NOVEMBER 28, 2018

WEDNESDAY

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RSNA 2018 TOMORROW'S RADIOLOGY TODAY

Daily Bulletin

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INSIDE WEDNESDAY

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Oscillating Microbubbles: The Next Wave in Ultrasound Innovation

By Richard Dargan

A novel class of ultrasound (US) contrast agents is expanding the possibilities of the modality in cancer treatment and other areas of medicine, according to a leading researcher in the field who spoke Tuesday in the Arie Crown Theater.

Flemming Forsberg, PhD, professor of radiology at Thomas Jefferson University in Philadelphia, began his New Horizons lecture, "Oscillating Microbubbles — Driving Innovation in Ultrasound," by declaring himself "a huge fan of bubbles."

"Why we love them, apart from the fact that you need bubbles for champagne," he said, "is because they give us up to a 30-decibel increase in our signal-to-noise ratio and they give us an order of magnitude better depiction of vascularity."

Microbubbles — gas-filled bubbles smaller than a red blood cell — are well-established vascular tracers and contrast agents for US imaging. They can be made to oscillate and burst by increasing the amount of acoustic pressure applied by the transducer. This ability has opened up many new avenues of research, Dr. Forsberg said.

Forsberg

Through the technology of subharmonic imaging (SHI), microbubbles can be used as pressure sensors, a discovery that led the way to the development of a noninvasive pressure measurement technique known as subharmonic-aided pressure estimation (SHAPE).

Noninvasive SHAPE measurements may be a useful alternative to catheter-based measurements of cardiac conditions. They can help noninvasively predict portal hypertension, a condition in which blood pressure is too high in the vein that carries blood to the liver.

Oscillating microbubbles have shown promise as an early predictor of the effectiveness of chemotherapy in breast cancer, sparing patients the unpleasant side effects of an ineffective drug cocktail. The technique takes advantage of the fact that interstitial fluid pressure is higher in a tumor than in normal tissue. In one study, SHAPE was able to

CONTINUED ON PAGE 14A

Klein Joins RSNA Board of Directors

Jeffrey S. Klein, MD, has been elected to the RSNA Board of Directors and will serve as the Board liaison for publications and communications.

Dr. Klein is the A. Bradley Soule and John P. Tampas Green and Gold Professor of Radiology at the University of Vermont College of Medicine. A renowned expert in lung cancer staging and detection, Dr. Klein has served as editor of *RadioGraphics* since 2011.


Klein

After receiving his bachelor's degree from Brooklyn College, Dr. Klein earned his medical degree at the State University of New York Health Downstate Medical Center. He completed an internship at the Staten Island University Hospital, a residency at the State University of New York (SUNY) Kings County Hospital Center in Brooklyn, and a fellowship in thoracic radiology at the University of California, San Francisco (UCSF) Medical Center.

Dr. Klein began his academic radiology career in 1988 as a clinical instructor of radiology and assistant professor in residence at the UCSF School of Medicine. In 1990, he became an assistant professor in residence at the San Francisco General Hospital.

From 1993 to 1995, Dr. Klein was a clinical associate professor, chief of thoracic imaging, and associate director of the residency training program in the Department of Radiology at St. Joseph's Hospital and Medical Center in Phoenix. He then joined the University of Vermont College of Medicine, where he served as vice chair of the Department of Radiology from 1998 to 2000 and chief of thoracic imaging from 2000 to 2010. Dr. Klein was named to the endowed professorship in 2006. From 2005 to 2010 he served as Associate Dean for Continuing Medical Education at the University of Vermont College of Medicine.

Editor-in-chief of the *Journal of Thoracic Imaging* from 2000 to 2005, Dr. Klein is a longtime manuscript reviewer for *Radiology* and *RadioGraphics*, as well as the *American Journal of*

CONTINUED ON PAGE 14A

Borgstede is RSNA President-Elect

James P. Borgstede, MD, is president-elect for 2019. Dr. Borgstede is a professor of radiology and vice chair of professional services, clinical operations and quality for the Department of Radiology at the University of Colorado, Denver.

As president-elect of the RSNA board, Dr. Borgstede will support RSNA's commitment to fostering radiologic research and providing high-quality education.


Borgstede

"RSNA provides unparalleled leadership in radiology research and education," Dr. Borgstede said. "I am excited to have the opportunity to serve our specialty and our patients through RSNA. As an RSNA leader, my goals include promotion of innovative education and cutting-edge research for the benefit of our patients and radiologists throughout the world."

An RSNA member since 1976, Dr. Borgstede was a member of the Quality Committee from 2009 to 2011. He joined the RSNA Board of Directors in 2013 and served as board chair in 2018. Prior to serving as board chair, Dr. Borgstede was the board liaison for the International Advisory Committee and the International Radiology Education Committee and was chair of the Board Committee on International Affairs. Dr. Borgstede has been active on many committees of the RSNA Research & Education (R&E) Foundation. He served on the R&E Foundation Board of Trustees from 2008 to 2014, the Corporate Giving Subcommittee from 2009 to 2012, the Finance Committee from 2012 to 2014 and was chair of the R&E Foundation from 2012 to 2014.

Over the years, Dr. Borgstede has been very involved with the RSNA annual meeting. He has delivered scientific presentations and refresher courses, participated in symposiums and was co-presenter in 2005 of a special focus session, "The Diffusion of

CONTINUED ON PAGE 14A

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RSNA SPOTLIGHT COURSE

Wednesday At a Glance

Formenti

Annual Oration in Radiation Oncology

1:30-2:45 | (E450A)
Arie Crown Theater
Radiotherapy to Convert the Tumor into an in Situ Vaccine
Silvia C. Formenti, MD

Dr. Formenti will discuss how the optimal delineation of the target and real-time visualization of organ movement have merged radiology and radiation oncology to achieve increasingly precise and effective delivery of cytotoxic ionizing radiation. Dr. Formenti is the Sandra and Edward Meyer Professor of Cancer Research and chair of radiation oncology at Weill Cornell Medical College, radiation oncologist-in-chief at New York-Presbyterian Hospital and the associate director of the Meyer Cancer Institute, all in New York.

7:15-8:15

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

Hot Topic Session
Fast MSK MR Imaging (E450A)

8:30-10:00

Educational Courses

BOOST: Bolstering Oncoradiologic and Oncoradiotherapeutic Skills for Tomorrow
Pediatrics-Oncology Anatomy and Case-Based Interactive (S103CD)

8:30-NOON

Series Courses

8:30-5:00

RSNA/ESR Sports Imaging Symposium (E352)

10:30-NOON

Scientific Paper Sessions

BOOST: Bolstering Oncoradiologic and Oncoradiotherapeutic Skills for Tomorrow
Lymphoma-Oncology Anatomy and Cased-Based Interactive (S103CD)

11:00-2:00

Machine Learning Theater Presentations (North Building Hall B)

12:15-1:15

Scientific Poster Discussions (Learning Center)

1:00-3:00

3D Printing & Advanced Visualization Theater Presentations (South Building Hall A)

1:30-2:30

BOOST: Bolstering Oncoradiologic and Oncoradiotherapeutic Skills for Tomorrow
Pediatric CNS Tumors and Diagnostic Dilemmas after Radiation Therapy (S103CD)

1:30-6:00

Interventional Oncology Series
Colon and Neuroendocrine Liver Mets (S405AB)

2:30-4:00

Educational Courses

3:00-4:00

Scientific Paper Sessions

3:00-4:15

BOOST: Bolstering Oncoradiologic and Oncoradiotherapeutic Skills for Tomorrow
Advanced Techniques in Image-Guided Therapy (S103CD)

3:00-4:30

AOSR-RSNA Joint Symposium (S504AB)

4:30-5:30

BOOST: Bolstering Oncoradiologic and Oncoradiotherapeutic Skills for Tomorrow
Spinal SBRT eContouring (S104B)

4:30-6:00

Educational Courses

Controversy Sessions
Marginally Operable Stage I Non-small Cell Lung Cancer: Cut or Shoot (Surgery vs Radiation)? (E353C)

CT or MRI after Equivocal Appendix Visualization on Pediatric Ultrasound? (N226)

Gadolinium for MR Examination: To Give or Not to Give (N228)

CTA or MRA? (E353A)

RSNA Diagnosis Live™
Neuro and MSK (E451B)

View the full program and add sessions to My Agenda on the RSNA 2018 App or at *Meeting.RSNA.org.*

DailyBulletin

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RECYCLED PAPER · PRINTED WITH SOY INK · RECYCLABLE PAPER

Teaching Residents Advanced Technology will 'Future-Proof' the Profession

By Nick Klenske

As one of the fastest moving fields in medicine, the radiology of tomorrow will be defined by advanced technologies. But are graduate medical education programs adequately preparing today's students for this future?

According to a presentation on Tuesday, the answer is no.

"There aren't a lot of programs that have resident training in 3D printing, augmented and virtual realities and machine learning," said Summer Decker, PhD, of the University of South Florida (USF) Health Morsani College of Medicine.

This is changing, however, especially as many of today's residents arrive tech-savvy, she said.

"Residents have told me that they were attracted to radiology because of its use of technology," Dr. Decker said. "We would be setting them up for failure if we didn't provide opportunities to be exposed to and trained in using such technologies as 3D printing."

Dr. Decker noted that what we train today's residents in will not necessarily be what radiology looks like in 20 years.

"Our teaching isn't only about familiarizing students with current technologies," she said. "It's about making them comfortable with technology in general, so they are prepared for the next big development – whatever it may be."

Decker

This forward-looking approach to resident training is what Dr. Decker calls "future proofing radiology." At USF, students, residents and fellows are all exposed to 3D technologies from day one. Dr. Decker and her colleagues regularly speak at the hospital's daily resident conference on such topics as types of 3D printing, post-processing of images, and tips on how to best capture images for 3D visualization and printing.

Our teaching isn't only about familiarizing students with current technologies. It's about making them comfortable with technology in general, so they are prepared for the next big development – whatever it may be.

Summer Decker, PhD

Training Colleagues in Other Fields Critical

USF involves residents and fellows in research in diagnostic and interventional radiology. Residents are also sent to international presentations and conferences, where they both speak and learn about the use of advanced technologies in radiology.

"I've been so impressed with the ideas and new applications that our residents have come up with," Dr. Decker said. "We've seen them teach other fields about what's possible with radiology and have novel medical devices developed that have gone on to be patented."

Another key component to Dr. Decker's strategy is to train her colleagues in other fields so they can add 3D technologies into their teaching. "At USF, we're developing training that will be shared so other programs can collaborate and implement it into their program," she said.

By training both radiologists and colleagues in other fields, Dr. Decker is demonstrating the value-added role of radiology in collaboration with other disciplines.

"I love it when our residents can be proud of the role that 3D technology played in the success of a case," she said. "One of the biggest benefits of this hands-on approach is that it gets residents comfortable using and sharing new technologies, which is a skill they will benefit from throughout their careers."

New Technology Allows Ultra-Fast Whole-Body PET/CT

By Lynn Antonopoulos

New generation photon counting PET detector technology may be a game-changer for PET imaging, delivering reliable, ultra-fast whole body PET/CT within minutes.

In a Tuesday session, Michael Knopp, MD, PhD, professor of radiology and Novartis Chair of Imaging Research at The Ohio State University's Wexner Medical Center, presented the promising results of a phase II clinical trial assessing the feasibility of the technology.

He and his team developed the intra-individual study comparing a new generation, digital PET/CT system (dPET) with a current generation, conventional system (cPET). They performed three separate acquisitions on 63 prospective patients scheduled for FDG whole-body PET/CT.

Investigational dPET was imaged approximately 55 minutes after an injection of 13mCi FDG at 90 seconds per bed position and approximately 17 minutes of table time. Then, a true, ultra-fast acquisition was made with a two-minute scan at nine seconds per bed position.

Standard cPET imaging was performed approximately 80 minutes post-injection with 90 seconds per bed position acquired during an average table time of about 20 minutes.

The resulting data sets were evaluated by three blinded reviewers who examined the visual appearance of noise in the whole-body scans, noise of liver in the axial plane, diagnostic readability assessed by reader and a match comparison of the nine-second dPET against the 90-second cPET.

"At first, the nine-second acquisitions looked horrible, but that wasn't the whole truth," Dr. Knopp said. "Through optimized reconstruction methodology, we were able to get very acceptable image quality. All ultra-fast scans were classified to be assessable."

Visual assessment scores were significantly higher for the 90 seconds/bed dPET whole-body scans compared to the nine-second scans. With optimization, no significant difference between the ultra-fast whole-body and cPET scans was reported.

The ultra-fast scans presented with slightly increased background noise levels and substantially fewer motion artifacts including bowel movements.

For Dr. Knopp, the results were somewhat unexpected. "We are imaging at 1/10th of the count density/time. I thought the ultra-fast imaging would show a larger number of unacceptable studies. I also did not anticipate that shorter imaging would lead to substantially less motion within the field of view," he said.

Knopp

According to Dr. Knopp, though the concept of rapid acquisition is feasible, it requires count-density, adaptive, regularized reconstruction.

"While image reconstruction via iterative calculations is complex, we cannot keep the settings at the same defaults," he said. "Adjusting or regularizing the reconstruction was a key strategy that enabled this radical increase in speed."

The study predominantly consisted of head/neck, colorectal and lung cancer because, as Dr. Knopp noted, those were the available cases. However, when asked about pediatric applications, he said with the ability to perform low-dose, ultra-fast PET, sedation may also be reduced and multiple scanning sweeps could be performed quickly to allow radiologists to choose the image with the least motion.

"The magic is going to be happening in the reconstruction, so the more we are able to utilize the promising, advanced methodologies we have with deep learning and adaptive intelligence, at the end of the day, optimization will be possible between dose, reconstruction matrix and acquisition time."

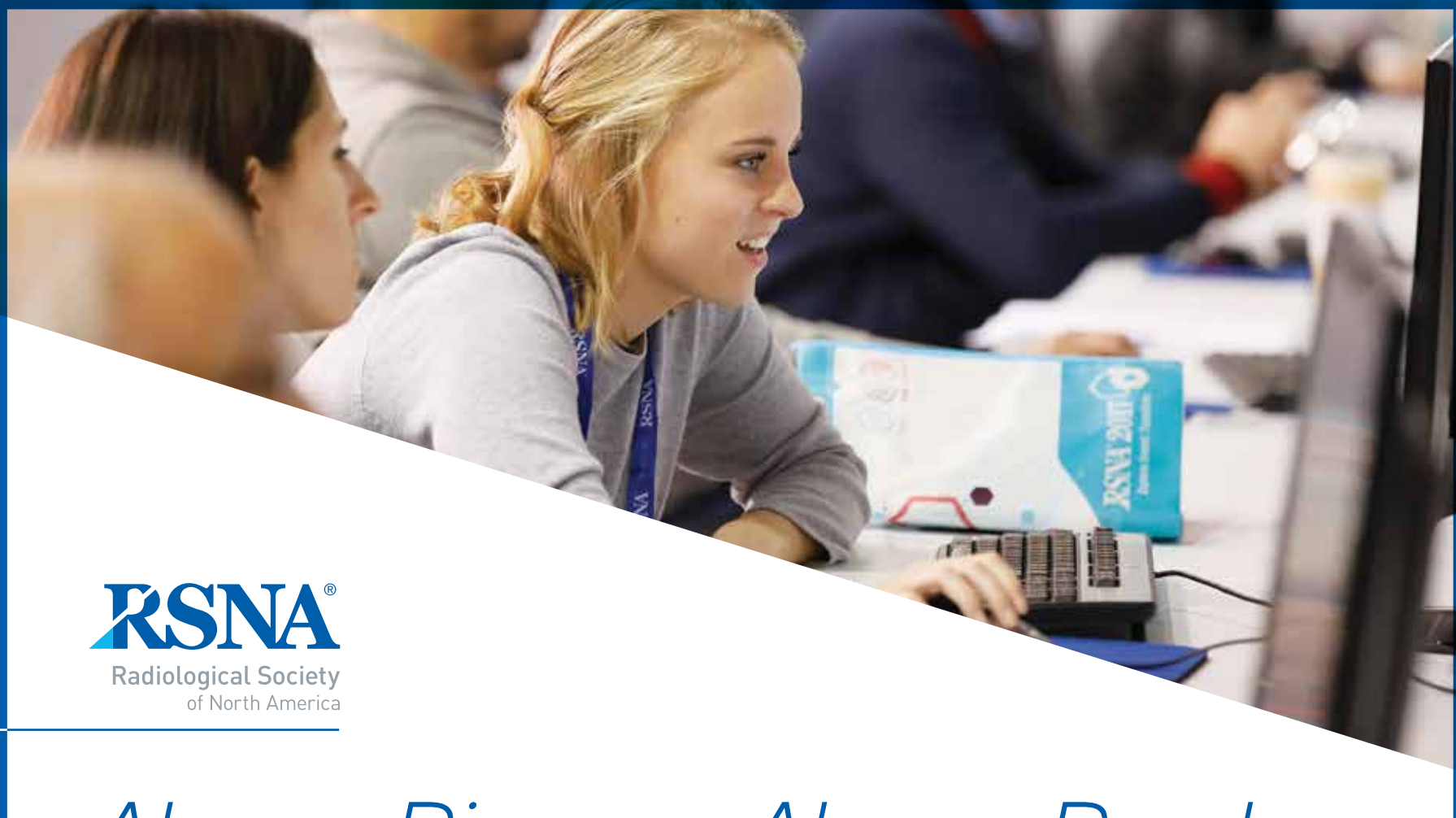
With the ultra-fast technology, new PET workflow processes, improved patient comfort, minimized patient movement and whole-body, pseudo-dynamic imaging of FDG tracer are achievable.

American Association of Physicists in Medicine

Wednesday's

Physics Tip

Picking a "medium adult" patient on an X-ray machine will mean different things to different vendors. There is no cross-vendor standard for the words small, medium and large found on radiography control panels.



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Imaging May Aid Addiction Diagnosis, Treatment

By Michael Bassett

While imaging has played a role in understanding the behaviors of addiction, it has, according to Jody L. Tanabe, MD, mainly been performed by psychiatrists, psychologists, and researchers who study addiction.

Yet, Dr. Tanabe, who is a professor in the departments of radiology and psychiatry at the University of Colorado School of Medicine in Denver, believes that it is becoming increasingly important for radiologists to understand more behind the science of imaging and addiction, which was one of her goals in co-moderating a special interest session Monday, "Imaging Cognition 2018: Addiction."

This is particularly so when one considers the extent of the nation's current opioid epidemic.

In her presentation Diana M. Martinez, MD, of the Columbia University Department of Psychiatry in New York City, noted that Americans are dying from opioid overdoses in ever increasing numbers — about 50,000 in 2017.

Using PET to Monitor Dopamine Levels

In her own research, Dr. Martinez uses positron emission tomography (PET) as a tool in investigating addiction. "We use imaging to look at dopamine levels and see how they change, and also if it predicts compulsive drug use," Dr. Martinez said. "And the short answer is, yes, it does."

"What the data show is that when we image people who have a long history of addiction, and they haven't emerged from it on their own, they have significantly blunted, lower dopamine levels compared to healthy controls," Dr. Martinez said.

And since people need dopamine to shift between competing rewards, they are no longer able to shift their behavior. "They stick with their habitual behavior even if the reward environment has shifted," she said.

The hope, she added, is that this kind of research can lead to the development of medications based on this neurobiology.

"We've been very excited to see research being done with Adenosine 2A antagonists in Parkinson's disease because what we see in the addictive brain is very similar to Parkinson's," Dr. Martinez said, for example. "But, pharmaceutical companies have shown no interest in seeing whether these compounds can be used for addiction, even though there is a wealth of imaging data that suggests this may be an effective treatment."

Targeted Treatments Using fMRI

Dr. Tanabe discussed how functional MRI (fMRI) imaging can be used to target areas for neuromodulatory treatment, such as deep brain stimulation (DBS) or transcranial magnetic stimulation (TMS), in order to affect addiction by reducing craving.

There have been single or small case reports that DBS can reduce craving and drug use, said Dr. Tanabe. Small studies have also shown that TMS can reduce craving, she said. "Whether it actually reduces drug use is another question."

"These are very small and open label studies," Dr. Tanabe pointed out. "We'll need control trials to explore this further. Imaging-based targeted treatment may become an adjuvant therapy for substance abuse disorder, which is why I think it's very important for radiologists to educate themselves, especially as to what these potential targets might be."


Tanabe


Martinez


Port

MR Spectroscopy Identifies AUD

John D. Port, MD, PhD, of the Mayo Clinic in Rochester, MN, discussed the use of MR spectroscopy to measure glutamate, which has been implicated in alcohol addiction.

"And if your glutamate levels are abnormal it's possible your neurotransmitter levels are abnormal," Dr. Port said. "Which would be good to know as we try to sort out which patients [with alcohol use disorder (AUD)] respond to which treatment."

For example, Dr. Port pointed out that with MR spectroscopy researchers have found elevated glutamate in persons with AUD that normalizes on a drug called acamprosate.

"The bottom line is that MR spectroscopy is a very valuable tool for the diagnosis and treatment of psychiatric illnesses," Dr. Port said. "And that includes AUD."

Peer Learning vs. Peer Review: One Hospital's Experience

By Melissa Silverberg

As vice chair for radiology quality and safety at Lahey Hospital and Medical Center in Burlington, MA, Jennifer Broder, MD, began to realize the peer review process in her department was not as productive as it could be.

The 40 radiologists at her hospital were using RADPEER, a traditional peer review program developed by the American College of Radiology that allows doctors to review and score their peers' work while reporting discrepancies and their clinical significance. Seeking to improve on the process, Dr. Broder sought an alternative that took a peer learning vs. a peer review approach.

In a Tuesday session, Dr. Broder described the successful results in a presentation, "Adopting Peer Learning: A Practical Approach for Improving Clinical Performance Feedback and Learning among Colleagues within a Radiologic Practice."

> ***If all of our mistakes stay in a black box, we can never get better. The only way to improve the work we do is to first understand where we're going wrong, and to understand where we are doing well and to amplify that.***
>
> **Jennifer Broder, MD**

Traditional peer review methods in radiology involve giving a score to a peer's work which can be divisive in the workplace and affect collegial relationships, particularly because people are worried the reviews will impact their professional evaluations, Dr. Broder said.

"In a scored peer review system, people will go through the motions of scoring, but they often won't really give honest feedback," Dr. Broder said. "That can mean skipping cases with significant errors because they do not want to submit a poor score. You end up with data that shows everyone is doing great, but that is not useful."

Dr. Broder said she experienced this problem first hand, realizing that she would find mistakes in her own work that no one pointed out to her. Overall, her department had a 1 percent reported discrepancy rate in RADPEER, which Dr. Broder knew could not be accurate; it just meant many mistakes were going unreported.

At a prior RSNA Annual Meeting, Dr. Broder attended a session led by David Larson, MD, MBA, vice chair of education and clinical operations in the department of radiology at Stanford University School of Medicine, who was instrumental in developing the Peer Learning Model as an alternative to the traditional format. She took the idea back to Lahey Hospital and Medical Center and started working with her colleagues and hospital leaders to develop and implement the process.

Increase in Sharing of Cases, Discrepancies Reported

Implemented in the radiology department at Lahey in April 2017, the Peer Learning Model eliminated scores attached to cases and created a system where radiologists anonymously submit errors or "great calls" on their peers' work. What makes a great call is subjective, but Dr. Broder said it is a way to highlight and learn from good work rather than just point out mistakes. The submitted cases are not used for radiologist performance evaluation.


Broder

Dr. Broder and colleagues studied the 10-month period before the Peer Learning Model was implemented and 10 months after. Under the RADPEER model, the hospital's radiology department reported 64 discrepancies. Under the Peer Learning Model, 488 discrepancies were reported along with 396 great calls, and 157 cases submitted for further discussion.

The department also moved from monthly whole department traditional morbidity and mortality conferences to quarterly subspecialty-focused peer learning conferences to discuss cases in a more in-depth, but anonymous fashion. In total, 286 cases were shown in conferences under the Peer Learning Model compared to only 47 under the traditional morbidity and mortality model.

Dr. Broder said she was happy with the results and hopes to see departments across the country implement the Peer Learning Model of review.

"If all of our mistakes stay in a black box, we can never get better," she said. "The only way to improve the work we do is to first understand where we're going wrong, and to understand where we are doing well and to amplify that."

Go to *RSNA.org/Bulletin* to watch an interview with Dr. Broder.

Wednesday's

Physics Quiz

American Association of Physicists in Medicine

Q **Lowering what acquisition parameter will increase contrast media signal in a CT angiogram?**

[Answer on page 11A.]

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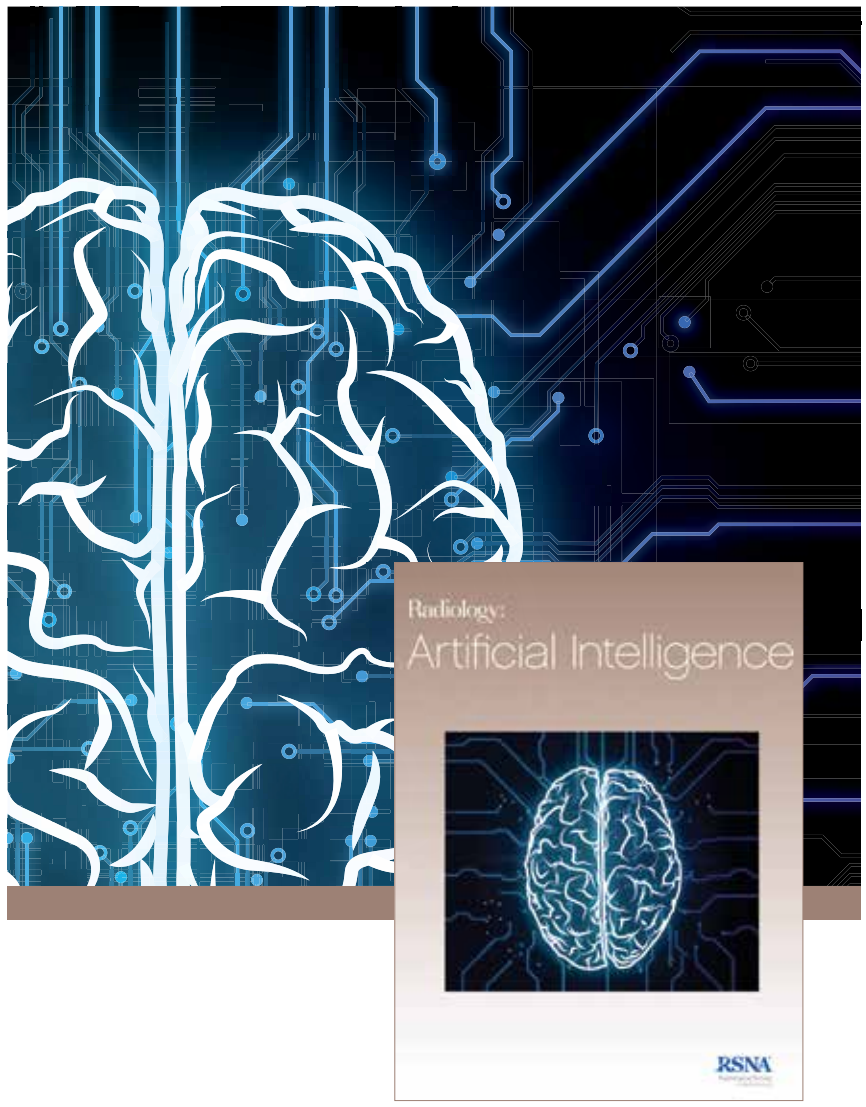

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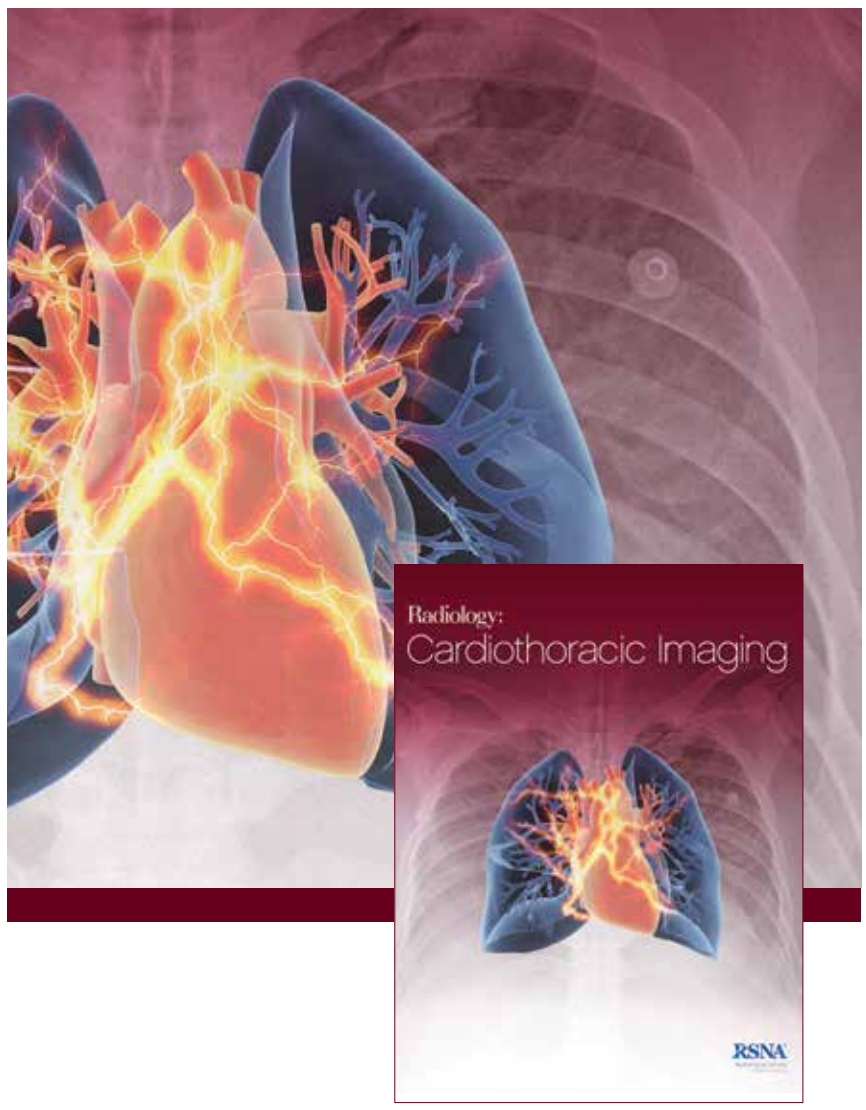


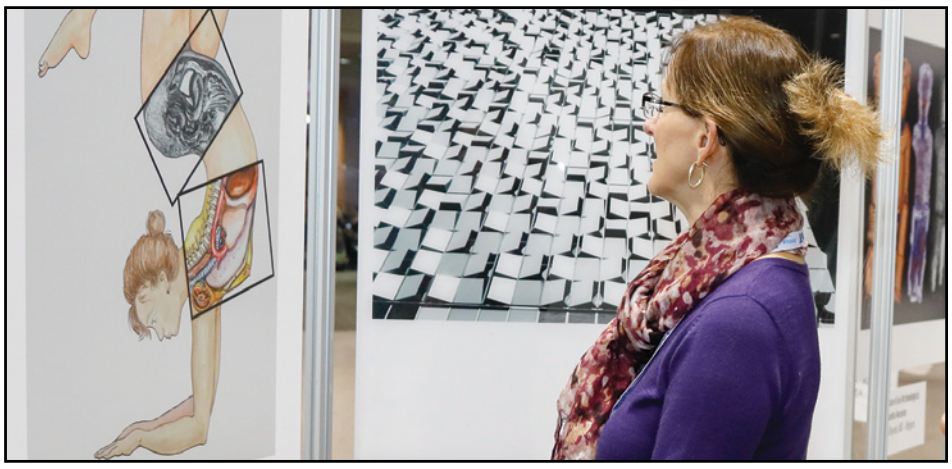
RSNA CELEBRATES YOU!

RSNA 2018 is the perfect opportunity to honor the many talented and accomplished radiology professionals in the specialty. This week we recognized lifetime contributors with prestigious RSNA Gold Medals. Research & Education Foundation grant recipients and donors were also recognized. The Discovery Theater was filled Monday afternoon with more than 300 people as the Brigham and Women's Hospital team clinched victory in the 2nd Annual RSNA Diagnosis Live™ Resident Competition.

RSNA President Vijay M. Rao, MD *(second from left),* presents Gold Medals to Sarah S. Donaldson, MD *(left),* Deborah Levine, MD *(second from right),* and Kay H. Vydarney, MD *(right),* accepting for her husband William J. Casarella, MD.

A Distinguished Donor Reception Monday evening hosted generous individuals who support the mission of the RSNA Research & Education Foundation.

The RSNA Research & Education Foundation recognized this year's grant recipients during a Tuesday luncheon.



Meeting attendees can take a break and enjoy some of the top entries from past RSNA Image Contests in the North Building.

Novel Uses Propelling the Future of Low-Dose CT

By Jennifer Allyn

Advances in CT, including the use of low-dose CT and its use in the early detection and characterization of lung cancer, are having a substantial impact on routine clinical practice and remain an important topic of research, according to speakers at Tuesday's RSNA/American Association of Physicists (AAPM) symposium, "State of the Art in CT Imaging."

"Within the last five years, there have been numerous changes in CT imaging, including physics and clinical developments related to dose, new classes of iterative CT image reconstruction algorithms and new lung nodule classification rules," said Paul E. Kinahan, PhD, symposium moderator, vice chair for radiology research and head of the imaging research laboratory, University of Washington, Seattle.

Image Quality Remains the Goal as CT Dose Lowers

During her presentation, "CT Technology - and Dose - in the 21st Century," Cynthia H. McCollough, PhD, president-elect of AAPM and a professor of biomedical engineering and medical physics at Mayo Clinic College of Medicine and Science, Rochester, MN, reviewed the unique challenges and changes within CT over the years and discussed important current considerations, especially regarding the use of low-dose CT.

"With all the advances in CT over the last decade, including changes in scanner design, dual-energy CT and widespread adoption of iterative reconstruction and noise reduction techniques, body CT doses have fallen by over a factor of three since the early 80s," Dr. McCollough said. "It is important to remember though that as doses fall lower and lower, we don't want to inadvertently drive the clinical image quality lower too."

Additional emerging technologies, such as deep learning and photon-counting detector CT, will continue to drive the expansion that has already taken place in the early part of this century, according to Dr. McCollough.

"Dose customization that is specific to the patient and to the reason for the exam as well as technical advances such as tube current modulation and tube potential optimization have the ability to ensure that patients get a quality CT exam at lower doses," she concluded.

Evolving Technology Allows New Approaches to Lung Cancer

During her presentation, "Contemporary CT of the Indeterminate Lung Nodule: Where We Are and Why it Matters," Denise R. Aberle, MD, professor of radiology and bioengineering at the University of California Los Angeles (UCLA) and vice chair for research in the Department of Radiological Sciences in the David Geffen School of Medicine at UCLA, discussed the current role of low-dose CT in lung cancer screening and early detection, including current approaches to the classification of indeterminate lung nodules.

Aberle

McCollough

Given the prominent role of semantic features in current diagnostic classification models of lung cancer, Dr. Aberle described approaches to standardizing semantic characterization of lung nodules based on an illustrated lexicon.

"The use of these more standard semantic features will play a role in training convolutional neural networks (CNN) to make output more interpretable to humans for lung nodule detection," Dr. Aberle said.

The benefits of this ever-changing landscape of CT and its diagnostic uses are pushing the boundaries of technology and customization.

"The greatest gains in CT may be multiparametric approaches," Dr. Aberle said. "Combining clinical, imaging and molecular features to complement the data and assist in its interpretation."

2018 Machine Learning Challenge Results Announced

Ten winning teams of the RSNA 2018 Pneumonia Detection Challenge were recognized on Monday.

Over 1,400 teams developed algorithms to identify and localize pneumonia in chest X-rays and 346 submitted results during the evaluation phase of the competition.

The second annual Machine Learning Challenge made use of a publicly available chest X-ray dataset from the National Institutes of Health, which was annotated to provide the "ground truth" for participants to train their algorithms and to evaluate their submissions in the final phase of the challenge.

The challenge was run on a platform provided by Kaggle, Inc. (a subsidiary of Alphabet, Inc., also the parent company of Google). Kaggle also provided $30,000 in prize money to be shared among the winning entries.

As More Cervical Spine Injuries Present, Patient Management Becomes Critical

By Lynn Antonopoulos

Employment and lifestyle changes over the past two centuries, including increased use of motor vehicles and heavy industrial equipment, have contributed to a rise in cervical spine trauma and the significant financial burden that accompanies it.

Findings from an in-depth examination at a Level I trauma center in Houston offered perspective on the pattern and frequency of cervical spine injuries and may provide a pathway to reduction of unnecessary imaging and improvements in patient management.

"Every day we are faced with diverse imaging appearances in trauma patients that would have been non-existent in earlier years," said Roy Riascos, MD, professor of diagnostic and interventional radiology at University of Texas Health and Science Center of Houston (UTHSC).

"Injuries associated with cervical spine trauma can be devastating and have enduring implications. Focusing our attention on spine trauma is a necessity rather than an option," he added.

Motor Vehicle Accidents Cause Most Injuries

Dr. Riascos and his fellow researchers performed a retrospective analysis of 13,956 patients who underwent imaging for cervical spine trauma at a Level I trauma center. The team examined medical records for 934 patients from the initial study population who had positive CT scans and analyzed them for correlation between demographic, clinical and imaging features.

The results showed subjects between the ages of 21 and 40 demonstrated peak incidence of cervical spine trauma with a male-to-female ratio of two to one.

> ***Injuries associated with cervical spine trauma can be devastating and have enduring implications. Focusing our attention on spine trauma is a necessity rather than an option.***
>
> **Roy Riascos, MD**

Not surprisingly, most of the injuries, 66 percent, were caused by motor vehicle accidents. Falls from a height of less than eight feet accounted for approximately 12 percent.

Within the study population, the highest number of vertebral body fractures were due to compression injury. "We identified 438 injury levels in vertebral bodies, especially in C1 and C2 with incidence of C2 injury being most frequent. Body and lateral mass fracture incidence was slightly higher than odontoid fractures," Dr. Riascos said.

A review of injuries to the subaxial spine revealed that C7 was the most fractured vertebral body with 11 percent occurrence followed by C6 then C5. When evaluating for posterior element fractures, transverse process was common.

Drawn from a Level 1 trauma facility, the data look at the most serious injuries and do not account for lower level trauma incidents. "Efficient triaging of patients based on severity of injury is the first step in trauma, and it allows us to focus our resources," said Shekhar Khanpara, MD, a research associate at UTHSC and one of the study authors.

Riascos

Dr. Khanpara also said that exploring the risk factors associated with spine trauma and understanding the patterns of injury in light of mechanism can provide better insight in patient management and prevent lifelong disability and the mortality associated with it.

"Two decades ago, European countries were facing the same issues with motor vehicle accidents. They have since seen a decrease through stricter vehicular safety rules. However, in the U.S., the incidence is still rising, and even more so in the Houston area where the roads are large and laws are flexible," said Dr. Riascos adding, "The percentage of such accidents is higher than the rest of the country, and we have to make changes to reverse the trend."

Wednesday's

Answer

[Question on page 6A.]

A Lowering kV increases photoelectric effect interactions and makes contrast media brighter on the images.

Integrated Diagnostics Bridge the Gap Between Radiology, Pathology and Genomics

By Richard Dargan

Integrated diagnostics — the combining of radiology, pathology and genomics into an innovative diagnostic tool — has the potential to greatly improve patient care while reducing costs, according to presenters at a special interest session Monday.

Despite its importance, diagnostics has suffered from too little coordination among the medical specialties responsible for ordering and performing tests, said presenter Pablo R. Ros, MD, PhD, radiologist-in-chief at the University Hospitals Health System in Cleveland. Integrated diagnostics provides solutions for bridging this gap, he said, partly by leveraging the power of artificial intelligence and data.

"We have been integrating diagnosis, but in an analog rather than digital fashion," Dr. Ros said. "Now, we have the computing power to allow meaningful, clinically active communication among the diagnostic disciplines of radiology, pathology and genomics."

The ideal setting for such communication is a diagnostic institute based around Centers of Excellence — specialized programs within hospitals with high concentrations of expertise. Dr. Ros, who was instrumental in setting up the University Hospitals Diagnostic Institute, said these fledgling institutes are already attracting the attention of health care stakeholders.

"Health care systems are recognizing that the overlap in radiology, pathology and genomics provides an opportunity for better care at lower costs," he said.

Integrated diagnostics also offer the potential for greater patient satisfaction and adherence to testing recommendations, according to R. Nick Bryan, MD, PhD, chair of the Department of Diagnostic Medicine at the Dell Medical School (DMS) in Austin, TX. By providing a one-stop setting for imaging, blood tests and other procedures, the approach has the potential to reduce no-shows. Approximately 20 percent of indicated/recommended tests in the U.S. are never performed, Dr. Bryan said, in part because of patient anxiety and issues with the scheduling system.

> *Health care systems are recognizing that the overlap in radiology, pathology and genomics provides an opportunity for better care at lower costs.*
>
> **Pablo R. Ros,MD,PhD**

Dr. Bryan, who helped launch the Department of Diagnostic Medicine at DMC, urged radiologists to look beyond the ordered test itself and assume more of a role in the inferences drawn from the results and the clinical correlation.

"I hope and I think that we will take more responsibility as radiologists in the full diagnostic process," Dr. Bryan said.

Erasmus Medical Center Takes Integrated Approach

Across the Atlantic, Erasmus Medical Center (MC) in Rotterdam, the Netherlands, has optimized its organizational structures for the implementation of the integrated diagnostics concept. All diagnostic specialties are gathered in the division, Diagnostics and Advice, and agreements with referring physicians are performed jointly.

The shift to integrated diagnostics has been challenging, said Jacob Visser, MD, PhD, from the Department of Radiology and Nuclear Medicine at Erasmus MC, but not without success.

For example, the center has been performing minimally invasive autopsies in cases where family members of decedents are reluctant to authorize conventional autopsies because of their invasiveness. The minimally invasive approach uses CT, MRI and biopsies and brings the findings together into one integrated diagnostic report.

From left: Pablo R. Ros, MD, PhD, Jacob Visser, MD, and R. Nick Bryan, MD, PhD.

Dr. Visser pointed to the integration of radiology and pathology workflow as an example of the division's "think big, act small" approach. Radiologists use a five-level scoring system on tumor reports ranging from benign to malignant and the pathologist does the same with the addition of two levels. The system automatically compares the two scores and creates a so-called discordant worklist that both specialists can review and develop a joint conclusion. This process will eventually exploit the power of big data to increase the level of decision support, Dr. Visser said.

"By doing so, we bring all of the pieces of the puzzle together and make a real integrated diagnostics approach," he said.

U.S. Residents Building Training Program for African Radiology Colleagues

By Mary Henderson

On Tuesday afternoon, Simone Montoya, MD, a radiology resident at the University of Rochester School of Medicine (URMC), unveiled the details of an initiative to increase the availability of radiology services in Zambia, Africa and invited radiologists to become involved in the project.

Montoya

"A Portable Radiology Curriculum for Training, Evaluating and Retaining Radiologists in Africa (PRACTERRA) is a U.S. radiology resident-driven project designed to support the training of radiologists in resource-limited countries. The project is funded by a 2018 Derek Harwood-Nash International Education Scholar Grant through the RSNA Research & Education Foundation.

Dr. Montoya said 66 percent of the world's population lacks access to diagnostic imaging. Zambia, a country just slightly larger than Texas, has 14 CT scanners and four MRI units, but just two radiologists to serve 17.6 million residents.

"The hardware is available, but what's lacking are doctors and training," she said.

Dr. Montoya and other URMC residents are developing the PRACTERRA web-based modular curriculum, which will initially be offered to 12 radiology postgraduates per year from Lusaka APEX Medical University. The initiative is a collaboration between URMC, Lusaka APEX Medical University and the Zambian Ministry of Health.

"PRACTERRA will be a how-to guide for young radiologists that is in tune with the pathologies of Sub-Saharan Africa," Dr. Montoya said. "It will help teach postgraduates how to interpret and report on imaging studies, communicate with clinical colleagues and, ultimately, how to integrate radiology into the local health care system."

The curriculum also includes weekly web conferences with U.S. residents for case discussion, lectures and case reviews.

Dr. Montoya's mentor, Michael Potchen, MD, professor of imaging services at URMC, has been working for more than a decade to advance radiologic training in Zambia.

"This country needs a sustainable program to train Zambian radiologists who can in turn train the next generation," said Dr. Potchen. "But first we need to train this initial cohort and build out the PRACTERRA curriculum."

"We're looking for more people to get involved," Dr. Montoya added. "We have 500 DICOM case studies but we need more normal and relevant pathologies, along with videotaped lectures and written support materials. We can take DICOM files, PDFs and videos."

Dr. Montoya and two other residents will spend January in Lusaka to continue developing the curriculum and collecting local cases.

Once the team has completed and obtained proof-of-concept for the program, URMC plans to make the web-based curriculum available free of charge to other resource-limited countries looking to train local radiologists.

Stereotactic Radiosurgery Used Increasingly in Treating Metastatic Lung Cancer

By Melissa Silverberg

Non-small cell lung cancer is one of the most common malignancies associated with brain metastases at diagnosis. As doctors explore more aggressive treatment, new research seeks to understand trends in use and outcomes for both whole brain radiation therapy (WBRT) and stereotactic radiosurgery (SRS).

In a Tuesday session, "Modern Treatment Patterns and Overall Survival of Non-Small Cell Lung Cancer Patients Receiving Palliative Radiation Therapy for Brain Metastases at Diagnosis," Pamela Samson, MD, a radiation oncology resident at Washington University in St. Louis, presented the trends observed through a review of data from the National Cancer Database.

The SRS method provides a more focal treatment and can spare normal brain tissue, Dr. Samson said. "It is important in terms of preserving quality of life for as long as possible and ensuring the brain has appropriate local control for a period of time," she said.

The analysis looked at 11,299 non-small cell lung cancer patients with brain metastases at diagnosis who were treated with palliative brain radiotherapy between 2010 and 2014. The analysis found that 85.7 percent of patients received WBRT and 14.3 percent received SRS, meaning that whole brain radiation therapy is still the predominant mode of treatment for these patients.

However, the frequency of SRS increased from 9.9 percent in 2010 to 19.6 percent in 2014, showing it is a quickly growing method of treatment for patients with advanced lung cancer. Factors that were associated with increased likelihood of receiving SRS included increasing age, most recent year of diagnosis, treatment at an academic facility, private insurance, income in zip code, living more than 20 miles from a treatment facility, and receiving chemotherapy.

"We found that oncologists are starting to treat patients with Stage 4 lung cancer in a more aggressive and definitive manner," Dr. Samson said.

Multidisciplinary Care is Key

Independently, Dr. Samson said the analysis showed that patients who received WBRT had a median overall survival of 4.1 months while those who received SRS had a median overall survival of 8.9 months.

SRS however, does not prevent new lesions from forming. When necessary, patients can change their treatment plan to WBRT at a later date if needed, Dr. Samson said.

The National Cancer Database does have its limitations, Dr. Samson said. For example, it does not identify the number of brain metastases that are present at time of diagnoses, which could influence which mode of treatment is used and patient outcomes.

Dr. Samson said multidisciplinary care is key in treating this aggressive form of cancer. Physicians should understand the role SRS plays along with immunotherapy, chemotherapy and other treatment methods.

"Stage 4 non-small cell lung cancer is one of the scariest diagnoses that a person can receive," Dr. Samson said. "But at the same time, given all the recent developments, I want patients to know that we are seeing evidence that we can provide a focal, aggressive treatment that we hypothesize can improve quality of life and is associated with increased overall survival."

Samson

Paras Lakhani, MD, Accepts Alexander R. Margulis Award for Scientific Excellence

RSNA President Vijay M. Rao, MD, presented Paras Lakhani, MD, with the Margulis Award for Scientific Excellence.

In his *Radiology* research, "Deep Learning at Chest Radiography: Automated Classification of Pulmonary Tuberculosis by Using Convolutional Neural Networks," Paras Lakhani, MD, from Thomas Jefferson University Hospital (TJUH) in Philadelphia, used deep learning — a type of artificial intelligence — using pre-trained convolutional neural networks (CNNs) to identify TB on chest X-rays.

The study, published online in the April 2017 issue of *Radiology*, has earned Dr. Lakhani the seventh annual RSNA Alexander R. Margulis Award for Scientific Excellence.

"We determined that deep learning with CNNs can classify TB at chest radiography," said Dr. Lakhani, lead author on the study authored with colleague Baskaran Sundaram, MD. "This method means that radiography may facilitate screening and evaluation efforts in TB-prevalent areas with limited access to radiologists."

Copies of the study are available in the Membership & Resources area of the Connections Center.

Imaging Helps Reduce Unneeded Prostate Biopsies

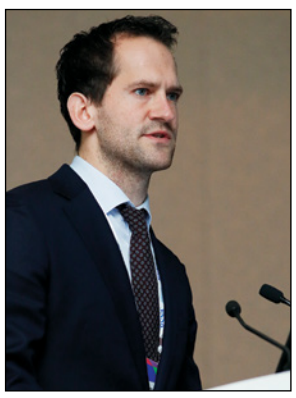
By Michael Bassett

Multiparametric MRI (mpMRI) of the prostate is effective in helping men avoid unnecessary prostate biopsies, according to research presented on Tuesday.

In a study presented by Wulphert Venderink, MD, Radboud University Medical Centre, Nijmegen, The Netherlands, researchers found that that more than 50 percent of patients suspected of having prostate cancer were able to avoid biopsy because of negative findings on mpMRI.

"MRI of the prostate has become such a big game changer because so many studies have showed it to be superior to the alternative — 12-core transrectal ultrasound [TRUS] guided biopsies," Dr. Venderink said. "TRUS comes with the risk of infection, and it under detects clinically significant prostate cancers and over detects insignificant cancers."

In this study Dr. Venderink and his colleagues retrospectively reviewed patients having mpMRI in their institution between January 2012 and December 2017. They included patients who were suspected of having prostate cancer and had either a history of negative TRUS biopsy or were biopsy-naïve.



Venderink

Lesions were classified using the ACR's Prostate Imaging Reporting and Data System (PI-RADS) by one of eight different radiologists, each with a varying amount of experience. The primary outcome was a negative mpMRI, defined as an index lesion classified as PI-RADS <3.

"In our hospital we do not biopsy lesions that are classified as PI-RADS 1 or 2," Dr. Venderink said. "We also do not biopsy lesions that are classified PI-RADS 3 in combination with a low PSA density [below 0.15 ng/ml]."

The study included 4,259 men with a median age of 64 years and a median PSA of 8.5 ng/ml. Slightly less than half (47.9 percent) had a history of previously negative TRUS biopsy, while the remaining men (52.1 percent) were biopsy-naïve.

More than half of the men (53.6 percent) were classified as having a negative mpMRI (PI -RADS <3) and avoided biopsy. Of the remaining men, 12 percent were classified as PI-RADS 3, 15 percent as PI-RADS 4, and 19 percent as PI-RADS 5. Furthermore, the researchers determined that 5.3 percent of the men imaged were classified as PI-RADS 3 and had a PSA density below 0.15 ng/ml, meaning they avoided biopsy as well.

Dr. Venderink and his colleagues found that the number of men with negative mpMRIs didn't substantially differ from year to year. They also noted that when broken down into cohorts (biopsy-naïve men and those with previously negative biopsies), the percentage of men with negative mpMRIs was similar.

According to Dr. Venderink, of those patients with a positive mpMRI, radiologists were able to detect clinically significant prostate cancers with targeted biopsies in 75 percent of them. "So, MRI not only allows patients to avoid biopsy, it also allows us to target a lesion and biopsy it with two needle cores instead of randomly performing 12 biopsies," he said.

The researchers also noted that just 9 of the 2,281 patients with a negative mpMRI (0.4 percent) had a clinically significant prostate cancer detected after a median period of 29 months.

"Our research underlines the importance of using MRI in men who are suspected of having prostate cancer," Dr. Venderink said. "It also demonstrates that PI-RADS is an adequate tool to select patients who need subsequent targeted biopsy, and those who may safely avoid biopsy."

MRI of the prostate has become such a big game changer because so many studies have showed it to be superior to the alternative — 12-core TRUS guided biopsies.

Wulphert Venderink, MD

Klein Joins RSNA Board of Directors

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Roentgenology, *Journal of Thoracic Oncology*, *Cardiovascular and Interventional Radiology*, and *Cancer*. He received a *Radiology* Editor's Recognition Award for reviewing with special distinction in 2010.

Esteemed for his dedication to radiology education, Dr. Klein has received teaching awards from the UCSF Medical Center, the University of Vermont College of Medicine and SUNY Downstate.

Dr. Klein held several leadership positions with the Society of Thoracic Radiology (STR), including as president from 2005 to 2006. He served on the American College of Radiology committee on CT accreditation from 1998 to 2008, and as an examiner for the American Board of Radiology. Dr. Klein was part of an expert panel convened by the U.S. Department of Justice regarding the Radiation Exposure Compensation Act of 1990, a group that developed a protocol for high-resolution CT examinations of Navajo uranium miners. From 2001 to 2005, he represented Vermont on the American College of Chest Physicians Council of Governors, and from 2002 to 2010 Dr. Klein was a member of the Data Safety and Monitoring Board for the Lung Cancer Screening Trial of the National Cancer Institute. He was elected to membership in the Fleischner Society for Thoracic Imaging and Diagnosis in 2011.

In addition to his tenure as editor for *RadioGraphics*, Dr. Klein is a member of the RSNA Scientific Program, Refresher Course and Education Exhibits committees and the Publications Council. He also serves on the RSNA Research & Education Foundation Grant Program Committee and the RSNA Digital Roadmap Content Steering Committee.

Borgstede is RSNA President-Elect

CONTINUED FROM PAGE 1A

Imaging and Peril of Inappropriate Utilization." At RSNA 2007, Dr. Borgstede lectured during the Opening Plenary Session. He has published dozens of articles and has lectured at more than 120 scientific and educational meetings worldwide.

Dr. Borgstede currently serves as a reviewer for the *Journal of the American College of Radiology* and previously served on the editorial board from 2004 to 2008. Since 2004, he has served on the editorial advisory board for *American Family Physician*.

Dr. Borgstede was president of the International Society of Radiology from 2014 to 2016. He was American College of Radiology (ACR) chairman of the Board of Chancellors from 2004 to 2006 and president from 2006 to 2007. Since his presidency at ACR, he has continued on various ACR committees, including the Committee on International Service, with which he traveled multiple times to Grace Children's Hospital Port-au-Prince, where he worked as part of the Haiti Radiology Project. He has also held committee or leadership positions for the Society of Radiologists in Ultrasound (SRU), Colorado Radiological Society (CRS), El Paso County Medical Society and Rocky Mountain Radiological Society.

The recipient of numerous honors and awards throughout his career, Dr. Borgstede has received the gold medal and the William T. Thorwarth Award for Excellence in Economics and Health Policy from ACR. He received service awards from CRS and was the first CRS gold medalist. He is a recipient of the University of Colorado Hospital President's Award for Leadership.

He received his medical degree in 1974 from the University of Illinois, Chicago, and completed his residency in 1978 at the University of Colorado Health Sciences Center.

Oscillating Microbubbles

CONTINUED FROM PAGE 1A

predict treatment response with 100 percent accuracy after just one round of chemotherapy.

Tumor hypoxia, or oxygen deprivation, has been known to limit radiation therapy's effectiveness, so researchers hatched the idea of delivering oxygen-filled microbubbles to the site of a tumor and then destroying them, releasing the oxygen into the tumor. In a study of 50 mice, the combination of oxygen delivery and radiation therapy significantly increased tumor volume control.

The FDA has not yet approved this approach in humans, so researchers have been studying US-targeted microbubble destruction (UTMD) as a more immediate option.

Early Phase of Clinical Trial is Promising

Dr. Forsberg and colleagues are in the early phase of a clinical trial studying UTMD on liver cancer patients undergoing radioembolization. The researchers introduced the microbubbles into the tumor and then destroyed them with acoustic waves, making the tumor more sensitive to the radiation. Follow-up imaging showed that of the seven patients who underwent UTMD, two experienced complete response to treatment and four had partial response. In contrast, of the four patients who did not get UTMD, only one had partial response and three had no response at all.

"We are about a quarter of the way into our ongoing clinical trial, but we think these preliminary efficacy results show us that there is potential for this to work," Dr. Forsberg said.

Oscillating microbubbles are also being studied as a way to deliver drugs to the brain through the almost impermeable blood-brain barrier. Research out of the University of Toronto on five Alzheimer's disease patients showed that microbubbles could be used to safely, reversibly and repeatedly open the barrier. The researchers now want to attempt drug delivery through the temporary opening.

In Norway, scientists found that by applying vibrations to microbubbles, they could improve the effectiveness of chemotherapy in pancreatic cancer patients. The patients were able to tolerate more treatments, and median survival increased from nine months to 17 months.

"There are a number of therapeutic approaches that we are pursuing for clinical use with our bubbles," Dr. Forsberg said.

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