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The Precautionary Principle and the assessment of risk of gadolinium deposits

The recent announcement from the Pharmacovigilance and Risk Assessment Committee (PRAC) of the European Medicines Agency, recommending that the marketing authorisations for four linear gadolinium contrast agents be withdrawn has been cited by some observers as a good example of the sensible application of the famous “Precautionary principle” beloved of the EU and by others as an over-hasty reaction. The standard procedure of the PRAC allows for affected parties to request a review of the recommendation and some of the manufacturers of the Gadolinium Based Contrast Agents (GBCAs) concerned have exercised this right. This review process will conclude in July of this year, whereupon, if the recommendation is maintained, it will pass to the Committee for Medicinal Products for human use (CHMP) before final approval by the European Commission. With an estimated 40 million contrast enhanced scans carried out worldwide per annum at a market estimated at approximately half a billion dollars per year, any recommendations regarding the withdrawal of even some of the molecules have a financial impact.

The background to the PRAC’s decision is by now well known. Over the last few years, evidence has appeared showing that small amounts of gadolinium have been found in patients in certain structures of the brain in patients who have been previously administered intravenous GBCAs. Gadolinium of itself is toxic and is understandable be interpreted as “potentially adverse effects”; evaluation of the scientific data available and finally the identification of the actual causative agents of potentially adverse effects; evaluation of the scientific data available and finally the extent of scientific uncertainty. In this context, the presence in the brain of gadolinium ions known to be toxic could be interpreted as “potentially adverse”.

However — and this was emphasised by the PRAC in its recommendation for the withdrawal of the approval of linear GBCAs — no symptoms or disease linked to gadolinium in the brain have been reported, although they point out that data on the long-term effects on the brain are limited. Given all this, it is not surprising that the PRAC invoked the Precautionary principle in making its recommendations. (Across the Atlantic, the FDA so far has limited its action to “investigating the risk of brain deposits following repeated use GBCAs). Originally introduced with the aim of ensuring a higher level of protection through preventative decision-taking in the case of risk in the environmental sector, the precautionary principle has now been extended to other areas including health. The principle may only be invoked when three preliminary conditions are met, namely, the identification of potential adverse effects; evaluation of the scientific data available and finally the extent of scientific uncertainty. In this context, the presence in the brain of gadolinium ions known to be toxic could be understood as “potentially adverse”.

However the more serious potential risk is that the current controversy regarding gadolinium deposits in the brain is somehow interpreted that no GBCA should ever be given. This would be extremely counter-productive — the diagnostic accuracy provided by contrast-enhanced MRI is vital in many pathologies.
The data from a recent trial (Hinson JS et al. Ann Emerg Med. 2017), suggest that in cases where contrast-enhanced CT is indicated to avoid delayed or missed diagnosis of critical disease, the potential morbidity and mortality resulting from a failure to diagnose potentially life-threatening conditions outweigh any potential risk of kidney injury.

COVER STORY

IODINATED CONTRAST MEDIA IN CT IS NOT ASSOCIATED WITH INCREASED RISK OF ACUTE KIDNEY INJURY

The results of a propensity-matched, case-controlled study, show that there was no difference in the frequency of AKI between enhanced and non-enhanced patients undergoing CT, suggesting that the current fear of triggering AKI by intravenous contrast media is not supported by objective data.

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PET/CT improves radiotherapy targeting for recurrent prostate cancer

A recently published article has demonstrated that the PET radiotracer \(^{18}\)F-fluciclovine can help guide and monitor targeted treatment for recurrent prostate cancer, allowing for individualized, targeted therapy. [Jani AB et al. Impact of \(^{18}\)F-Fluciclovine PET on Target Volume Definition for Postprostatectomy Salvage Radiotherapy: Initial Findings from a Randomized Trial. J Nucl Med. 2017; 58: 412]

"This is the first study of its kind demonstrating changes in post-surgery radiotherapy target design with advanced molecular imaging in recurrent prostate cancer, with no demonstrated increase in early radiotherapy side effects," explained Dr Ashesh B. Jani, of the Winship Cancer Institute of Emory University, Atlanta, Georgia, USA.

It is estimated that one in seven men will develop prostate cancer in his lifetime. In 2017, more than 161,000 new cases of prostate cancer are expected to be diagnosed in the U.S., and about 26,730 deaths from the disease are anticipated. Similar statistics apply in Europe.

For the Emory study, 96 patients were enrolled in a clinical trial of radiotherapy for recurrent prostate cancer after prostatectomy. All patients underwent initial treatment planning based on results from conventional abdominopelvic imaging (CT or MRI). Forty-five of the patients then underwent treatment-planning modification (better defining the tumor-targeted area) after additionally undergoing abdominopelvic \(^{18}\)F-fluciclovine PET/CT. No increase in toxicity was observed with this process. The Emory researchers determined that the inclusion of \(^{18}\)F-fluciclovine PET information in the treatment planning process leads to significant differences in target volumes (the areas to receive radiotherapy). The modified targets did result in higher radiation dose delivered to the penile bulb, but no significant differences in bladder or rectal radiation dose or in acute genitourinary or gastrointestinal toxicity. These are preliminary results in a three-year study, which hypothesizes that there will be an increase in disease-free survival for patients in the \(^{18}\)F-fluciclovine-modified treatment group over those in the standard treatment group.

This study could have implications beyond prostate cancer, as Jani points out, “Our methodology is readily applicable to other novel imaging agents, and it may potentially facilitate improvement of cancer control outcomes.”

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

To screen or not to screen for lung cancer?

Lung cancer screening using a low-dose CT scan can be a lifesaving test for high-risk patients. While it offers clear benefits, incidental findings and radiation exposure mean there are some potential risks associated with annual screening. Most patients do not fully understand the benefits or potential harms of a screening program, nor are they clear on exactly who should undergo testing. A new study has determined that a structured prescreening counseling and shared decision-making visit with healthcare professionals leads to a better understanding of the benefits and risks, as well as the eligibility criteria. [Mazzone PJ et al. Impact of a Lung Cancer Screening Counseling and Shared Decision-Making Visit. Chest. 2017; 151: 572]. Lung cancer screening is recommended for anyone over the age of 55 who has smoked for more than the equivalent of 30 pack-years. (Pack-years are calculated by multiplying the packs per day smoked by the number of years someone has been a smoker). Current evidence suggests that the benefits of lung cancer screening for this population outweigh the risks, but practitioners also recognize that there is always a risk/benefit balance for all interventions.

“Screening presents a unique challenge to this balance as a minority of patients screened will experience the benefit while all have the potential to be harmed," explained lead investigator Dr P J. Mazzone, Director of the Lung Cancer Program for the Respiratory Institute and the Lung Cancer Screening Program, Cleveland Clinic, Cleveland, OH, USA. During the study, investigators designed a program that involved a counseling and shared decision-making visit for patients prior to starting lung cancer screening. These visits were divided into different educational components, focusing on eligibility requirements, the benefits and harms of lung cancer screening, and the personalized benefit and risk for each participant. Patients were encouraged to ask questions during sessions.

After analyzing pre- and post-visit surveys, investigators found...
That participants initially had a very modest understanding of the eligibility criteria, benefits, and harms of screening. However, after viewing educational materials and participating in the shared decision-making process with the practitioner, follow-up surveys showed patients had a better grasp on the nuances of screening. Patients generally felt the messages were delivered at an appropriate level and felt more comfortable about their decision after the visit.

The study showed that people started with a better understanding of the benefits of lung cancer screening than the harms or eligibility criteria. Researchers theorize this is because health care providers are more comfortable discussing the benefits of screening than trying to convey the complexities of potential harm. Patients with a lower level of education were also less likely to understand the concepts pre- and post-visit but did show benefit from the counseling sessions, leading investigators to recommend exploring strategies to enhance the teaching tools used for people with the lowest education levels.

Information about personalized risk has been shown to help patients make more informed choices about participation in screening for other cancers. “This portion of the visits may have contributed to the increased level of comfort with the decision to pursue lung cancer screening expressed by our patients,” concluded Dr. Mazzone. 

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

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Small leakages from blood vessels in the brain, known as microbleeds, increase with age and are associated with cognitive decline. In a recent study, it was shown that in a group of 84 older patients undergoing transcatheter aortic valve replacement (TAVR), nearly a quarter developed new microbleeds after their procedure. The results of the single-center study were presented at the recent American College of Cardiology’s Annual Scientific Session.

Microbleeds can be observed using MRI scans of the brain and are detrimental to thinking and memory. Previous studies of MRI scans in patients age 80 and older have shown evidence of microbleeds in up to 30 percent of elderly patients. This study revealed increased risks of microbleeding among patients who had undergone a previous cardiovascular intervention and among those with more prolonged exposure to anticoagulant medications, which are used to prevent blood clots that cause strokes and mini-strokes in patients undergoing cardiac procedures. It is the first study to link microbleeding with TAVR and the first to investigate microbleeding as a side effect of any cardiac procedure.

“We are all aware of the potential for silent ischemic strokes (‘mini-strokes’) after these endovascular procedures, but our study points to the opposite risk—microbleeding—that we have not previously been aware of,” said Dr E Van Belle, cardiologist at the Centre Hospitalier Regional in Lille, France and the study’s lead author. “With more and more endovascular procedures, which require anticoagulants, it could be that these procedures are one of the main triggers of microbleeding seen in the older population. It raises the concern that we may be increasing the risk of this microbleeding with each intervention we perform.”

To shed light on microbleeds and their possible connection to endovascular procedures such as TAVR or anticoagulant use associated with these procedures, researchers performed MRI scans and questionnaire-based neurological tests in 84 patients before and after the patients underwent TAVR, the procedure to replace a patient’s faulty aortic valve with an artificial valve, which is threaded to the heart through a catheter in the groin or chest.

TAVR is generally used for patients in whom open-heart surgery poses an intermediate to high risk, which typically includes older patients and those who have multiple health problems. Patients underwent MRI scans one day before TAVR and three days after TAVR. Questionnaire-based neurological tests were conducted prior to TAVR, followed by three days after and six months after the procedure.

Before TAVR, MRI scans revealed at least one microbleed in 26 percent of patients. At three days after the procedure, a total of 40 percent of patients had microbleeds and 23 percent had new microbleeds that were not present before TAVR.

Microbleeds observed both before and after TAVR were associated with deficiencies in thinking and memory in the questionnaire-based neurocognitive assessments. Factors that were associated with a significantly higher risk of microbleeds included having a previous cardiovascular intervention, prolonged exposure to anticoagulation, history of bleeding, longer exposure to fluoroscopy during TAVR, and balloon post-dilation, a procedure sometimes used in conjunction with TAVR to reduce leakage of blood across the new valve.

Van Belle said the results strongly suggest that further research is needed to elucidate the causes of microbleeds and determine whether changes in anticoagulation management can help to reduce the risk. He said that the results suggest systematic MRI investigation should be conducted in studies investigating new anticoagulation regimen for patients undergoing TAVR. Currently, he said, MRI scans of the brain are rarely used to assess safety outcomes in cardiovascular studies, in part because MRI cannot be used in patients with a pacemaker or other types of implanted devices.

“To shed light on microbleeds and their possible connection to endovascular procedures such as TAVR or anticoagulant use associated with these procedures, researchers performed MRI scans and questionnaire-based neurological tests in 84 patients before and after the patients underwent TAVR, the procedure to replace a patient’s faulty aortic valve with an artificial valve, which is threaded to the heart through a catheter in the groin or chest.”

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Schematic representation of TAVR

Microbleeds in the brain can be detected by MRI.
Men need more frequent CT lung cancer screening than women

Men need more frequent lung cancer screening than women, according to research presented at the recent European Lung Cancer Conference (ELCC) in Geneva, Switzerland. “Less frequent screening would reduce radiation exposure but previous studies of longer screening intervals produced varied results,” said lead author Dr Mi-Young Kim, a radiologist at Asan Medical Center, Seoul, Korea. “This may have been caused by differences in the clinical and radiological presentation of lung cancer in women and men.” The recent study investigated sex differences in newly developed lung cancer and calculated the optimal CT screening intervals for women and men. The study retrospectively included 46,766 patients who had undergone chest CT screening at Asan Medical Center. During the study period, 282 patients developed lung cancer. Of these, 186 patients were diagnosed from the initial CT scan and were excluded from the study, while 96 patients (85 men, 11 women) were diagnosed from subsequent CT scans and were included in the study. In the 96 patients, the researchers analyzed the CT screening intervals and the stage and pathology of lung cancer when it was diagnosed, to see if there were any sex differences.

The average time between lung cancer being diagnosed on CT and the previous CT scan was significantly longer in women (5.6 years) than in men (3.6 years). However, the lung cancer stage at diagnosis was higher in men: 82% of lung cancers diagnosed in women were stage I compared to just 49% in men.

Pathological analyses showed that solid nodule (72%) was the most common finding in men, while ground glass opacity nodule (45%) was the most common in women. In men, adenocarcinoma was the most common type (42%), followed by squamous cell carcinoma (35%), small cell lung cancer (18%), and others (5%). All women patients had adenocarcinoma.

Kim said: “Because ground glass opacity nodule is the most common feature of lung cancer in women and all cases are adenocarcinoma, the growth rate of cancers might be low. Most female patients were non-smokers (82%), who have a lower risk of lung cancer, while 87% of men were smokers. We included all patients screened for lung cancer in a 17-year period, but the number of women patients was low and further studies are needed to confirm the sex differences we found.”

She concluded: “Our study suggests that the annual follow-up interval for CT recommended in the U.S. is too frequent for women, and that scans every 2-3 years might be suitable. By reducing the number of unnecessary CT scans, we can decrease radiation exposure and increase cost effectiveness.”

http://Tinyurl.com/ELCC-paper

MRI scans and machine learning algorithms can determine ‘brain age’

A method for predicting someone’s ‘brain age’ based on MRI scans could help to spot who might be at increased risk of poor health and even dying at a younger age according to the results of a study carried out by a team of neuroscientists at Imperial College London and University of Edinburgh, Scotland (Cole JH, et al. Brain age predicts mortality Mol Psychiatry. 2017. doi: 10.1038/mp.2017.62).

Scientists around the world are working to find reliable biomarkers that can be used to measure age. “We’ve come up with a way of predicting someone’s brain age based on an MRI scan of their brain,” explained Dr James Cole, lead author “Our approach uses the discrepancy between their chronological age and what we call their brain-predicted age as a marker of age-related atrophy in the brain. If your brain is predicted to be older than your real age then that reflects that something negative may be happening.”

At the heart of the approach is a technique that measures brain volume and uses machine learning to estimate the overall loss of grey and white matter – a hallmark of the ageing process in the brain. Dr Cole took this basic technique and refined it by testing it on publicly available datasets of MRI scans of more than 2,000 healthy people’s brains, resulting in normalised maps which accurately predicted the person’s age. Following this fine-tuning, it was then applied to scans of 669 people who had undergone MRI scans at age 73, giving them a score for predicted brain age. Analysis revealed that those with a brain age older than their chronological age performed worse on standard physical measures for healthy ageing, including grip strength, lung capacity and walking speed.

Crucially, those with ‘older brains’ were statistically more likely to die before the age of 80, with the average discrepancy between brain age and chronological age being eight years for deceased males and two years for deceased females.

Currently, the high cost associated with MRI scans inhibit the technique’s use as a screening tool in the near term, but large scale projects such as the UK Biobank demonstrate the economies of scale that could help reduce the costs in future.

The researchers also stress that while the technique has great potential, there is still a relatively large margin of error, with the absolute error in determining brain age across all of the MRIs found to be five years.

http://tinyurl.com/Brain-age-paper
Mobile CT stroke unit reduces time to image and treatment

For several years now a Mobile Stroke Treatment Unit (MSTU) has been operating in the city of Cleveland, OH, USA. The goal of the MSTU is to shorten the time between the onset of stroke-like symptoms and the delivery of thrombolytic drugs, which must be administered within three hours of when symptoms began.

The unit resembles an ambulance on the outside, but inside it contains highly specialized staff, equipment and medications strictly used for diagnosing and treating strokes. It is equipped with a portable CT scanner that is capable of imaging the patient’s brain to detect the type of stroke they are experiencing. The CT scans are then wirelessly transmitted to Cleveland Clinic neuroradiologists, who decipher if the patient is experiencing a stroke, and if so, whether the stroke is ischemic or hemorrhagic. A mobile lab is able to test blood samples on board. If it is found that the patient is experiencing an ischemic stroke – which account for about 87 percent of all strokes – the on-board medical team can initiate intravenous (IV) tissue plasminogen activator (tPA) to attempt to break up the clot.

"Despite the fact that tPA has been approved to treat stroke patients for almost 20 years, it is still underutilized, since only 15 percent of patients arrive within the three-hour time window for intravenous tPA, making delay in presentation the most common reason patients were ineligible for this life-saving treatment," says Dr Peter Rasmussen, Director of Cleveland Clinic’s Cerebrovascular Center.

Now the Cleveland Clinic team have analyzed statistically the effect of the MSTU on the time to evaluation and initiation of thrombolytic treatment compared to a control group who were brought to the hospital in a traditional ambulance (Taqui A et al. Reduction in time to treatment in prehospital telemedicine evaluation and thrombolysis. Neurology. 2017; 88(14):1305).

In a cohort of 100 patients treated in the MSTU vs 53 control patients, it was found that there was a significant reduction of median alarm-to-CT scan completion times (33 min MSTU vs 56 min controls), median alarm-to-thrombolysis times (55.5 min MSTU vs 94 min controls), median door-to-thrombolysis times (31.5 min MSTU vs 58 min controls), and symptom-onset-to-thrombolysis times (97 min MSTU vs 122.5 min controls). Sixteen patients evaluated on MSTU received thrombolysis, 25% of whom received it within 60 minutes of symptom onset.

Thus, compared with the traditional ambulance model, telemedicine-enabled ambulance-based thrombolysis resulted in significantly decreased time to imaging and treatment.

The Cleveland Clinic team behind the mobile stroke treatment unit visited one of the first units of its kind in Berlin, Germany, to learn more about their experience with it. Recently, the Berlin team reported in the Journal of the American Medical Association that "ambulance-based thrombolysis resulted in decreased time to treatment without an increase in adverse events." In addition, the Berlin unit reduced ambulance-arrival-to-drug time by 36 minutes and increased IV tPA utilization rate to 50 percent in acute ischemic stroke patients. http://tinyurl.com/Taqui-et-al-paper

Fatty liver diagnosis improved with magnetic resonance spectroscopy

Taking tissue samples from the liver to diagnose fatty liver can be replaced in most cases by a painless magnetic resonance investigation, according to a new study from Linköping University in Sweden, published in the scientific journal Gastroenterology (Nasr P et al., Using a 3% Proton Density Fat Fraction as a Cut-off Value Increases Sensitivity of Detection of Hepatic Steatosis, Based on Results from Histopathology Analysis. Gastroenterology. 2017. pii: S0016-5085(17)30267-6). As a result of their findings, the authors propose that the current value considered to be a normal amount of fat in the liver should be lowered.

Excess energy from food and drink can be stored in fat cells, or it can be stored as fat in the liver. The condition fatty liver has long been associated with unhealthy alcohol consumption. There is, however, a close correlation also between being overweight and fatty liver, and the condition is in this case known as "non-alcoholic fatty liver disease", or "NAFLD".

The condition is often discovered as an incidental. Most people who have fatty liver will not experience impaired liver function. In some cases, however, scar tissue forms and liver cirrhosis can arise. The standard method used to diagnose
Reducing radiation exposure in pediatric orthopedic patients

Pediatric patients are particularly vulnerable to radiation exposure from medical imaging, potentially raising their risk to develop cancer later in life. Now, a new analysis looks at the available evidence on radiation exposure in medical imaging in pediatric orthopaedic care -- and provides recommendations aimed at optimizing decision-making to reduce unnecessary exposure. The findings were presented at a Scientific Exhibit at the recent American Academy of Orthopaedic Surgeons 2017 Annual Meeting.

“Traditionally, there has not been enough discussion on how we can disseminate information to best treat children with the least possible exposure to radiation,” said senior research author Dr David H. Godfried of the Center for Children at NYU Langone’s Hospital for Joint Diseases. “A CT scan may be absolutely necessary for a child. But whenever there is an option, physicians should choose to obtain this information another way.”

Godfried and colleague Dr A Rahman analyzed peer-reviewed literature on different options in imaging technology that may be used in pediatric orthopaedic injuries, including X-rays and CT scans of the spine, pelvis, hip, knees, shoulder, elbow, hand and wrist, and foot and ankle. They then quantified the amount of radiation in each of these scans.

They subsequently identified that pediatric patients who require surgery for hip dysplasia, scoliosis and leg-length discrepancy are among those most likely to undergo imaging such as X-rays or CT scans, and therefore may be among those children who are most vulnerable to exposure risk.

For example, their analysis found that pediatric patients with hip dysplasia that required surgery received two times more X-rays than non-surgical patients, amounting to twice the radiation exposure to the breasts, ovaries and bone marrow, and correlating to a greater than two percent increased lifetime risk of fatal breast cancer, almost one percent risk of fatal leukemia, and three percent risk of genetic defects. Non-surgical patients had approximately half that risk.

**Best Practices to Reduce Radiation Exposure in Children**

Based on the available evidence, the authors developed the following list of best practices that orthopaedic surgeons should follow:

- Follow the ALARA, or "as low as reasonably achievable" principle, to limit exposure to parts of the body that are absolutely essential for diagnosis
- Eliminate repeated exposures resulting from technical errors
- Limit precise collimation to the region of interest
- Limit fluoroscopy to short bursts as needed (don’t “go live”)
- Utilize low-dose CT protocols adjusted for the size of the patient
- Limit CTs of the spine and pelvis in pediatric patients
- Female patients are more susceptible to adverse effects than male patients
- Scoliosis patients should have limited follow-up X-rays
- Leg length, scoliosis, and hip dysplasia (anteversion) studies should utilize EOS imaging technology rather than traditional X-rays
- X-rays are an acceptable diagnostic tool for extremities, such as the wrist, ankle, etc.
- CT scans are an acceptable diagnostic tool for triplane fractures

“We have examined our use of X-rays in different clinical situations and the effect on patient outcomes, and have been able to reduce or eliminate the need for X-rays in many instances, including certain post-operative and routine follow-up visits,” says Dr. Rahman. “While X-rays are still a necessary and important diagnostic tool in the pediatric population, our goal is to reduce radiation exposure to these patients wherever possible without compromising patient care.”

https://tinyurl.com/Godfried-Rahman-paper
MRI study shows effect of heavy alcohol use on adolescents’ brains

Heavy alcohol use during adolescence alters the development of brain, according to a recent study from the Kuopio University Hospital, Finland. (Heikkinen N et al Alcohol consumption during adolescence is associated with reduced grey matter volumes. Addiction. 2017;112: 604).

MRI of the brain revealed statistically significant differences between the groups. Among the heavy-drinking participants, grey matter volume was decreased in the anterior cingulate cortex bilaterally as well as in the right insula.

“The maturation of the brain is still ongoing in adolescence, and especially the frontal areas and the cingulate cortex develop until the twenties. Our findings strongly indicate that heavy alcohol use may disrupt this maturation process,” said Noora Heikkinen, the first author of the study.

The cingulate cortex has an important role in impulse control, and volumetric changes in this area may play an important role in the development of a substance use disorder later in life. Structural changes in the insula, on the other hand, may reflect a reduced sensitivity to alcohol’s negative subjective effects, and in this way contribute to the development of a substance use disorder.

“The exact mechanism behind these structural changes is not known. However, it has been suggested that some of the volumetric changes may be reversible if alcohol consumption is reduced significantly. As risk limits of alcohol consumption have not been defined for adolescents, it would be important to screen and record adolescent substance use, and intervene if necessary.”

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

Less follow-up imaging if ED ultrasound is interpreted by radiologists

According to just published research, the use of follow-up imaging is significantly less when initial emergency department (ED) ultrasound examinations are interpreted by a radiologist than a non-radiologist (Allen B et al. Downstream Imaging Utilization After Emergency Department Ultrasound Interpreted by Radiologists Versus Nonradiologists: A Medicare Claims-Based Study. J Am Coll Radiol. 2017; 14(4): 475). The researchers from the Harvey L. Neiman Health Policy Institute used American data files from 2009 through 2014 to identify episodes of care where the place of service was “emergency room hospital” and the patient also underwent an ultrasound examination. They determined whether the initial ultrasound was interpreted by a radiologist or a nonradiologist and then summed all additional imaging events occurring within 7, 14 and 30 days of each initial ED ultrasound. The mean number of downstream imaging procedures was calculated by specialty group for each year and each study window.

“We found that of 200,357 ED ultrasound events, 81.6 percent were interpreted by radiologists and 36,788 by non-radiologists.”
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nonradiologists,” said Dr D Hughes senior director for health policy research and senior research fellow of the Neiman Institute.

Hughes and his colleagues discovered that across all study years, ED patients with ultrasounds interpreted by nonradiologists underwent 1.08 more imaging studies within seven days, 1.22 more imaging studies within 14 days, and 1.34 within 30 days of the initial ED ultrasound event. For both radiologists and nonradiologists, the volume of subsequent imaging decreased over time. Despite that decline, differences in follow-up imaging between radiologists and nonradiologists persisted over time.

“When the causes of this difference are not clear, the previously documented higher use of limited ultrasound examinations by nonradiologists or a lack of confidence in the interpretations of nonradiologists may potentially explain this increase in follow-up imaging examinations,” said Dr B Allen, lead study author. Allen added that “further analysis will be necessary to fully elucidate the causes of the discrepancy since resource use will be a critical metric in health care reform. Emerging patterns of care such as point of care ultrasound should include resource use in outcomes evaluation. Efforts toward improving documentation of findings and archiving of images as well as development of more robust quality assurance programs could all be beneficial.”

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

MRI may “change the equation” for prostate cancer screening

Screening for prostate cancer is controversial. It can save lives, but it can also lead to unnecessary diagnoses, followed by surgical or radiation procedures, which themselves may lead to severe side-effects. Now a new study, coming from the Dutch part of the European Randomised study for the Screening of Prostate Cancer (ERSPC) has found that MRI-based screening can reduce overdiagnosis by 50% and reduce unnecessary biopsies by 70%, potentially changing the equation for prostate cancer screening. This work was presented at the recent European Association for Urology (EAU) conference in London.

Prostate cancer is the most common cancer in men worldwide; in Europe alone there are more than 100,000 prostate cancer deaths each year. Despite this, prostate cancer has a rather slow progression rate, needing several years before becoming threatening for a patient. Cancer screening can cut the deaths significantly, but the current prostate cancer screening approach with repeated measurements of PSA (Prostate Specific Antigen) followed by a transrectal ultrasound-guided random prostate biopsy (TRUS-biopsy) does not give a satisfactory balance between lives saved and harm caused.

If a man has an elevated PSA level, the next step to determine whether he has prostate cancer is a TRUS-biopsy. This normally involves taking a series of 6 to 12 individual samples from the prostate, using a fine needle. This is often a hit or miss procedure, but the more samples taken, the more likely are the chances of finding a small cancer, with however a concomitant risk of finding a small cancer which may not be clinically threatening.

Now a group of Dutch researchers has compared the outcomes from the TRUS-biopsy approach with an MRI-based screening approach in a group of heavily pre-screened men. They took 6-core TRUS-biopsy samples from 177 men, and 12-core TRUS-biopsy samples from 158 men: the 158 men who received a 12-core TRUS-biopsy had first been given an MRI scan. If the MRI showed a suspicious area, then further MRI-targeted biopsy samples were taken.

The researchers found that the 6-core TRUS-biopsy, 12-core TRUS biopsy and MRI-targeted biopsy method all had a similar detection rate for more dangerous (high-grade) cancers; however using the MRI-targeted biopsy method the majority of men (70%) did not need a biopsy at all as the MRI scan had shown no suspicious areas. In addition to potentially eliminating 70% of biopsies, the MRI-targeted biopsy only approach meant that the number of men who were overdiagnosed with non-aggressive cancer was reduced by half.

“This could change the balance of the equation” said lead author Dr A Alberts of the Erasmus Medical Centre, Rotterdam, The Netherlands. “It means that population-based prostate cancer screening with MRI instead of TRUS-biopsy has a significantly better risk/benefit ratio and could offer real benefits to men at risk of prostate cancer. MRI screening for prostate cancer will be more expensive than the currently used approach, but introducing mammography screening a generation ago was also expensive. We have to decide if it’s worthwhile. In this study we achieved a 70% reduction in biopsies and a 50% reduction in overdiagnosis of insignificant prostate cancer: if larger studies can reproduce these results it will mean a considerable saving further down the line.”

Commenting, Professor Jochen Walz of the Institut Paoli-Calmettes Cancer Centre, Marseille, France and Chair of EAU Section of Urological Imaging, said:

“MRI indeed has great potential to improve prostate cancer diagnosis. Still, we need to note that prostate MRI is a challenging imaging technology with good results depending on the skills of dedicated and well trained experts, which is another parallel shared with mammography. Moreover, the cost effectiveness and the extensive need of health resources are another pending issue, needing further realistic analyses before the above approach can be recommended for routine use.”

https://tinyurl.com/EAU-Presentation
The optimal approach for screening for cardiovascular disease remains controversial. A new standard of “therapeutic efficacy” requires that screening tests which involve cardiac imaging not only predict events but also improve clinical outcomes compared with usual care. To date, five prospective randomized trials have been conducted to compare outcomes based on imaging-guided screening and prevention versus assignment to usual care in screening populations. One trial involved cardiac stress imaging, three involved coronary artery calcium scanning, and one involved coronary computed tomography angiography. Due to the current very low event risk in asymptomatic populations, these trials have been substantially underpowered to assess the impact of imaging-guided prevention on hard cardiac events.

A team of researchers from Mount Sinai, New York recently published the results of a review of the lessons that could be learned from these trials as far as the future design of imaging-based screening trials is concerned (Rozanski AQ et al. Primary Prevention of CVD: The Role of Imaging Trials. JACC Cardiovasc Imaging. 2017;10:304.).

The group found that the simple CT imaging technique of coronary artery calcium (CAC) scan—may be particularly useful when screening for coronary artery disease.

As Dr A Rozanski, lead author and chief academic officer, division of cardiology at Mount Sinai St. Lukes Hospital in New York, pointed out, there is currently no consensus regarding when to use cardiac imaging to screen for heart disease—even though heart disease is a leading cause of death. Instead, a patient is typically assessed using a combination of historical data and a standard blood test to measure serum lipids and blood glucose levels to arrive at a risk score to help determine if they will have heart disease in the future. While these risk scores have been proven to be somewhat useful, increasing data indicates that a CAC scan is far more accurate for this purpose.

Coronary calcium builds up at the site of coronary plaque, so a CAC scan can be effective in detecting even minute amounts of CAC. “The CAC scan can detect heart disease even decades before the symptoms of heart disease may first appear,” said Dr Rozanski, “Additionally, using current state-of-the-art scanners, CAC scans are associated with only very low radiation exposure, similar to that of a mammogram, and they are less costly than all other types of imaging. Given these advantages, there is increasing interest in determining whether the use of CAC scanning could lead to earlier and more effective treatment of heart disease.”

Research has shown that in approximately 40-60 percent of cases, the first time heart disease is discovered is when a heart attack or death occurs.

“By using imaging for screening, we can detect problems early on, which gives the patient an opportunity to make lifestyle changes to help avoid developing heart disease—such as by improving nutrition, starting to exercise or quitting smoking,” Rozanski said. “We believe this will not only help improve and save lives but that it can ultimately contribute to lower health costs since the earlier adoption of positive health habits can reduce patients clinical risk and potentially eliminate the need for more costly interventions later on.”

To help understand the best type and methods of imaging to use for screening to prevent cardiac disease and learn more about the clinical outcomes related to screening, the researchers evaluated five clinical trials with 4,615 participants who were not showing signs of heart disease: one trial involved cardiac stress imaging, three involving CAC scanning and one involved noninvasive coronary CT angiography.

Collectively, the trials showed an important hurdle: because modern therapies have markedly reduced the frequencies for developing the most serious consequences of heart disease, such as heart attacks and sudden death, it may be difficult to prove that the use of imaging techniques reduce cardiac death, per se, in clinical trials. Instead, investigators may be increasingly interested to determine if CAC scanning and other screening techniques can improve the overall cardiac risk profile of patients without increasing medical costs. In one of the trials that were reviewed, the EISNER trial, the use of CAC scanning was shown to improve cardiac risk profiles without increasing overall medical costs, but more studies in this area are needed.

“There is now sufficient evidence to support the routine use of CAC scanning for screening in clinical practice ...”

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Iodinated contrast media in CT is not associated with increased risk of acute kidney injury

This article summarizes a recently-published study designed to determine how often acute kidney injury (AKI) occurs after contrast-enhanced and non contrast enhanced CT in the emergency setting. The results of the propensity-matched, case-controlled study, showed that there was no difference in the frequency of AKI between enhanced and non-enhanced patients undergoing CT, suggesting that the current fear of triggering AKI by intravenous contrast media is not supported by objective data.

The conclusion of a recently published study — the largest controlled study of acute kidney injury following contrast media administration in the emergency department is that intravenous iodinated contrast media used in computed tomography (CT) does not appear to be associated with chronic kidney disease, dialysis, kidney transplant or acute kidney injury, despite long-held fears to the contrary [1]. The study involved case analyses of a total of 17934 unique patient visits. The outcome measure was the frequently-used criterion of contrast-induced nephropathy (CIN), namely an absolute or relative increase in serum creatinine level.

As Dr. Jeremiah Hinson, of Johns Hopkins University School of Medicine in Baltimore, MD, USA, lead author of the study, pointed out [1], iodinated contrast media administration has been cited as the third most common cause of iatrogenic acute kidney disease and has been linked to an increased risk of major adverse events including initiation of dialysis, renal failure, stroke, myocardial infarction. Other studies have linked contrast-induced nephropathy to a 2-fold increased risk of major adverse events within one year.

However, although such reports are worrisome, the causal relationship between the administration of intravenous iodinated contrast media and the development of acute kidney injury has recently been challenged [2]. Current understanding of contrast-induced nephropathy (CIN) is complicated by studies that pre-date the widespread usage of low- and iso-osmolar contrast media. In addition, most of these studies did not use control populations who did not receive contrast media.

"Over 80 million doses of IV contrast media are administered every year, and in the emergency department its use can be essential to accurately diagnose certain acute critical conditions," said Dr Hinson. "But physicians have had concerns that the administration of contrast media causes serious kidney problems later on, with some studies showing contrast-induced nephropathy occurring in as many as 14 percent of patients receiving it. However, studies used to establish this risk were performed prior to the development of modern contrast reagents or without adequate controls. Using a controlled design in current context, we could not find an association between intravenous contrast media use and acute kidney injury."

The Johns Hopkins researchers studied five years of records for patients receiving CT with or without contrast-enhancement in the emergency department. Of all CT scans, 57.2 percent were contrast-enhanced. The probability of developing acute kidney injury was 6.8 percent for patients undergoing contrast-enhanced CT, 8.9 percent for patients receiving unenhanced CT and 8.1 percent for patients not receiving CT at all.

"While a well-controlled randomized prospective study is required to fully determine the contribution of intravenous contrast media to the development of acute kidney injury, our results clearly demonstrate that in emergency departments such as ours where practice patterns have evolved to protect patients' kidneys, contrast media is not associated with increased risk of kidney injury," said Dr. Hinson. "Our data also suggest that in cases where contrast-enhanced CT is indicated to avoid delayed or missed diagnosis of critical disease, the potential morbidity and mortality resulting from a failure to diagnose potentially life-threatening conditions likely outweigh any potential risk of kidney injury".

References
When efficacy meets efficiency and compliance

This article summarizes the proceedings of the recent symposium sponsored by Bracco Imaging at ECR 2017 on the optimization of CT imaging. Chaired by Prof Thomas Albrecht, the symposium featured presentations by three clinicians highly experienced in the optimization, application and regulatory implications of modern CT imaging.

Chairman’s introductory remarks

Prof Albrecht welcomed the audience to the Bracco-sponsored symposium on CT by reminding them of the central “workhorse” role of CT in modern imaging and clinical diagnosis. It’s now 40 years since the Nobel Prize was awarded to Godfrey Hounsfield for his invention of CT, but development of the technique hasn’t stopped—scanners are today much faster, have higher resolution, and permit high quality imaging at lower radiation dose. Inevitably however, these developments have resulted in CT becoming more complex. Current challenges focus on optimal scanner configuration especially in the quest to reduce radiation dose. It shouldn’t be forgotten that CT is the biggest single contributor to overall radiation exposure in diagnostic medicine.

Iodinated contrast media are fundamental to most CT examinations and a great deal of work has looked at optimizing contrast protocols and system settings, not only to improve image quality but also to reduce dose.

High concentration contrast media in clinical routine: possibilities for radiation dose and contrast media reduction

Prof. Tobias Bäuerle

Prof. Bäuerle’s starting point was in emphasizing the need to individualize CT protocols as much as possible. Two factors play a key role in such individualization. namely contrast medium administration and radiation optimization. Typically, contrast medium (CM) formulations containing between 300 and 400 mg Iodine/mL are used in routine CT examinations, with the high end of this range being known as High Concentration Contrast Media (HCCM). HCCM are beneficial in that both the volume and injection rate can be reduced while still administering the same amount of iodine. The greater flexibility of HCCM in terms of injection protocol means that radiation dose can be reduced in certain applications such as CTA while maintaining the same signal-to-noise ratio. All this is to the advantage of the patient, with a lower risk of CM-induced nephropathy, lower volumes of CM and the possibility of lower radiation dose.

Basic Principles

In the interplay of CM, radiation dose and image quality, the basic principles are worth recalling. The number of X-ray photons delivered in CT depends on the tube current (mA) and exposure time (s) and increases linearly with increasing mAs. The number of photons is directly proportional to the applied radiation dose. Conversely, the kVp determines the energy of the photons delivered. Lowering the kVp will lower the energy of the photons delivered but not their number. A common misconception is that the lower energy of the delivered photons is the reason for the radiation dose reduction potential of low kVp examinations in CT. However, the actual reason the radiation dose is lower at low kVp is that the number of photons generated by the CT tube is lower at low kVp than at higher kVp when the same mAs value is used. This is primarily for technical reasons such as the lower effectiveness of the tube at low kV and stronger filtering of low-kV photons.

Figure 1. There are many parameters such as kV, mAs and contrast media. The above example is CT angiography using a HCCM and low mAs protocol. Left Panel: High flow (5mL/s) of Iomeron 400 mg/mL; low mAs. Right Panel: Moderate flow rate (3.5mL/s)  Iomeron 400 mg/mL) and high mAs). Constant kV.

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At lower kV the attenuation of iodine is increased but the lower number and energy of the photons means that also the noise is increased. If a constant signal-to-noise (SNR) ratio is maintained then the greater noise can be offset by the greater iodine signal. The value of HCCM in this context is that the greater signal relative to the increased noise can be used to reduce the mAs and thus the radiation dose. By maintaining a high iodine delivery rate (IDR), the peak enhancement is higher than that with lower concentration CM which means that greater noise can be accepted which in turn means that the mAs can be reduced.

Prof Bäuerle presented practical examples of the effect of varying scan parameters.

- High flow, low mAS protocol for CTA [Figure 1] A reduction of radiation dose of up to 33% can be obtained with higher image quality and contrast to noise ratio
- In another study of CTA used to monitor endovascular aortic repair after abdominal aneurism, two protocols were compared. One used 90 mL of Iomeron 400 mg/mL at 80 kV and the other used 120 mL Iomeron 300 mg/mL at 120 kV. It was found that a radiation dose reduction of 74% could be obtained with the low kV protocol without significantly affecting the contrast to noise ratio (CNR).

TAILORING PROTOCOLS
The existence of built-in automated tools for kV/mAs optimization on modern scanners makes tailoring protocols much easier. The availability of the web-based software package DistinCTive (Bracco; www.braccoMDCT.com) provides additional benefit to radiologists in permitting customization of CT protocols for individual patients. The system optimizes the contrast volume, flow rate, radiation dose (kV) and also takes into account patient-related factors such as renal insufficiency etc. [Figure 2]. The system has been validated in a multi-center trial involving 1493 patients undergoing MDCT examinations of the abdomen, liver and aorta using either Iomeron 400 or Iopamidol 370. The aim of the validation study was to compare a standard conventional protocol with individualized patient protocols as determined by the DistinCTive system. The results revealed equivalent diagnostic quality for both groups, but with significant reductions in both radiation dose and contrast media in the tailored group.

SUMMARY
- Greater radiation dose reductions are possible in low kV/mAs protocols with the use of HCCM
- Tailored protocols to suit individual patients are desirable. Automated tools and software solutions such as Bracco’s DistinCTive system greatly facilitate individualization of protocols.
- The take-home message is that HCCM better permit greater reductions in radiation/contrast dose due to greater flexibility of administration.

Evolving technology, evolving needs: an integrated approach to patient management

Prof Riccardo Manfredi.
The principal objectives of Prof Manfredi’s presentation were to review the development of scanner technology and in the light of this, to discuss the benefits of high concentration contrast agents and the recent evolution of CT power injectors.

Evolution of CT scanner technology.
One consequence of the development of CT scanners from the original single slice spiral CT up to current 256, and 320 slice scanners and dual source MDCT systems is a reduction in scan time. This development has been accompanied by a dramatic rise in the number of CT exams being performed. Approximately 50% of all CT exams involve the administration of contrast medium.

The classical curve of enhancement on CM administration can be affected by several factors such as
- the scanner parameters, e.g. scan delay, duration, bolus tracking
- contrast medium parameters, e.g. injection rate/time, volume, concentration
- patient-related factors such as age weight, height, cardiac output etc.

All these factors combine to influence the contrast enhancement.

Regarding contrast medium, factors such as increased injection rate will mean that the peak enhancement curve is increased and moves to the left whereas the delayed enhancement remains basically unchanged [Figure 3].
Conversely, if the injection volume is increased, both the peak and delayed enhancement are increased. Another factor which affects the curve is the iodine concentration. Increasing the iodine concentration with a constant volume and injection rate results in greater enhancement but a higher amount of administered iodine. However, reducing the volume while maintaining the injection rate permits a tighter bolus and greater possibilities for contrast dose reduction.

Accompanying these developments in CT scanner technology and the advent of high iodine concentration contrast media, has been the evolution of CT power injectors, which are now critical components in the CT suite. The two major needs to be met in CT are ensuring the uniform injection of contrast medium at the desired volume and rate while maintaining the overall expectations and diagnostic accuracy of the CT examination itself. The CT Exprès injector system from Bracco has been developed to meet these objectives. Designed for optimal safety and efficiency, the CT Exprès system is syringeless and can be operated to tailor contrast administration to individual patients/special protocols [Figure 4].

SUMMARY
- CT scanner technology has evolved considerably and rapidly.
- High concentration contrast media are beneficial in conjunction with more rapid scan times, enabling tighter boluses and increased opportunities for radiation dose saving.
- The development of syringeless power injectors such as CT Exprès brings considerable advantages.

Implementing ALARA with imminent Compliance Directives: dose optimization through monitoring

Prof Angelo Vanzulli
Prof Vanzulli had three objectives in his presentation:
- to provide a simple practical and overview of the imminent EURATOM directive
- to describe practical implementation of the ALARA principle and the use of dose monitoring as a tool for optimization
- to share the experience of his team’s use of the NEXO Dose system in the Niguarda Hospital in Milan

EURATOM DIRECTIVE
The directive (2013/59) is due for implementation in February 2018 and sets out the various responsibilities of the radiologist, technologist and the medical physicist in establishing, optimizing and maintaining protocols such that they deliver a dose that is As Low as Reasonably Achievable (ALARA). An additional stipulation of the directive is that the radiologist must explain the implications of the risk/benefits of the radiation dose to which the patient will be exposed. The Directive requires that by the Feb 2018 deadline, written protocols for standard medical procedures should be established (and appropriately maintained and applied) for “relevant categories of patient”. In addition, dosimetric indices from diagnostic procedures should be collated and entered into the patient records. Fortunately the directive recognizes that a “graded approach” to such regulatory control can be applied. Thus for example only newly installed hardware must have the dose reporting facility — and in fact all modern scanners already have the ability to store DLP and CTDI data.

It is still unclear as to what precisely should be entered in the records for dosimetric indices. Some experts recommend that hard data such as DLP should be recorded. Others consider that non-numerical information such as Exposure band classification based on Radiation Protection RP 118 guidelines should be included. These are easy to understand and avoid direct comparisons since no numerical data are cited, but this approach in not very informative and also somewhat outdated.
ALARA or ALADA?
Another debate is still on-going regarding the danger of overemphasis of the ALARA principle — it has been suggested that the “As Low as Diagnostically Acceptable “ (ALADA) principle is more appropriate.

Article 60 of the Directive requires that protocols be adequately tested and maintained; fortunately industry is already producing integrated Radiation Dose Index Monitoring (RDIM) systems which are extremely useful. RDIM systems are designed to:

- Collect radiation dose index (RDI) from the imaging modalities
- Store the RDI in a database together with patient demographics and study information
- Enable easy visualization and analysis of the RDI data.

RDIM systems are however not databases for patient dose and patient organ dose. These involve complex calculations not just based on X-ray output, and are typically generated by medical physicists. Organ and effective doses should therefore not be included in the report.

PRACTICAL EXPERIENCE
The Radiation Dose and Monitoring system from Bracco is known as NEXO [Dose] and efficiently collects dosimetric data from PACS or from radiology devices. The data are stored in a web-based database from which the data can be exported for statistical analysis. The Niguarda hospital has a long experience of the Nexo-Dose and has now accumulated more than 220 000 CT angio exams. The Nexo system permits information such as the number of patients that have received the most angio and/or CT exams over the previous year to be retrieved. Alternatively an overview can easily be retrieved of the dose associated with each type of exam, e.g. CT of the thorax, of the head, etc. over whatever given time period.

The rationale for the use of the NEXO [Dose] system in the Niguarda hospital is summarized in Figure 5, with the principal objective being the establishment of appropriate protocols. This involves initial definition of the procedure followed by a period during which the protocol is run in practice for a certain amount of time, after which the system allows monitoring of the associated doses which is then used for eventual updating of the protocol.

Niguarda has found that the monitoring phase is particularly useful in that it can identify non-optimized protocols, as well as reveal scanner malfunctions and any misuse of the procedures.

Figure 5. In the Niguarda Hospital, Milan, the NEXO [Dose] system plays a central role in the process of designing, running, monitoring and optimizing of protocols. The monitoring phase is particularly useful in that it can identify non-optimized protocols, reveal any scanner malfunctions or any misuse of procedures.

A typical example of the practical application of this process is shown in Figure 6, which demonstrates the dose associated with CT of the abdomen over time. It can be seen that after protocol optimization the dose data are lower and more homogeneous.

Additional information that can be generated by the system includes a comparison of doses associated with various scanners throughout the institution, or for example a comparison of doses with scanners that use iterative reconstruction compared to those that utilize Filtered Back Projection. The system can also generate email alerts whenever a particular patient has been exposed to a radiation dose greater than the 95% percentile of the mean radiation dose exposure. Niguarda received 131 such notifications over a 6 month period. The system enables analysis of the reasons behind the alerts and can differentiate cases in which the additional dose was due to uncontrollable factors such as patient obesity from technical errors such as miscentering or arm-lowering.

Figure 6. An example of the effect of use of the NEXO [Dose] system. The above figure shows the dose associated with CT of the abdomen over time. It can be seen that after protocol optimization the dose data are lower and more consistent.

TAKE HOME POINTS
- Implementing ALARA to comply with the new (2013/59) directive which will be implemented in 2018 requires a multidisciplinary team, with medical physicists playing a central role
- Diagnostic images must be acquired using tested protocols optimized for radiation dose for each type of examination
- Accurate radiation dose values must be recorded for diagnostic procedures
- The NEXO [Dose] system is extremely useful for such CT protocol optimization and monitoring
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The potential of eye movement measures as a marker of expertise in interpreting CT studies

In this article, we present a summary of our recent study [1], in which we assessed eye movement behavior as a function of expertise during reading of abdominal computed tomography (CT) studies. We show that expertise in CT reading is characterized by enhanced perceptual processes and greater adaptivity in eye movement patterns in response to the demands of the task and environment. This could serve as indication of achieved competence during radiology resident training.

In medical fields such as pathology and radiology, residents train to develop visual pattern recognition skills towards an expert level. Several studies have shown that this development is reflected in changes in eye movement behavior. An increasing level of expertise is associated with faster times to first fixation on abnormalities [2], less coverage of images [3], longer saccades (i.e. rapid movements of the eye between fixation points) [4], and shorter overall viewing times [5]. These findings are accommodated by the global-focal model [6], according to which experts concentrate on detailed inspection of the foveal area in parallel with global processing of the extrafoveal area (including the parafoveal area and the periphery). This entails that experts – upon viewing a radiograph – quickly extract the gist of the image in order to guide subsequent eye movements to suspicious locations. This quick extraction is related to superior encoding of domain-related configurations including visual patterns associated with normal and abnormal anatomic structures. Direct evidence for the quick extraction of extrafoveal information was provided by the flash view paradigm in which images are shown for a very short period of time. Even when images were shown for only 200 ms, experts performed well above chance level in identifying extrafoveal abnormalities in mammograms [7]. Under similarly brief exposure conditions, expert radiologists could detect chest nodules 15° away from the fixation point [8].

The studies reported above are all dedicated to understanding search in 2-D. Searching in volumetric space may lead to different search strategies and may require a different interpretation of eye movement measures. For instance, when reading chest CTs in the axial plane it may be needed to keep fixations within a relatively small area of interest in the x and y plane to distinguish a potential long nodule from a blood vessel, as they differ in how much they extend into the z-plane. This implies that relatively long saccades are taken as an indicator of visual expertise in the 2-D environment, are not necessarily a sign of increased visual expertise in a volumetric environment. Recent volumetric eye movement studies investigated global search strategies and found that performance and CT reading strategy differ between radiologists [9-12]. These studies allowed for free scrolling and were not specifically designed to investigate more detailed eye movement behavior and the development of perceptual skills in volumetric space. However, it is important to investigate this development, as image reading in volumetric space has become common practice in radiological assessments.

In our recent volumetric study [1] we aimed to gain insight into the development of perceptual processes and establish potential markers of visual expertise in eye movement patterns during interpretation of abdominal computed tomography studies presented at a fixed rate (3 and 5 frames per second (fps), respectively). Diagnostic performance and the eye movement behavior of early residents, advanced residents and specialists were assessed while they were to detect several lesions in the abdominal area across studies. Our paradigm can be seen as a “continuous
Computed Tomography

Flash "view" paradigm, as each image in the image stack was replaced with the next very swiftly. This deviates from a typical clinical setting, but has the advantage of absolute experimental control. Most importantly, it can be seen as an ultimate test of visual expertise for several reasons. First of all, lesions were at the moment of appearance mostly in the parafoveal region or periphery. This means that readers were required to not only inspect the foveal area, but also to use global vision to detect any potential abnormalities in the extrafoveal area [Figure 1]. Second, several lesions were present on only a few sections [Figure 1, upper panel] and consequently needed to be detected with extrafoveal vision only. Even when readers managed to foveally inspect these lesions, time to do so was very limited. Third, several lesions were not very salient and therefore hard to detect [Figure 1, middle panel]. Fourth, on several occasions more than one lesion appeared in the same sections forcing readers to allocate attention to different locations in the same timeframe (Figure 1, lower panel). These perceptual challenges call heavily on visual expertise and provide an opportunity to assess the extent to which domain-related configurations have developed and how they are served by efficient eye movement behavior.

Design and Methodology
Fifteen early and fourteen advanced residents as well as twelve specialists participated in the study. Hours at work on the same day before experimentation were registered for each participant and included in the analyses. Twenty-four experimental axial CT studies of the abdomen containing altogether 63 lesions and reformatted to 2.5-3 mm section thickness were selected and anonymized. The saliency of lesions was operationalized by number of sections the lesion was visible (from 2-98 sections, average 27). Also, contrast between the intensity of the lesions and their background was assessed. The CT studies contained 131-160 sections with half of the studies presented at 3 frames per second (fps) and the other at 5 fps (meaning that each section was visible for 333 ms and 200 ms, respectively). After presentation of each CT study, participants had to tick the appropriate findings on a paper checklist including 32 possible lesions covering most of the commonly encountered pathologies in the abdominal area. Eye movements were recorded by EyeLink 1000, which has a spatial resolution of 0.4 degrees.

Results
Data were analyzed by generalized linear mixed effects models with separate analyses for Detection Rate (DR), Fixation Duration (FD) and Saccade Length (SL) as dependent variables. Independent variables were expertise group (early residents vs advanced residents vs specialists), lesion saliency (continuous variable), frame rate (3 vs 5 fps), presence of lesion (present or absent on section) and working hours before experimentation (continuous variable). DR of specialists was higher than that of residents with advanced residents detecting more lesions than early residents. For all groups, the DR was higher at 3 than at 5 fps, and the saliency of a lesion increased the likelihood of it being detected. An increased number of working hours decreased the lesion detection rate for early residents, but not for advanced residents or specialists. Early residents detected fewer of the low contrast abnormalities than specialists or advanced residents, whereas there were no differences between groups in the detection of high contrast abnormalities. A summary of the DR results is listed in Table 1.

The Fixation Durations (FDs) of specialists and advanced residents increased when frame rate was increased from 3 to 5 fps, whereas there was no such an increase for early residents. Other manipulations elicited the same

Figure 1. Upper panel. Liver cyst that was only visible for 7 sections. The lesion was not fixated directly by any of the participants, but detected by 90% nevertheless. Middle panel. Large bowel tumor, visually complex lesion that was visible on 10 sections only. Detected by 75% of the specialists, but by 25% of the residents only. Lower panel. Two lesions in the same timeframe: Dilation of pancreatic duct on section 1-7 and a kidney cyst on section 4-6. Attention has to be allocated to two lesions within the same timeframe.
Table 1. Detection rate of lesions (% ) as a function of expertise, frame rate, contrast, saliency, and increased number of working hours after experimentation

<table>
<thead>
<tr>
<th>Measure</th>
<th>Expertise group</th>
<th>Overall Rate</th>
<th>3 fps</th>
<th>5 fps</th>
<th>High contrast</th>
<th>Low contrast</th>
<th>Increased Saliency</th>
<th>Increased in working hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR (%)</td>
<td>Specialists</td>
<td>60</td>
<td>62</td>
<td>58</td>
<td>56</td>
<td>62</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Advanced residents</td>
<td>55</td>
<td>59</td>
<td>52</td>
<td>51</td>
<td>56</td>
<td>56</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Early residents</td>
<td>49</td>
<td>52</td>
<td>45</td>
<td>52</td>
<td>45</td>
<td>45</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>

DR: Detection Rate; +: Increase in DR; 0: No change in DR; -: Decrease in DR.

Table 1. Detection rate of lesions (% ) as a function of expertise, frame rate, contrast, saliency, and increased number of working hours after experimentation

reactions in all groups. Fixation durations were longer in the presence of a lesion in than when no lesion was present and in case of high-contrast lesions rather than low-contrast lesions. Specialists shortened their Saccade Lengths (SLs) more than residents in the presence of a lesion in comparison to whenever no lesion was present. In other respects all groups responded in the same manner to the manipulations. SL was shortened for high contrast in comparison to low contrast lesions and was lengthened — a frame rate of 5 fps in comparison to 3 fps.

Additional preliminary analyses on relatively salient and more obscure lesions indicated other interesting perceptual processes [13]. All expertise groups frequently visited or came close to the vicinity of the more obscure lesions; lesions that were more salient were fixated less, despite the fact that they were detected more often. Interestingly, when fixating lesions, specialists did so more quickly than residents.

**DISCUSSION**

This study showed both similarities and differences in detection performance and eye movement behavior in volumetric space as a function of expertise. The similarities underline that in this more complex environment (compared to a static 2D environment) residents are developing towards high-level domain-specific expertise in medical image reading. An earlier study by our research group [14] using a similar paradigm showed that — unlike residents - less experienced CT readers do not adapt fixation duration and saccade length to the appearance of abnormalities. Increasing fixation duration and shortening saccade length in a volumetric space paradigm is very sensible and allows for foveal scrutinization of a potential lesion in all planes. Both findings are thus indicative of growing visual expertise. Lesions were detected frequently in our continuous flash view paradigm, sometimes without even being fixated; this supports the idea that encoding of domain-related configurations has been established and that global vision is used to detect abnormal anatomic structures or to direct the eye towards suspicious regions. Nevertheless, detection rate is higher and the time to arrive at a lesion is shorter for specialists than advanced residents, who show better performance than early residents. This result pattern is evidence that the development of larger knowledge structures and the development of perceptual processes is gradual and that it requires a substantial amount of practice to reach the highest expertise level.

**CONCLUSION**

The current paradigm offers new possibilities for the assessment of the stage of development in resident training. In fact, a combination of the methods discussed in this paper can be used to create an eye movement profile of any resident and can be compared to expert behavior. Perhaps a more elaborate selection of CT studies and lesions would be needed to get a still more detailed picture of perceptual development. Also, it would be important to fully disentangle visual knowledge and perceptual abilities. A future study could for instance include a post-experimental session in which participants are given unlimited time and a free scrolling opportunity to determine what lesions are detected under unconstrained circumstances. However, the current set-up already provides ample evidence that also in volumetric space eye movement behavior is indicative of competence achieved during radiology resident training.

**REFERENCES**

Breast Care Day

The day-long symposium devoted solely to recent developments in breast imaging which traditionally takes place on the first day of the ECR annual congress, namely the Siemens Healthineers-sponsored Breast Care Day, is fast becoming a must-attend fixture of the congress. With a cast-list of speakers prominent in their field, this year’s Breast Care Day was the most successful ever — more than 1300 radiologists attended the morning, lunch and afternoon sessions.

This article summarizes a selection of some of the papers presented at the Siemens Breast Care Day, which also benefitted from cooperation with Bayer Healthcare.

Preoperative Breast MRI: first results from the MIPA study

To set the scene Prof. Sardanelli pointed out that opinions regarding pre-operative breast MRI are sharply divided between professionals who are against, those who are for and the rest who are undecided as to its value.

The recommendations of the American Society of Breast Surgeons are however clear: don't routinely order breast MRI in new breast cancer patients. The question then becomes how routine is routine?

It is well accepted that breast MRI provides information about tumor extent but whether this should be used to determine tailored treatment is a complex question since there is always the danger of overdiagnosis and subsequent overtreatment such as an increased number of mastectomies. Several years ago the working committee of the EUSOMA group on the various applications of breast MRI was undecided about breast MRI with finally a difficult consensus being established for its use in several scenarios: for newly diagnosed invasive lobular cancer; cancer in high risk women; discrepancy in lesion size between mammography and ultrasound and for eligibility for partial breast irradiation (PBI). (Of note, in the context of PBI a recent meta-study showed that approx. 11% of women originally considered suitable for PBI were found to be in fact not suitable for PBI after MRI).

It shouldn't be forgotten that breast MRI images acquired for one of many valid diagnostic reasons (e.g. in high-risk women or for monitoring neo adjuvant chemotherapy, for occult breast cancer, etc.) already constitute a pre-operative MRI. The real issue is whether an MRI image should be acquired expressly for pre-operative use in women with breast cancer but without any existing MRI images. This is in fact a complex question since the sensitivity/specificity characteristics of MRI do not, according to strict Evidence-Based Medicine criteria, justify its use as a screening tool for example in contralateral breast screening.

However there have been two randomised controlled trials (RCTs) whose results favour the use of pre-operative MRI for reducing reintervention for positive surgical margins. But there are also two RCTs whose results argue against such use. Several observational studies have confirmed the high sensitivity (and also specificity) of breast MRI but the question remains how to assess the clinical impact of pre-operative MRI in terms of outcome for the patient. The problem with such observational studies of women having MRI is that there are no corresponding data for women who have not had MRI.

THE MIPA TRIAL

All this provides the background rationale for the Multicenter International Prospective Analysis (MIPA) pre-op breast MRI study. This is an on-going observational study.

The first results of the MIPA trial. The main message is that pre-planning of a mastectomy based on mammography/ultrasound data prompts an MRI scan (frequently requested specifically by a surgeon who wants the assurance of MRI prior to carrying out the surgery). The MRI scan does not result in the carrying out of more mastectomies.
non-randomized trial. Up to now more than 5000 women have been enrolled, and half have had already their data analyzed. Of these approximately half of whom have had MRI and the other have not had MRI. Since MIPA is not an RCT, the two groups, i.e. with or without MRI, are not homogeneous — understandably the group receiving MRI included, on average, younger women and those with denser breasts compared to the women who did not receive MRI.

Notwithstanding these reservations, one of the most important findings of the MIPA study at this stage is already becoming clear, namely that, considering those women who finally had breast conserving surgery (BCS) treatment after MRI, 73% had that treatment unchanged by MRI, 13% had a less extensive BCS compared to that planned before MRI, and 14% had more extensive BCS compared to that planned before MRI. Thus, BCS was tailored, personalized to the disease extent.

In terms of surgery actually carried out, there were significantly more mastectomies (21%) in the MRI group compared to 16.0% in the non-MRI group. However, this difference is NOT due to the use of MRI, but mainly due to the differences in patient selection.

CONCLUSION
The principal findings of the MIPA study are shown in the diagram above, with the clear main message so far being: Pre-planning of a mastectomy based on mammography-ultrasound prompts an MRI scan (frequently requested specifically by a surgeon who wants the assurance of MRI prior to carrying out the surgery). — the MRI scan does not result in the carrying out of more mastectomies. On the contrary, mastectomy prompts MRI, not vice versa.

Gadolinium retention — impact on breast MRI
The objectives of Prof. Barkhausen's presentation were clear — to review the basic need for contrast media in breast MRI and then review the current status and clinical data regarding gadolinium deposition, the current regulatory recommendations and the specific impact on breast MRI.

Regarding breast MRI, the relatively recent introduction of diffusion weighted imaging (DWI) has shown potential for the detection and characterization of cancer although some issues related to image quality can limit the more widespread use of the technique. Nevertheless the potential benefits of the technique are the differentiation of benign and malignant lesions; the assessment and prediction of therapeutic efficacy and — perhaps — the non-contrast -detection of breast cancer. Despite these advantages there are many cases where the identification of lesions using DWI is however much more difficult than with Dynamic Contrast Enhancement. Direct comparison of DWI and DCE in breast cancer was carried out in a recent meta-analysis of 14 clinical studies, with the result showing that DCE had a higher sensitivity than DWI (93% vs 85% respectively), although specificity was slightly lower (72% vs 76% respectively).

Thus while DWI is an exciting new technique with promising potential, contrast media is currently still needed for breast MRI.

"...mastectomy prompts MRI, not vice versa..."

In patients who had received multiple administrations of (mostly linear) GBCAs, depositions of Gadolinium have been found in the dentate nucleus region of the brain. So far, no adverse events associated with this have been reported identified as being associated with the administration of gadolinium-based contrast agents (GBCA), particularly in patients with poor renal function. The European regulatory authorities (EMA) issued an advisory notice classifying the GBCA into low, medium and high risk categories. Use of low risk GBCAs and ensuring that the patient receiving the GBCA had normal renal function has basically resulted in the effective disappearance of NSF.

However in 2014 a potential new problem was identified when an intense signal was observed in the dentate nucleus in the brains of patients who had previously received GBCAs. The implication that this signal was the result of gadolinium from the previous GBCAs somehow remaining deposited in the brain. Since this initial observation there have been many publications confirming and expanding the original findings. The overall conclusions are that the observed signals are indeed due to the prior use of GBCAs, with mass spectrometry analysis of autopsy samples confirming that gadolinium was present in the dentate nucleus and that the amount of gadolinium deposited in the brain correlated with the total amount of gadolinium given in the previous GBCA administrations. Since GBCAs are known not to pass the blood-brain barrier, it was speculated that gadolinium may be being released from the chelating molecule in which it is formulated. Laboratory trans metallation tests confirmed that Gd could indeed be released from its chelate, with significant differences being observed in the

Adverse events of MRI contrast media
In general MR contrast agents have excellent safety profiles although in 2006, cases of a new condition, known as Nephrogenic Systemic Fibroses (NSF) were identified as being associated with the administration of gadolinium-based contrast agents (GBCA), particularly in patients with poor renal function. The European regulatory authorities (EMA) issued an advisory notice classifying the GBCA into low, medium and high risk categories. Use of low risk GBCAs and ensuring that the patient receiving the GBCA had normal renal function has basically resulted in the effective disappearance of NSF.

MAY/JUNE 2017
The benefits of contrast enhanced MRI in breast imaging. The above case is a 53 yr old woman, with BIRADS 4 on mammography but a negative stereotactic biopsy. Contrast enhanced MRI (images above) clearly show the lesion; MRI-guidance for a second biopsy would clarify the case.

enhanced MRI (images above) clearly show the lesion; MRI-guidance for a second woman, with BIRADS 4 on mammography but a negative stereotactic biopsy. Contrast The benefits of contrast enhanced MRI in breast imaging. The above case is a 53 yr old woman, with BIRADS 4 on mammography but a negative stereotactic biopsy. Contrast enhanced MRI (images above) clearly show the lesion; MRI-guidance for a second biopsy would clarify the case.

stability of the different chemical structures. Thus multi-purpose linear chelates, e.g. Magnevist and MultiHance showed significant deposition of Gd ions whereas macrocyclic compounds such as Dotarem and Gadovist showed no deposition of Gd. However animal studies have shown the presence of minimal amounts of Gd in the brain with all tested GBCAs. It should be noted that so far there have been no reports of any adverse reaction in patients with Gd deposited in their brain.

Breast MRI
There are several excellent indications for the use of contrast media in breast MRI, but the majority of patients only need one or two contrast enhanced breast MRI examinations. In the light of this it is recommended that any patient with a need for contrast enhanced breast MRI should receive the exam. However the situation is slightly more complex in a more difficult population of patients, e.g. the repeated screening of high risk patients, e.g. BRCA patients. In such cases individual risk/benefit analyses should be established. For this it is necessary to be able to quantitate the benefit of MRI in screening high risk patients. Recently an extensive meta-analysis covering more than 1950 patients showed that the use of MRI yielded significantly higher sensitivity and specificity than mammography alone. This position is reflected in several regulatory guidelines, such as the NICE guidelines in the UK which recommend that annual MRI surveillance should be offered to high-risk women such as those with a BRCA mutation. However such guidelines (so far) do not address the question of Gd deposition so Dr Barkhausen’s recommendations are based on his own experience. These are that

1) In Contrast Enhanced Breast MRI there are more benefits than risks — cancers can be missed without MRI
2) Written informed consent should be recorded including reference to Gd deposition
3) Macrocyclic GBCAs should be used where possible
4) However the carrying out of contrast enhanced MRM should NOT be stopped

In Europe the first prospective DBT studies also looked at the effect of adding DBT to FFDM and showed even greater increase in sensitivity although there were variable effects on the recall rate. It should be noted that, perhaps due to the practice of double reading in Europe the recall rate is anyway considerably lower than that in the States. Later trials in Europe used different protocols to look at tomo alone vs DM alone. The Malmö trial used Siemens

Is tomosynthesis ready for use in mammography screening?
Prof. Heywang-Köbrunner started off with a reminder of the values of mammography screening, which so far is the only method with a proven effect on mortality reduction and proven to be appropriate for mass screening. Nevertheless there are some drawbacks to the technology, such as the possibility that an early diagnosis of a slow-growing tumor may in fact represent over-diagnosis. There is also the risk of false positives, not to mention that the late detection of some tumors may be too late for adequate intervention. The relatively recent technique of digital breast tomosynthesis (DBT) is attracting a lot of interest with its excellent sensitivity and good specificity. Despite this no organized screening program with DBT has yet been set up although several large studies of DBT have been carried out. In America such studies are retrospective whereas the European studies are generally prospective and differ in several respects from those in America. In Europe highly trained readers are used; double reading is carried out and screening is on a bi-annual basis. All the American studies show that the sensitivity of mammography screening can be increased significantly (on average by 27 %) by the addition of DBT and that there is a slightly lower recall rate. The main drawback of these trials is that by combining FFDM with DBT the patient has a double exposure of ionizing radiation, which would not be acceptable in Europe for screening.

Comparison of the two most recent European studies of tomosynthesis. Although there were differences in study design and in methodology, both the Malmö and STORM2 trials reported significant increases in the cancer detection, albeit with increases in recall rate.

Note added in proof
Since Prof Barkhausen’s presentation at the Breast Care Day, the Pharmacovigilance and Risk Assessment Committee (PRAC) of the European Medicines Agency has issued a preliminary assessment of Gd contrast agents and recommended regulatory actions including suspension of the market authorisation for some linear GBCAs. Full details of PRAC position available DI Europe May 2017 p 35.
mammography system to compare wide-angle tomo (without a synthetic 2D view) directly with DM. In the Malmö trial there was no increase in radiation dose in the tomosynthesis arm of the study compared to FFDM, since in the tomo arm only one view (MLO) was taken as opposed to the two-view (CC and MLO). In fact there was even a small reduction in dose.

The results showed that the cancer detection rate was 43% higher than that of DM alone but there was also an increase in the recall rate. The STORM-2 trial showed that, compared to a combination of DBT + DM, the combination of DBT plus a synthetic 2D image gave an equivalent increase in cancer detection rate (39%), but of course without the additional radiation dose caused by the DM. However the recall rate was significantly increased.

Overall these recent European results confirm that the increased cancer detection rate of DBT can be achieved without the need for a DM scan. There is a moderate increase in recall rate.

A remaining challenge is however the significance of the increased rate of detection of cancerous lesions and whether this could simply be overdiagnosis. This aspect is partly addressed via analysis of interval cancer rates. The preliminary data from the European trials are relatively encouraging in this context. However the recent data on interval cancers from the US trials (all retrospective) are a bit worrying in that the increase of detection rate of cancers is approximately ten times that of the decrease in interval cancers. More information is needed on interval cancer rates and stage distribution in follow-up rounds.

Conclusion
- DBT has significant advantages over DM and is more promising for mass screening than US or MRI
- Approval of DBT will however require more data on interval cancer rates.
- More time will be needed for optimization of logistics, reader training, dealing with the question of extra time needed for reading tomo images and for carrying out focussed research on these issues

The Malmö Breast Tomosynthesis Screening trial

Dr Lång described the basic aim of the Malmö trial which was to study the accuracy of a one-view wide-angle Digital Breast Tomosynthesis (DBT) compared to two-view Digital mammography (DM) in population-based screening.

In the trial, the Siemens Mammmomat Inspiration system was used for both DBT and DM. With this system the absorbed dose in one-view (MLO) DBT is actually less (1.6mGy) than that of two-view DM.

The prospective, population-based study involved approximately 15000 women randomly taken from the screening population in Malmö, Sweden where women are screened starting from 40 years of age. All women underwent DBT and DM and the images were read by independent double readers. The reading work flow is shown below: Interim results have already been published. The data from 7500 women showed that in the DBT arm of the trial, the recall rate was 3.8% whereas in the DM arm, 2.6% were recalled. Thus there was a 43% increase in the DBT recall rate compared to that in DM, but it shouldn't be forgotten that there was a 43% increase in the detected cancers with DBT compared to DM so in this context the recall rates are acceptable.

From the trial several conclusions can be drawn
1) Tomosynthesis increases breast cancer detection in screening. Although there are several differences in the design and technology of other European prospective population-based trials (e.g. the others used Hologic systems whereas the Malmö trial used Siemens Mammmomat systems) they all showed increased cancer detection rates
2) Tomosynthesis detects small invasive cancers.
3) There is an increase in recall rates using DBT, when starting from a low base-line. This is mainly due to the higher detection rate but also to a slight increase of false positives.
4) There is a slight change in the false positive panorama
5) One-size fits all — DBT finds additional cancers in both dense and non-dense breasts
6) One-view wide-angle tomosynthesis is sufficient
7) Breast compression can be reduced
8) There will be workflow challenges arising from the longer reading times in DBT. The development of software based on artificial intelligence algorithms however is showing great promise in increasing the efficiency of reading
9) The interval cancer rates needs further investigation.

Summary
- Breast tomosynthesis increases the cancer detection rate with a reasonable elevation of the recall rate.
- Once the question of interval cancer rates has been further investigated, tomosynthesis should be used in screening mode, with artificial intelligence-based systems being used to alleviate the longer reading time required with DBT.
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Development of radiation safety culture in the UK medical sector

The importance of a good radiation safety culture is becoming increasingly recognised, and has been the subject of a number of international initiatives over recent years, with some specific focus in healthcare applications. Work in this area has been undertaken in the UK by a national working group and has involved both assessment of current radiation safety culture, utilising a widespread staff survey, and development of strategies for improving this culture. Developments have been from both a top-down and bottom-up perspective, and have resulted in a ten-point assessment tool, including a number of measurable indicators for each point. The ten point assessment complements existing international guidelines and provides a practical framework for both internal audit and external inspection.

Radiation safety culture is becoming a topic of increasing importance globally. On an international level, the International Conference on Radiation Protection in Medicine: 'Setting the Scene for the Next Decade' held in Bonn, Germany, in December 2012 led to the Bonn Call for Action [1] and concerns improvement of radiation safety specifically for patients. A global initiative, launched by the International Radiation Protection Association (IRPA) on culture, resulted in publication of a set of guiding principles [2] in 2014. More recently, a joint initiative by IRPA together with the World Health Organisation (WHO) and the International Organisation of Medical Physics (IOMP) has been launched to develop a framework to support the establishment and maintenance of a radiation safety culture in healthcare facilities, as an integral component of safety culture programmes in medical settings. This ongoing project includes a series of workshops to collect feedback from key stakeholders in different regions of the world.

Within the UK, the Society for Radiological Protection (SRP) first set up a working group to look at radiation protection culture in 2011 [3] and more recently have developed this to form four sector-specific working groups looking at assessment and development of RP culture in the UK workplace. One group deals specifically with the medical sector and includes representation from a range of professional groups within healthcare. The work of this group was presented at the IRPA14 Congress in Cape Town, and subsequently published in the Journal of Radiation Protection Dosimetry [4].

Radiation safety culture has some very specific challenges within the medical sector primarily because, with the focus of healthcare on diagnosis and treatment of patients, there are many other safety issues that tend to take precedence, resulting in radiation safety potentially being viewed as being of relatively little concern. However, with the rapid development of radiation technology for imaging and treatment, there is a growing awareness of the need to be vigilant over patient doses, including the justification of examinations, with exposure of paediatric patients often of particular concern.

**SURVEY OF UK STAFF ATTITUDE TO RADIATION SAFETY**

Part of the remit of the Medical Sector Working Group was to assess the current state of radiation safety culture in UK hospitals. To investigate this, a survey was carried out of hospital staff attitudes to radiation safety. The survey was aimed at all staff groups within both NHS and private hospitals, including both radiation and non-radiation workers. It consisted of a series of multiple choice questions, some of which were specific to role, and included questions on knowledge of both staff and patient doses and risks; awareness of, and compliance with, radiation safety policy and procedure; and levels of training received.

The results of the survey have been described in detail [4] and comprised data from almost 3700 individuals, covering all geographical areas of the UK, and across the spectrum of roles within the hospital. It was encouraging that approximately 80% of all respondents considered that radiation safety was given adequate importance within their organisation, and also that they had received adequate training in radiation protection. Wearing of personal protective equipment and personal dosimetry were also reported to be at a high level of compliance, although this may have been influenced by the voluntary nature of participation in the survey.

The areas of the survey that raised some concern were chiefly concerning specific knowledge on radiation dose and risk. Around 30% of respondents felt they had insufficient knowledge of their own risk, and 40% lacked understanding of that to patients. There were also questions raised concerning referral guidelines, as the majority of respondents claimed to be using local rather than national professional guidelines for referring patients for X-ray.

**PROMOTING IMPROVEMENT TO RADIATION SAFETY CULTURE IN UK HEALTHCARE**

The second part of the remit of the working group was to investigate ways of improving the current radiation safety culture in the UK. The first approach was ‘top down’ and involved engaging with managers and management organisations, regulators and inspectors. Discussions with management representatives from both the NHS and the Association of Independent Healthcare...
Organisations (AIHO) considered issues such as the radiation safety information available on relevant web sites, and how related communication to senior healthcare management could be improved. At a local level, drivers for safety culture primarily relate to national healthcare standards, and it was recognized that the inclusion of radiation safety culture metrics within these would have a beneficial effect. Culture metrics have also been discussed with regulatory groups, with a view to their more comprehensive inclusion within future inspections of healthcare organisations.

In order to provide a starting point in culture metrics, the working group has developed a ten point assessment tool for radiation safety culture, which comprises a list of ten relevant topics, each with a number of measurable indicators associated with it [Table 1]. The use of measurable indicators is important as it allows for a semi-quantitative assessment to be made at a point in time, which might serve as a baseline against which future improvements can be assessed, in addition to facilitating a performance rating for departments. The framework has potential for use both in formal inspections and as an internal assessment tool, in addition to use in training or standards. The ten point assessment has been cross-linked to the IRPA Guiding Principles and

<table>
<thead>
<tr>
<th>Assessment Topics</th>
<th>Measurable Indicators</th>
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| 1. Management     | •Senior management understand their role & responsibility in relation to radiation safety  
| engagement        | •There exists a clear management structure for radiation safety from shop floor to Board  
|                   | •The RSP contains clear description of management responsibilities & how these are audited  
|                   | •Evidence of communications between management and staff on radiation safety issues |
| 2. Appropriate    | •Appropriate radiation safety training/qualifications are included in relevant job description  
| training          | •Induction training contains appropriate level of radiation safety training – including general awareness training for non-radiation workers  
|                   | •Radiation workers and individuals recognised under IRMER have documented update training at specified intervals  
|                   | •Evidence that training complies with best practice guidelines if when available from professional bodies |
| 3. Regular audit  | •Schedule of audits incl. internal compliance audits with LRs and IRMER procedures  
| of radiation      | •Recent audit results of above compliance audits  
| safety procedures | •Independent schedule of audits by e.g. RPA, RWA with reports |
| 4. Appropriate    | •Documented use of referral criteria  
| use of diagnostic | •Evidence of culture whereby radiologists & radiographers challenge inappropriate requests  
| imaging using     | •Availability of non-ionising imaging modalities |
| ionising radiation|                       |
| 5. Appropriate    | •Documented management system in place  
| management of     | •Evidence of equipment replacement programme  
| radiation        | •Evidence of service/maintenance contracts  
| generating        | •Evidence of QA of equipment & SOPs  
| equipment and     | •Evidence of action upon QA results  
| radioactive       | •Evidence of audit of RAM policy and procedures  
| materials         | •Disposal records  
|                   | •Evidence of compliance with Permits |
| 6. Appropriate    | •Policy statement of their appointment and consultation requirements  
| appointment and   | •Evidence of appointment of suitably qualified and sufficient experts [RPA/RWA/MPE]  
| use of Accredited| •Evidence of action following reports from experts  
| Experts           | •Evidence of existence of Radiation Protection Committee  
|                   | •Evidence of appointment of suitable and sufficient RPs  
|                   | •Evidence of ‘lead manager for RAM’ |
| 7. Optimisation   | •Formation of multi-disciplinary ‘Dose Champion’ teams  
| of patient dose   | •Local DRLs in place  
|                   | •Results of audits against DRLs  
|                   | •Documented results of optimisation strategy |
| 8. Management of  | •Evidence of management system for personal dosimetry  
| staff doses       | •Percentage of incomplete dose records monitored  
|                   | •Evidence that dose results checked against Investigation Levels  
|                   | •Understanding of typical and maximum doses for different staff roles  
|                   | •Results of audits of use, checking and storage of PPEs  
|                   | •Audits of compliance with LRs |
| 9. Appropriate    | •Documented procedures for handling incidents  
| incident handling | •Evidence of timely reporting and investigation of incidents  
|                   | •Evidence of appropriate management involvement  
|                   | •Action plans for lessons learned & implementation of change  
|                   | •Evidence of open culture for reporting incidents |
| 10. Effective     | •RP issues on staff meeting agenda  
| communication     | •Staff have access to managers to raise concerns  
|                   | •Staff have access to union safety officers to raise concerns  
|                   | •Staff have access to ‘mentors/guardians’ to raise concerns  
|                   | •Managers & experts regularly communicate RP performance to relevant staff |

Table 1. The Ten Assessment Topics and associated measurable indicators.
the Bonn Call for Action, as shown in Table 2, and is complementary to these. The second, and simultaneous, approach to improving radiation safety culture is from a ‘bottom up’ perspective. This includes the dissemination of the survey results, through the professional bodies and mail-bases, to highlight the issues raised, and also focuses on addressing radiation safety training for the different staff groups and roles. Training of referers in patient dose and risk is of particular importance, but there are also issues to be addressed in ensuring that radiation safety update training is provided for all those working with radiation, along with appropriate basic training for those who come into occasional contact with radiation equipment or radioactive patients. Effective training can be realized by incorporating a variety of different techniques, and routinely assessing their impact.

**CONCLUSION**

The importance of a good culture in radiation safety for the protection of both patients and staff is being increasingly recognised, and recent initiatives in the UK complement a number of international projects in this regard. Work has been completed on assessing attitudes to radiation safety through a nationwide survey, and both top down and bottom up approaches to improving safety culture have been established. This includes production of a ten-point assessment tool, with measurable indicators, which complements existing IRPA guidelines on radiation safety culture, and the Bonn Call for Action on patient protection.

<table>
<thead>
<tr>
<th>Assessment Topics</th>
<th>Mapping to International Initiatives</th>
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<td>2. Appropriate training</td>
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<td></td>
<td>– Education &amp; Training</td>
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<td></td>
<td>Assessment of Radiation Protection Culture (Ch 5)</td>
</tr>
<tr>
<td>3. Regular audit of radiation safety procedures</td>
<td>Assessment of Radiation Protection Culture (Ch 5)</td>
</tr>
<tr>
<td>4. Appropriate use of diagnostic imaging using ionising radiation</td>
<td>Developing a Radiation Protection Culture &amp; Criteria of Success (Ch 4)</td>
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<td>– Additional factors for Medical Field</td>
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<td>5. Appropriate management of radiation generating equipment and radioactive materials</td>
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<td>– Communication Processes</td>
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**Table 2.** Correlation of the Ten Point Assessment Topics with IRPA guidelines and the Bonn Call for Action

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New Bracco fellowships for the development of young radiologists

To celebrate the 90th anniversary of the foundation of Bracco Imaging, now one of the world’s leading companies in the diagnostic imaging business, the company has launched “Bracco Fellowships”, a new educational initiative for the development of young European radiologists. A total of 90 grants will be allocated in the initiative which will be administered jointly with the European Society of Radiology.

“At the recent annual ECR congress, Bracco Imaging, announced the launch of “Bracco Fellowships”, a new and unique initiative introduced in partnership with the European Society of Radiology (ESR), with the aim of promoting excellence among European radiologists. This educational program, devoted to the professional development of young radiologists, has been created to mark the occasion of the 90th anniversary of Bracco’s Foundation, in line with the company’s long-lasting commitment to support the diagnostic imaging community.

“I am particularly proud to partner with the ESR for this important educational program,” said Fulvio Renoldi Bracco, Head of the Business Unit Imaging at Bracco Imaging. “For decades, we have been supporting the development of the radiological community with continuous efforts in education. This year, on the occasion of the 90th anniversary of Bracco, we are further confirming our commitment to the values that have been at the core of our focus, namely education for the talented personnel of the future and development of the radiology profession,” he added.

Prof. Paul M. Parizel, who is Chair of the Board of Directors of the European Society of Radiology and Past President of ECR 2017 and ESR, added: “I am very happy that Bracco and ESR share a common vision of radiology education. This convergence of ideas and joining together of our forces, will open up the world of international education for a new generation of young radiologists.”

With the “Bracco Fellowships” program, which will be coordinated by the European School of Radiology (ESOR), Bracco will provide a total of 90 grants that will be used to support the training of young radiologists with high leadership potential at leading healthcare centres.

Bracco Imaging S.p.A., part of the Bracco Group, is one of the world’s leading companies in the diagnostic imaging business. Headquartered in Milan, Italy, Bracco Imaging develops, manufactures and markets diagnostic imaging agents and solutions that meet medical needs. Bracco Imaging offers a product and solution portfolio for all key diagnostic imaging modalities: X-ray Imaging (including Computed Tomography-CT, Interventional Radiology, and Cardiac Catheterization), Magnetic Resonance Imaging (MRI), Contrast Enhanced Ultrasound (CEUS) and Nuclear Medicine through radioactive tracers.

The diagnostic imaging offer is completed by several medical devices and advanced administration systems for contrast imaging products in the fields of radiology.

For more information, please contact Bracco Imaging
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BRACCO IMAGING
MILAN, ITALY
http://imaging.bracco.com
B. Braun and Philips collaborate on ultrasound-guided regional anesthesia and vascular access

B. Braun Melsungen, the global leader in regional anesthesia and pain management, and Philips, global leader in ultrasound and image guided therapy solutions, have announced a multi-year strategic alliance to innovate ultrasound-guided regional anesthesia — a rapidly growing alternative to general anesthesia — and vascular access. The two companies are jointly developing and commercializing solutions to support anesthesiologists and hospitals in critical areas of regional anesthesia. These products are intended to enhance needle visualization and guidance, as well as to optimize procedure workflow and resource planning. The alliance will also focus on vascular access procedures, such as those used to insert catheters into deeply seated veins as part of catheter-based treatments.

As a platform on which to implement their joint innovations, Philips and B. Braun have launched the new Xperius ultrasound system, which will be available in a cart and ultra-mobile tablet version and was specifically designed to support the needs in regional anesthesia at the point of care.

Regional anesthesia involves the injection of anesthetic in the proximity of a nerve, in areas of a patient’s body that will be accessed surgically. The approach has significant advantages over general anesthesia for both patients and hospitals. Patients undergoing regional anesthesia typically benefit from reduced opioid consumption, fewer side-effects and faster post-surgical recovery, thus allowing them to ambulate or be discharged from the hospital sooner. However, regional anesthesia and especially peripheral nerve blocks are not easy to perform. Maximizing anesthetic effectiveness and preventing damage to the targeted nerve or other tissue structures depends on the accurate placement of the needle tip through which the anesthetic is injected or a catheter placed. Hence, there is a real need for innovations for safety and efficiency improvement.

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Deep learning research consortium receives Swedish government grant

A Swedish consortium including ContextVision, the medical technology company specializing in image analysis and artificial intelligence, has received a support grant of SEK 500 000 from the Swedish government-funded innovation agency, Vinnova. The funds are for a project to evaluate whether deep learning can provide a more accurate and more reliable analysis of images than visual inspection. The research will focus on a well-defined group of cancer patients where PET/CT-images before- and after-treatment are available. The consortium includes two prestigious Swedish institutions, the Royal Institute of Technology and the Karolinska Institute, as well as two commercial partners, namely Electa AB and ContextVision AB. “This is a very prominent group of skilled researchers and we are proud to be chosen as a close research partner for this project,” said Anita Tollstadius, CEO of ContextVision. Advanced analysis with deep learning will be carried out through close collaboration within the consortium, with ContextVision as expert advisors in deep learning technology. Clinical data will be used to develop algorithms that can predict survival and cure.

ContextVision has developed an expertise in deep learning, the latest technology within the broader field of artificial intelligence, and uses the technology for the development of new, innovative products with the potential to improve healthcare.

In a separate announcement from ContextVision, the company announced its collaboration with the Centre for Medical Imaging Science and Visualization (CMIV) at Linköping University which is developing a new database for medical and pathology images to offer training data for new artificial intelligence-based (AI) products. As an early partner, ContextVision and another Swedish company, Sectra, will have the opportunity to create commercial value from the database.

New, AI-based solutions have the potential to improve workflow, accuracy and patient care, and ultimately overall healthcare, but a large quantity of data is required for accurate training of new algorithms. This new database will facilitate the development of different AI-based systems supporting cancer-related medical imaging. The evaluation of medical images is crucial for accurate cancer care but is currently complex to manage for radiologists and pathologists due to the ever-increasing number of images.

“Accessing images is the starting point for AI product development within medical imaging. Ensuring ContextVision has broad access to these different images increases our flexibility and opens up further opportunities,” said Tollstadius.

CONTEXTVISION
STOCKHOLM, SWEDEN
www.contextvision.com
European regulatory committee recommends the suspension of marketing authorization for some linear GBCAs

Several years ago the world of contrast-based MRI was concerned by the occurrence of Nephrogenic Systemic Fibrosis (NSF) — a potentially serious scarring condition in patients with kidney impairment — associated with the administration of Gadolinium Based Contrast Agents (GBCAs) in patients with impaired renal function. Studies into GBCAs prompted the categorisation of GBCAs into low-, mid- and high-risk categories depending on the chemical structure of the molecule used to chelate the gadolinium ion itself. Macrocyclic molecules were low risk whereas linear, non-ionic chelates were shown to be greater risk of dissociation of the Gd ion and so were classed as high risk. In practice the occurrence of NSF has now effectively been eliminated by avoiding the administration of GBCAs to patients with poor renal function.

Now there are again questions regarding the safety of GBCAs, triggered by the findings three years ago of deposits of gadolinium in the brains of patients who had received several GBCA MRI scans. Several studies have since confirmed these findings and suggest that deposition of Gd in the brain is not dependent on the patient’s renal function. However, so far at least, there have been no reports of any adverse events associated with the deposition of Gd in the brain.

The European Commission tasked the European Medicine Agency to investigate the question of Gd deposition in the brain (GBCAs are regulated as drugs).

The Pharmacovigilance and Risk Assessment Committee (PRAC) of the European Medicine Agency has now issued its report and has recommended the suspension of the marketing authorizations for four linear gadolinium contrast agents because of the evidence that small amounts of the gadolinium they contain are deposited in the brain.

The agents concerned are intravenous injections of gadobenic acid, gadobamide, gadopentetic acid and gadoversetamide — marketed as Multihance, Omniscan, Magnevist and Optimark respectively.

The PRAC recommends that macrocyclic GBCAs be used in MRI — above is a diagrammatic representation of the molecular structure of Gadoterate meglumine, marketed by Guerbet as Dotarem. Macrocyclic GBCAs are considered less likely to release gadolinium than linear GBCAs, whose marketing authorisation the PRAC has recommended to be suspended.

The PRAC’s review of gadolinium agents found convincing evidence of accumulation of gadolinium in the brain from studies directly measuring gadolinium in brain tissues and areas of increased signal intensity seen on MRI scan images many months after the last injection of a gadolinium contrast agent.

Although no symptoms or diseases linked to gadolinium in the brain have been reported, the PRAC took a precautionary approach, noting that data on the long-term effects in the brain are limited. Deposition of gadolinium in other organs and tissues has been associated with rare side effects of skin plaques and NSF. Furthermore, non-clinical laboratory studies have shown that gadolinium can be harmful to tissues.

The four agents recommended for suspension are linear agents which have a chemical structure shown to be more likely to release gadolinium, which can build up in body tissues. Other agents, known as macrocyclic agents, are more stable and have a much lower propensity to release gadolinium. The PRAC recommends that macrocyclic agents be used at the lowest dose that enhances images sufficiently to make diagnoses and only when unenhanced body scans are not suitable.

For those marketing authorizations recommended for suspension, the suspensions can be lifted if the respective companies provide evidence of new benefits in an identified patient group that outweigh its risks or show that their product (modified or not) does not release gadolinium significantly (dechelation) or lead to its retention in tissues.

**THE PROCEDURE**

The review of gadolinium contrast agents was initiated on 17 March 2016 at the request of the European Commission.

The review has been carried out by the Pharmacovigilance Risk Assessment Committee (PRAC), the Committee responsible for the evaluation of safety issues for human medicines, which made a set of recommendations. The PRAC’s final recommendations will be sent to the Committee for Medicinal Products for Human Use (CHMP), responsible for questions concerning medicines for human use, which will adopt the Agency’s opinion. The final stage of the review procedure is the adoption by the European Commission of a legally binding decision applicable in all EU Member States.

**RE-EXAMINATION REQUESTED OF PRAC RECOMMENDATION**

In an update issued on 7th April, the PRAC issued a statement:

Following the PRAC’s March 2017 recommendation, some of the marketing authorisation holders concerned by this referral procedure have requested a re-examination. Upon receipt of the grounds for their requests, the PRAC will start a re-examination, which is expected to conclude in July 2017.
21st Annual Meeting of the European Association of Cardiovascular Imaging (EACVI), a registered branch of the ESC, in cooperation with the Portuguese Working Group of Echocardiography.

2017 Deadlines
Call for Abstracts and Clinical Cases 1 April - 31 May
Early registration 30 September
Late registration 31 October

Lisbon - Portugal
6-9 December 2017

www.escardio.org/EACVI
Clinical cardiac MRI in China: current status and future

A newly published review article describes the real-world clinical application of Cardiac Magnetic Resonance Imaging in China and discusses obstacles for its future development. (Chen S, Zhang Q & and Chen Y. The Role of Clinical Cardiac Magnetic Resonance Imaging in China: Current Status and the Future. Cardiovascular Innovations and Applications; 2017; 2: 61.)

Cardiac magnetic resonance (CMR) imaging plays an important role in the diagnosis and management of cardiovascular diseases and has many advantages in cardiac imaging, including excellent spatial and temporal resolution, unrestricted imaging field, no exposure to ionizing radiation, excellent tissue contrast, and unique myocardial tissue characterization. Clinical CMR imaging is widely used in cardiovascular diagnostic workup in the United States and some European countries.

SITUATION IN CHINA

Ischemic heart disease is a major cardiovascular disease in China. There are two million patients with myocardial infarction and almost 500,000 new cases of myocardial infarction annually.

In China, the use of CMR imaging in hospitals is emerging and has a promising future. On the basis of a brief survey conducted in 2015 to investigate current CMR imaging practice in mainland China, 77 of the 108 participating hospitals reported that they routinely perform clinical CMR imaging. Most of them (63, 82%) were university or academic hospitals. About half of these hospitals performed 50–200 scans per year and only five centers performed more than 500 scans per year. For example, the number of clinical CMR scans in West China Hospital increased from 20 per year to more than 1000 per year from 2009 to 2015, but this still lags far behind clinical demands.

The common reasons for CMR imaging are suspected cardiomyopathies, mostly non-ischemic, including hypertrophic cardiomyopathy (HCM; 24.6%), dilated cardiomyopathy (DCM; 17.9%), amyloidosis (2.5%), restrictive cardiomyopathy (2.1%), arrhythmogenic right ventricular cardiomyopathy (ARVC; 1.1%), left ventricular noncompaction (0.4%), and Fabry disease (0.4%); only 21.1% of patients were referred for evaluation of viability after myocardial infarction. In addition, the survey showed that there are state-of-the-art scanners in most hospitals, which provide a good means to promote the clinical utility of CMR imaging.

To further evaluate the situation in China, Chen et al. carried out a search for the terms “stress CMR” and “China” in all available databases, including PubMed, Ovid, and Chinese Wanfang databases, to conclude that there are very few reports on stress CMR imaging performed in patients with suspected ischemic heart disease.

THE CHALLENGES AND FUTURE DIRECTION OF CLINICAL CMR IMAGING IN CHINA

Although advanced MRI scanners are available in an increasing number of hospitals in China, Chen et al.’s recent survey recent survey demonstrates that very few hospitals in China have the ability to perform clinical CMR imaging programs. The number of hospitals with a CMR examination volume of more than 200 cases per year is low.

Secondly, few cardiologists have been trained in CMR imaging, whereas most of the scanning and reporting work is done by technicians and radiologists, who are less experienced in interpreting the images.

Lastly, there was no evidence of guidelines or consensus for the clinical use of CMR imaging in China until the first Chinese expert consensus on CMR application in cardiomyopathy was released in 2015. This consensus defined the possible clinical roles of CMR imaging and potential indications for application of CMR imaging, and provides useful instructions for referring patients for CMR imaging and helps clinicians to understand the unique role of CMR imaging in cardiomyopathy.

THE FUTURE

With regard to future developments, Chen et al. propose that standardizing the CMR protocols should be the first step, including scanning, postprocessing, and reporting, to ensure a high quality of clinical CMR imaging.

This must be followed by the establishment of a multidisciplinary team to enroll more cardiologists who are interested in CMR imaging.

Thirdly, more high-quality CMR studies in the Chinese population should be encouraged, in particular in those diseases that are more prevalent in China with different phenotypes within the population.

https://tinyurl.com/Chen-Zhang-et-al-paper
Korean research project describes smarter MRI diagnosis with a nano MRI lamp based on magnetic resonance tuning

A research team at the Center for Nanomedicine, in the Institute for Basic Science (IBS), in Daejeon, Korea have published preliminary results of their research designed to overcome the limitations of current contrast agents (Choi J, Kim S, Yoo D, Shin T-H, Kim H, Gomes MD, Kim SH, Pines A and Cheon J). Distance-dependent magnetic resonance tuning as a versatile MRI sensing platform for biological targets. Nat Mater. 2017;16(5):537-542. The Nano MRI Lamp that the team have developed is a new technology platform that tunes the magnetic resonance imaging (MRI) signals “ON” only in the presence of a targeted disease.

MRI is the increasingly popular non-invasive imaging modality which does not use involve radiation and frequently involves the administration of a contrast agent to enhance the difference between the target area and the rest of the body. “Typical MRI contrast agents, like gadolinium, are injected in an “ON” state and distributed across the whole biological system with a relatively large background signal,” explained Dr J Cheon, lead author and director of the Nanomedicine Institute. “We found a new principle to switch the MRI contrast agent “ON” only in the location of the target.” IBS scientists do this by using a Nano MRI Lamp which consists of two magnetic materials: a quencher (magnetic nanoparticle) and an enhancer (MRI contrast agent). The so-called switch depends on the distance between the two. When the two materials are at a critical distance apart, greater than 7 nanometers (nm), the MRI signal is “ON” whereas if they are closer than 7 nm, the MRI signal is “OFF”. This phenomenon is known as Magnetic REsonance Tuning (MRET), which is analogous to the powerful optical sensing technique called Fluorescence Resonance Energy Transfer (FRET).

The researchers tested the Nano MRI Lamp principle in animal models of cancer and were able to detect the presence of an enzyme that can induce tumor metastasis, matrix metallo-proteinase-2 (MMP-2) in mice with cancer. They connected the two magnetic materials with a linker that is naturally cleaved by MMP-2. Since the linker keeps the two materials close to each other, the MRI signal was “OFF”. However, in the presence of the cancer, the linker is cleaved by MMP-2, which cause the two materials to be separated and the MRI signal switched “ON”. Therefore, the MRI signal indicated the location of MMP-2, and the tumor. The scientists also found that the brightness of the MRI signal correlates with the concentration of MMP-2 in the cancerous tissue.

Most importantly, the Nano MRI Lamp remains switched off until it meets a biomarker associated with a specific disease, allowing higher sensitivity. “Current contrast agents are like using a flashlight during a sunny day: the effect is limited. Instead, this new technology is like using a flash light at night and therefore more useful,” explained Cheon.

“Although we still have a long way to go, we established the principle and believe that the MRET and Nano MRI Lamp can serve as a novel sensing principle to augment the exploration of a wide range of biological systems,” concludes Cheon.

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

Radiation exposure from nuclear cardiology practices in Oceania

Worldwide there is concern about radiation exposure associated with radionuclide myocardial perfusion imaging (MPI). A sub-study of the International Atomic Energy Agency (IAEA) Nuclear Cardiology Protocols Study was carried out to report on radiation doses from MPI, and the use of dose-optimisation protocols in Australia and New Zealand (ANZ), and to compare them with data from the rest of the world. The results have just been published (Biswas S et al; Cardiology Practices and Radiation Exposure in the Oceania Region: Results From the IAEA Nuclear Cardiology Protocols Study (INCAPS). Heart Lung Circ. 2017; 26(1):25-34). Data were collected from 7911 MPI studies performed in 308 laboratories worldwide in one week in 2013, including 439 MPI studies from 34 ANZ laboratories. For each laboratory, the effective radiation dose (ED) and a quality index (QI) score (out of 8) based on pre-specified “best practices” was determined.

In ANZ patients, ED ranged from 0.9-17.9 milliSievert (mSv). Median ED was similar in ANZ compared with the rest of the world, as were mean QI scores. Median ED was significantly lower in metropolitan versus non-metropolitan laboratories (10.1 mSv vs. 11.6 mSv, P<0.01), although mean QI scores were similar.

The authors conclude that across ANZ, there is large variability in Effective Dose from MPI, and use of radiation safety practices, particularly between metropolitan and non-metropolitan laboratories. However overall, ANZ laboratories have a similar median ED to laboratories in the rest of the world.

https://tinyurl.com/Biswas-et-al-paper
A recently published paper has reviewed the current situation of breast mammography in Japan and has highlighted the need for supplemental breast imaging.\(^{(Uematsu T. The need for supplemental breast cancer screening modalities: a perspective of population-based breast cancer screening programs in Japan. Breast Cancer. 2017;24: 26-31)}\)

Mammography is the only screening test that has been proved to reduce breast cancer mortality. However, mammographic sensitivity is inversely proportional to breast density. Japanese women have in general a smaller breast volume and relatively dense breasts, and screening mammography tends to be less effective because of the masking effect. The mammographic sensitivity of 88–100% which can be obtained in Japanese women with fatty breast tissue can decrease by up to 50–57% in Japanese women with extremely dense breast tissue.

Unfortunately, relatively few Japanese women participate in screening programs — the participation rate for screening mammography has been reported to be as low as 34.2% in Japan compared to 72.4% in the United States.

World-wide, breast cancer-related morbidity and mortality are highest in the United States and Europe and lowest in Japan. However in Japan both morbidity and mortality have been increasing over the past three decades.

As in the rest of the world, breast cancer is the most common cancer in women worldwide, including in Thailand, where currently screening mammogram facilities are available only in large and/or well-funded hospitals (e.g. medical schools, regional hospitals, cancer hospitals, and large private hospitals).

The results of the first longitudinal cohort of women undergoing opportunistic mammographic screening in Thailand have just been published.\(^{(Sripaiboonkij N et al. Breast Cancer Detection Rate, Incidence, Prevalence and Interval Cancer-related Mammography Screening Times among Thai Women. Asian Pac J Cancer Prev. 2016;17(8):4137)}\). A total of 47,430 women were included in the retrospective study, of normal women between 30 and 80 years who underwent the procedure. The detection rate was calculated for the whole period of observation using ‘number of women with positive findings’ divided by ‘total number of women screened’.

Dr Uematsu highlights the current status and clinical pathways regarding possible supplemental breast cancer screening modalities for younger women with dense breasts from the point of view of population-based breast cancer screening programs in Japan. Some supplemental breast cancer screening modalities (e.g. supplemental Ultra Sound, digital breast tomosynthesis, MRI or even PET, have been proposed to increase sensitivity and detection rates of early stage breast cancer in women with dense breasts. However, there are no global guidelines that recommend the use of such supplemental breast cancer screening modalities in such women. Also, no reference standard exists for breast density assessment. An appropriate population-based breast cancer screening program based on cost and benefit balance should therefore be a high priority.

Further study and research based on evidence-based medicine for possible supplemental breast cancer screening modalities are to be encouraged. Furthermore, it is very important that ethnicity, workforce, workflow, and resources for breast cancer screening be considered when considering supplemental breast cancer screening modalities for women with dense breasts.

The Japan Breast Cancer Screening Mammography Program started in the year 2000 for women aged 50 years and over, with biennial mammography using one-view, namely mediolateral oblique. Since 2004, two-view screening mammography has been recommended for women aged 40–49 years. The age-specific incidence of breast cancer is highest for women aged between 45 and 49 years, supporting the argument that screening mammography should begin at the age of 40 years in Japan. At present, clinical examinations are not recommended by the Ministry of Health, Labor, and Welfare of Japan.

http://tinyurl.com/Uematsu-paper
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Changing perspectives in endoscopic ultrasonography training in Asia

Endoscopic ultrasonography (EUS) is an increasingly important sub-specialty practice for endoscopists in Asia. Formal training in EUS is traditionally provided as a one-year advanced endoscopy fellowship to experienced endoscopists. Considered technically daunting, the practice of EUS calls for a skillset that is beyond the scope of ordinary endoscopy. To become an endosonographer, an endoscopist must master the necessary technical, cognitive and interpretive skills. Acquiring the basic skills is just the beginning of a long journey in EUS education and practice. As technological advancements in EUS keep pushing the boundaries of its applications, endosonographers today must continue to learn and master new EUS techniques or procedures to remain professionally relevant.

This has significantly impacted EUS education/training, which now must cater for novices, as well as for practising endosonographers at varying levels of experiences. In Asia, where opportunities for formal EUS fellowship are extremely limited, this is a massive shortfall in training to fill up. To keep pace with the rapid developments in EUS practices, stakeholders must accelerate the delivery of EUS education/training.

To meet this challenge, the Asian EUS Group (AEG) has taken the lead in fast-tracking the dissemination of EUS knowledge and skills across Asia through its multinational network of training centres. AEG has conducted more than 100 short-term EUS courses in more than 16 Asian cities since 2012, with remarkable success. Almost 1600 endosonographers have benefitted from the AEG programs, which are designed to cater to the needs of both basic and continuing EUS education. Programs typically combine lectures, live-case demonstrations, and hands-on training on phantoms, simulators or live animal models. Eligible candidates can enrol for the course that best suits their experience level, and can progress over as many courses as desired to attain their educational goals. AEG’s programs are brought to wherever there is demand. Its versatile modular structure allows the programs to be easily customized and scaled up or down to suit local needs, making it highly adaptable to the changing and varying needs in different countries.

Fundamentals of EUS education and training

Endoscopic ultrasonography (EUS) is the minimally invasive imaging modality that enables the sonographic visualization of the walls of the gastrointestinal tract and adjacent structures in the mediastinum and pancreaticobiliary region. It enables the endoscopist to visualize anatomical details of the organs scanned, make diagnosis and initiate and monitor treatment [1].

Training endosonographers is a rigorous process since carrying out EUS requires a blend of technical, cognitive and interpretive skills. The technique necessitates a good background knowledge of ultrasonic imaging and familiarity with the cross-sectional anatomy of the gastrointestinal wall and nearby organs. Apart from acquiring the technical skills needed to safely manoeuvre the various types of echoendoscopes, the aspiring endosonographer must know the indications for EUS, expected outcomes, as well as risks involved. He/she must learn to recognize ultrasound patterns of organs in diseased and normal state, interpret whatever abnormalities are present, and be able to discriminate an imaging artefact from a real abnormality. By the end of basic EUS training, the trainee...
is expected to have acquired the essential skills to perform diagnostic EUS procedures, including EUS-guided fine needle aspiration (EUS-FNA) of biological fluids, as well as to be able to accurately diagnose stage submucosal masses, and evaluate/manage common pancreatic-biliary disorders. Once a certain competency in performing these diagnostic EUS procedures is achieved, the trainee may advance to learn more complicated interventional procedures, e.g., drainage of pancreatic cysts, neurolysis of celiac plexus.

**Conventional EUS training, credentialing, and shortage of training opportunities**

Traditionally, the training of endosonographers in Asia has relied on both formal and informal training approaches. As in other regions, a formal advanced endoscopy fellowship with preceptorship by an expert EUS practitioner has always been perceived as the ideal way of training aspiring endosonographers. Such EUS fellowships are offered only to candidates with documented competence in diagnostic endoscopy and relevant aspects of therapeutic endoscopy. To-date, these fellowships remain the only formal and accredited form of EUS education in Asia. Delivered via lectures and hands-on tutelage, a typical EUS fellowship may run over a period of 12 months (in rare instances, 6 months), with clinical apprenticeship as the focal point of training. As training of EUS on human patients can involve significant risk of complications, fellows are given ample opportunities to hone their skills outside the endoscopy suite, using animal models or simulators. Clinical apprenticeships are particularly sought-after in Asia as such learning opportunities are extremely limited. A diverse range of diagnostic and therapeutic procedures is needed to accomplish the basic EUS training. For a new endosonographer to be credentialed, he/she must successfully complete a sizable number of luminal, pancreatic-biliary EUS, and EUS-FNA procedures. There is no Asian consensus on the minimum level of training and experience to attain competency in EUS, but generally the internationally recognized guidelines for EUS credentialing are adopted, such as those stipulated by the European Society of Gastrointestinal Endoscopy, British Society of Gastroenterology, or the American Society for Gastrointestinal Endoscopy (ASGE) [2-5].

Overall, the number of EUS fellowships in Asia has increased substantially in recent years, but the number of additional vacancies created is still insufficient to meet the rising demands. Scaling up of clinical apprenticeship is almost impossible as the number of trainees that a preceptor can take on each time is limited. Besides, there aren’t many qualified mentors available to take on preceptorship responsibilities. There is thus a serious dearth of accredited EUS training opportunities for endoscopists in Asia. Some institutions in Asia now provide supplementary opportunities in the form of EUS observership programs that facilitate learning by observations of clinical procedures, but trainees on such programs are not allowed to actively carry out EUS.

**Advancement in EUS practices and shift in training needs**

EUS is a rapidly evolving subspecialty in gastroenterology. Continual advancements in EUS technologies is pushing the boundaries of EUS applications. What started off as a purely diagnostic imaging modality in the 1980s, EUS is now an indispensable imaging modality for diagnosis and preoperative staging of gastrointestinal and pancreaticobiliary cancer, and a tool for a wide range of image-guided interventional therapeutic procedures, e.g., intratumoral drug delivery, celiac plexus neurolysis, brachytherapy, radiofrequency ablation of tumor, and drainage of pancreaticobiliary fluid collections [6, 7, 8]. The need to train more endosonographers and upgrade skills of existing ones has become more pressing than ever before.

This poses a strain on limited EUS education resources which must now cater to the training of novices, as well as endosonographers at varying levels of their careers. The situation is especially critical now in Asia, where the shortage of formal EUS training fellowships persists.

**New education models to accelerate EUS education and training**

To accelerate the delivery of EUS education and training, more adaptive models of teaching that can be readily configured to meet specific local needs are necessary. In this respect, the Asian EUS Group (AEG), a non-profit professional interest group made up of regional EUS experts, has made the first move to fast-track the dissemination of EUS knowledge and skills across Asia. It does so by conducting regular intensive short-term EUS education programs through its network of training centres in countries across Asia. The programs, each comprising multiple modules/courses, are carefully designed to cater to the needs of both basic and continual EUS education in the region. Each course is tailored to a specific level of learning and aimed to accomplish specific learning outcomes. Programs typically combine the use of didactic lectures, hands-on learning using phantoms, simulators or live animal models, and skills demonstrations by expert practitioners through live video-streaming [9]. Where appropriate, newer innovative models of practical teaching are used to teach interventional EUS, e.g., using the novel Mumbai 3-dimensional stereolithography bile duct prototype and artificial cysts filled with various materials for training of EUS-guided biliary and pseudocyst drainage, respectively [10]. A discussion forum after each hands-on session provides a platform for trainees to interact directly with experts and gain from the meaningful case discussions. Trainees have access to an expert international faculty throughout the duration of the course. AEG’s courses are offered from basic to advanced levels, with advanced programs tailored to meet the continuing education needs of mid- to senior-level EUS practitioners interested to learn various EUS-guided...
interventional procedures. Eligible candidates can enrol for the course that best suits their experience level, and advance over as many courses as desired to attain

“The Asian EUS Group (AEG) has made the first move to fast-track the dissemination of EUS knowledge and skills across Asia…”

their educational goals. AEG’s programs are brought to wherever there is demand. Its versatile modular structure allows programs to be easily customized and scaled up or down to suit local needs, making it highly adaptable to the varying requirements in different countries.

Advantages of AEG’s short-term EUS training programs

AEG’s open-ended model of learning provides an alternative pathway to gain EUS knowledge or skills where formal training opportunities are lacking or not suitable. Although not as rigorous as full-time EUS fellowships, these short-term intensive and interactive programs are useful, effective, and a certain boost to existing efforts. A study conducted by Wang et al. (2015) has shown that the well-structured EUS training programs organized by AEG improved EUS skills significantly [11]. Post-training, the trainees recorded significant improvement in the overall mean (±SD) scores in tests conducted (77.5 ± 0.2% vs. 66.0 ± 0.3% pre-training, P < 0.0001). The short term training programs are not meant to replace established EUS fellowships; rather they complement existing education/training efforts, and help expedite the dissemination of EUS knowledge and skills at an Asia-wide level. Compared to one long fixed-term fellowship, breaking the course of training to shorter progressive modules can in fact be advantageous to some. Modular learning makes it expedient for learners to learn at their own pace, and is particularly appropriate for continual EUS education of busy endosonographers who need the flexibility of progressive learning to avoid long down-time and disruption to their regular practices.

Propagating EUS education – the training of propagators

Since 2012, AEG has conducted more than 100 EUS training programs in Northeast Asia (mainland China, Hong Kong SAR, Japan, Korea, Taiwan), Southeast Asia (Vietnam, Thailand, Myanmar, Philippines, Malaysia, Singapore, Indonesia), South Asia (Sri Lanka, India, Pakistan), and West Asia (Saudi Arabia), with remarkable success [11]. Thus far, the number of endosonographers trained through AEG programs has reached nearly 1600 (personal communication, Ho K Y). With this early success, the AEG has gone beyond the training of endosonographers to train a group of professional EUS trainers who could be assigned to train others in the region. The AEG “train-the-trainer” program is uniquely suitable for Asian requirements, and is only offered to senior endosonographers who are sufficiently experienced and willing to take on EUS teaching and mentoring responsibilities at their own places of practice. Prospective trainers must undergo a brief AEG trainer course, become familiar with the AEG model of EUS education, and achieve a certain competency before they are authorised to train endoscopists in their own localities. To-date, AEG’s “train the-trainer” programs have produced almost 50 trainers in countries across Asia. These qualified trainers are now doing their part to fill the gaps of EUS education/training in their home countries, using the same AEG training model.

Prospects of further development

AEG’s EUS programs are still in the early stage of development: there is plenty of room for improvement. For example, the curriculum for various modules could be further strengthened by better streamlining content to enhance learning outcomes. As the programs do not provide clinical tutelage, arrangements must be made with various centres of excellence for EUS training to allow graduates from the AEG programs who have acquired sufficient credits to undergo a variable-term apprenticeship under a senior EUS practitioner to gain hands-on experience and to achieve proper credentials for the practice of EUS. To this end, it may be necessary to work with regional academic tertiary centres to devise a common robust system for proper assessment of the competency of graduates from alternative learning pathways, and open the way for qualified graduates to gain further hands-on experiences to enter mainstream EUS practices.

Conclusions

The education and training of endosonographers will remain a formidable challenge in most parts of Asia for years to come. A shift in mind-set on how endosonographers should be trained to accommodate a diverse range of training programs should help Asia cope with the current dearth of formal EUS training fellowships. AEG’s open-ended progressive learning model is expected to adapt well to the changing needs and help expedite the training of endosonographers in Asia. But the value of these training programs can only be fully realized if these programs can be officially endorsed and graduates can move on to formal clinical apprenticeship to achieve the credentials required for EUS practice.

References

Impressively innovative high-end 3Tesla MRI

The official public launch of the innovative Magnetom Vida, the new high-end 3 Tesla MRI from Siemens Healthineers, took place in the course of a special symposium in which leading staff members of the Department of Diagnostic and Interventional Radiology at the prestigious University Hospital of Tübingen, Germany presented the results of their evaluation of the new system and described the intended use and applications they plan for the new system.

The first scanner to be equipped with BioMatrix, a brand-new, innovative scanner technology, the Magnetom Vida has been undergoing extensive clinical tests and evaluation for several months at Tübingen and other test sites. However for more than five years now, Siemens Healthineers has actually been developing the innovative BioMatrix technology which addresses the challenges posed by the inherent anatomical and physiological differences among individual patients, as well as variability among users. The Magnetom Vida and BioMatrix combination allows users to meet the growing demand for MR imaging, perform the full range of routine as well as complex examinations, and deliver robust results for every patient.

The new scanner has been shown to make MRI more cost-effective by reducing rescans and increasing productivity. High-precision imaging means that radiologists can deliver essential and comprehensive image information available. "Magnetom Vida gives us this data quality and reproducibility of whole-body diffusion. Precise control of scan parameters in real-time to match the individual patient anatomy makes it possible to avoid distortions, which can render diffusion imaging non-diagnostic, especially in 3 Tesla MRI."

BioMatrix Interfaces accelerate the scanning process by up to 30 percent. Automated patient positioning based on intelligent body models automatically moves the patient table to the correct scan position. An intuitive touchscreen user interface integrated onto the scanner allows for one-touch positioning. A new, easy-to-move motorized patient table further simplifies examinations, especially for adipose, immobile, and trauma patients.

The ability to provide consistent and reproducible quality regardless of the individual patient and user will help reduce rescans, which can be a great financial burden for healthcare institutions. It has been shown that MRI rescans can account for up to 100,000 Euro additional costs per year per system (André et al, J Am Coll Radiol 2015:12:689).

In his presentation at this symposium, Prof K. Nikolaou, Medical Director of the Department of Diagnostic and Interventional Radiology at University Hospital Tübingen considered the Magnetom Vida to be a useful part of the general trend toward precision medicine: "To provide our patients with individual therapies, we need every piece of information available". Referring to the clinical validation of the new MRI scanner in his department, Nikolaou continued "Magnetom Vida gives us this data quality and comprehensive image information so that we can choose the right kind... It has been shown that MRI rescans can account for up to 100,000 Euro additional costs per year per system. (André et al, J Am Coll Radiol 2015:12:689)"

Copyright: Siemens Healthineers
system were translated into a new 3 Tesla magnet design. Magnetom Vida’s all-new system architecture offers extremely high performance and provide previously unmet long-term stability – without requiring any more space than previous clinical systems. The new scanner’s 60/200 XT gradient system provides over 2.7 megawatts of power, making it the most powerful commercially available gradients in a 70-centimeter bore scanner. And, thanks to a very large field of view (55 x 55 x 50 cm), Magnetom Vida can also cover larger body regions in one step, such as full coverage abdominal exams.

The result is a great increase in productivity for routine examinations of the brain, spine, and joints – from correct patient positioning at the touch of a button to transferring the clinical images to the PACS archiving system. A new user interface allows not only for automated acquisition and processing, but also more advanced post-processing applications to run at the scanner. With spine examinations, for instance, the time needed can be reduced by about a fifth. This means that a department could carry out four additional spine examinations per day and per system. Given the decline in reimbursement rates, this is of great value to many radiological institutes.

**BROADER PATIENT GROUPS AND NEW CLINICAL GROWTH AREAS**

Thus, with Magnetom Vida, Siemens Healthineers is not only helping radiology providers around the world to optimize their workflows. The system also allows customers to access additional clinical growth fields – for instance, by serving patient groups that were previously deemed unsuitable for MRI due to issues such as cardiac arrhythmias, excess weight, or health problems that prevent them from actively supporting the scan. Magnetom Vida, expands Siemens’ Compressed Sensing applications – which can make MRI scans up to ten times faster – to cover more body regions. It features Compressed Sensing Cardiac Cine, which allows free-breathing cardiology examinations Now, Compressed Sensing Grasp-Vibe, which enables dynamic, free breathing liver examinations in one comprehensive scan at the push of button and for every patient, is also available. Until today, in contrast, dynamic liver imaging required four steps with exhausting breath-holds and complex timing.

Grasp-Vibe technology also makes the post-processing of liver images significantly faster. In the studies carried out on the new system in Tübingen, Professor Notohamiprodjo found that post-processing times fell from 20 to just four minutes.

Magnetom Vida even simplifies whole-body scans, which are currently particularly challenging, because they have to cover multiple scan sections. The new Whole-Body Dot Engine acquisition of whole-body MRI exams is assisted and with many automated steps the acquisition can be performed in 25 minutes only.

Whole-body MRI is a rapidly expanding clinical field but is difficult to perform and time consuming. With the new Whole-Body Dot Engine acquisition of whole-body MRI exams for therapy control. Providing high-quality diffusion weighted imaging is important for whole body exams — Magnetom Vida, with its BioMatrix Tuner technology, can provide this distortion-free. Combined also with its strong 60/200 gradients and a large homogeneous field of view, Magnetom Vida makes whole-body examinations simple to perform, reproducibly, and with very high quality. The planning and execution of the scan requires only a few simple clicks.

While this is partly due to BioMatrix technology, it is also a result of several insights and technical advances that developers at Siemens Healthineers have gained from intense fundamental research and close customer collaboration. Key lessons from the development of a 7 Tesla research MRI

As part of BioMatrix technology, CoilShim 1 helps users avoid costly rescans by adapting imaging parameters to the patients’ unique anatomy. In challenging areas like the head/neck region, various tissue boundaries can compromise quality. CoilShim improves homogeneity in this region to deliver more consistent, reproducible high-quality imaging.

Copyright: Siemens Healthineers

of personalized therapy and evaluate it – to see, for instance, how a patient responds to chemotherapy before tumor removal.”

**FASTER SCANS WITH VERY HIGH PATIENT COMFORT**

Magnetom Vida has another major advantage: “We can examine patients faster with Magnetom Vida,” said Prof M Notohamiprodjo who, as head of MRI at University Hospital Tübingen, has also worked intensively with the new scanner. As examinations in Tübingen show, the new scanner decreases measurement times for musculoskeletal and prostate imaging compared to previous MRI systems. What is more, it does so with significantly improved image quality: “The signal-to-noise ratio in the clinical images is up to 30 percent higher than with systems from the previous generation,” says Notohamiprodjo.

While this is partly due to BioMatrix technology, it is also a result of several insights and technical advances that developers at Siemens Healthineers have gained from intense fundamental research and close customer collaboration. Key lessons from the development of a 7 Tesla research MRI

... This means that a department could carry out four additional spine examinations per day...”
ICIS 2017 will focus on quantitative and functional oncologic imaging and the multidisciplinary management of oncology patients. There will be a spectrum of sessions ranging from innovative and state-of-the-art imaging, practical hands-on-workshops, essential refresher courses and live-case workshops.

- **2 Keynote lectures** 'Cancer Imaging in the era of precision medicine' and 'Immunotherapy: Imaging challenges'
- **8 Computer hands-on workshops** using Siemens workstations on evaluation of cancer of prostate, breast, lung, liver, lung, ovary, uterus and whole-body imaging
- **25 sessions** addressing structured reporting, response evaluation, complications of medical and radiation therapy, metastatic disease, joint sessions with radiation and medical oncologists, precision medicine, radiogenomics, prostate, female pelvis, liver, pancreas, lung, lymphoma, CEUS and many more
- **4 Scientific Sessions** dedicated to proffered papers, and a poster exhibition with prizes for the best overall paper and poster
- **4 live-case workshops** Transarterial chemoembolization (TACE) in HCC / liver metastases, Radioembolization (SIRT), Microwave ablation of a pulmonary tumour in metastasis or small lung cancer, Radiofrequency ablation of liver metastasis

Delegates will received 17 CPD points from the Royal College of Radiologists (Monday - 6, Tuesday - 6, Wednesday - 5). CME accreditation will be sought from the European Accreditation Council Continuing Medical Education (EACCME).

**Programme planning committee:** Stefan Diederich ICIS President (DE), Bernhard Gebauer (DE), Dow-Mu Koh (UK), Beth McCraville (US), Anwar Padhani (UK), Andrea Rockall (UK), Heinz-Peter Schlemmer (DE), Harriet Thoeny (CH).

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Deep learning workflow

TeraRecon demonstrated their Within Image Analysis (WIA) Cloud machine learning solution at the recent Healthcare Information & Management Systems Society (HIMSS17) Conference and Exhibition. WIA Cloud aims to accelerate and automate image interpretation & advanced post-processing tasks using artificial intelligence to eliminate repetitive operator tasks.

WIA Cloud is a platform that can provide access to closed-loop, semi-automated ground-truth machine learning engines and artificial intelligence algorithms. This platform will have the ability to rapidly impact clinical applications and deliver customized workflow enhancements by providing a wide range of artificial intelligence and machine learning engines that identify, categorize and characterize images. The platform will integrate to 3rd party applications and learn end-user behaviors, all the while allowing physicians to independently validate the macro-level indications of each engine’s output.

“We are merely at the ground floor of what WIA Cloud can offer. We are extremely optimistic about its broad potential and direct impact to imaging workflow. As we continue to grow the application spectrum, we see immediate opportunities to apply this science in the areas of stroke patient triage, complex cardiac MR interpretation automation and specific types of analysis tools that are not achievable with more common deterministic methods of image analysis”, said Jeff Sorenson, President and CEO of TeraRecon. Jeff continued, “WIA Cloud is a game changer for TeraRecon because it allows us to innovate faster and to do so in a more inclusive way with other industry partners. It holds the potential to redefine the future of advanced visualization and intelligent image review.”

WIA Cloud is currently in development as an application of iNTuition Cloud.

TERARECON
FOSTER CITY, CA, USA
www.terarecon.com

Color display for general radiology and mammography

Barco has introduced a new diagnostic color display with a 5.8 megapixel resolution, making it suitable for general radiology as well as breast imaging, including breast tomosynthesis. The Nio Color 5MP has been designed especially for demanding radiology applications that require excellent grayscale rendering and detail, especially appreciated in mammography and breast tomosynthesis.

In addition, it includes sophisticated calibrated color that also improves gray images, a feature previously only available on Barco’s groundbreaking Coronis Uniti display system.

The new system comes with Barco’s unique color calibration technology for consistent images, whether in color or in grayscale, to ensure the accuracy of the display and to support confident diagnostic decisions. The high-resolution color display is cleared for mammography.

With its 5.8 megapixel resolution, the new Nio offers more pixels than traditional mammography displays, so more of the image can be seen. Its aspect ratio is a perfect fit for tall X-ray images – especially for the MLO view in mammography – resulting in less panning and zooming for a better reading experience. It also comes with Barco’s SpotView technology to get a closer look at a particular region of interest. Just as the DICOM standard ensures consistent grayscale across displays, color images also need additional monitoring, correction and calibration in order to render them in a meaningful way. That’s why Barco developed its SteadyColor technology, which ensures consistency in color, from display to display, so radiologists can make a diagnosis based on reliable images.

Barco’s renowned sensor technology combined with MediCal QAWeb for automated calibration and Quality Assurance, makes sure every image is displayed to perfection in a highly regulated environment. Compliance with MQSA and QA guidelines is effortless.

Like most of Barco’s medical displays, Nio Color 5MP comes with a set of tools to help radiologists work smarter, not harder. These include features for dimming of auxiliary displays, enhancing visualization of details, and personalizing display settings, such as Clearbase or BlueBase, switchable on the same display, even per radiologist.

Enabling visualization of both general radiology and mammography images, Nio Color 5MP eliminates the need for separate workstations. This leads to reductions in display cost, real estate, and the operational expenditure required to maintain an enterprise-wide display fleet.

BARCO
KORTJUK, BELGIUM
www.barco.com
CMOS flat-panel technology in full-size mobile C-arms

The latest C-arm models from Ziehm Imaging deliver superior image quality while minimizing dose and feature new flat-panels based on CMOS technology as an alternative to amorphous silicon detectors. This enables higher image resolution at the same dose and thus bridges the gap between the image quality of flat-panel technologies and the cost efficiency of image intensifiers. The new CMOS detectors are incorporated in the company’s Vision RFD and the Solo FD systems.

Thanks to its versatile design, the Solo FD ensures maximum flexibility and the mobile C-arm provides optimal soft tissue and bone contrast especially in orthopedic, trauma and pain management procedures.

The Vision RFD comes with a 25 kW power generator for demanding vascular procedures. Vision RFD Hybrid Edition is the first fully motorized mobile C-arm and is a space- and cost-saving alternative to fixed installed systems as it does not require any room preparation. Due to its low installation and operating costs, the Vision RFD Hybrid Edition is a comprehensive mobile hybrid solution for highly demanding cardiovascular procedures.

Monitoring key performance indicators in breast imaging

The recently released VolparaEnterprise2.0 software update helps breast imaging facilities deliver high quality, personalized breast screening, and delivers key performance indicators (KPIs) for hundreds of performance and quality metrics, including patient positioning, compression and equipment utilization. The software provides continuous quality assurance and performance monitoring through dynamic, interactive dashboards feeding ConstantQuality metrics that are updated with every mammography or tomosynthesis (3D mammography) exam.

The software is fully integrated with VolparaDensity software, the most clinically validated 3D Density solution. Designed to support large or small enterprises, VolparaEnterprise software enables breast centers to perform rapid quality control checks that help optimize the productivity and efficiency of imaging resources. This in turn helps decrease costs through the reduction of retakes, increase employee effectiveness, and enhance the patient experience.

Updates to the software include new infographics and analytics tools to help improve understanding of resource utilization and performance and provide better understanding of their patient population and referral patterns: the new Technologist dashboard enables each radiographer to monitor her own performance and self-train to fix positioning and compression problems; the Lead Radiographer now sees a Quality Quadrant diagram that summarizes patient positioning and compression performance by each radiographer, helping to identify training opportunities. Also, the broader use of infographics on each new role-specific “landing page” makes data quicker and easier to summarize and interpret.

“Adding VolparaEnterprise software has enabled us to implement new quality processes that will help ensure that every woman’s mammogram is the best that we can offer. Being able to pull out data that has been hidden, we’re able to improve the practice’s efficiencies and effectiveness, which will help improve outcomes. We owe that to our patients,” said Kathy Schilling, MD, Medical Director, Boca Raton Regional Hospital’s Christine E. Lynn Women’s Health & Wellness Institute in Florida.

Varex acquires PerkinElmer’s medical imaging business

Varex Imaging has announced that it has completed the acquisition of the Medical Imaging business of PerkinElmer. The acquired business develops, manufactures and sells digital detectors that are key components in medical and industrial X-ray imaging systems made by global OEM manufacturers. Varex believes the acquisition will be transformative to the company’s digital detector operations, enabling Varex to increase innovation, leverage its manufacturing scale and expand its cost leadership position.

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Software training module for prostatic artery embolization

The Prostatic Artery Embolization (PAE) software unit from Mentice is a unique training solution designed for interventional radiologists starting to perform embolization of the prostatic artery, or those who wish to maintain their advanced skills in this challenging procedure. PAE requires highly developed microcatheter and microwires skills, as well as strategic decision-making to avoid potentially hazardous outcomes. The training module was designed in collaboration with two of the world’s leading physicians in the field: Dr. Marc Sapoval of Paris, France and Dr. Shivank Bhatia of Miami, FL, USA. The training simulation module focuses on increasing the operator’s knowledge of the anatomy, and training and honing the advanced microcatheter and microwire skills necessary to successfully catheterize the challenging anatomy. A guide for identifying the prostatic artery is provided, as well as advice from experts on how and where to embolize.

Essential imaging functionality such as cone beam computed tomography is available during the cases to prevent non-target embolization. Due to the long procedural and fluoroscopic time of PAE, training in the proper usage of imaging equipment, and working according to the ALARA (as low as reasonably achievable) principle is an integral part of the training module.

All the above can be learned in a safe environment, without risk of complications or radiation exposure. Extensive metrics and measurements are collected throughout the training cases. These provide the user with a performance result that can be used to chart personal progress, or as a comparison to an expert reference.

The Mentice PAE training simulation module is thus an ideal platform for acquiring and maintaining an advanced endovascular skill set; for learning the vast variations of the angiographic anatomy of the internal iliac artery; identifying the prostatic artery for catheterization of the prostatic artery and for avoiding non-target embolization and managing collateral vasculature.

MENTICE AB
GOTHENBURG, SWEDEN
www.mentice.com

CT designed for cost-conscious healthcare organizations

The newly introduced Access system is Philips’ newest computed tomography (CT) solution specifically designed for healthcare organizations seeking to establish or enhance CT imaging capabilities at an accessible cost for a high return in value. The new system provides consistent image quality across a diverse patient population and a wide range of exam types, enabling healthcare organizations to expand care capabilities to treat more patients. As healthcare needs grow across the globe, many healthcare organizations are increasingly challenged to efficiently diagnose and treat a greater number of patients. Health providers looking to enhance their CT capabilities may be faced with challenges such as reimbursement cuts, patient populations with low ability to pay, or inefficiencies related to growth and expansion. For cost-conscious healthcare organizations, a value-focused CT solution such as the Philips Access CT thus offers the low total cost of ownership and diagnostic confidence needed to drive clinical, financial and operational efficiencies.

Philips Access CT also provides a number of benefits for physicians and organizations to realize true value from their CT investment, including:

• Increased Referrals – The iFlow console workflow platform enables consistently high image quality through features that simplify and automate the technologist’s routine, helping providers to maintain and increase their referral base.
• Lowering Operating Costs – Philips’ iDose4 reduces the need for tube replacement—the most significant recurring cost associated with CT ownership—by offering a proven reconstruction algorithm that allows providers to reduce exposure time (mA) and extend tube life.
• Greater Clinical Breadth – Advanced applications on the console allow hospitals to stretch their clinical capabilities from routine imaging to more advanced applications such as brain perfusion, lung nodule analysis, vessel analysis and virtual colonoscopy (CTC), while keeping costs down.
• Dose Management – The 70 kV scan mode can reduce dose by up to 20 percent, which is especially valuable in pediatric patients.
• Maximum Uptime - Philips’ 24/7 monitoring can predict issues before they arise, ensuring that providers can minimize downtime and maximize patient throughput.

PHILIPS HEALTHCARE
EINDHOVEN, THE NETHERLANDS
www.philips.com
GE Healthcare launches macrocyclic gadolinium based contrast agent

In an announcement issued only ten days before the Pharmacovigilance Risk Assessment Committee (PRAC) of the European Medicine Agency recommended the withdrawal from the market of several linear-structured Gadolinium Based Contrast agents (GBCAS) but maintaining GBCAs of macrocyclic structure, GE Healthcare announced the introduction of a macrocyclic GBCA, under the trade name of Clariscan.

The PRAC recommendations, (for more details see page 35) are not officially in force since they have not yet been endorsed by the Committee for Medicinal Products for Human Use (CHMP). The recommendations were issued in the midst of the current debate triggered by the recent discovery of the deposition of free gadolinium ions in the brains of patients who have previously been administered GBCAs. Gadolinium is always administered in the form of a chelate, which is generally in the form of one of two main chemical structures, linear and macrocyclic. The linear structure has been found to release its gadolinium more easily than macrocyclic agents, which explains the PRAC’s recommendations of withdrawing the linear molecules but maintaining the macrocyclic agents on the market. The PRAC stressed the point that so far no symptoms or diseases linked to gadolinium in the brain have been reported, although it pointed out that data on the long-term effects in the brain are still limited.

Until the introduction of Clariscan, the only GBCA that GE marketed was a linear molecule, Omniscan. The introduction of the Clariscan means that now GE joins other principal manufacturers of GBCAs (Bracco, Bayer, Guerbet) in offering macrocyclic GBCAs

Demand for contrast media has in general significantly increased over the past decade due to rapid procedural advancements in MR imaging, elevating the importance of uninterrupted and sustainable product supply, as well as meeting the individual needs of patients undergoing diagnostic procedures. Clariscan is designed to support effective visualisation of abnormalities in the brain, spine and associated tissues, and will be provided alongside GE Healthcare’s comprehensive support services and solutions to healthcare practitioners worldwide. The new GBCA has been approved using the decentralised procedure with marketing authorisation in place in Norway and will be introduced to European countries across 2017.

GE HEALTHCARE
CHALFONT ST GILES, BUCKS, UK
www3.gehealthcare.com

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Will robots replace surgeons? - Shafi Ahmed, Consultant General, Laparoscopic and Colorectal Surgeon, Associate Dean and Honorary Senior Lecturer, Barts and the London Medical School

Machine learning and AI - Eliot Siegel, Professor and Vice Chair Research Informatics, University of Maryland

Joint UKRC/UKRO plenary debate
The end is nigh…AI-enabled machines have placed imaging and oncology professionals on the path to extinction
Chair: Phil Hammond, GP & Presenter

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