A novel 3D depth camera built into a CT scanner automatically positions the table for each patient. The new system significantly reduces the extent of vertical off-centering compared to manual setting of the table height.

Cardiac Imaging Special

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- The role of intravascular ultrasound imaging in the detection of acute aortic syndrome
- A focused transthoracic echocardiography training curriculum for advanced practice providers
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Workload in radiology - more examinations, more content per exam, less time: a recipe for burnout

The recent reports that in many countries a smaller proportion of newly graduated medical students are opting for radiology for their chosen specialisation raises the question as to why the profession is apparently becoming less attractive to potential new entrants. Inevitably, the question of radiology work-load is being put forward as an explanation. The central and inexorably growing role of medical imaging in modern medicine could (should?) be interpreted as a sign of a vital and growing discipline but instead is frequently seen simply as the cause of an ever-increasing work-load for the radiologist in the front line.

However, as pointed out in a study from the Mayo Clinic (McDonald RI. The effects of changes in utilization and technological advancements of cross-sectional imaging on radiologist workload. Acad Radiol. 2015; 22(9): 1191-8.) the problem is not just the steady rise in the number of examinations performed per year, it is also due to the increase in the number of images that must be interpreted in each examination. The Mayo Clinic team estimate that increases in examination content alone have increased the workload of the radiologist between fourfold to sevenfold.

Among examination types, diagnostic CT and MRI studies have experienced the greatest increases in utilization and are predominantly responsible for the observed workload increases, particularly within neuro, body, and chest radiology subspecialties. To these applications can now be added that of breast imaging, where the undoubted benefit of sharply increased sensitivity in the detection of suspicious breast lesions brought about by the increasing adoption of breast tomosynthesis, is accompanied by a significant increase in the number of images to be read per examination.

Studies have shown that efficiency and accuracy of interpretation declines with increasing fatigue, and that there is probably a finite limit to the number of images that a radiologist can confidently interpret in any day before patient safety is compromised. Endangered patient safety is bad enough, but yet another problem is the risk of increasing levels of burnout among radiologists. More and more reports on the issue of burnout in radiology and how to deal with it are being published. One very recent report (McLuckey MN, Gunnderman RB Burnout Education: The Relationship of Personal Life to Work Life. Acad Radiol. 2018 Aug;25(8): 1097-1098. doi: 10.1016/j.acra.2018.02.021) makes the reasonable point (perhaps a bit utopic) that efforts to reduce burnout and enhance morale among radiologists are unlikely to be successful if they deal only with the domain of the workplace and neglect the aspects of personal life and how these spheres interact.

Even the august body of the American College of Radiology has expressed itself to be concerned about the burnout issue (Blath EI, et al. Burnout: Redesign the Work Process Rather Than the Person... J Am Coll Radiol. 2017; 14(10):1375). The ACR Commission on Human Resources has noted in particular that discussions about reducing burnout in the past have focused primarily on how individuals can adopt attitudes and techniques to avoid developing this problem. Recommended personal solutions have included adopting stress reduction techniques such as exercise or yoga, improving time management, maintaining a positive attitude, restoring lifestyle balance, encouraging humor, and improving the efficiency of the radiologist. The ACR Commission on Human Resources has spent a lot of time considering the issue and has now come up with the suggestion that “perhaps our profession should consider making a change in direction to address this problem. Rather than redesigning the person, the commission feels that it would be better to focus on redesigning the system of work in which radiologists participate. Attention should be directed to their level of involvement in decision making, their supervision responsibilities of allied health personnel, their requirements for night and weekend call, increased clerical activities, the level of ancillary support, and their incentives”.

All well and good but not a mention of the workload issue. Interestingly, the words “Artificial Intelligence” are nowhere to be seen in the JACR paper.
COVER STORY

CARDIAC HYBRID IMAGING - AN EFFECTIVE TOOL FOR PREDICTING HEART ATTACKS

A recent study has evaluated the long-term prognostic value for cardiovascular outcomes of hybrid SPECT Perfusion imaging and Coronary CT Angiography. In summary, in patients evaluated for coronary artery disease, cardiac hybrid imaging was found to be an excellent long-term predictor of adverse cardiac events. A matched hybrid finding is associated with a high annual cardiac event rate.

REGULARS

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CARDIAC IMAGING ARTICLES

Misdiagnosed aortic intramural hematoma and the role of intravascular ultrasound imaging in the detection of acute aortic syndrome

MRI wideband sequences with Late Gadolinium Enhancement are of use in cardiac MRI in patients with cardiac implanted electronic devices (CIEDs)

A recent study evaluated the effect of a novel 3D depth camera built into the CT scanner to automatically position the table for each patient. The new system significantly reduced the extent of vertical off-centering compared to manual setting of the table height.

CARDIAC IMAGING NEWS

Intracardiac flow at 4D CT: comparison with 4D flow MRI.

Severe preeclampsia heart imaging study reveals roots of cardiac damage in pregnant women.

Danger of coronary artery compression in children is more common than we think.

Study suggests cardiac monitoring should be prioritized for high-risk breast cancer patients.

CT coronary angiography: a paradigm shift for functional imaging tests.


IN THE NEXT ISSUE:

Breast Imaging.

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Benefits of ultrasound screening for abdominal aortic aneurysm questioned

Screening for abdominal aortic aneurysm may not substantially reduce deaths from the condition, according to a recently published study involving more than 130000 men (Johansson M et al. Benefits and harms of screening men for abdominal aortic aneurysm in Sweden: a registry-based cohort study. Lancet. 2018;16: 91). The findings question the need for screening, which is usually carried out by ultrasound imaging.

In recent years, the number of cases of abdominal aortic aneurysm have decreased significantly, probably due to the decline in the number of men smoking cigarettes; the drop in the number of cases which may alter the benefits and harms of the screening.

In the study, the authors estimate how many deaths were avoided as a result of screening, how many people were over-diagnosed, and how many people were treated when they did not need to be. Overdiagnosis is the detection of swelling in the artery that would never have caused symptoms in a person’s lifetime, nor caused their death. The surgery for abdominal aortic aneurysm is a complex operation in which the swelling of the major artery in the abdomen is replaced with a graft. The surgery has a risk of serious complications such as stroke, myocardial infarction, amputation, renal failure, and even death.

Screening involves an ultrasound scan of the abdomen to measure the size of the aorta. Men who have an aorta that is 30 mm wide or more are diagnosed with abdominal aortic aneurysm, and monitored regularly. Men with an aorta wider than 55 mm are offered preventative surgery.

The Swedish study followed 25265 men aged 65 years or older who underwent screening and 106087 men as unscreened controls. The researchers calculated how many men were diagnosed with an abdominal aortic aneurysm, how many underwent surgery, and how many men died from the condition. Between 2000-2015, mortality from abdominal aortic aneurysm declined by 70% across Sweden (from 36 to 10 deaths per 100000 men aged 65-74), with rates remaining similar in men who were and were not screened. In addition, screening did not substantially reduce mortality, with an estimated two deaths avoided for every 10000 men screened six years after screening. The difference was not statistically significant.

Screening was associated with significant harm from overdiagnosis and unnecessary treatment - six years after screening, 49 in every 10000 men screened were likely to have been overdiagnosed, and 19 of these men were likely to have undergone needless surgery.

As a result, the authors conclude that abdominal aortic aneurysm screening had only a minor effect on mortality, and instead suggest that the lower mortality from abdominal aortic aneurysm may be caused by declining smoking rates. They warn that the harms of screening may outweigh the benefits, and question its continued use. They also note that many cases are identified outside of the screening programme, through opportunistic testing and identification.

“Our findings suggest that this screening programme may be outdated, because the number of deaths from abdominal aortic aneurysm has been greatly reduced, likely due to lower smoking rates,” says lead author Dr Minna Johansson, University of Gothenburg, Sweden. “As a result, the harms of this screening appear to outweigh the benefits, and our findings question the continued use of screening for abdominal aortic aneurysm in men. The results from this study are likely to be applicable to countries with similar trends in smoking rates and abdominal aortic aneurysm, which applies to many Western countries, for example the UK.”

https://tinyurl.com/aneurysm-screening-paper

Using radiomics to reduce false positives in CT for lung cancer

A team of researchers including investigators from Mayo Clinic has identified a technology to address the problem of false positives in CT-based lung cancer screening (Peikert T et al. Novel high-resolution computed tomography-based radiomic classifier for screen-identified pulmonary nodules in the National Lung Screening Trial. PLoS One. 2018; 13:e0196910.)

“One of the most challenging problems in screening patients for lung cancer is that the vast majority of the detected pulmonary nodules are not cancer,” said Dr Tobias Peikert, “Even in individuals who are at high risk for lung cancer, up to 96 percent of nodules are not cancer.” These false-positives cause significant patient anxiety, often lead to unnecessary additional testing, including surgery, increase health care costs and may
New PET tracer increases detection of neuroendocrine tumors


Neuroendocrine tumors (NETs) can occur in almost any organ, but they are most commonly observed in the pancreas and gastrointestinal tract. The average time until diagnosis is 3 to 10 years. An estimated 40 to 95 percent of cancerous gastrointestinal NETs (GEP-NETs) have spread to other parts of the body (metastasized) by the time of diagnosis.

Most GEP-NETs express a high density of somatostatin receptor subtype 2 (sst2). These receptors have therefore become a prime target for imaging and treating these tumors. Currently, gallium-68 (68Ga)-DOTATOC/-TATE for diagnostic imaging and lutetium-177 (177Lu)-DOTATOC/-TATE for therapy are paired for “theranostic” identification and treatment of NETs. Preclinical and preliminary clinical evidence indicates that the new radiolabeled tracer 68Ga-OPS202, an sst antagonist with a high affinity for sst2, has the potential to perform better than other sst agonists since it binds to more sst receptor binding sites.

This first-in-human Phase 1/2 study, included 12 patients with well differentiated GEP-NETs. The study showed that 68Ga-OPS202 is rapidly cleared from the blood, resulting in low background activity, especially in the liver and gastrointestinal tract.

“Even though the effective dose of 68Ga-OPS202 is comparable to other 68Ga-labeled somatostatin analogs, there are striking differences concerning its biodistribution and organ doses such as in liver, gastrointestinal tract, pancreas and spleen,” explains Dr D Wild, of the University Hospital in Basel, Switzerland.

He points out, “The lower organ doses and tracer uptake of 68Ga-OPS202, especially in the gastrointestinal tract and the liver, is clinically relevant, as it allows improvement of the imaging contrast (tumor-to-background ratios) and sensitivity for detecting primary tumor or liver metastases of GEP-NETs. What is important for patients is that 68Ga-OPS202 was well tolerated and did not raise any safety concerns.”

Wild concluded, “68Ga-OPS202 could be a favorable alternative to the current radiolabeled somatostatin agonists for PET/CT imaging of neuroendocrine tumor patients. In addition, due to their enhanced binding properties, radiolabeled sst antagonists may open a new avenue for PET imaging and targeted radionuclide therapy in non-neuroendocrine tumor indications”

Could serum biomarkers reduce the need for CT scans in patients with suspected TBI?

A multicentre group of researchers from the United States and Europe have studied whether two serum biomarkers could be used to indicate the absence of traumatic brain injury (TBI) and so rule out the need for CT scans in patients with a head injury. (Bazarian JJ et al. Serum GFAP and UCH-L1 for prediction of absence of intracranial injuries on head CT (ALERT-TBI): a multicentre; observational study Lancet Neurol. July 24 2018).

An estimated 54–60 million people worldwide sustain a traumatic brain injury (TBI) each year. A head CT scan is the diagnostic modality of choice to evaluate patients for traumatic intracranial injuries, contributing to the approximately 20 million head CT scans performed annually in the USA alone. Although effective for detecting traumatic injuries that require observation or neurosurgical evacuation, the widespread use of
head CT scanning has been questioned due to potential adverse effects of radiation exposure, unnecessary emergency department resource use, and cost. Preliminary evidence suggested that two proteins namely, ubiquitin C-terminal hydrolase-L1 (UCH-L1) and glial fibrillary acidic protein (GFAP), were accurate predictors of CT-detected intracranial injuries but these previous studies were limited by small cohort size, variability in the timing of blood sample acquisition, and retrospective determination of cutoff values that probably biased the estimate of diagnostic accuracy. To address this issue a large, prospective, multicentre trial, “A Prospective Clinical Evaluation of Biomarkers of Traumatic Brain Injury (ALERT-TBI)”, was set up with the aim of validating the ability of a test combining UCH-L1 and GFAP, at predetermined cutoff values, to predict traumatic intracranial injuries on head CT scan within 12 h of TBI. The researchers reported that the results correctly identified 99.6 percent of patients who did not have a TBI on head CT scans in more than 1,900 adults presenting to emergency departments in the United States and Europe. They concluded that the results support the potential clinical role of the biomarker test to dramatically reduce the need to order CT scans of the head, cutting patient exposure to radiation and health care costs for unnecessary scans.

“This study is exciting for a few reasons. This is the largest study of any biomarker for TBI that has been performed in the United States and provides robustness of the findings compared to many earlier smaller studies,” said co-author Dr. Welch Department of Emergency Medicine, Wayne State University. “Our results were the basis for the first FDA approved blood biomarker panel that will aid in the diagnosis and care of patients with mild TBI. To a certain degree, this has been a holy grail for quite some time.” However in an accompanying comment in the same journal two clinicians raised three questions regarding the Alert-TBI trial (Maas AIR & Lingsma HF, Lancet Neurol July 24, 2018). The questions were: 1) Whether both UCH-L1 and GFAP biomarkers were really needed as opposed to just one of the pair? 2) Validation of the cut-off values used in trial. The final question raised by Maas and Lingsma concerned what precisely do the new tests add to current practice, given that “current clinical decision rules (CDR) for triaging CT scanning are available and have shown reductions in the number of CT scans (from 22% up to almost 50%) that are comparable with the UCH-L1 and GFAP test”. Also, studies on another serum biomarker, astroglial calcium-binding protein B (S100B) have shown that S100B, which is already widely used in Europe would have reduced the number of CT scans by 32% with little to no impact on patient outcomes. www.thelancet.com/neurology

Public access to largest CT multi-lesion medical imaging dataset to aid deep learning

The largest CT lesion-image database yet has just been made accessible to the public (Yan K et al DeepLesion: automated mining of large-scale lesion annotations and universal lesion detection with deep learning. J Med Imaging (Bellingham). 2018;5:036501). Such data are the foundations for the training sets of machine-learning algorithms; until now, large-scale annotated radiological image datasets, essential for the development of deep learning approaches, have not been publicly available. DeepLesion, developed by a team from the National Institutes of Health Clinical Center, was developed by mining historical medical data from their own PACS. This new dataset has tremendous potential to jump-start the field of computer-aided detection (CADe) and diagnosis (CADx). The database includes multiple lesion types, including kidney lesions, bone lesions, lung nodules, and enlarged lymph nodes. The lack of a multi-category lesion dataset to date has been a major roadblock to development of more universal CADe frameworks capable of detecting multiple lesion types. A multi-category lesion dataset could even enable development of CADx systems that automate radiological diagnosis. The database is built using the annotations - “bookmarks” - of clinically meaningful findings in medical images from the image archive. After analyzing the characteristics of these bookmarks - which take different forms, including arrows, lines, ellipses, segmentation, and text - the team harvested and sorted those bookmarks to create the DeepLesion database. Whereas the field of computer vision has access to the robust ImageNet3 dataset, which contains millions of images, the medical imaging field has not had access to the same quantity of data. Most publicly available medical image datasets contain just tens or hundreds of cases. With over 32,000 annotated lesions from over 10,000 case studies, the DeepLesion dataset is now the largest publicly available medical image dataset.

“We hope the dataset will benefit the medical imaging area just as ImageNet benefited the computer vision area,” said Dr Ke Yan. In addition to building the database, the team also developed a universal lesion detector based on the database. The researchers note that lesion detection is a time-consuming task for radiologists, but a key part of diagnosis. This detector

The ground-truth and two enlarged lymph nodes are correctly detected, even though the lymph nodes are not annotated in the dataset. Image courtesy of @SPIE
may be able to serve as an initial screening tool for radiologists or other specialist CADe systems in the future. In addition to lesion detection, the DeepLesion database may also be used to classify lesions, retrieve lesions based on query strings, or predict lesion growth in new cases based on existing patterns in the database. Future work will include extending the database to other image modalities, like MR, including data from multiple hospitals, and improving the detection accuracy of the detector algorithm. The database can be downloaded at https://nihcc.box.com/v/DeepLesion

Having a meal activates the functioning of human brown fat

The importance of human brown adipose tissue (BAT) has become clearer over the past ten years. Using PET scans it has been shown that adult humans have functional BAT with coldness being an effective activator of the BAT metabolic function. Animal studies have shown that in rodents, eating has the same effect. Now, researchers at Turku PET Centre in Finland have proven that having a meal increases oxygen consumption in human BAT as much as coldness (U Din M et al. Postprandial oxidative metabolism of human brown fat indicates thermogenesis. Cell Metabolism, 14 June 2018).

Most people avoid repeated exposure to cold due to the uncomfortable sensation. Coldness activates brown adipose tissue (BAT) found in the neck above the clavicles and accelerates the metabolic function of BAT. People whose BAT is functionally active have more favorable metabolic health, and their circulating glucose and lipid concentrations are lower compared to people with non-active BAT. One of the main functions of BAT is heat production. Heat production is obviously generated in cold environments, but, in animal models it has already been proven that eating also stimulates heat production in BAT. Even though there are few direct tools for measuring this in humans, the Finnish researchers were able to utilise non-invasive imaging to measure oxygen consumption in BAT. Healthy volunteers participating in the study were given a standard and balanced meal which included vegetable lasagna, salad, bread and margarine, and a glass of milk. After the meal, a PET scan was performed on the upper thoracic region containing BAT in order to measure oxygen uptake and tissue perfusion. The PET scan was repeated on another day during exposure to cold. “We found that BAT oxygen consumption increased as significantly after a meal as it did during exposure to cold,” said Dr K Virtanen. “This indicates that having a meal accelerates the mechanisms related to heat production in BAT”. After eating, there is quite a hormonal storm in the human body. Insulin is one of the most significant hormonal signals, and it promotes the transfer of nutrients, glucose and fatty acids to be oxidized in the tissues. In addition, several genes regulating fatty acid metabolism in BAT are expressed after eating.

“We were able to show that having a meal activates the functioning of BAT. Boosting this with regular eating may have an essential impact on weight maintenance - BAT remains active and functional and is able to participate in the regulation of metabolism”, said Virtanen. https://tinyurl.com/U-Din-et-al-paper

3D imaging analysis technique could improve arthritis treatment

An algorithm to monitor the joints of patients with arthritis, which could change the way that the severity of the condition is assessed, has been developed by a team of engineers, physicians and radiologists from the University of Cambridge in the UK. (Turmezei TD et al. A new quantitative 3D approach to imaging of structural joint disease. Sci Rep. 2018 Jun 18; 8: 9280). The technique, which detects tiny changes in arthritic joints, could enable greater understanding of how osteoarthritis develops and allow the effectiveness of new treatments to be assessed more accurately, without the need for invasive tissue sampling.

Osteoarthritis develops when the articular cartilage, which coats the ends of bones and allows them to glide smoothly over each other at joints, is worn down, resulting in painful, immobile joints. Currently there is no recognized cure and the only definitive treatment is surgery for artificial joint replacement. Osteoarthritis is normally identified on an x-ray by a narrowing of the space between the bones of the joint due to a loss of cartilage. However, x-rays do not have enough sensitivity to detect subtle changes in the joint over time. "In addition to their lack of sensitivity, two-dimensional x-rays rely on humans to interpret them," said lead author Dr Tom Turmezei from Cambridge’s Department of Engineering. “Our ability to detect structural changes to identify disease early, monitor progression and predict treatment response is frustratingly
limited by this.”

The technique developed by Turmezei and his colleagues uses images from a standard CT scan, which isn’t normally used to monitor joints. The semi-automated technique, called joint space mapping (JSM), analyses the CT images to identify changes in the space between the bones of the joint in question, a recognized surrogate marker for osteoarthritis. After developing the algorithm, the researchers found that it exceeded the current ‘gold standard’ of joint imaging with x-rays in terms of sensitivity, showing that it was at least twice as good at detecting small structural changes. Color-coded images produced using the JSM algorithm illustrate the parts of the joint where the space between bones is wider or narrower.

“Using this technique, we’ll hopefully be able to identify osteoarthritis earlier, and look at potential treatments before it becomes debilitating,” said Turmezei. “It could be used to screen at-risk populations, such as those with known arthritis, previous joint injury, or elite athletes who are at risk of developing arthritis due to the continued strain placed on their joints.”

While CT scanning is regularly used in the clinic to diagnose and monitor a range of health conditions, CT of joints has not yet been approved for use in research trials. According to the researchers, the success of the JSM algorithm demonstrates that 3D imaging techniques have the potential to be more effective than 2D imaging. In addition, CT can now be used with very low doses of radiation, meaning that it can be safely used more frequently for the purposes of ongoing monitoring.

“We’ve shown that this technique could be a valuable tool for the analysis of arthritis, in both clinical and research settings,” said Turmezei. “When combined with 3D statistical analysis, it could also be used to speed up the development of new treatments.”

https://tinyurl.com/Turmezei-et-al-paper

How fast can acute stroke treatment become while still being reliable?

Stoke centers worldwide strive to optimize “Door to Needle Times” or DNTs, which inevitably leaves less time and consideration for diagnostic certainty.

For example, every day roughly three new stroke suspects are rushed by ambulance to Helsinki University Hospital Emergency Department in Finland to be considered for urgent clot-busting thrombolytic therapy or thrombectomy to prevent permanent stroke damage caused by acute cerebral ischemia. But alarmingly, out of one hundred such ‘thrombolysis candidates’ only half are actually caused by stroke while the remaining patients have other diagnoses. This illustrates the need for rapid diagnoses to be accurate, despite the tremendous time-pressure.

For almost two decades the neurologists and emergency physicians in Helsinki have endeavored to create the most efficient acute stroke chain of recovery in the world.

“Since 2011 we have been able to examine suspect stroke patients admitted to our hospital, perform the necessary brain imaging and reach a decision regarding thrombolysis in less than 20 minutes’‘door-to-needle time on average”, says Prof Pu Lindsberg. “But we wondered whether this narrow time frame could in fact backfire and lead to underperformance in diagnostic accuracy.”

To clarify this, Lindsberg and colleagues initiated a prospective study in which the study cohort consisted of 1 015 patients, who had been admitted as emergency stroke code patients during 2013 to 2015 (Pihlasviita S et al. Diagnosing cerebral ischemia with door-to-thrombolysis times below 20 minutes. Neurology. 2018 Jul 11).

“The results proved that for every hundred stroke code patients, only two received unnecessary thrombolysis or missed it because of inaccurate initial admission diagnosis”, said Lindsberg.

Achieving accurate diagnosis was most challenging in the so-called stroke mimic conditions, which include various conditions e.g. epileptic seizures, migraine, psychogenic disturbances or just nonspecific headache or numbness.

Diagnostic inaccuracy was deemed to have influenced patient management in 6.9 percent of the stroke code patients. For example, it could have delayed the initiation of standard treatment for the underlying condition. In detailed scrutiny, however, it was established that inaccurate admission diagnosis had potentially worsened the outcome in only eight (0.8%) patients and no patient died because of this.

“The results showed that the stroke chain of recovery, which we have been gradually optimizing for years, is both safe and expedient, and that the speed has not been achieved at the expense of diagnostic accuracy”, added Prof. Lindsberg.

“This study has provided us also with useful comparator values, which allow us to monitor our performance in the face of potential organizational renovations, and perhaps other hospitals can also use them for benchmarking. In common, debilitating diseases such as stroke we cannot accept the slightest decline of the delivery of effective treatments, neither in the diagnostic performance nor in the efficiency of management. Operation can always be optimized, but only on top of existing expertise.”

Lindsberg considers that one area of future development in ED stroke evaluation is the more active utilization of rapid magnetic resonance imaging, especially in patients with challenging or unusual clinical syndromes as well as in those stroke thrombolysis candidates with unknown symptom onset time.

https://tinyurl.com/Pihlasviita-et-al-paper
Radiation Exposure in Pediatric CT Scans and Subsequent Cancer Risk

A recent study suggests that pediatric CT scans may increase the risk of brain tumors. (Johanna M. Meulepas et al Radiation Exposure From Pediatric CT Scans and Subsequent Cancer Risk in the Netherlands. JNCI J Natl Cancer Inst (2019) 111(3): dju104)

The use of CT scans has increased dramatically over the last two decades and has greatly improved diagnostic capabilities (which improve clinical outcomes). Of course, CTs deliver higher radiation doses than other imaging modalities. As a result, radiation protection is naturally a concern, especially among children, who may receive higher radiation doses, are more susceptible to radiation-related malignancies than adults and have more time to show effects from the potential risk.

The most common malignancies caused by radioactivity among children and young adults are leukemia and brain tumors. A group of Dutch researchers therefore evaluated leukemia and brain tumor risks following exposure to radiation from CT scans in childhood.

For a nationwide group of 168,394 Dutch children who received one or more CT scans between 1979 and 2012, the researchers obtained cancer incidence data and vital status by record linkage. They surveyed all Dutch hospital-based radiology departments to ascertain eligibility and participation. (In the Netherlands, pediatric CT scans are only performed in hospitals).

They found that overall cancer incidence was 1.5 times higher than expected. For all brain tumors combined, and for malignant and nonmalignant brain tumors separately, dose-response relationships were observed with radiation dose to the brain. Relative risks increased to between two and four for the highest dose category. The researchers observed no association with leukemia. Radiation doses to the bone marrow, where leukemia originates, were low.

The researchers caution that this pattern of excess cancer risk may be partly due to confounding by indication, because the incidence of brain tumors was higher in the cohort than in the general population. CT scans are sometimes used to identify conditions associated with an increased tumor risk; the reason these children had CT scans may be associated with their risk of developing cancer.

“Epidemiological studies of cancer risks from low doses of medical radiation are challenging,” said the study’s principal investigator, Michael Hauptmann. “Nevertheless, our careful evaluation of the data and evidence from other studies indicate that CT-related radiation exposure increases brain tumor risk. Careful justification of pediatric CT scans and dose optimization, as done in many hospitals, are essential to minimize risks.”

Meulepas et al paper doi: 10.1093/jnci/dju104

Artificial intelligence platform screens for acute neurological illnesses

An artificial intelligence platform designed to identify a broad range of acute neurological illnesses, such as stroke, hemorrhage, and hydrocephalus, was shown to identify disease in CT scans in 1.2 seconds, faster than human diagnosis, according to a recent study conducted at the Icahn School of Medicine at Mount Sinai, NYC, NY, USA (Titano JJ et al Automated deep-neural-network surveillance of cranial images for acute neurologic events. Nat Med. 2018 Aug 13. doi: 10.1038/s41591-018-0147-y)

“With a total processing and interpretation time of 1.2 seconds, such a triage system can alert physicians to a critical finding that may otherwise remain in a queue for minutes to hours,” says senior author Dr Eric Oermann, “We’re executing on the vision to develop artificial intelligence in medicine that will solve clinical problems and improve patient care.”

This is the first study to utilize artificial intelligence for detecting a wide range of acute neurologic events and to demonstrate a direct clinical application. Researchers used 37,236 head CT scans to train a deep neural network to identify whether an image contained critical or non-critical findings. The platform was then tested in a blinded, randomized controlled trial in a simulated clinical environment where it triaged head CT scans based on severity. The computer software was tested for how quickly it could recognize and provide notification versus the time it took a radiologist to notice a disease. The average time for the computer algorithm to preprocess an image, run its inference method, and, if necessary, raise an alarm was 150 times shorter than for physicians to read the image.

This study used “weakly supervised learning approaches,” which built on the research team’s expertise in natural language processing and the Mount Sinai Health System’s large clinical datasets. The next phase of the research will entail enhanced computer labeling of CT scans and a shift to “strongly supervised learning approaches”

“The expression ‘time is brain’ signifies that rapid response is critical in the treatment of acute neurological illnesses, so any tools that decrease time to diagnosis may lead to improved patient outcomes,” says study co-author Dr J Bederson, https://tinyurl.com/Titano-JJ-et-al
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ESC 365 is supported by Bayer, Boehringer Ingelheim, Bristol-Myers Squibb and Pfizer Alliance, and Novartis Pharma AG in the form of an educational grant.
Researchers at Linköping University (LiU) in Sweden have for the first time been able to use information from CT images to simulate the heart function of an individual patient. Some of the modelling methods they use have been developed in the motor industry. The results of their studies have recently been published (Lantz J et al. Intracardiac Flow at 4D CT: Comparison with 4D Flow MRI. Radiology. 2018;173017. doi: 10.1148/radiol.2018173017).

CT scanners are found in most hospitals and have many applications one of which is the simple investigation to rapidly determine whether a patient has cardiovascular disease. The initial investigation is quick, and the patient can go home immediately after the scan. “However if it is suspected that something is wrong, the next step is significantly longer and involves a more complicated investigation, during which the patient must spend the night in hospital. We have developed a method where instead we use all of the information that we already have from the first investigation. Our method may have major clinical significance,” says Anders Persson, professor in medical imaging and director of the Center for Medical Image Science and Visualization (CMIV).

One person who has played a key role in this development is Jonas Lantz, researcher at the Division of Cardiovascular Medicine and CMIV. He has a doctoral degree in applied thermodynamics and fluid mechanics at LiU and has vast knowledge of the methods used to simulate flowing fluids and turbulence in the aeronautical and motor industries, and their application to flow through human blood vessels. He has used these modelling methods to simulate the blood flow in a patient’s heart, using the high-resolution images that are produced from the CT scanner. To do this he used the huge computing power available from the supercomputers at the Swedish National Supercomputer Centre (NSC) at LiU.

“This is the first time we have shown that we can simulate the function of the heart in a particular patient. In the future, however we won’t need to use supercomputers: the calculations can be done at the CT scanner,” says Matts Karlsson, director of NSC and professor in applied thermodynamics and fluid mechanics.

In order to be certain that the images calculated in the computer agree accurately with reality, the researchers asked a dozen patients whether they were willing to remain for a short time after the CT investigation and undergo a further investigation using MRI.

“Most of them agreed to the further investigation, and this means that we have been able to compare the calculated images with reality. The images are nearly identical,” says Anders Persson.

Even though only twelve patients took part in the study, the researchers consider their results to be remarkable. Tino Ebbers, professor of cardiovascular medicine, is convinced that the technology will be useful.

“Magnetic resonance imaging systems are effective, but they are not available everywhere. The investigation is expensive, patients should not have any metal like pacemakers in their body, and the investigation takes quite some time. Since CT scanning is quick and easy, we can reach completely new patient groups. We can now simulate how the heart is functioning in individual patients,” he says.

“We can study the motion of the heart muscle, its physiological condition and its function, while the patient is comfortable at home,” Anders Persson emphasises.

It is no coincidence that LiU researchers present results that require deep knowledge within not only flow patterns and turbulence but also medicine and image processing,
using methods that require supercomputers.

“This is a good example of how we manage the infrastructure we have at LiU, with MRI systems, computer tomographs and supercomputers. We don’t sit in our own isolated rooms: it’s easy to carry out cross-disciplinary research at LiU. However, at the same time it does need people with a foot in both camps, such as Jonas Lantz, since our methods have been taken from medical research, image processing and applied fluid mechanics,” says Matts Karlsson.

The overall conclusion of the researchers is that a 4D flow CT method based on clinically available CT data can produce qualitatively and quantitatively similar intracardiac blood flow patterns compared with the current reference standard, 4D flow MRI, and therefore has the potential to provide incremental value in the assessment of both acquired and congenital heart disease.

https://tinyurl.com/Lantz-et-al-paper

Severe preeclampsia heart imaging study reveals roots of cardiac damage in pregnant women

Johns Hopkins researchers say a heart imaging study of scores of pregnant women with the most severe and dangerous form of a blood pressure disorder has added to evidence that the condition — known as preeclampsia — mainly damages the heart’s ability to relax between contractions, making the organ overworked and poor at pumping blood.

Preeclampsia is the condition marked primarily by high blood pressure and organ damage. It occurs in an estimated 5 to 8 percent of pregnant women, and in developing countries it causes up to 60 percent of all maternal deaths as well as premature births. In recent decades, researchers have been aware that preeclampsia also significantly increases the risk of heart failure, heart attack and stroke in mothers who had it but recovered — just how and why this risk occurs has been unclear.

In the new study, the Johns Hopkins researchers used imaging technology to study the pumping and relaxing activity of hearts in the sickest 10 percent of pregnant women with preeclampsia. A report on the study was recently published (Vaught AJ et al Acute Cardiac Effects of Severe Pre-Eclampsia. J Am Coll Cardiol. 2018 Jul 3;72(1):1-11. doi: 10.1016/j.jacc.2018.04.048)

“Although we have ways of identifying and managing risk factors in many women, severe preeclampsia sometimes hits the healthy without warning,” says Dr A J Vaught, assistant professor of gynecology and obstetrics at the Johns Hopkins University School of Medicine. “If we can find the causes and mechanisms behind the disorder, the idea is that we find better ways to prevent and treat it.”

Because Johns Hopkins treats many high-risk pregnancies, the researchers were able to identify 63 women with severe preeclampsia for their study, along with 36 healthy matched controls. They defined severe preeclampsia as having a blood pressure higher than 160/110; abnormal levels of protein in the urine reflecting kidney damage; diagnosed kidney or liver damage; fluid in the lungs; low platelet counts and/or vision problems. Study participants had an average age of 30; 47 percent were

The effects of pre-eclampsia with severe features (PEC) on the heart. LV ¼ left ventricle; RVLSS ¼ right ventricular longitudinal systolic strain; RVSP ¼ right ventricular systolic pressure.

African-American, 44 percent were white, 9 percent were Hispanic and 4 percent were Asian.

All participants underwent echocardiography to acquire images of the heart's chambers at about 33 weeks of pregnancy. Results of the imaging showed that women with severe preeclampsia had higher contraction pressures in the right ventricles of their heart, and an average 31 mm of mercury compared to the healthy group with 22 mm of mercury. Because the right ventricle "shortens" during heart contraction, researchers were able to see a 5 percent difference in the change of the heart's shape in those with severe preeclampsia compared with healthy controls.

The researchers also concluded that among the women with severe preeclampsia, the periods between contractions when the heart relaxes and fills with blood were also abnormal, decreasing the heart's ability to pump an adequate amount of blood to the body and overworking the heart when it did pump, leading to heart failure, according to Dr. Sammy Zakaria assistant professor of medicine at the Johns Hopkins University School of Medicine.

Because of the abnormal relaxation rates in the hearts of women with severe preeclampsia, eight of the participants already had signs of heart failure and were classified as having grade II diastolic dysfunction.

In women with preeclampsia, the left atrium was about 3 cm² larger than those in healthy women. This was yet another sign of heart enlargement and overwork, the researchers say. And the walls of the hearts in women with preeclampsia were on average 0.2 cm thicker than those of healthy women.

“A thicker, larger heart shows that the heart is working harder than normal,” says Zakaria. “It gets bigger like the body's muscles when you work out, but in this case it isn’t a good thing, and it's a serious risk factor for heart failure.”

Six of the women with severe preeclampsia also had peripartum pulmonary edema, which, Zakaria says, is characterized by a fluid buildup in the lungs, causing swelling, difficulty breathing and other complications for both mother and fetus.

“The damage done to the heart's pumping ability during pregnancy in women with preeclampsia is striking, and it makes sense that this particular kind of damage puts them at greater risk of heart disease and strokes in the future,” says Vaught.

The researchers do not at this point suggest that all pregnant women routinely undergo heart imaging, but say their study advances scientific understanding of the risks.

Long-known risk factors for preeclampsia include very young or relative old age when pregnant, being overweight, high blood pressure, family history of some autoimmune disorders such as lupus, and African or Hispanic descent.

https://tinyurl.com/Vaught-et-al-Paper

**Danger of coronary artery compression in children is more common than we think**

The incidence of coronary artery compression in children fitted with epicardial pacemakers may be slightly more common than previously believed, say cardiologists from Boston Children’s Hospital. After reviewing patient records they advocate stricter monitoring to identify patients at risk and prevent complications. Their recommendations have recently been published (DY. Mah et al. Coronary artery compression from epicardial leads: more common than we think Heart Rhythm 2018;1–9 doi.org/10.1016/j.hrthm.2018.06.038)

Children who require pacemakers or defibrillators often need to have wires placed on the outside of their heart due to their size or unique anatomy. In rare instances, these wires can place the child at risk for “cardiac strangulation,” which can lead to compression of the heart muscle and coronary arteries. “Coronary artery compression is thought to be rare,” explained lead investigator Dr. D. Y. Mah, director of the Pacemaker and ICD Program in the Department of Cardiology, Boston Children’s Hospital, “Its true incidence, however, may be higher than we believed due either to a lack of awareness or lack of reporting in the literature.”

The sudden death of a child with an epicardial pacemaker following coronary artery compression prompted investigators to enhance surveillance of all patients with epicardial pacing or defibrillation systems. They reviewed the records of all patients followed at Boston Children's Hospital from 2000-2017 who had either active or abandoned epicardial wires that included coronary imaging, either by CT scan or catheter angiography. Of 145 patients, eight (5.5 percent) exhibited some degree of coronary compression from their epicardial leads. Six of these patients displayed symptoms; in addition to the case of sudden death, there were three cases of chest pain and two cases of unexplained fatigue. As a result of the review, seven patients underwent surgical removal or repositioning of their epicardial leads.

This study helps provide a framework for monitoring patients with epicardial pacemakers or defibrillators and identifying those who may need revision or removal of their epicardial wires. Dr. Mah and colleagues compared three screening techniques. They recommend that pediatric patients with epicardial devices should get screening chest x-rays every few years to

Images of the different imaging techniques used to diagnose one of the patients who displayed symptoms. Chest x-ray in the posterioranterior (A) and lateral (B) projections, showing the classic pattern of cardiac strangulation from epicardial leads, as the ICD lead courses leftward and posterior around the heart. Computed topography (C) shows the ICD lead constricting the left ventricle and obtuse marginal branch of the circumflex artery. Catheter angiography (D) shows loss of contrast within the obtuse marginal branch as it courses below the ICD lead.
assess how their wires look in relation to their heart, as the positioning may change as the child grows. They found that chest x-ray had a high specificity and was a good screening tool, easy to perform, inexpensive, and non-invasive. However, it can produce some false-negatives even when patients were symptomatic.

The authors propose that patients with concerning chest x-rays, symptoms such as unexplained chest pain or tiredness, or evidence of heart muscle damage or dysfunction should ideally have a cine CT scan that can image the heart moving in relation to the epicardial wires. Although this can also result in a false-positive, CT is less risky for pediatric patients because radiation doses are now much lower for this non-invasive imaging method.

If cine CT is not available, they advocate that patients undergo catheter angiography to confirm the diagnosis before taking a patient to surgery.

"The use of pacemakers and defibrillators in children is growing," noted Dr. Mah.

"As more epicardial devices are implanted, more children may be at risk for developing coronary compression from their leads. We hope to increase awareness among healthcare providers and patients of this important, possibly preventable, and potentially fatal complication and provide a useful screening algorithm to detect at-risk patients and ultimately prevent complications."

"This article clearly emphasizes the need to not only carefully evaluate the potential site of electrode head fixation to avoid coronary injury, but also the need to evaluate closely where to route the electrode body to the device pocket," commented Gerald A. Serwer, MD, FHRS, pediatric cardiologist at the University of Michigan’s C.S. Mott Children’s Hospital, Michigan Medicine, Ann Arbor, MI, USA, in an accompanying editorial.

Dr. Serwer emphasizes that all cardiologists who have patients with epicardial electrodes should always be aware of this potential complication and periodically assess patients for coronary issues with at least a periodic chest x-ray. When evidence strongly suggests ischemia secondary to coronary compression due to electrode position, electrode replacement must be considered in view of the potential morbidity and mortality.

"I strongly concur with the authors that any additional information one can obtain to aid in risk assessment would be of benefit and agree with them that additional studies to establish the efficacy of nuclear cardiology techniques are indicated," concluded Dr. Serwer.

doi.org/10.1016/j.hrthm.2018.06.038

Study suggests cardiac monitoring should be prioritized for high-risk breast cancer patients

Overall, heart failure is an uncommon complication of breast cancer treatment. However, the risk is higher in patients treated with certain types of chemotherapy and lower in younger patients, according to a recently published study (Henry ML et al Cardiotoxicity and Cardiac Monitoring Among Chemotherapy-Treated Breast Cancer Patients. JACC Cardiovasc Imaging. 2018 Aug;11(8):1084-1093. doi: 10.1016/j.jcmg.2018.06.005).

Cardiovascular disease is the second leading cause of death of breast cancer survivors, behind secondary malignancies, due in part to the cardiotoxicities of some cancer therapies. However, little is known about the rate of chemotherapy-related cardiotoxicity and the rate of cardiac monitoring seen in the patients treated with trastuzumab, including a low perceived need on the part of the physicians, rather than a lack of awareness of the guidelines...

"...there could be many explanations for the low rates of cardiac monitoring seen in the patients treated with trastuzumab, including a low perceived need on the part of the physicians, rather than a lack of awareness of the guidelines..."

"We must remember that while cardiac monitoring is recommended in different guidelines, such recommendations are not based on category 1 data, and the timing recommended, and the intervals of testing are rather arbitrary," said Mariana L. Henry, lead author of the study "In examining the rate of both cardiac monitoring and cardiotoxicity we could begin to address the controversial issue of whether cardiac monitoring is warranted in young breast cancer patients."

https://tinyurl.com/Henry-et-al-paper
The UK National Institute for Health and Care Excellence (NICE) have just updated their guideline on new-onset stable chest pain, recommending that all patients should be investigated with a CT coronary angiography (CTCA). In a separate guideline, NICE recommended CT fractional flow reserve (CT-FFR), to assess coronary stenoses, found on CTCA, stating that this would reduce the need for invasive coronary angiography and hence reduce cost. In a recent paper (Alfakih K et al CT coronary angiography: a paradigm shift for functional imaging tests Open Heart. 2018;5(1):e000754. doi: 10.1136/openhrt-2017-000754) discuss the evidence base for CT-FFR and emphasise that functional imaging tests have already been established, with extensive evidence base for efficacy and prognosis and that CT-FFR should be compared with this standard of care and not with the much more expensive and invasive fractional flow reserve undertaken during invasive coronary angiography.

The authors conclude that CT-FFR needs to be directly compared with functional imaging tests and the health economic evaluations of CT-FFR should be based on such studies. This is particularly important in the UK as UK hospitals have recently had to expand their functional imaging test resources to be able to deliver the NICE 2010 guidelines.

CT coronary angiography: a paradigm shift for functional imaging tests

The British Society of Cardiovascular Imaging executive summary states that the switch to CTCA for all patients with stable chest pain will require a significant investment in CT scanners and workforce. In the UK, the tariff of CT-FFR is an additional £700 per patient, on top of the cost of the CTCA. This is significantly higher than the tariff for a functional imaging test such as stress echo at £270, which has the added advantage of an extensive evidence base. 
https://tinyurl.com/Alfakih-et-al-paper

Book Review

Comparative Cardiac Imaging: A Case-based Guide

Editted by Jing Ping Sun; Xing Sheng Yang; Bryan P. Yan
Published by Wiley 2018; 384 pages; Hardcover $ 99.95; e-book $ 79.99 -

This book provides the information necessary to guide clinicians to more efficient and appropriate use of the cardiac imaging modalities at their disposal. Most books currently available on cardiac imaging focus on just one modality. As the number of imaging options has increased, the choice of procedure has become more complicated. This comprehensive book will guide the practitioner in choosing the most appropriate test when confronted by various cardiac symptoms and diseases and to understand the benefits and limitations of each imaging modality. It demonstrates the advantages and disadvantages of various imaging modalities such as echocardiography, computer tomography, MRI, and nuclear cardiology in the evaluation of various disease states both commonly and infrequently seen in a standard practice.

Comparative Cardiac Imaging—A Case-based Guide utilizes actual case examples to demonstrate the state of the art in comparative cardiac imaging. It offers in-depth chapter coverage of Aortic Diseases; Aortic Valvular Diseases; Mitral Valvular Diseases; Prosthetic Valves; Coronary Artery Disease; Pulmonary Artery Diseases; Congenital Heart Disease; Cardiac Tumor; Infective Disease; Cardiomyopathy; and Cardiac Trauma.

- Uniquely focuses on and compares the many different modalities for cardiac imaging
- Breaks the topic down by anatomy and pathophysiology in order to cover all aspects of non-invasive cardiac imaging
- Covers newer and lesser known modalities like speckle tracking and velocity vector imaging
- Offers coverage of more controversial topics, such as CT angiography

Comparative Cardiac Imaging—A Case-based Guide presents a level of data that is appropriate for the practicing cardiologist and cardiology trainee, as well as residents, internists, and other primary care clinicians.

Acute aortic syndrome (AAS) is the term that refers to the acute presentation of potentially life-threatening abnormalities of the aorta, including classic aortic dissection, aortic intramural hematoma (AIH), and penetrating atherosclerotic ulcer (PAU). These diseases may present with a variety of symptoms and mimic other conditions, such as acute coronary syndrome, pulmonary embolism, and pericarditis. However, the diagnosis of AAS has many potential difficulties. Because of the similar clinical manifestations, there is a high risk of misdiagnosis. AIH belongs to AAS, as do PAU and aortic dissection. These conditions are different in their pathogenesis and clinical signs; hence they require different therapeutic approaches. Whereas in classic aortic dissection direct flow communication occurs through a primary intimal tear and blood flow propagation creates a second blood-filled channel within the wall, intramural hematoma occurs as a bleeding into the aortic wall as a consequence of rupture of the vasa vasorum in the medial wall layers. In AIH the hemorrhage occurs in the absence of initial intimal disruption or a false lumen. Thus the diagnosis of AIH has many potential difficulties. Conventional noninvasive imaging techniques such as transthoracic echocardiography, transesophageal echocardiography, and CT are useful for detection of intimal flap or false lumen in classic aortic dissection. However, they often fail to identify AIH or PAU, where the lesion may be not so distinct.

Although conventional non-invasive imaging techniques have high sensitivity and specificity in the diagnosis of AAS, they still have some limitations in differentiating the particular forms of AAS. A case example is presented in which intravascular ultrasound (IVUS) imaging could be useful in this aspect [Figure 1, 2]

CONCLUSION

The case presented draws attention to the importance of clinical suspicion of AAS, with its particular forms, the value of using more than one imaging method, and the benefits of IVUS imaging in the prompt diagnosis of this condition, which is essential to saving the life of patients.

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Coronary artery disease (CAD) remains a leading cause of morbidity and mortality worldwide. Invasive coronary angiography has long been seen as the reference standard for the assessment of CAD. However, the angiographic severity of coronary lesions is a poor predictor of their hemodynamic relevance [2]. While traditionally a coronary stenosis with a luminal narrowing of 50% or greater was considered to be hemodynamically relevant, it has been recognized that a large proportion of intermediate lesions have no hemodynamic impact, while lesions with luminal narrowing of less than 50% may cause ischemia as well.

Two large randomized trials including patients with known CAD failed to demonstrate a prognostic benefit of revascularization compared with modern medical treatment if patients were not stratified by prior ischemia testing. The recent prospective randomized FAME trial [3] has shown that ischemia-driven revascularization based on fractional flow reserve measurements improves outcomes. Hence, current evidence-based guidelines recommend myocardial ischemia testing prior to coronary revascularization [4].

Cardiac hybrid imaging combining anatomic and functional information by fusing coronary CT angiography and myocardial perfusion imaging (MPI) may provide a comprehensive noninvasive assessment of CAD. So far, several studies have shown the incremental diagnostic value of fusion imaging over one imaging modality alone [5] as well as over the side-by-side analysis of coronary CT angiography and MPI images. Thus, currently available prognostic data on cardiac hybrid imaging are encouraging but are limited to short-term observations; no long-term outcome data are available so far [6]. Therefore, the objective of the study conducted by a team from the University Hospital Zurich, Switzerland was to determine the value of cardiac hybrid imaging performed by combining SPECT-MPI with coronary CT angiography as a long-term predictor [1].

**METHODS & RESULTS**

In the retrospective single-center study, the research team looked at 428 patients who underwent hybrid imaging. During a median follow-up of 6.8 years, a total of 160 major adverse cardiac events, including 45 deaths, were observed in the

**Figure 1.** Example images in a patient with a matched cardiac hybrid finding (arrows). A, Multiplanar contrast material-enhanced coronary CT angiography reconstruction shows a stenosis of the proximal left anterior descending artery in a 62-year-old man. B, C, Cardiac hybrid SPECT/coronary CT angiography images show a matched perfusion defect (arrow) in the territory served by the left anterior descending artery at, B, stress; this defect was reversible at, C, rest, indicating a stress-induced anterior ischemia.

Images from [1] courtesy of Radiology, RSNA.
Kaplan-Meier survival curves show prognostic value of cardiac hybrid imaging. Cardiac hybrid imaging findings predict, A, all-cause death, B, “hard events” (all-cause death and nonfatal myocardial infarction), and, C, major adverse cardiac events (MACEs) (hard events, unstable angina requiring hospitalization, and coronary revascularization). Matched findings = stenosis of 50% or greater (at coronary CT angiography) with ischemia (at SPECT) in subtended territory, unmatched (findings) = coronary CT angiography and/or SPECT findings in unrelated territories. Image from [1] courtesy of Radiology, RSNA.

final study population. Patients with matched findings—stenosis of 50 percent or more on CCTA with evidence of ischemia on SPECT in the area of the heart to which the blocked vessel was supplying blood—had more than five times the risk of adverse events than those with normal findings. Patients with unmatched findings, or evidence of ischemia but not in the area of the heart being fed by the stenotic artery, had three times the risk. Major adverse cardiac event rates were 21.8 percent for matched findings and 9.0 percent for unmatched—considerably higher than the 2.4 percent rate for normal findings.

The study supports CCTA use for an initial, noninvasive evaluation of patients with known or suspected stable coronary artery disease. No additional imaging would be necessary if the results were normal. If a lesion is evident, then clinicians could employ a nuclear scan to assess ischemia and take advantage of both modalities by fusing the results together to make a hybrid image.

“...The strategy of direct referral to invasive coronary angiography without noninvasive imaging is obsolete... Even after documenting coronary artery disease with coronary CT angiography, we need further noninvasive evaluation before deciding upon revascularization versus medication...”

CONCLUSION
Cardiac hybrid imaging combining CT coronary angiography with SPECT-MPI allows anatomic and functional assessment of CAD at the same time. Patients with a normal fusion myocardial perfusion SPECT/coronary CT angiography examination have an excellent prognosis at long-term follow-up. Cardiovascular outcomes are worse in patients with matched abnormalities at SPECT/CT angiography compared with patients with unmatched abnormalities. According to the researchers, their study is the first to expand the proven predictive short-term value of cardiac hybrid imaging over a long-term period. In summary, in patients evaluated for coronary artery disease, cardiac hybrid imaging is an excellent long-term predictor of adverse cardiac events. A matched hybrid finding is associated with a high annual cardiac event rate.

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Closing the gap: creating a focused transthoracic echocardiography training curriculum for advanced practice providers

By Christian Santos, Ami Grek, Diane McLaughlin & Dr Jose L. Diaz Gomez

In the United States, ultrasound examinations can be carried out by non-medically qualified personnel such as nurse practitioners and physician assistants, collectively known as Advanced Practice Providers (APPs). This article summarizes a recently published study describing a training curriculum on Focussed Transthoracic Echocardiography (FoTE) and created for critical care APPs. It is shown that, with training, APP’s can successfully achieve echocardiogram images equivalent to their physician counterparts.

The utilization of advanced practice providers (APPs) in the intensive care unit (ICU) has become an increasingly popular model to offset the shortage of intensivists and meet the demands of critical care [1, 2]. Currently, there are more than 248,000 nurse practitioners (NPs) and 123,000 physician assistants (PAs) practicing in the United States with predicted growth of more than 30% each by 2026 [3-6]. Safety and efficacy of APP-staffed ICUs is well documented with comparable measurable outcomes, such as mortality and length of stay, to non-APP staffed units [1,7].

One gap that still exists is that ultrasound training has been integrated into medical school and residency training programs but not into most APP programs. Point-of-care ultrasound is no longer reserved in the United States for sonographers to perform and radiologists to interpret. In fact, ultrasound technology has become essential to the critical care provider, as clinical decisions are made by consideration of self-obtained and interpreted data. In order for APPs to perform in both a complementary and at times, as an independent provider from their physician counterparts, training modalities and competency standards for APPs in ultrasound assessment of the critically ill patient are needed. Focused transthoracic echocardiography (FoTE) has emerged as an efficient and powerful resource for clinicians to improve diagnostic accuracy and guide management of life threatening conditions...

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In the United States, ultrasound examinations can be carried out by non-medically qualified personnel such as nurse practitioners and physician assistants, collectively known as Advanced Practice Providers (APPs). This article summarizes a recently published study describing a training curriculum on Focussed Transthoracic Echocardiography (FoTE) and created for critical care APPs. It is shown that, with training, APP’s can successfully achieve echocardiogram images equivalent to their physician counterparts.

“...Focused transthoracic echocardiography (FoTE) has emerged as an efficient and powerful resource for clinicians to improve diagnostic accuracy and guide management of life threatening conditions...”
METHODS AND RESULTS
A 6 phase curriculum is described, based on the American Society of Echocardiography and Society of Critical Care Medicine (SCCM), with a primary outcome comparing FoTE diagnostic concordance between APPs and critical care physicians. The APP group included 10 NPs and 2 PAs with no formal or significant FoTE training, while the control group included 3 critical care physicians certified in Special Competencies in Adult Echocardiography, actively involved in critical care ultrasound education within the SCCM, and also greater than 5 years’ experience in FoTE. Education methods included didactic in-classroom training on ultrasound machine technology and cardiac views followed by wet lab interaction with porcine hearts. Porcine heart manipulation improved learners understanding of the imaging planes pertinent to each cardiac view. Unique to this article was the use of a registered diagnostic cardiac sonographer (RDCS) who spent a mean time of 48.5 hours and roughly 20 studies with each APP to provide 1:1 instruction in the clinical setting. Evaluation of technical skills followed 6 months of training and utilized the Vimedix Cardiac ultrasound simulator to identify types of shock common in critically ill patients. Specific parameters were measured including image acquisition, time to diagnosis, and accuracy of diagnosis. Blinded evaluations included APP and physician comparison in the time it took for image acquisition and accurate diagnosis of shock in an ICU patient identified by the RDCS. Image quality was also scored based on a measurement defined by the RDCS and control group. Finally a 30-question written exam was utilized to evaluate recall and content understanding.

The study reports better image quality, quicker image acquisition, and time to diagnosis of shock in the intensivist group compared to APP, all statistically significant. However, despite the statistical significance of the speed at which intensivists performed, the median time difference of 83 seconds was not clinically relevant. The APP group achieved the correct diagnosis of shock in 83.33% of cases, which was also statistically significant, and the mean test score on the final evaluation was 24.6 out of 30.

The impact of this investigation is evident in a second study by Santos et al [12], which described and evaluated the effect of a 1-day APP-developed and directed course designed to provide fellow APPs with the skills to procure basic echocardiographic views as well as image interpretation. The course consisted of an 8-hour day with didactic content and an emphasis on hands-on instruction, delivered at a faculty: student ratio of 1:3. This study demonstrated that an APP proctorship utilizing hands-on and didactic approach is an effective method as an entry point for FoTE in ultrasound novice APPs. Indeed, it has been the only course where both the learners and instructors were solely APPs.

DISCUSSION
The research described by Diaz-Gomez and colleagues is one of few studies describing ultrasound curriculums and establishment of ultrasound proficiency for APPs. Guidelines for the training and evaluation of competency are clearly established for residents and fellows; however, no such guidelines exist for APPs. The American College of Chest Physicians (ACCP) has proposed 10 hours of general critical care ultrasound and 10 hours of critical care echocardiography, divided between didactic and hands-on modalities. In Diaz-Gomez et al’s study [11], participants went through approximately 60 hours of training, divided between didactic and hands-on. In contrast, cardiology fellows have established levels of competency, with Level 1 being considered introductory level of proficiency and is achieved after 3 months training and 75 transthoracic echocardiograms (TTE) performed and 150 interpreted.

“... Ultrasound is a mandatory component of physicians training but has not yet being included in physicians assistants or nurse practitioners curricula …”

Further research is needed to determine the ideal number of training hours and cases to establish proficiency. Additionally, research should be conducted to standardize the evaluation of competency. If there is continued research and publication regarding the expanding role of APPs and necessity of ultrasound mastery in critical care, there could be consideration of APP eligibility to sit for national certification. Santos et al’s [12] investigation could be used as a foundation for large-scale courses for both APP and physician learners and demonstrate that APPs can be trusted as inter-professional and multidisciplinary critical care ultrasound faculty. The SCCM has already involved APPs in their fundamental ultrasound courses which are held bi-annually in the United States (US). It is possible that APPs can be involved in international courses organized by the SCCM in the near future.

We are in the infancy of point-of-care ultrasonography as, so far, we do not have the studies available to develop consistent standards. Thus, Diaz-Gomez and Santos investigations are ready to bring our inter-professional collaboration to the next level, generating knowledge and seeing the educational and potential impact in our patients-the most important step in any healthcare process. Future enhanced educational interventions for competence assessment in echocardiography include utilization of computer-based simulators able to provide immediate feedback to the learner and metrics for assessment of technical skills that are based on transducer tracking data [17,18]. Simulator-based competency testing in diagnostic ultrasound is likely to contribute to the paradigm change in medical ultrasound education. Moreover, Sheehan et al [18] developed a simulator-based, self-taught curriculum for focused cardiac ultrasound that provides immediate feedback for rapid performance improvement in residents. Average error in image acquisition and cognitive skills improved with utilization of this simulator-based curriculum instead of expert oversight curriculum. We can speculate that APPs can have similar training and still achieve appropriate competence in FoTE. Nevertheless, accuracy of diagnosis utilizing echocardiography is critically dependent on the skill of the examiner so this latest advancement in simulation education deserves to be explored by APPs as we move forward.

CONCLUSION
Ultrasound proficiency has become an expected skill for critical care providers. The majority of literature focuses on
physicians as critical care providers; though APPs are increasingly demonstrating their value across the majority of ICUs in the US. Ultrasound is a mandatory component of physicians training but has not yet being included in physicians assistants or nurse practitioners curricula. The curriculum described by Diaz-Gomez and Mayo Clinic colleagues demonstrates that with training, APPs can successfully achieve echocardiogram images equivalent to their physician counterparts. The study also demonstrated that beyond image acquisition, APPs were able to successfully come to the correct diagnosis of shock, albeit in slightly more time than physicians.

“... The study also demonstrated that beyond image acquisition, APPs were able to successfully come to the correct diagnosis of shock, albeit in slightly more time than physicians, ...”

able to successfully come to the correct diagnosis of shock, albeit in slightly more time than physicians. The investment in the training and development of APPs is necessary to promote safe and independent practice.

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The 18th International Cancer Imaging Society Meeting and Annual Teaching Course
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Recent developments in MRI in patients with cardiac implanted electronic devices (CIEDs)

By Dr NG Boyle & Dr DH Do

BACKGROUND
Over 1 million pacemakers and approximately 325,000 ICDs were implanted worldwide in 2009, and this number continues to rise annually [1]. It is likely that over 50% of patients with a cardiac implanted electronic device (CIED) will have a clinical requirement for magnetic resonance imaging (MRI) following device implantation [2]. Following a number of reports in the 1990s, some of which raised the possibility of patient deaths related to MRI scans in pacemaker patients, there was widespread concern regarding the associated risks [3,4]. MRI scanners use static and gradient magnetic fields, with radiofrequency energy pulses which can cause electrical malfunction of the CIED device and heating at the lead tissue interface and potential myocardial damage [5,6]. These reports resulted in most MRI departments declaring the presence of a CIED as an absolute contraindication to any form of MRI scanning, as recommended by the American Heart Association position statement in 2007 [7]. However a European position paper published in 2008 adapted a more nuanced approach, and proposed a protocol for performing MRI scans in selected patients with careful monitoring, requiring close cooperation between radiologists and cardiologists [8].

TECHNICAL ADVANCES
Given this major unmet need in large numbers of CIED patients, pacemaker companies rushed to develop so called “MR conditional” devices. Devices were modified to include fewer ferromagnetic materials, Hall switches rather than Reed switches which behave more predictably in magnetic fields, and improved internal circuit protections; leads were also remodeled to reduce their susceptibility to heating from radiofrequency energy. Clinical studies with these “MR-conditional” devices have shown virtually no clinically significant effects with MRI scanning at 1.5T either acutely or with intermediate term follow-up [9,10].

CLINICAL ADVANCES
Given the large number of patients with so called “legacy” (non-MR conditional) devices, and the major clinical need for MRI scans in these patients, several centers developed protocols for scanning these patients, similar to that proposed by the ESC position paper of 2008. One of the first large reported studies was that of Nazarian and co-workers from Johns Hopkins university reported in 2011 [11]. In a series of 555 MRI scans in 438 patients (54% pacemakers, 46% ICD, 12% CRT) with mostly non-thoracic scans (thoracic -18%), only 3 patients experienced a device “reset” to a backup mode and the study was completed in all but one patient who experienced mechanical forces on the device. While there were changes in ventricular sensing and pacing parameters which did not require reprogramming, these mostly occurred with thoracic scans; no devices required replacement.

Meanwhile, the MagnaSafe multicenter registry, led by Russo and co-workers was underway, reported in the NEJM in 2017 [12]. Starting in 2009, through 2014, they enrolled 1500 cases (1000 pacemakers, 500 ICDs) with ‘non-MRI conditional’ devices, undergoing non-thoracic MRI scans at 1.5 Tesla. Scans were performed according to a predefined protocol with careful monitoring and follow-up. A total of 75% of the MRIs were performed on the brain or on cervical/lumbar spine. Only one ICD patient had a device malfunction requiring replacement of the device (in this patient there was a breach of protocol). In six pacemaker cases, there was a partial generator electrical reset where device settings reverted to default values; all these devices were approximately 6-10 years or post implant. Changes in lead impedance (<1% of cases), pacing threshold (<1%), battery voltage (<1% pacemakers, 4% ICDs), and P-wave (<1%) and R-wave amplitude (<1%) were observed but were all clinically insignificant. Repeat MRIs in 94 pacemaker patients and 40 ICD patients resulted in no adverse effects. There were six cases of self-terminating atrial fibrillation or flutter, mostly in patients with a prior history.

Later in 2017, the NEJM published an updated 12-year experience from Nazarian and co-workers for 1509 patients (58% pacemakers, 42% ICDs) who underwent MRIs at 1.5 T between 2003 and 2015 [13]. Scans comprised head and neck -52%, abdomen - 27% and thorax -12%. At long term follow-up (median 1 year), changes in P wave amplitude were noted in 1% of patients, atrial capture threshold in 4% and ventricular capture threshold in 4%. These changes, however, were not clinically significant and did not lead to device reprogramming or revision. In nine cases (8 pacemakers, 1 ICD) the device entered a ‘reset mode’, and all were reprogrammed successfully except for one pacemaker which had reached battery elective replacement indicator (ERI) prior to the scan. All of these were Medtronic devices. The scans were successfully completed in 8 of these 9 patients, except for the one patient who experienced a pulling sensation in the chest, as had been previously reported. Of note thoracic scans were performed in 12% of the patients, without evidence of any increased risk (none of the electrical reset cases occurred with thoracic scans).

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While a growing number of centers adopted protocols for extrathoracic MRI in patients with non-conditional devices, thoracic and cardiac MRI imaging, particularly in ICD patients, has remained an area where few were willing to venture. An important application of MRI in patients with ventricular tachycardia undergoing ablation procedures is the use of late gadolinium enhancement (LGE) to define scar zones and borders, information that is extremely valuable in procedure planning. A major drawback however, was the frequent presence of device and lead artifact obscuring the LGE images, rendering them uninterpretable in up to 44% of basal and 66% of apical ventricular segments [14]. Recent advances in MRI protocols include the development of modified "wideband" imaging sequences which eliminate hyperintensity artifacts in up to 90% of cases, enabling clinically useful image interpretation [15].

In the largest study of cardiac MRI in CIED devices, Do et al. reported our group’s experience in 114 consecutive studies (12 pacemakers, 73 ICDs, 29 CRT-D), using a wideband sequence with LGE imaging [16]. There were no electrical resets, generator or lead failures, loss of capture in pacemaker dependent patients, new arrhythmias or patient deaths occurred. Three scans were stopped prematurely due to patient anxiety, angina chest pain and nonsustained ventricular arrhythmia prior to start of scan, respectively. Overall, 3 (3%) of studies had major artifact, while 14 (13%) had some artifact, of which 6 were mostly interpretable. Hilbert and colleagues from the Leipzig Heart Institute recently reported an 86% success in interpreting cardiac MRI using a wideband sequence, although they had proportionately more pacemakers than ICDS and more right sided implants.[17] This is similar to our overall imaging success rate of 87%. Our approach is outlined in the algorithm shown in Figure 1.

**ABANDONED LEADS**

Abandoned leads remain the most controversial area, with even fewer centers prepared to undertake MRIs in these patients. Particular concerns include a higher risk of RF induced lead tip heating with abandoned leads [18]. However, overwhelming clinical need for MRI, typically for brain or spinal imaging, has driven the need for scans in some patients. In an initial study reported in 2014, Friedman and colleagues at the Mayo clinic reported no serious adverse effects in 19 patients with an average of 1.6 abandoned leads [19]. The same group recently reported on a larger series of 80 patients with 90 abandoned leads who underwent a total of 97 MRI scans (Head-38, chest-22, lumber-29, limb-8), with 1.5 T scanners [20]. There was no clinical or electrical evidence of device dysfunction, arrhythmias or pain. Pre and post MRI tropin values were obtained in 40 patients with no changes, indicating no evidence of myocardial injury. The authors conclude that the risk associated with MRI with abandoned leads appears low. Epicardial leads have also raised concerns, particularly as almost no data are available. In one study of MRI in pediatric patients with congenital heart disease, 11 patients (mean age 9.2 years) with pacemakers (nine with epicardial leads) underwent MRI without any evidence of device malfunction or inappropriate pacing [21].
CONCLUSIONS

The use of MRI in patients with CIEDs has seen major changes over the last decade. While MRI is now widely available with MR conditional CIEDs, it is now being increasingly utilized with legacy devices following the findings of the MagnaSafe Registry and Nazarian et al. studies, both published in 2017 in the New England Journal of Medicine. The most common adverse event appears to be a partial device reset seen in approximately 0.5% of devices following MRI. Changes in battery voltage and lead parameters, while measurable, have been found to be clinically insignificant. The risk of a device problem requiring replacement appears to be <1:1000 for pacemakers and 1:500 for ICDs. The 2017 HRS Expert Consensus on MRI and Radiation Exposure in Patients with CIEDs shows the marked shift in practice since the 2007 AHA statement [22]. Overall, performing an MRI scan in patients with a non-conditional MR device is given a Class IIa recommendation. The report also underlines the need for a collaborative effort between radiologists and cardiologists, and emphasizes the need for patient monitoring during and after the scan. No guidance is provided for the situation of abandoned or epicardial leads. As always, the benefit /risk ratio needs to be carefully assessed for each clinical situation.

ABBREVIATIONS

AHA: American Heart Association
CIED: Cardiac Implantable Electronic Device
Class IIa Recommendation: Moderate, can be useful/effective/beneficial.
Annual Congress of the European Association of Nuclear Medicine

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eanm18.eanm.org
China approves ultrasound contrast media for vesicoureteral reflux (VUR)

Bracco Imaging recently announced that its ultrasound contrast agent SonoVue (sulphur hexafluoride microbubbles) has been approved in China for use in ultrasonography of the urinary tract (voiding ultrasonography) for the evaluation of suspected or known vesicoureteral reflux (VUR) in pediatric patients. This is the first ultrasound contrast agent to be approved in China for such an indication.

VUR is a urinary tract abnormality in neonates, infants and children and is characterized by retrograde flow of urine from the bladder into the ureter and towards the kidney. VUR represents a common cause of recurrent urinary tract infections and chronic nephropathy in pediatric patients. Voiding cystourethrography and direct radionuclide cystography are the imaging procedures currently used to diagnose VUR, but both involve exposure to ionizing radiation.

“This approval of SonoVue for voiding ultrasonography addresses an important unmet medical need for accurate detection and follow-up of VUR, a frequent cause of urinary tract infections and renal complications in neonates, infants and young children, without exposing them to the potential harmful effects of ionizing radiation,” said Dr Alberto Spinazzi, Head of Global Medical and Regulatory Affairs, Bracco. “We are particularly proud that, after the United States and Europe, this important indication for our contrast ultrasound agent SonoVue has now been also approved in China,” said Fulvio Renoldi Bracco, CEO of Bracco Imaging. “This new indication for SonoVue reflects our efforts and investments to offer
significant clinical benefit by expanding the range of approved clinical indications for contrast enhanced ultrasound in China, one of the most relevant areas of development for Bracco. Since 2004, China has been at the forefront of research in contrast enhanced ultrasound, with the development of innovative clinical applications in various clinical scenarios and patient populations. SonoVue is the ultrasound contrast agent most widely used in clinical studies and routine clinical practice in China, and the first and only one approved for use in the pediatric population in the country.

**BRACCO IMAGING**  
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**Siemens and Screenpoint to collaborate on AI-based applications in breast imaging**

Siemens Healthineers and the Dutch-based company ScreenPoint Medical have agreed to enter a strategic partnership whose aim is to enable personalized breast care pathways by leveraging artificial intelligence, from risk stratification to image acquisition and diagnosis. Innovative clinical and workflow applications will be jointly developed to help expand precision medicine.

The collaborative arrangement also includes the acquisition of a strategic minority stake in ScreenPoint Medical by Siemens Healthineers.

The partnership intends to leverage the superior expertise of Siemens Healthineers in breast imaging as well as that of ScreenPoint Medical in mammography decision support to develop innovative clinical applications for breast cancer screening and diagnosis. Professor Nico Karssemeijer, CEO of ScreenPoint Medical, explains, “Together with Siemens Healthineers, we can bring our expertise in AI into the entire screening and diagnostic pathway, starting from risk stratification to image acquisition and diagnosis.”

“The aim of our collaboration with ScreenPoint Medical is to expand precision medicine by providing automated clinical decision support that makes it easier and faster to distinguish between healthy and tumor tissue, thus increasing diagnostic accuracy,” added Dr. Peter Schardt, head of X-ray Products at Siemens Healthineers. "Working with strong partners such as ScreenPoint will help us drive personalized breast care pathways with new applications based on deep learning and artificial intelligence."

Both companies will pool their individual strengths in their strategic partnership. ScreenPoint Medical’s current, highly innovative mammography reading software, Transpara, is available for a variety of mammography systems. It enables clinical decisions support and computer-aided detection for higher reading accuracy and has been proven to help radiologists better detect breast cancer with mammography and reduce variations between different users – both aspects integral in expanding precision medicine. Transpara is cleared for clinical use in CE-countries with the digital mammography and reading portfolio of Siemens Healthineers. In the coming months, ScreenPoint plans to attain regulatory approvals for the Transpara solution in further clinical applications and countries.

Siemens Healthineers has a long standing history of innovations in breast imaging and a comprehensive portfolio of systems across ultrasound, mammography and MRI as well as the accompanying reading solutions. The latest addition in mammography, Mammmomat Revelation, offers the highest depth resolution on the market with a unique 50-degree wide angle for tomosynthesis. Automated and precise breast density measurements allow for instant risk stratification. On the reading side, Syngo.BreastCare offers advanced visualization for 2D and 3D mammography with automatic workflows and Artificial Intelligence (AI) based tomosynthesis reading.

**ESAOTE ACQUIRED BY CHINESE CONSORTIUM**

Esaote SpA, the Italian-based company active in ultrasound, dedicated MRI and software for managing diagnostic processes has announced the completion of the acquisition of its share capital by a consortium of leading Chinese investors. The consortium is composed of major companies in the medical and healthcare technology sectors as well as investment funds with significant experience in this field.

A spokesman said that as a result of this change in ownership, Esaote will be in a stronger position and have the opportunity to accelerate its development plans, and in particular its growth projects in China. In addition to its current worldwide presence, Esaote will benefit from the widespread distribution networks of the new shareholders, relying on the full complementarity of its products with those of the consortium. Significant synergies will also derive from the distribution of consortium’s main products in the international markets in which Esaote operates.

The consortium is composed of Yufeng Capital (a leading private equity fund co-founded by Mr. Jack Ma and...
Mr. David Yu); Wandong (China's largest listed medical equipment manufacturer); Shanghai FTZ Fund (China's first Free Trade Zone fund); Tianyi (an investment group focused on the healthcare sector); Yuyue (the holding company of the largest homecare medical equipment manufacturer in China) and Kangda (a leading OEM manufacturer and distributor of medical imaging equipment).

Under the agreement Esaote will continue to operate as an independent international company, with its headquarters in Italy (Genoa) and R&D and production centres in Italy (Genoa and Florence) and the Netherlands (Maastricht).

Mr. Karl-Heinz Lumpi, CEO of Esaote, said: “What we have achieved, with the investment and expertise of our shareholders, has produced important gains for Esaote over these last three years. Now we are ready to embark on an exciting next journey for the company with the support of our new shareholders, who are highly committed to the healthcare industry and see a great future for Esaote. We look forward to learning from and leveraging their deep knowledge and experience of the Chinese market where the potential for growth is significant, especially considering that the ultrasound sector alone is worth nearly EUR 1.3 billion in China”.

Esaote Genoa, Italy, www.esaote.com

First global installation of Siemens Biograph PET/CT system

Siemens Healthineers has announced that University Medical Center Groningen (UMCG) in the Netherlands has become the first health care institution worldwide to complete installation of the new Biograph Vision PET/CT system which provides a new level of precision in PET/CT imaging. Its new Optiso Ultra Dynamic Range (UDR) Detector Technology, which is based on silicon photomultipliers (SiPMs) rather than photomultiplier tubes (PMTs), delivers lutetium oxyorthosilicate (LSO) crystal elements of just 3.2 x 3.2 mm for higher spatial resolution. The system also has the industry’s fastest time-of-flight, with a temporal resolution of just 214 picoseconds, as well as the highest effective sensitivity at 100 cps/kBq. For these reasons, the Biograph Vision helps to reduce scan time by a factor of 3.9 to improve patient throughput as well as reduce patient radiation exposure and tracer cost. And the system’s 78 cm bore enables improved patient comfort and positioning as well as advanced applications in radiation therapy planning.

“The University Medical Center Groningen is proud to acquire the world’s first commercially available Biograph Vision PET/CT system,” said Prof. Rudi Dierckx, of the University Medical Center Groningen. “The system’s exceptional time-of-flight speed and spatial resolution have the potential to help us improve the detection of disease in patients. Additionally, the large bore will help to provide better comfort and positioning for our patients. Also, we are excited about the Biograph Vision’s parametric imaging capabilities.”

Siemens Healthineers Erlangen, Germany, www.healthcare.siemens.com

Trade Association welcomes end to unjustified restrictions on non-personal data flows in the EU

COCIR, the European Trade Association representing the medical imaging, radiotherapy, health ICT and electromedical industries has welcomed the recent political agreement creating a new framework for rules that abolish unjustified restrictions on the free flow of non-personal data being stored and processed anywhere in the EU. These rules, agreed by the European Parliament, Council and the European Commission, are a consequence of the proposed Regulation for a framework for the free flow of non-personal data within the EU. This represents an important advance in ensuring that patients and healthcare systems can fully benefit from cross-border care.

This agreement goes a long way to addressing industry concerns; the sector increasingly relies on the free flow of non-personal data across EU borders to provide the true economies of scale needed for innovation. It also reflects many of the realities of modern healthcare technologies. Keeping equipment updated frequently relies on the capacity of appropriately-skilled, but often decentralised, support staff to be able to connect and access equipment across borders and jurisdictions. In addition, for the large number of SMEs involved in providing digital health solutions and applications, these rules provide them with greater certainty on data storage, particularly cloud-based solutions.

Nicole Denjoy, COCIR Secretary General, said; “This agreement is a positive development, one that will allow patients and healthcare systems to benefit from the advantages offered by big data analysis. The fact that these rules are designed to complement, rather than conflict with the GDPR, is very welcome. This agreement will help our industry bring these benefits to those that need them more quickly.”

COCIR Brussels, Belgium, www.cocir.org/
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Philips signs two major long-term strategic partnership agreements in Germany

Philips has signed two long-term strategic partnership agreements with hospital groups in Germany.

The Cologne Clinics group (Kliniken der Stadt Köln) and Philips signed a 15-year partnership contract, under the terms of which Philips will be responsible for the delivery, upgrade, replacement and maintenance services of advanced medical imaging solutions to support precision diagnosis and therapy. Philips will also help to improve the hospital's radiology workflows to further enhance the quality and efficiency of its care, as well as patient and staff satisfaction. Under the terms of the approximately 90 million euro agreement with the Kliniken der Stadt Köln Philips will be responsible for the procurement of new and replacement medical imaging solutions, together with their maintenance and service. The agreement covers all three of the clinic’s locations: Holweide, Merheim and the Children's Hospital Amsterdamer Strasse. Philips will also provide strategy and operational consultancy services to identify cost savings and improve the quality and efficiency of care. In addition to providing innovative health technology solutions and services, Philips will support the Kliniken der Stadt Köln with the planning of a new radiology-unit, including a new building construction in Merheim and with optimization of the clinic’s operating procedures in radiology for children and adults.

Philips recently also signed an 8-year strategic innovation partnership agreement for medical imaging solutions, including healthcare consultancy services, with the Munich Municipal Hospital Städtische Klinikum München one of the largest municipal hospital groups in Germany.

Under the terms of the approximately 50 million euro agreement with the Städtische Klinikum München, Philips will provide the hospital with state-of-the-art imaging systems and clinical informatics. In total, over 200 imaging systems throughout the hospital group will be renewed, making this the largest medical technology project for a single clinic in Europe. Philips will also provide its strategic consultancy services. Strategies will be developed and implemented to support the hospital in digitizing its operations and enabling seamless connected care across locations and medical disciplines. In addition, department designs and care pathways will be analyzed with the aim of optimizing planning, technology utilization, clinical processes, treatment outcomes and patient and staff experiences.

As part of both agreements, Philips will install its IQon Spectral CT solutions in both hospitals. The IQon Spectral CT was developed through a collaboration of physics, radiology and medicine, and adds spectral resolution to traditional CT scanning through a dual-layer spectral detector. With a Yttrium-based scintillator, the NanoPanel prism detector identifies photons of high energy and low energy simultaneously, allowing not only a view of the anatomy, the system also uses color to characterize the material content of critical structures.

Dr. Axel Fischer, Chairman of the Board of Management at the Städtische Klinikum München, said “The goal of the partnership with Philips is to jointly increase the quality and efficiency of care with a focus on enhancing the patient and staff experiences. By combining innovative technology concepts that address the evolving needs of our patient population with continuous improvement of our processes, we aim to ensure cost-effective care for patients in the Munich region over the long-term.”

The 8-year innovation partnership will be based on a needs-based concept that will integrate new state-of-the-art technologies intelligently, via a timely phased approach, into the hospital's processes. It will help the Städtische Klinikum München drive optimum clinical and economic value from its technology investments. “Through these innovative partnership models we will support the Städtische Klinikum München and the Kliniken der Stadt Köln to continuously improve delivery of care for their patient populations,” said Peter Vullinghs, Market Leader Philips DACH. “These partnerships underline Philips’ transition to becoming an integrated solutions provider that takes a holistic approach to meeting its customers’ needs.”

As part of both agreements, Philips will install its IQon Spectral CT solutions in both hospitals. With its enhanced tissue characterization and visualization capabilities, IQon Spectral CT allows for more effective imaging and fewer repeat scans, improving clinical confidence and helping clinicians to make the right diagnosis during the first scan. Philips’ latest healthcare informatics solutions will enable the integration of patient information across both hospital group’s locations to improve care team collaboration, clinical decision making, and patient outcomes.

Philips Healthcare
BEST, THE NETHERLANDS
www.philips.com
US enterprise radiation dose monitoring contract granted to Sectra

Sectra has announced that it will install its cloud-based, radiation dose monitoring software, Sectra DoseTrack, throughout the Memorial Hermann Health System which is the largest not-for-profit health system in southeast Texas, USA and consists of 16 hospitals, 8 Cancer Centers, 3 Heart & Vascular Institutes, and 27 sports medicine and rehabilitation centers, in addition to other outpatient and rehabilitation centers. The software will enable increased patient safety by detecting patients’ radiation exposure, ensure compliance with regulatory requirements and standardize all radiation dose data throughout the enterprise.

Sectra DoseTrack gathers and reports dose data from all sources within the imaging department. Robust analysis capabilities for dose optimization assist in the identification of necessary actions such as changing modalities for specific procedures, staff training or imaging protocol revisions. Consideration of patient size and demographics allow for effective organ dose calculations and patient risk assessment.

Carestream names new Chairman, President and CEO

David C. Westgate has been named the new Chairman, President and CEO of Carestream Health, the Rochester, NY, USA based company which has more than 6,000 employees worldwide and conducts business in nearly every country in the world. Carestream is an independent provider of medical imaging systems and healthcare IT solutions; X-ray imaging systems for non-destructive testing; and precision contract coating services for a wide range of industrial, medical, electronic and other applications.

“Our focus will be on delivering innovation that is life-changing—for patients, customers, employees, communities and other stakeholders—and we will grow our business for long-term success,” said Mr. Westgate. “We are very excited about pursuing new product development road maps that will position us to meet the diverse needs of our customers in the markets we will serve. Customer satisfaction, continuous innovation and operational excellence will be fundamental to our culture and we are committed to being the very best at what we do.”

Mr. Westgate previously served as CEO of Jason Industries, Inc., where he led successful efforts to diversify the company’s portfolio while emphasizing a culture of growth and innovation. “Dave has an impressive record of success in corporate leadership roles and his vision for Carestream is clear: move the company toward long-term growth and market leadership, and drive continuous innovation across the company’s broad portfolio of products,” said Robert Le Blanc, a Senior Managing Director of Onex Corporation.

Mr. Westgate replaces Kevin Hobert who had decided to leave the company and will assist with the transition. “Kevin Hobert has done an excellent job leading Carestream’s development into a worldwide leader in the medical and dental imaging fields, and has prepared the company for sustainable growth in the coming years. I would like to thank Kevin for the many significant contributions he has made to Carestream’s success since launching the company more than 11 years ago,” said Mr. Le Blanc.

Elekta acquires QA company

Elekta have announced that they have acquired the Canadian quality assurance company Acumyn, a stand-alone commercial spin-off of University Health Network, Toronto, who commercialize AQUA, a comprehensive software platform that coordinates and centralizes all of the quality assurance tests that need to be performed in a radiotherapy clinic. AQUA provides improved end-to-end integration and workflow automation, making it a key addition to the Elekta portfolio. It enables the adherence to demanding QA standards with consistent replication, efficiency and ease of use.

With automated and ready-to-use software, AQUA supports internationally recognized QA tests and standards. It also provides clinics with limited physics resources, particularly those in emerging and frontier markets, the potential to quickly adopt and implement advanced treatment techniques.

“This acquisition is an important step in our Elekta Digital strategy,” said Richard Hausmann, President and CEO, Elekta. “With AQUA as the backbone for all quality assurance measurements in the clinic, we can now integrate machine data acquisition and analysis across the whole department.”

Elekta
STOCKHOLM, SWEDEN
www.elekta.com
This article summarizes the proceedings of the recent symposium sponsored by Bracco Imaging at ECR 2018 on the evolving roles and uses of Contrast-Enhanced Ultrasound (CEUS). Chaired by Prof. V Cantisani, the symposium featured presentations by three experienced clinicians who described respectively the role of CEUS in vesico-ureteral reflux, the latest update of the EFSUMB guidelines on the use of CEUS and, finally, the role of the technique as a diagnostic tool in routine examinations with examples covering the liver, renal cysts and Endovascular Aneurysm Repair (EVAR).

Vesico-ureteral reflux: the role of contrast ultrasound

Dr Papadopoulou began her presentation by reminding the audience that vesico-ureteral reflux (VUR) is relatively common in children. For many decades, the techniques of Fluoroscopic Voiding Cystourethrography (VCUG) and Radionuclide Cystography (RNC) have been the standard methods for the diagnosis of VUR, but both techniques have the disadvantage of involving the use of ionizing radiation.

Over the last twenty years or so, Contrast-Enhanced Voiding Ultrasonography (CE-VUS) has emerged as a safe, sensitive and radiation-free alternative that is now widely accepted in Europe for both reflux diagnosis and urethral imaging. The method involves ultrasonography and the administration of an ultrasound (US) contrast medium (CM). For many years the CM SonoVue was widely used off-label but this agent has now been approved for intra-vesical use in VUR — the only CM approved for this indication in children.

- **The technique.**
  This involves the catheterization of the bladder, which is first completely emptied and then filled with ultrasound CM either by direct injection into the bladder or by infusion. The infusion approach has several advantages over direct injection, such as homogeneous bladder opacification and thus better bladder wall delineation, and easier visualization of Grade 1 VUR, i.e. reflux into the lower part of the ureter.

A relatively frequent problem with the approach occurs if there is incomplete emptying of the bladder. Since the patient is in the supine position, this means that residual urine can prevent access of the CM to the posterior bladder wall. If this happens there is a risk of not detecting reflux or of missing bladder wall lesions. The solution is to repeat the bladder emptying operation, and to temporarily place the child in the prone position.

There are several important practical aspects of the technique which should be respected:
- The use of contrast-specific software and low Mechanical Index (MI < 0.1)
- The bladder and both ureters should be scanned alternately during voiding and filling in both the supine and prone positions.
- The urethra is usually scanned in the supine position during voiding/filling, suprapubically for girls or perineally for boys.

The in-vial half-life of the reconstituted CM SonoVue is several hours, so there is ample time to perform several scans. Unlike VCUG and RNC, there is no concern over repeated radiation exposure in small children.

The extent of the reflux is described using a 5-point scale, as in VCUG [Figure 1].

A special form of reflux is the intra renal reflux (IRR), i.e. reflux of contrast and urine into the renal parenchyma. This is important clinically because of the risk of pyelonephritis. It should also be noted that a normal non-contrast ultrasound scan does not necessarily mean that there is no reflux. Figure 2 shows an example of reflux seen on CE-VUS that had not been apparent on non-enhanced ultrasound. [Figure 2]. Also, VUR grading is dynamic: a grade III VUR on filling can be classified as a grade IV VUR during voiding.

- **Diagnostic Value of VUS.**
  As reported in many publications, the sensitivity of CE-VUS is
greater than that of VCUG and RNC. A recent meta-analysis of 30 studies, involving 2549 patients and 5078 kidneys, found a sensitivity of 90% and a specificity of 92% for the detection of reflux. The sensitivity of CE-VUS has also been found to be higher than that of VCUG for the detection of IRR.

A further question regarding the diagnostic value of CE-VUS concerns more complex congenital anomalies. Can CE-VUS be used in such cases or is it necessary to use VCUG or RNC? Several publications have shown that CE-VUS can indeed identify even complex anomalies. For example, studies of cases of duplex kidneys have demonstrated that CE-VUS can easily identify the condition. Dr Papadopoulo presented another example in which CE-VUS showed its diagnostic value, namely the case of a 5 year-old boy with recurrent UTIs and known Grade IV reflux. In this case a Hutch diverticulum had been missed by VCUG but was identified using CE-VUS. Hutch diverticula can be difficult to identify since their size changes significantly upon voiding.

- Safety of the CE-VUS procedure.
  There are currently eight original studies in the literature on the safety of CE-VUS, involving a total of 2420 children who underwent CE-VUS with SonoVue and were observed for 48h after examination. No serious adverse events were reported. The largest of these safety-focused studies involved more than 1000 children who were injected intravesically with 0.5 mL SonoVue. (Papadopoulou F et al Pediatr Radiol. 2014; 44:719-28). The children were observed for 7 days and only a few (3.7%) minor adverse events such as dysuria were observed. These events were probably due to the catheter itself rather than the CM.

- Updated Indications for CE-VUS
  Current indications for the use of CE-VUS include:
  - As a first reflux study in both boys and girls (previously VUS was indicated for first reflux study only in girls)
  - Examination of urethral pathologies in girls and boys.
  - Follow-up of VUR in all children
  - Screening for prenatal hydronephrosis
  - Evaluation of siblings with VUR.
  In many European centers, CE-VUS has now almost completely replaced VCUG/RNC.

- Future perspectives
  A study to investigate 3D and 4D CE-VUS versus VCUG has shown that both approaches can provide more accurate VUR grading and improve the depiction of anatomy. (Woźniak MM et al Eur J Radiol. 2016; 85:1238)
  The study also investigated the intraoperative use of CE-VUS, such as during endoscopic treatment of VUR, and showed that results can be evaluated directly and that better estimations of outcome can be achieved.

- Conclusions
  CE-VUS has high diagnostic value for the detection and grading of reflux as well as in imaging of the urethra. SonoVue has been approved for intra-vesical use in children and no serious adverse events have been reported. The power of CE-VUS looks set to be even further enhanced with the introduction of 3D/4D and intraoperative CE-VUS.

  - The method is safe and does not require radiation. The diagnostic efficacy is high enabling CE-VUS to be used as a first-choice method for the examination of reflux in children.

The latest update of EFSUMB Guidelines for the use of CEUS
Prof. Sidhu began his presentation by suggesting that, even if they didn’t know it, a large proportion of the audience were, thanks to membership of their national society, actually members of EFSUMB — the European Federation of Societies for Ultrasound in Medicine and Biology.

The EFSUMB was established in 1972 by 13 European countries and now has 28 membership societies, for a total of over 23 000 members. The EFSUMB is a multi-disciplinary society that includes physicists, clinicians and radiologists (who, in fact are not the majority of the membership). As far back as 2004, the EFSUMB was the first society to establish guidelines on the use of CEUS.

A huge amount of information has been published on CEUS — nearly 3500 papers — for many different indications. The most widely used contrast agent, SonoVue is used predominantly in the heart, breast, peripheral vasculature and liver.
but many other uses have been reported. The reasons behind the wide-spread use of CEUS are of course the many distinct advantages over CT and MRI. It can be performed immediately and in a variety of scenarios such as bedside, operating room, CT suite, etc. Importantly, it operates in real time so that rapid changes can be captured.

Underpinning all this is the fact that CEUS is a very safe procedure with a very low incidence of side effects. The reported CEUS-related fatality rate is 0.0006%, i.e. much lower than that occurring with iodinated contrast agents.

However, it is important to understand that many new areas are in effect “off-label” and are unlikely to become a “licensed usage”. This has been discussed in the guidelines but is worth emphasizing further and deliberating the consequences especially in pediatric applications. Physician obligations are particularly pertinent to the further development for “off-label” use of CEUS.

Certain legal obligations however have to be met when using CEUS off-licence, such as being sure that it serves the patients’ needs and being sure that there is sufficient evidence to demonstrate safety and efficacy. The guidelines provide the information for this.

**Update on guidelines for non-hepatic use of CEUS**

The EFSUMB guidelines on CEUS are intended to inform clinical practice rather than to report on research projects. Thus, they are a digest of current findings, formulated by a group of experts and are primarily based on surveys of the published peer-reviewed literature.

The procedure for updating the guidelines is quite involved, rigorous and lengthy, typically taking several years to produce guidelines ready for publication.

Levels of evidence and grades of recommendations are assigned according to the Oxford Centre for Evidence-based Medicine criteria. The end result of this process in the case of the latest update for non-hepatic use of CEUS is a document containing 74 recommendations in 19 chapters for a total word count of 17560 words, including 578 references [Figure 3]. Before publication, the guidelines are subjected to the usual peer-review processes and published in the European Journal of Ultrasound in two versions, short (without the references) and long, with references. (Sidhu PS et al The EFSUMB Guidelines and Recommendations for the Clinical Practice of Contrast-Enhanced Ultrasound (CEUS) in Non-Hepatic Applications: Update 2017 (Short Version). Ultraschall Med. 2018 Apr;39(2):154-180. doi: 10.1055/s-0044-101254. Epub 2018 Mar)

The EFSUMB guidelines do NOT cover pediatric CEUS. In the United States, however, in 2016 the FDA approved the use of Lumason (the commercial name in the United States for SonoVue) for “ultrasonography of the liver for characterisation of focal liver lesions in adult and pediatric patients”, despite there being no published evidence for its use in pediatric patients or any prior-conducted dedicated clinical trial in pediatrics. This lack of evidence was the reason that EFSUMB has not included pediatric applications in the guidelines. Instead, the EFSUMB has issued a Pediatric Position Statement, (Sidhu PS et al. Role of Contrast-Enhanced Ultrasound (CEUS) in Pediatric Practice: An EFSUMB Position Statement. Ultraschall Med. 2017; 38: 33). In the position statement, the EFSUMB recognizes that there is mounting evidence of the usefulness of CEUS in children, primarily as an imaging technique that reduces exposure to radiation, iodinated contrast medium and provides the "patient-friendly" circumstances of ultrasonography. The position statement of the EFSUMB assesses the current status of CEUS applications in children and makes suggestions for further development of the technique...

**Extended use of CEUS**

Given all the advantages of CEUS, the question could reasonably be asked as to why microbubble contrast agents aren’t used much more often?

In fact, use of microbubble contrast agents is steadily increasing, with 25% growth in USA, and growth also in China and Europe. Nevertheless one obstacle to even wider use is the reluctance of many sonologists to accept this way of performing ultrasound scanning. This may be due to the perceived obstacle of the need to interrupt the patient examination to insert an i.v. line for the administration of the contrast agent. In contrast, in CT there is currently no such barrier, although in the very early days of CT, the recommendation was only to “consider” use of contrast. A development in the acceptability of the use of contrast such
as occurred years ago in CT is likely to occur in ultrasound also.

**CEUS, a powerful diagnostic tool in daily practice: clinical cases**

Prof Clevert’s presentation covered three applications of CEUS, namely in the liver, kidneys and in Endovascular Aortic Aneurysm Repair (EVAR)

**Liver**
The prevalence of liver lesions is approximately 5% in the population as a whole. Since 25-50% of tumor patients show hepatic metastases at the time of diagnosis, reliable detection of such metastases is vital for the establishment of a therapeutic treatment procedure. Overall, the diagnostic performance of CEUS compared to CT in the detection of focal liver lesions has been assessed in a prospective multi-center trial involving nearly 1300 patients examined under routine clinical conditions. (Seitz K et al. Ultraschall Med. 2009; 30: 383.). Diagnostic accuracy was found to be greater than 90%, and it was shown that CEUS was equivalent to CT for the assessment of tumor differentiation and characterisation.

**Conclusion: CEUS in the liver**
In the detection of focal liver lesions, the use of CEUS improves the diagnostic value of ultrasound and enables a complete diagnosis of liver lesions

**Renal Cysts**
The characteristic sonographic criteria of renal cysts include relative dorsal enhancement; well-defined round or oval mass; echo-free; enhanced surface and outlet echo; a thin imperceptible wall. Renal cysts are mostly asymptomatic and usually do not need any therapy. However there can be complications in renal cysts, such as bleeding, infection, rupture and — rarely — carcinoma in the cystic wall. The classification system introduced by Bosniak for the CT characterisation of renal cysts, has been adapted for CEUS [Figure 4]. The **take-home points and questions** to be asked regarding CEUS for renal lesions are:
- Are the renal cysts simple or complicated?
- Are they solitary?
- For classification of cystic lesions the Bosniak CT (and sonographic) criteria should be used
- These allow a decision on therapeutic approach, such as the avoidance of surgical intervention for cysts of category I or II and the identification of category III or IV cysts that need surgery.

**Endovascular Aneurysm Repair (EVAR)**
The prevalence of aortic aneurysms (defined as having a diameter > 3 cm) in the Western world is 4.5% at the age of 65 and 11% at the age of 80. Aneurysms occur predominantly in males; 60% of all aneurysms are asymptomatic and most are discovered incidentally.

There is a close correlation between the risk of rupture and the diameter of the aneurysm.
- The risk of rupture is 2% for aneurysms less than 4.5 cm in diameter with diameter growth rates of less than 1 cm/yr.
- The rupture rate is only 3.5% over 10 years for aneurysms less than 5 cm diameter, but increases up to 10% for aneurysms measuring 4.5 – 6 cm. Defined as the persistence of blood flow outside the lumen of the endoluminal graft but within the aneurysm sac. High flow endoleaks such as Type 1 and Type III need immediate treatment. The more common low flow endoleak, Type II, which occur in 5% to 17% of cases, need monitoring to determine if the leak is increasing with time, in which case intervention is necessary

In a study involving approximately 500 patients, the sensitivity and specificity of CEUS for the detection of endoleaks after EVAR were found to be 97% and 93%, respectively. This suggests that CEUS is as good as multislice CT angiography in this application, but with the added advantage of no radiation dose and no contrast nephrotoxicity.

**EVAR take-home messages**
- CEUS can facilitate EVAR interventions and improve follow-up monitoring, which is needed for the rest of the patient’s life
- CEUS does not affect renal function and has higher sensitivity in detecting endoleaks than CT with the added advantage of a lower risk of side-effects.
Use of a 3D Camera system for precise, automatic patient positioning in CT

By Dr N Saltybaeva & Prof. H Alkadhi

Automatic tube current modulation (TCM) is an important method for the reduction of the radiation dose to which the patient is exposed in CT examinations, while still maintaining image quality. Optimal implementation of TCM relies on accurate estimates of patient size as derived from projection localizer radiographs, which however can be significantly affected by non-optimal positioning, or off-centering, of the patient.

This article summarizes the results of recent study to evaluate the effect of a novel 3D depth camera built into the CT scanner to automatically position the table for each patient.

It was found that the new system significantly reduced the extent of vertical off-centering compared to manual setting of the table height. Consequently, significant dose reductions could be obtained.

INTRODUCTION

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Ever since the introduction of computed tomography (CT) in the 1970s, the number of CT examinations has grown steadily. As a consequence, the cumulative radiation dose from medical imaging procedures to which the patient population is exposed has increased significantly [1, 2]. To address this challenge, the medical community, physicians and manufacturers of CT systems have developed and are advocating novel techniques for radiation dose optimization and reduction. Such techniques include automatic tube voltage selection, spectral shaping filtering, adaptive collimation, iterative image reconstruction and automatic tube current modulation (TCM)[3-6]. The TCM technique can be defined as a set of techniques which allow automatic adjustment of the tube current as a function of the size of the patient and the attenuation of the body part being scanned.

“... The most recent study of CT examinations using TCM has shown that patient off-centering of only 20 mm can cause changes in organ dose of up to 38%....”

This adjustment can be performed in the x-y plane (angular modulation), along the z-axis (longitudinal modulation) or as a mixture of both. Of the many other technological innovations introduced to manage CT radiation dose, TCM is generally considered to be one of the most important. Many studies have reported that the usage of TCM can result in dose reductions of up to 60%, while still maintaining image quality [7-9].

Although the practical implementation of TCM varies between vendors, tube current values are always based on estimates of patient size derived from projection localizer radiographs (LR) [10-12]. This point is extremely important, since such estimates can vary depending on the positioning of the patient in the CT gantry, resulting in different tube current values being applied by the TCM system. Inaccurate patient centering may result
in magnification of the acquired LR when the patient is positioned too close to the X-ray source, leading to an overestimation of the patient size. Conversely, when the patient is placed further away from the X-ray source, the LR image becomes smaller and patient size is underestimated as a result. Thus, accurate patient positioning at the gantry isocenter is crucial for evaluation of patient size and efficient usage of the TCM function. Several studies have shown that vertical patient off-centering results in undesirable consequences with regard to both radiation dose and image quality [13-17].

The most recent study of CT examinations using TCM has shown that patient off-centering of only 20 mm can cause changes in organ dose of up to 38%. Thus, the development of techniques for accurate patient positioning appear highly desirable [18].

A recently introduced CT scanner (SOMATOM Edge Plus, Siemens Healthineers, Forchheim, Germany) incorporates a system which enables automatic table positioning with the help of a three-dimensional depth camera. This 3D depth camera employs infrared light to measure the distance of objects from the camera, with the result that a virtual patient avatar can be created based on depth data. The geometric center of this avatar is then used for automatic table positioning.

**STUDY DESIGN.**

We set out to evaluate automatic patient positioning using this novel approach and to compare its performance with that of manual patient positioning as carried out routinely by our technologists. To do this we set up a study in which we analyzed image data from 120 patients who had undergone CT examinations in our radiology department between March and December 2017.

Sixty eight (68) of the patients were scanned on a third-generation 192-slice dual-source CT scanner (SOMATOM Force, Siemens Healthineers, Forchheim, Germany) using routine clinical abdomen (30) and chest (38) protocols. For this group of patients the table height was manually selected and set for each patient by the technologist carrying out the CT examination, with the help of the scanner’s built-in lasers. Another group of 52 patients underwent abdomen (22) and chest (30) CT examinations on the novel single-source 128-slice CT scanner.
COMPUTED TOMOGRAPHY

(SOMATOM Edge Plus, Siemens Healthineers, Forchheim, Germany), equipped with the built-in depth camera. With this group of patients, the optimal table height was automatically determined for each patient by the CT system based on a single image from the 3D infra-red camera. The values of table height for patients positioned manually ($T_{\text{man}}$) and those for patients positioned automatically ($T_{\text{aut}}$) were then compared with the ground truth table height ($T_{\text{GT}}$), which is defined as the vertical table position at which the axial center of the patient is aligned with the scanner isocenter. The axial center of the patient was defined retrospectively from the DICOM images. The vertical center for each of the reconstructed slices was calculated as the middle position between the highest and the lowest point of the extracted skin surface. Then, the central values calculated for each slice along the z-axis of the entire scanned volume were averaged in order to define the final axial center of the patient.

RESULTS

The results of our study demonstrated that automatic patient positioning significantly reduces the error in patient off-centering compared to manual positioning performed by operators ($p<0.005$). The study showed that, on average, the offset in table height (i.e. the distance from the ideal table position to the one actually used) could be reduced from 18 mm to 5 mm by applying the algorithm which used the patient depth image from the 3D camera. For chest CTs, the average vertical off-centering was $7 \pm 4$ mm when using the automatic patient positioning system vs $19 \pm 9$ mm when the table height was set manually by technologists. For abdomen CT, the average vertical off-centering was $4 \pm 2$ mm and $18 \pm 11$ mm for automatic and manual patient positioning, respectively.

One of the most striking results of our study was that in the examinations with automatic patient positioning the offset never exceeded 15 mm, whereas in CT examinations with manual patient positioning the offset was greater than 20 mm in almost 50% of cases, with a maximal offset of 39 mm and 43 mm for chest and abdomen CT, respectively.

Interestingly, the results of our study showed that the great majority of patients (84%) undergoing chest CT examinations without automatic positioning were manually placed below the isocenter, whereas in the case of abdomen CT no particular direction of off-centering was observed.

CONCLUSION

Our study indicates that automatic individualized patient positioning using a 3D camera allows for more accurate patient centering as compared to manual positioning, resulting in improved radiation dose utilization.

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New evidence for digital mammography plus tomosynthesis in breast cancer screening

By Dr S Muller

Breast cancer accounts for 1 in 3 cancers in women in the European Union (EU), making it the leading cause of cancer among women throughout the continent. With a mean incidence rate of 160.2 per 100,000, western Europe also has one of the highest incidences of breast cancer in the world [1]. Screening is the mainstay of breast cancer detection, with numerous studies having found that early detection translates into substantially reduced mortality rates [2-4]. Screening mammography was the standard for decades until the advent of full-field digital mammography (FFDM) in 2000 [5]. However, these traditional technologies have several shortcomings. One of the most common is a relatively high false-positive recall rate, leading to unnecessary testing and biopsy [6,7]. False positive diagnosis causes anxiety and fear, and women who receive such results are more likely to delay their next mammogram [8].

Digital breast tomosynthesis (DBT), the latest generation in breast imaging, uses a limited-angle tomographic breast imaging technique to provide multiple low-dose projection views of the breast, thus reducing interference from overlapping tissues. A stack of slices (at typically 1-mm spacing) is then reconstructed to provide a threedimensional view of the breast.

Numerous observational and clinical studies support the improved performance DBT offers compared to FFDM alone, whether used as an adjunct to digital mammography (DM) or to synthetic 2D mammography, or as a stand-alone screening technique. Several studies have found that the use of DBT can reduce recall rates while improving cancer detection, particularly for invasive cancers, and provide better lesion characterization [7,16-21].

The combination of DBT and DM, while providing greater sensitivity than DM alone, initially required an increased radiation dose compared to DM only. Skaane et al later demonstrated comparable results between DBT combined with synthetically reconstructed two-dimensional images and DBT plus DM, enabling the use of lower radiation doses [20]. This is now becoming more common in centers using DBT as a screening modality.

The European Society of Breast Imaging (EUSOBI) in its most recent position paper on screening mammography concluded that DBT is set to become “routine mammography” in the screening setting in the near future, but also noted there are several unanswered questions around the technology [22]. The European Commission Initiative on Breast Cancer is also cautious in its recommendations for its use, as are the American Cancer Society and the US Preventive Services Task Force [23-25]. Areas for research include data on the challenges of implementing DBT-based screening programs; cost effectiveness; rates of overdiagnosis; and, most important, the ability of DBT to improve prognosis and reduce mortality and morbidity [23]. Thus, DM still remains the standard for organized mammography screening in Europe.

REGGIO EMILIA TOMOSYNTHESIS RANDOMIZED TRIAL

Recently published preliminary results of the Reggio Emilia Tomosynthesis Randomized Trial provide additional evidence regarding the strengths of DBT plus DM versus DM alone. This 2-arm, test-and-treat prospective randomized trial is comparing DM plus DBT (experimental arm) to DM alone (control arm) in 19,560 women aged 45-70 who had previously received 1 round of screening and had no familial risk of breast cancer. All screening mammograms were conducted using GE Healthcare digital mammography systems, 4 of which were equipped with tomosynthesis [26].

The authors report a detection rate 90% higher in the DBT arm than in the control arm (8.6 per 1,000 women screened vs 4.5 per 1,000 in a population previously screened with DM) across all age groups, with similar recall rates. The detection rate was higher for ductal carcinoma in situ (DCIS) than invasive cancer. Although there is debate regarding the increased rate of DCIS diagnosis that has occurred with screening mammography, there is also substantial evidence that some DCIS are precursor to invasive cancer and therefore should be detected during screening [27-28].

The detection rate was also higher for invasive cancers <10 mm (94% increase) and for cancers 10-20 mm (122% increase), corresponding to lesion size ranges that are most beneficial in the early diagnosis of breast cancer. The detection rate was also higher for grade 1 or 2 cancers. There was no difference between the 2 arms for larger or grade 3 cancers.

The investigators also reported a 12% lower rate of false-positive results in the experimental group than in the control group. The overall detection rate seen with DBT in this study is slightly higher than that seen in recent European studies, and significantly higher than those seen in US observational studies [5,16,19,29-31].

Finally, the study demonstrated a 70% longer reading time for DBT plus DM versus DM alone. The difference observed in reading time is
was related to negative cases, suggesting the longer time was primarily due to multiple image reviews and not to the interpretation itself. Moreover, variability between readers was similar in both arms. This result confirms the need for efficient image review protocols and software and may also be related to the radiologist learning curve in reading images of a new imaging modality.

Most of the gain in invasive cancer detection observed in the experimental arm was due to increased detection with DBT alone. Thus, the use of DBT alone may have the potential to reduce the higher dose in the experimental arm while preserving most of the clinical performance benefit. The use of synthetic 2D in addition to DBT is another attempt to provide a lower dose compared to DBT plus DM and preserve the performance of DBT plus DM. Advances in the ability of synthetic 2D images to improve their lower specificity are expected.[32]

**CONCLUSION**

The body of evidence for DBT’s ability to identify in a screening environment significantly more cancers with similar recall rates compared to DM continues to expand.[21 – 33] The gain in detection for small cancers (<20mm in diameter) and early stage lesions (stage I) shown in the Reggio Emilia study should prove beneficial for the early detection of breast cancer in mammography screening. However, data from following screening rounds are required to understand how this higher detection rate will impact interval cancers and overdiagnosis compared with digital mammography. In addition, the expected benefit of DBT versus DM in dense breasts has not yet been realized. Therefore, alternative approaches such as contrast-enhanced spectral mammography (CESM), possibly combined with DBT, may have a future role to play in screening women with dense breasts.[34]

Finally, synthetic 2D mammograms as an adjunct to DBT have the potential to reduce the dose of a DBT plus DM exam while preserving the clinical performance of DBT plus DM, but needs further technological improvement and generation of clinical evidence. Several multi-center clinical trials are currently underway that will, hopefully, answer some of the remaining questions currently preventing greater uptake of DBT in the clinical setting.

**REFERENCES**


Quality control in radiology: a telemedicine approach to peer-review

By Dr S. Morozov, Dr E Guseva, Dr N Ledikhova, Dr A Vladzymyrskyy & Dr D Safronov

PEER-REVIEW IN RADIOLOGY
Currently, the increasing requirement of quality control in modern radiology means that this vital aspect of the profession is becoming ever-more time-consuming and expensive. Peer review is a widely accepted approach that enables quality measurements to be carried out in routine practice, with the goal of improving overall performance through the recognition of initially unnoticed findings in diagnostic studies and the identification of appropriate corrective measures. In fact, peer review is an obligatory component of many radiological services. For example, in the USA, the Joint Commission (JCI) requires departmental peer-review systems to be in place as a pre-condition for the accreditation of the hospital radiology departments. As a result, almost all radiology departments, — certainly those in academic institutions — are involved in some form of peer-review process or another. However, each radiology department or the parent health system is free to define exactly how in practice this peer-review is carried out [1]. A recent paper on peer-review has identified important opportunities to create a non-punitive peer-review system, truly focused on learning from the errors we all make [2]. Thus, it is openly acknowledged that the radiologists' reporting performances cannot be perfect and some errors are inevitable, so a peer-review system should not only give rise to strategies to minimize errors but also to enable learning from any errors that do occur [3]. Quality control systems in radiology should thus get beyond the mere counting of errors and move on to a group learning and error prevention [4]. However, a major problem in current peer-review in radiology is that, more often than not, it is a purely internal departmental procedure. This affects not only the objectivity of quality control, but also its accessibility, especially in primary level hospitals with limited personnel. In short, current peer-review models usually focus on simply “scoring” errors and not on their elimination. In addition, the “scoring” approach may create tension between radiologists [3,5].

The rapid development of communication and diagnostic technologies, collectively well-known as tele-radiology, has enabled the acquisition of images in one place, their transmission over a distance via protected digital lines, and remote viewing for diagnostic or consultative purposes in another place. Many observers consider that the real potential of tele-radiology lies in such distant peer-review processes which are perfect tools for health care improvement and allow not only increases in quality control but also the objectivity of the review. However, to optimize the overall telemedicine peer-review approach, a system of linked actions for quality assurance in radiology also needs to be developed. Such a system has to replace the traditional “scoring” approach by more advanced and effective strategies. We have developed such a concept and system for quality assurance in radiology. Set up in 2016, the system involves an interlocking set of strategies, actions and tools [6]. The theoretical concept behind telemedicine-based peer-review is a cycle of actions: “discrepancies evaluation - routine support - quality improvement activity - discrepancies evaluation”, reflecting the quality improvement PDCA (plan-do-check-act) cycle. Each of these steps can be described as:

• Discrepancy evaluation is based on independent blinded peer-review methods and a formal classification of discrepancies.
• Routine support includes teleconsultations by subspecialized radiologists and technical support.
• Quality improvement activity involves various types of eLearning such as web-courses, webinars, online workshops, etc. with personal learning strategies. It can also include some administrative actions, but only in especially difficult and unclear clinical cases.

The combination of the system described above with a telemedicine network gives rise to a brand new tool for quality management in radiology. The authors have succeeded in turning this theory into practice [6].

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"...current peer-review models usually focus on simply “scoring” and enumerating errors and not on their elimination...”

DEVELOPMENT OF THE SYSTEM
In 2015, a so-called Unified Radiological Information Service (URIS) was set up to link 75 outpatient municipal hospitals in the Moscow area, as well as an Expert and eLearning center, that was established at the Research and Practical Center of Medical Radiology, in the Department of Health Care of Moscow. The URIS brings together 62 CT, 40 MRI and 30 digital mammography units, involving approximately 400 radiologists and technicians. As of July 2018 more than 1 000 000 studies
and associated reports have been uploaded to the system. However it is important to note that URIS is not just an archive of medical images; rather, it is a true telemedicine network, with a distributed archive, an established workflow and a defined cyclical quality improvement process. Every CT, MRI or digital mammography examination arrives at the URIS from which approximately 7% of all studies are randomly selected and sent for peer-review. If systemic discrepancies are detected, a personalized learning program is developed to address the issue and can be focused either on a departmental management team or on an individual physician or technician.

THE SYSTEM IN PRACTICE

Over a period of one year (August 2016 – September 2017), all CT and MRI examinations (n=380515) performed in municipal outpatient hospitals in Moscow were uploaded to the regional radiological system. From these exams, a sample set of studies (n=23199) was randomly selected and directed for peer-review. Prior to the peer-review process all personal data were removed, thus ensuring the anonymity of the patients. A group of experts, two or three for each record, carried out the remote peer-review which consisted of several iterations. If one of the experts considered the discrepancy to be significant, the system sends the study to another reviewer. If the second expert disagrees with the conclusions of his/her colleague, the study is re-directed for final evaluation to a third expert in the appropriate sub-specialty. The quality control evaluation focussed on:
- Technical performance: artifacts, selection of the study region, patient’s positioning, scanning technique, contrast enhancement timing and phases, pulse sequences, etc..
- Diagnostic performance: detection of pathology, discrepancies in the interpretation, terminological errors, etc.

The peer-review system assigns a score from four grading levels, namely:
1. No discrepancy;
2. General remarks - comments on terminology, protocol design, etc.
3. Discrepancy not significant from the clinical point of view, i.e. does not affect the patient’s treatment and/or quality of life;
4. Discrepancy significant from the clinical point of view, i.e. could possibly affect the patient’s treatment and/or quality of life.

The efficiency of the overall process was then assessed by comparing the levels of the significant/insignificant discrepancies during the first quarter of the study period versus those from the last quarter.

RESULTS

Clinically significant discrepancies were detected in 6% of all cases during the 12 months research period. Clinically insignificant discrepancies were found in 19% of the cases. The most common discrepancies were identified in the reporting of pancreas (28%), lymph nodes and peritoneum (18%), anterior abdominal wall (18%). The frequency of discrepancies varied between different clinical areas: problems frequently appeared in oncology (46%), infections (32%), cardiovascualr (24%). However by far the worst situation was in musculoskeletal imaging where almost 80% of studies had technical or diagnostic discrepancies. Specifically, the highest level of diagnostic imperfection was in cases of trauma MRI (70%) whereas there were discrepancies in only 26% of trauma CT. The identification by peer-review of any technical deficiency in the special support of technicians is particularly important, since such technical aspects during the examination can critically influence the radiologist’s subsequent decision-making. A moderate correlation between discrepancies and inadequate technique or artifacts was identified in trauma cases. Technical problems were most often detected in pelvis MRI (55%), patient and slice positioning (43%), field-of-view selection (23%), pulse sequence selection (19%). In CT, the most problematic areas were the neck and the larynx where approximately 42% of studies were shown to have been carried out with technical deficiencies. Finally, we showed that 90% of studies with imperfections belonged to a limited group of specialists: 11% of radiologists and 17% of technicians. This result allowed us to personalize and focus corrective training strategies. The problems so detected and the means of their future prevention were translated into more than 220 eLearning activities (including 27 web-courses for 1955 radiologists, 98 webinars, 82 workshops, etc.). The regular broadcasting of our webinars and the free access to the records have made our webinars very popular in the professional environment. In 2017, 10280 students from 20 regions of Russia and CIS countries took part in the above eLearning activities.

CONCLUSION

We have shown that the traditional “scoring” approach to the assessment of radiologists’ performance can be successfully replaced by a more sophisticated one based on the application of a remote peer-review process for the detection of systemic imperfections. Specific quality improvement strategies can then be developed, combining several actions (learning, management, etc.) specially developed for the radiology department concerned. In this way, quality improvement procedures become more personal and more effective. The new approach has resulted in an improvement in diagnostics quality. Just one year after the implementation of our systematic telemedicine-based peer-review approach and associated eLearning system, a significant drop in imperfections has been observed, with the level of clinically significant discrepancies decreasing by 67%.

REFERENCES.
**MEDICAL DOCTORS (respond below)**

1. What is your occupation? (check only one)
   - 50 Diagnostic Radiologist
   - 51 Other Physician (please specify)

1a. What is your radiology sub-specialty? (check only one)
   - 52 General Radiology
   - 53 Nuclear Radiology
   - 54 Pediatric Radiology

1b. I am a Head of my department
   - 56 Yes
   - 59 No

Please continue with question #2 below

---

**NON-PHYSICIAN PROFESSIONALS (respond below)**

1. What is your occupation? (check only one)
   - 60 Radiology Administrator
   - 61 Radiology Business Manager
   - 62 PACS Administrator

2. In what type of facility do you work?
   - 20 Private Clinic
   - 21 Hospital (check number of beds):
     - a More than 500 beds
     - b 200-299 beds
     - c 100-199 beds
     - d 50-99 beds

3. With what technologies or disciplines do you work? (check all that apply)
   - 01 Diagnostic X-ray
   - 06 MRI
   - 10 Mammography
   - 11 Bone Densitometry
   - 12 PACS/Teleradiology
   - 05 Ultrasound
   - 70 Cardiac Imaging

4. If you currently receive Diagnostic Imaging Europe, how many other people read your copy?
   - a 0
   - b 1
   - c 2
   - d 3
   - e 4
   - f 5

5. Please describe your involvement in the decision to purchase medical imaging equipment/products for your department.
   - (check all that apply)
   - 33 Approve purchase of product
   - 34 Recommend purchase of product
   - 35 Specify type of product to purchase

Please continue with question #2 below

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**ALL RESPONDENTS** reply to the questions below

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High-field MRI may release mercury from amalgam dental fillings

The American Dental Association has reported that 100 million amalgam filling procedures are performed every year in the United States. However, since 2008, the use of amalgam fillings has been forbidden or restricted in Sweden, Norway, Denmark, and Germany. In addition, the European Parliament has adopted a ban on the use of amalgam in clinical practice for children younger than 15. Nevertheless, the use of dental amalgam fillings remains popular despite the controversy surrounding its potential effects on human health.

Exposure to ultra-high-strength MRI may release toxic mercury from amalgam fillings in teeth, according to a new study [1]. The effect was not seen, however, in the lower strength, more commonly used 1.5-Tesla (T) MRI.

Amalgam fillings, also known as silver fillings, have been a staple of dentistry for many years. Amalgam consists of approximately 50 percent mercury, a known toxin that can cause a host of harmful effects in humans. Despite the presence of mercury, the U.S. Food and Drug Administration considers amalgam fillings safe for adults and children older than age six.

“In a completely hardened amalgam, approximately 48 hours after placing on teeth, mercury becomes attached to the chemical structure, and the surface of the filling is covered with an oxide film layer,” said the study’s lead author Dr Selmi Yilmaz, a dentist and faculty member at Akdeniz University in Antalya, Turkey. “Therefore, any mercury leakage is minimal.”

Previous research has found that exposure to the magnetic fields of MRI could cause mercury to leak from amalgam fillings. This concern has been heightened by the recent arrival of ultra-high-strength 7-T scanners in the clinic. The stronger magnetic field of 7-T MRI yields more anatomical detail, but its effects on amalgam dental fillings have not been studied.

To learn more, Dr. Yilmaz and colleague, Dr Mehmet Zahit Adişen evaluated mercury released from dental amalgam after 7-T and 1.5-T MRI in teeth that had been extracted from patients for clinical indications. While 7-T MRI was approved by the FDA in 2017, it has extremely limited availability. The lower-strength 1.5-T MRI is widely available and commonly used for patient exams.

The researchers opened two-sided cavities in each tooth and applied amalgam fillings. After nine days, two groups of 20 randomly selected teeth were placed in a solution of artificial saliva immediately followed by 20 minutes of exposure to 1.5-T or 7-T MRI. A control group of teeth was placed in artificial saliva only.

When the researchers analyzed the artificial saliva, the mercury content in the 7-T, 1.5-T and control group was 0.67 ± 0.18, 0.17 ± 0.06 and 0.14 ± 0.15 parts per million (ppm), respectively. At 0.67 ppm, the mercury content in the 7-T group was approximately four times the levels found in the 1.5-T and control groups.

“In our study, we found very high values of mercury after ultra-high-field MRI,” Dr. Yilmaz said. “This is possibly caused by phase change in amalgam material or by formation of microcircuits, which leads to electrochemical corrosion, induced by the magnetic field.”

An important point of discrimination concerning safety and hazard to human health is the amount of mercury that is absorbed by the vital tissues. “It is not clear how much of this released mercury is absorbed by the body,” Dr. Yilmaz said.

Further studies may be warranted, Dr. Yilmaz added, to evaluate the relationship between high-field MRI and release of mercury from dental amalgam. The researchers have three ongoing projects focused on phase and temperature changes of dental amalgam across different magnetic fields.

As no evidence of harmful effects was found in the 1.5-T group, patients with amalgam fillings should not be unduly concerned about having an MRI exam.

REFERENCES
Lightweight, portable X-ray system

Designed to be even more lighter and comfortable to use than its predecessor, the new Leonardo DR mini II is the second generation of the portable X-ray case mini system from OR technology. At only 8.9 kg, the new system is one of the world’s lightest portable X-ray case systems thanks to the efficient design which enables practical outdoor use. All necessary components for a fully functional system are built into the X-ray case. The wireless CsI X-ray detector yields optimal image quality even at low X-ray doses. The 17” laptop can easily be removed from its holder in the case and used as a tablet for presentation purposes. The notebook is equipped with DICOM PACS DX-R acquisition and diagnostic software. The Leonardo DR mini II is suitable for outpatient digital radiology in fields such as home care, disaster control, emergency medicine on ships, yachts and oil platforms.

OR Technology has been producing digital X-ray technology and image management systems since 1991. The company’s in-house solutions are routinely in hospitals, radiology departments and private practices in over 90 countries. The company’s portfolio ranges from DR retrofits for existing X-ray systems and CR systems to the mobile DR detector suitcase solution for out-of-hospital use.

OR TECHNOLOGY, ROSTOCK, GERMANY, www.or-technology.com

New MR designed to support diagnostic confidence, enhance productivity and improve patient experience

Philips’ newest MR system, the MR Prodiva 1.5T provides enhanced clinical performance, workflow and patient experience helping radiologists use MR-based innovations to achieve a simpler, faster and smarter path to a confident diagnosis, to enhance workflow and deliver better patient care.

Increased pressure on imaging procedures, complicated technology and longer wait times are hurdles that exist in many radiology departments globally. The new MR Prodiva 1.5T addresses this through Breeze Workflow, by providing a simplified, guided patient setup. Breeze Workflow consists of a flexible lightweight digital coil system to support fast patient setup. Combined with Philips’ dStream digital broadband technology, MR Prodiva 1.5T provides radiologists with consistent, high-quality images in support of improved patient care. It also helps manage costs through low transportation, installation and energy consumption expenses.

Patient discomfort during imaging exams can significantly impact outcomes, as has been shown in several studies. The new system features Philips’ unique Ambient Experience In-bore Connect, which elevates patient comfort by allowing them to personalize their environment with a visual theme, guiding them through the examination with instructions, and by reducing acoustic noise.

“Imaging plays an important role within the care delivery spectrum, and MR in particular has significant untapped potential,” said Kees Wesdorp, Business Leader, Diagnostic Imaging, Philips. “Philips continues to innovate its MR solutions to help radiologists unlock that potential and provide greater value to their organization and patients.”

Philips has also introduced two new MR innovations that aim to accelerate MR procedures and improve neuro-oncology diagnoses:

- Reducing exam times. In healthcare today, reimbursements are declining and chronic conditions are leading to more MR procedures and longer wait times, increasing the pressure on the radiology department. However, accelerating scans with current technology can compromise image quality. To address this issue in MR, Philips has created Compressed SENSE, an application that enhances productivity in imaging by increasing the data that can be pulled quickly from scans, including both 2D and 3D scans, all anatomical contrasts and all anatomies. It reduces imaging examination time and is applicable to the entire patient examination process.

- Elevating neuro-oncology. Today, MR is the gold standard in neuro-oncology imaging. However, opportunities exist for improvement, and new imaging contrast and biomarkers are needed. Philips’ new 3D APT helps address these needs. This contrast-free imaging solution uses unique Philips technology. It effectively supports neuro-oncology clinicians in providing a more confident diagnosis, and features a workflow that leverages optimized and standardized acquisition and visualization techniques.


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Addressing the big challenge in ultrasound imaging

Siemens Healthineers has announced the launch of its new ultrasound system, the Acuson Sequoia, which was developed as a general imaging ultrasound system to address one of the most prevalent challenges in ultrasound imaging today: the imaging of different-sized patients with consistency and clarity. With its new Deep Abdominal Transducer (DAX), a new high-powered architecture, and innovative updates to elastography and contrast-enhanced ultrasound, the new Acuson Sequoia produces penetration up to 40cm. With its powerful architecture and innovative features, the new Acuson Sequoia expands precision medicine by enabling high-resolution imaging that adapts to patients’ size and personal characteristics, contributing to more confident diagnosis.

“Ultrasound imaging has been plagued by variability. Patients’ varied physical characteristics and user-dependent variabilities can impact a clinician’s ability to deliver an accurate diagnosis,” says Robert Thompson, Head of Ultrasound at Siemens Healthineers. “With the new Acuson Sequoia, Siemens Healthineers provides users with a solution that enables real-time imaging for varying patient types, including those with high BMI, without sacrificing image quality and potentially reducing the need for repeat scans and unclear diagnoses.”

According to the World Health Organization, 1.9 billion people globally are reported as overweight with 650 million people classified as obese (with a BMI above 30). Because ultrasound imaging relies on the sending and receiving of echo signals to produce images, patients with more adipose tissue are more difficult to image. The deeper an echo signal needs to penetrate, the more attenuation occurs, resulting in image quality degradation. In attempting to overcome these challenges, clinicians have traditionally had to compromise on frame rates, resolution, or penetration of their ultrasound imaging.

In response, Siemens Healthineers built the entirely new Acuson Sequoia system to adapt to the “BioAcoustic Variations” of each patient, characteristics that include tissue density, stiffness, and absorption. The system provides high-resolution InFocus imaging throughout the entire field of view, from the near field to the far field, in real-time. Therefore, there is no need to adjust the focal point of the scan, resulting in faster scan time without compromising frame rates and resolution. The new ultrasound system also offers high resolution color flow, up to three times the sensitivity and up to 20% deeper penetration.

In addition to increased rates of obesity, prevalence of liver disease is also on the rise. Clinicians utilize ultrasound elastography to determine shear wave speed, a parameter correlated with tissue stiffness in the liver which can correlate to chronic disease progression. Imaging in these patients can be challenging, particularly in larger patients where the signals are attenuated. The innovative power architecture of the new Acuson Sequoia provides six times the energy capacity available for shear wave elastography, enabling imaging at greater depths and a reduction in image variability.

The BioAcoustic technology of Acuson Sequoia also improves Contrast Enhanced Ultrasound (CEUS) bubble longevity. Contrast enhanced ultrasound uses microbubble-based contrast agents to improve the visualization and assessment of lesions. With the new Acuson Sequoia system, the view time of contrast agents is significantly longer, allowing clinicians more time to scan for additional incidental lesions during their examinations and with up to twice the sensitivity.

As the most widely used medical imaging modality, ultrasound scanning preferences vary from user to user, making it a highly-personal experience. In a collective effort to eliminate variability and long-term ergonomic injuries, Siemens Healthineers hosted 170 workshops with 365 worldwide ultrasound users to create a platform designed by the user, for the user. The new Acuson Sequoia improves workflow by introducing user-friendly features, such as gesture detecting transducers – activated by touch, automated protocols, and streamlined registration which adapts to user preferences over time. A new ergonomically designed InTune transducer family reduces operator stress while increasing comfort. A unique new capability among diagnostic ultrasound systems, “UltraArt” provides several image choices which are automatically generated with a user’s preferred image parameter settings, right on the touch screen. The user can select the image that best matches the patient’s BioAcoustic characteristics, avoiding manual adjustment of multiple individual image parameters.

According to the World Health Organization, 1.9 billion people globally are reported as overweight with 650 million people classified as obese (with a BMI above 30).

“...the new Deep Abdominal Transducer (DAX)...produces penetration up to 40cm...”

www.healthcare.siemens.com
Portable ultrasound with one-touch image optimization for improved workflow and diagnostic efficiency

Konica Minolta has introduced the introduction of the SONIMAGE MX1 portable ultrasound system, optimized for musculoskeletal (MSK) and orthopedic practices, interventional guidance and outpatient centers.

The new system delivers the power, ease-of-use and portability that physicians need to make a confident and efficient diagnosis at the point-of-care. Designed for MSK, anesthesia and pain management exams, the new ultrasound system provides high-resolution image quality and simplified workflow with an intuitive touchscreen interface.

Developed with the MSK practitioner in mind to shorten the system learning curve, the easy-to-use MX1 System features one-touch image optimization to simplify operation. Multiple imaging parameters, such as frequency, focus and compounding, can be changed automatically by just adjusting the depth. The result of these customized settings is reliable, repeatable and exceptional image quality and resolution, enabling physicians to make a confident diagnosis, provide therapeutic needle guidance and monitor rehabilitation.

The new Dual Sonic Technology controls ultrasonic noise and enhances ultrasonic transmission efficiency to deliver clear delineation of structures as small as hundreds of microns in diameter.

"Konica Minolta’s commitment to MSK ultrasound continues with the economical yet powerful SONIMAGE MX1 portable ultrasound system," says Joan Toth, Senior Product Marketing Manager, Konica Minolta Healthcare. "From the one-touch image optimization and extreme portability, to the Simple Needle Visualization software, the MX1 System enables clinicians to do more with ultrasound at anytime and anywhere. In a competitive outpatient marketplace, the MSK practitioner can rely on the immediacy of information with the SONIMAGE MX1 to make confident decisions that enhance patient care and satisfaction."

Konica Minolta preserves the customer’s investment in the company’s ultrasound technology with transducers that are compatible with both the SONIMAGE MX1 and the SONIMAGE HS1.

Study demonstrates high diagnostic accuracy of vFFR software

The highly innovative CAAS vFFR software (Cardiovascular Angiographic Analysis Systems for vessel Fractional Flow Reserve), developed by Pie Medical Imaging can calculate the pressure drop and vFFR value in the coronary artery non-invasively, which means that there is no need for pressure wires and hyperemic agents.

FFR is an established technique used in interventional cardiology to measure pressure differences across a coronary stenosis. Based on this, the cardiologist may take a decision on whether a coronary stenosis has to be treated with angioplasty or not. The examinations are done during catheterization procedures using costly pressure wire and hyperemic agent.

CAAS vFFR allows clinicians to use two standard angiograms taken during a standard catheterization procedure as input to get access to coronary physiology assessment. For percutaneous coronary interventions (PCI), within one easy workflow, CAAS vFFR offers a unique combination of functional and anatomical lesion assessment (such as percentage stenosis) to support the interventional cardiologist in the clinical decision making process.

FAST, a clinical study led by Dr K Masjedi and Dr J Daemen from Erasmus Medical Center, Rotterdam showed that vFFR as calculated using CAAS vFFR has a high linear correlation to invasively measured FFR.

“In the FAST study” said Dr Daemen “we demonstrated that vFFR as calculated using CAAS vFFR has a high linear correlation to invasively measured FFR and high diagnostic accuracy to detect FFR ≤ 0.80. vFFR is a promising, fast and easy to use tool to assess coronary physiology without the need for a costly pressure wire or hyperemic agent.”

“We are very proud of this technological and clinical achievement” declared René Guillaume, CEO of PMI “which is the result of our 30-year commitment and experience of our company in the field of cardiovascular analysis software and of successful collaboration with the most prestigious medical and scientific research centers”.

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For more details about the study, visit: gehealthcare.co.uk/mammography

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¹ Digital Mammography versus Digital Mammography plus tomosynthesis for Breast Cancer Screening: The Reggio Emilia Tomosynthesis Randomized Trial. https://doi.org/10.1148/radiol.2018172119