healthcare. Press releases were distributed on the following Tuesday presentations:

Fat Distribution in Women and Men Provides Clues to Heart Attack Risk (SSC09-08)

It's not the amount of fat in your body but where it's stored that may increase your risk for heart attack, stroke and diabetes, according to a new study from Massachussetts General Hospital and Harvard Medical School in Boston. The study looked at the differences in fat distribution patterns among overweight and obese men and women and their associated cardiometabolic risk. Researchers recruited 200 young, overweight and obese, but otherwise healthy, men and women of similar age and BMI. The study participants underwent imaging scans to determine body composition and fat quantification. Compared to women, men had higher measures of cardiometabolic risk overall, but ectopic, or deep belly, fat was not significantly associated with cardiometabolic risk in men. Ectopic fat in women was strongly associated with cardiometabolic risk measures.

Weight Loss Through Exercise Alone Does Not Protect Knees (SSJ16-03)

Obese people who lose a substantial amount of weight can significantly slow down the degeneration of their knee cartilage, but only if they lose weight through diet and exercise or diet alone, according to a new study from University of California, San Francisco. The researcher investigated cartilage degeneration and joint abnormalities over the course of 96 months in 760 overweight and obese individuals who maintained stable weight and who lost weight via differing regimens. Patients were divided into a group of 380 patients who lost weight, and a control group of 380 patients who lost no weight. Cartilage degeneration was significantly lower in the people who lost weight through diet alone or diet and exercise, compared to the control group over the 96 months. Patients who lost the same amount of weight through exercise alone showed no significant difference in cartilage degeneration, compared to the group who lost no weight.

Migraines Linked to High Sodium Levels in Cerebrospinal Fluid (SSG11-03)

Migraine sufferers have significantly higher sodium concentrations in their cerebrospinal fluid than people without the condition, according to a new study from University Hospital Mannheim and Heidelberg University in Heidelberg, Germany. This is the first study to use a technique called sodium MRI to look at migraine patients. The researchers recruited 12 women with history of migraine and 12 healthy women of similar ages to serve as a control group. Both groups underwent cerebral sodium MRI. Overall, sodium concentrations were significantly higher for migraine patients in cerebrospinal fluid regions compared with healthy control individuals.

RSNA Honorary Membership Presented

2017 RSNA President Richard L. Ehman, MD (far right), presented RSNA Honorary Membership to three distinguished physicians during the Monday Plenary session. Pictured (from left) are Hassen A. Gharbi, MD, PhD, Renato A. Mendonça, MD, PhD, and Katrine Riklund, MD, PhD.

Dreyer, Criminisi Discuss Machine Learning in RSNA/AAPM Symposium Today

Keith J. Dreyer, DO, PhD, and Antonio Criminisi, PhD, will help radiologists and medical physicists further understand the current and potential impacts of machine learning (ML) and artificial intelligence (AI) on radiology in a symposium presented today in conjunction with the American Association of Physicists in Medicine (AAPM).

Criminisi

Dreyer

Dr. Dreyer will discuss how radiology can utilize ML and AI to improve the quality and relevance of imaging as well as benefit patients, while Dr. Criminisi will speak on the potential of assistive AI for cancer treatment. The session will be moderated by Paul E. Kinahan, PhD.

Dr. Dreyer is vice chair of radiology and director of the Center for Clinical Data Science at Massachusetts General Hospital in Boston, and associate professor of radiology at Harvard Medical School. He is a renowned informatics expert and has conducted research in clinical data science, cognitive computing, clinical decision support, clinical language understudying and digital imaging standards. He is particularly interested in the implications of technology for the quality of healthcare and payment reform initiatives.

He has served on the RSNA RadLex Steering Committee, the Imaging Informatics Coalition and as an annual meeting session and plenary moderator. He currently serves on the board of chancellors of the American College of Radiology (ACR) and is the chair of the commission on informatics. Dr. Dreyer has also served on numerous committees of the Society of Imaging Informatics in Medicine (SIIM).

Dr. Criminisi is a principal researcher at Microsoft in Cambridge, United Kingdom. His areas of research include AI, ML, computer vision and medical image analysis. Dr. Criminisi is leading Microsoft's InnerEye project that uses state of the art AI to build innovative image analysis tools to help doctors treat diseases such as cancer in a more targeted and effective way. He is the author of numerous scientific papers and books and in 2015, he received the David Marr Best Paper Prize from the International Conference on Computer Vision for his co-authored paper on deep neural decision forests.

Special Recognition for In-Kind Support

RSNA would like to recognize the following companies for contributing equipment to the Educational Courses at RSNA 2017:

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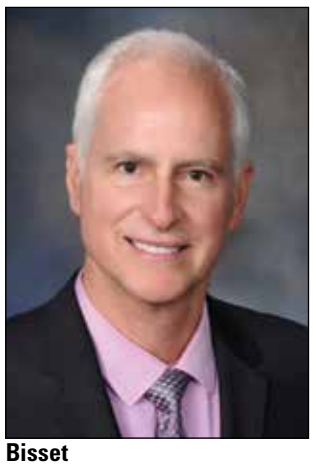
*Companies not exhibiting

RSNA 2017 Gold Medalists

RSNA's highest honor — the Gold Medal — will be awarded to three individuals during today's plenary session. A Gold Medal was awarded posthumously to 2017 RSNA President Richard Baron, MD, during yesterday's opening session.


Bisset


Charboneau


Pettigrew

In a career spanning four decades, George S. Bisset, III, MD, has earned a reputation as a preeminent authority on pediatric imaging and a world-class educator who has helped shape the next generation of radiologists.

Dr. Bisset is a professor of radiology at Baylor College of Medicine and Radiologist-in-Chief and Edward B. Singleton Chair of Radiology at Texas Children's Hospital, Houston.

After earning a medical degree from the University of South Florida, Dr. Bisset began his career as an assistant professor of pediatrics and co-director of the Section of Pediatric Cardiology at Tulane University in New Orleans.

He ascended the ranks in pediatrics and radiology at the University of Cincinnati, serving as chief of the Section of Body Imaging. He then moved to Duke University in Durham, NC, where he spent the next 16 years serving as a professor of radiology, chief of the Division of Pediatric Radiology, and vice chair, as well as interim chair of the Department of Radiology, before moving to his current position in Houston.

As a researcher, Dr. Bisset has focused primarily on cross-sectional imaging with an emphasis on MRI. He has authored or co-authored more than 200 articles and has served as a reviewer for journals including *Radiology, Pediatric Radiology* and the *American Journal of Roentgenology*.

Among his many honors, Dr. Bisset takes great pride in having received the Distinguished Alumni Award from the University of South Florida in 1996. He received the Society for Pediatric Radiology John Caffey Award in 2001 and the Pioneer Award in 2012. He was awarded Honorary Membership in the Austrian and German Societies of Radiology, the Colombian Association of Radiology, the Mexican Society of Radiology, the European Society of Radiology and the Sociedade Paulista de Radiologia. He is a Fellow of the American College of Radiology.

An ambitious educator and internationally recognized scientist, J. William Charboneau, MD, is a leading authority in diagnostic ultrasound and image-guided ablation of cancer of the liver, kidney and bone.

A professor emeritus of radiology at Mayo Clinic College of Medicine in Rochester, MN, Dr. Charboneau received his medical degree from the University of Wisconsin in Madison and completed his radiology residency at Mayo Clinic. He began his career in the radiology department at Mayo Clinic and continued to practice there for 30 years, until his retirement in 2010.

Dr. Charboneau pioneered the use of diagnostic ultrasonography for the characterization of focal thyroid nodules and liver masses and the critical role of ultrasound (US) in distinguishing benign from malignant lesions. He was also an early leader in the development of image-guided intervention for procedures including biopsy and ablation.

His clinical expertise and extensive research led to the publication of radiology's most authoritative reference book on US imaging, *Diagnostic Ultrasound*. He also authored more than 175 scientific publications and he is co-editor of several other textbooks.

Because of his expertise in imaging of thyroid cancer, the National Academy of Sciences asked him to join a committee to research the health implications of the I-131 fallout from nuclear bomb testing that took place between the 1940s and 1960s over the western U.S. From his work on this committee, he published several studies and perspectives on the role of ultrasound imaging in detection of thyroid cancer.

Dr. Charboneau presented the 2006 RSNA Eugene P. Pendergrass New Horizons Lecture entitled, "Image-Guided Cancer Treatment: The Science and Vision of an Emerging Field." He served as a member of the RSNA Public Information Committee and on the Public Information Advisors Network.

Among his many awards, Dr. Charboneau received the 2014 GI Lifetime Achievement Award from the Society of Abdominal Radiology and the 2015 Lawrence A. Mack Lifetime Achievement Award from the Society of Radiologists in Ultrasound.

Founding Director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB), Roderic I. Pettigrew, PhD, MD, is an innovative leader in convergence research who is helping lay the groundwork for tomorrow's medicine.

Dr. Pettigrew has charted the course for the National Institute of Health's (NIH) critical work in harnessing the power of transdisciplinary teams to create new technologies and catalyze discoveries that usher in a new era of medicine.

Among his accomplishments at NIBIB, Dr. Pettigrew jointly led a national effort with the Howard Hughes Medical Institute to create new interdisciplinary graduate training programs. In 2008, he established the Quantum Grants program to achieve "medical moon shots."

Dr. Pettigrew was an early advocate of a national system for patient-controlled sharing of medical images, leading to the RSNA Image Share project, which is poised to help realize the goals of the NIH precision medicine initiative All of Us. He co-chairs the Congressionally-requested federal Inter-Agency Working Group on Medical Imaging. Dr. Pettigrew serves as the NIH Liaison to NASA and the U.S. Department of Energy. He co-leads a joint effort with the Bill and Melinda Gates Foundation to develop a cell phone-based platform to test for influenza and other diseases at home.

At the time of his NIBIB appointment, Dr. Pettigrew was serving as professor of radiology and medicine at Emory University School of Medicine, and professor of bioengineering at the Georgia Institute of Technology, both in Atlanta. During this time, Dr. Pettigrew became known for pioneering work developing 4-D imaging of the cardiovascular system using MRI.

A graduate of Morehouse College in Atlanta, Dr. Pettigrew earned his PhD in applied radiation physics from the Massachusetts Institute of Technology, Cambridge, and his medical degree from the University of Miami School of Medicine.

Among his numerous honors, Dr. Pettigrew presented the RSNA 75th Anniversary Diamond Jubilee New Horizons Lecture and received the Pritzker Distinguished Achievement Award of the Biomedical Engineering Society and the Inaugural Gold Medal Award of the Academy of Radiology Research. He is an elected member of the U.S. National Academy of Medicine and the National Academy of Engineering.

A Turbulent Age for Imaging, a Golden Age for Innovation

CONTINUED FROM COVER

He compared this change to the difference between looking at a single image, which gives a single stream of visual information, and being at a live concert, which generates multiple streams of information that the brain quickly sorts through, eliminating unnecessary information and pinpointing the source on which to focus.

Dr. Sodickson predicted that techniques such as MR fingerprinting (which isolates unique information in MR images that might be used to identify specific tissue types, cell types or diseases) will take image information out of the realm of subjectivity, depending on the skill of the reader and the technician and the features of the scanner, and make it as objective as a blood test.

MR fingerprints will be available in a database and radiologists will look for a match to a specific patient's information, just as police identify criminals by running their fingerprints against the FBI database.

Where do these changes leave radiologists? In a good place, Dr. Sodickson said.

He suggested that radiologists begin thinking of themselves as "information innovators," due to their expertise in image data acquisition. The field is already headed in that direction, said Dr. Sodickson, pointing to the vast increase in sessions on machine learning and AI offered at major radiological meetings — including RSNA — in the past year.

"It's a turbulent age for imaging — there is no doubt," Dr. Sodickson said, "but I hope I have convinced you it is a golden age for innovation."

Sodickson

Dosage Answer

[Question on page 9A.]

A Dose will be higher

Q&A courtesy of AAPM.

Radiologists Perform the Majority of Percutaneous Embolization Procedures

By Nick Klenske

As minimally invasive treatment options become increasingly advanced, the use of percutaneous embolization procedures has more than doubled over the last decade. While radiologists are leading the way in performing percutaneous embolization, non-radiologists are gaining ground, new research shows.

On Monday, David Hansberry, MD, PhD, of Thomas Jefferson University in Philadelphia, presented the results of a recent study that evaluated the utilization of percutaneous embolization among both radiologists and non-radiologists.

Using the Medicare Part B fee-for-service databases for 2005 to 2015, Dr. Hansberry and colleagues analyzed the number of procedures (excluding head and neck embolization) performed by radiologists, vascular surgeons, cardiologists, nephrologists, obstetricians/gynecologists and other surgeons. The researchers used this data to track volume trends from 2005 to 2015 and to compare each physician group's market share for 2005 and 2015.

"Percutaneous embolization has proven to be an excellent non-invasive, non-operative procedure for managing hemorrhage, tumors and vascular malformations," Dr. Hansberry said. "With many patients preferring these options over traditional surgery, we're seeing a substantial increase in the number of these procedures being performed across an array of physician groups."

According to the study, the total volume of percutaneous embolization procedures performed by all providers increased from 20,265 in 2005 to 50,529 in 2015. Of these, radiologists performed the vast majority. Of 30,742 procedures performed in 2015 (up from 13,872 in 2005), radiology accounted for 61 percent of all percutaneous embolization procedures. Radiologists performed 68 percent of the 13,872 procedures in 2005.

> ***Radiologists performed five times as many of these procedures compared to vascular surgeons, who had the second highest volume.***
>
> **David Hansberry, MD, PhD**

"Radiologists performed five times as many of these procedures compared to vascular surgeons, who had the second highest volume," said Dr. Hansberry. "These findings mirror the move towards minimally invasive procedures that we've seen happening in radiology over the past 10 years."

Another key takeaway from the study is that other specialties are starting to perform percutaneous embolization procedures more frequently. For example, in 2015, vascular surgeons performed 6,284 procedures – up from 2,538 in 2005 – representing 12 percent of all procedures performed. Likewise, "other surgeons" performed 5,668 procedures in 2015, compared to 1,590 in 2005.

Hansberry

"While there has been continued growth in volume for radiologists, we are also seeing rapid progression among non-radiologists, who collectively performed 39 percent of all percutaneous embolization procedures in 2015," said Dr. Hansberry.

In the years ahead, Dr. Hansberry expects to see a continuation of this trend. "As we collect figures for the next five years, it will be especially interesting to see what happens in these non-radiologists groups," he said.

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