Teleradiology and mobile devices look certain to bring sweeping changes

By Philip Ward

Radiology and the role of radiologists will have to be redefined in the light of the rapid and sustained growth of telemedicine and mobile applications. That was the central message of Sunday’s special focus session, ‘Radiology on the road’.

Teleradiology in Europe is here to stay and its impact will increase, according to Dr. Erik Ranschaert, staff radiologist at the Jeroen Bosch Ziekenhuis teaching hospital in ‘s-Hertogenbosch, the Netherlands. Several key issues must be resolved, however, before TR can be used more widely.

“First, there’s the jurisdictional factor,” he said. “The language issue is still there, and the integration and implementation of IHE (Integrating the Healthcare Enterprise) standards, quality assurance, and of course the financial part. And then the patient is in the middle of the whole process because we should also see this type of healthcare provision as a patient-centric model.”

A clear regulatory framework is required to ensure the quality of services to patients, enable the use of cross-border teleradiology, enhance collaboration between radiologists and institutions across Europe and beyond, and deal with legitimate concerns about quality, security, privacy and liability. Acceptance and trust of teleradiology will only come with greater transparency in quality assessment and assurance, mutual recognition of qualifications within and even outside the EU, uniform accreditation system for teleradiology providers, secure data communication protocols and agreements, and transparent legislation within the EU and local support of EU regulations and directives, he said.

Increasingly, patients are managing their own images and can present them to any doctor or specialist. This trend is being hastened by the introduction of new services for patients offered via websites and applications, including second opinions in radiology, clarification of findings, and the ‘translation’ of reports into easily understood language. Reference sites about diagnosis, possible treatments and prognosis are popping up, and these developments are leading to more direct communication with radiologists, according to Ranschaert.

He presented the findings of a survey he conducted in autumn 2011, with support from the European Society of Radiology (ESR). Of the 368 respondents from 35 countries, 65% are using teleradiology. Of those, 53% are doing so at their institution, 32% at their homes, and 15% elsewhere. Overall, 80% of the sample had a strongly positive opinion about teleradiology, 46% thought its importance would grow, and 20% mentioned the need for further standardisation and better financial and legal regulations.

Outsourcing with teleradiology is being used by 35% of respondents, mostly for night readings, second or expert opinions, and part of their regular workflow. In 52% of cases, the outsourcing takes place at a commercial provider within the respondent’s own country. It occurs at a tertiary centre in 31% of cases, and at a commercial provider within the EU in 13% of cases.

Teleradiology has a bright future because there is always likely to be a shortage of radiologists, a need for on-call readings, and a need for subspecialty advice, Ranschaert pointed out. Opportunities for further growth include services offering expert or second opinions, emergency and on-call services, services to support small practices and hospitals, and creation of collaborative networks.

By 2015, 30% of all smartphone users will be using mobile health products, whereas the current figure is 5%, he noted. Within five years, half of ECR speakers will simply plug in their own Apple iPad and use it to give their presentations, rather than using the congress organizer’s system, predicted Prof. Osman Ratib, chair of the department of medical imaging and chief of the division of nuclear medicine and molecular imaging at the University Hospital of Geneva, Switzerland. Known widely as a trendsetter, he used his own iPad to give his talk during Sunday’s session.

Ratib first addressed the topic of hand-held devices at the 2001 RSNA congress, when he took part in a refresher course about new radiology must prepare for new developments and adopt solutions to preserve leading role in diagnostic work-up.
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SEE YOU IN LISBON ...
ECR 2013 will offer more interactivity and multidisciplinarity, promises Bilbao

By Mielanda Roaer

ECR Today met with ECR 2013 President, Professor José Ignacio Bilbao. He is Professor of Radiology and Head of Interventional Radiology at the Navarra University Hospital in Pamplona. He talked about how he plans to increase multidisciplinarity and interactivity next year and about his passion for architecture.

ECR Today: What will be the main highlights of ECR 2013?

Professor José Ignacio Bilbao: We will have a comprehensive course devoted to the evaluation of tumour response, which is a major issue. We will focus on how to evaluate response after any kind of therapeutic treatment or palliative procedure. It is not an easy course but it has a very well balanced programme.

The Clinical Category “Clinical Lessons for Imaging Practitioners” (CLIP) series will focus on arteries. I am an interventional radiologist and I have been working with catheters and arteries all my life. We will keep the course very practical, by addressing different clinical cases in 90 minutes.

There will be one speaker each day and both courses will be completely interactive.

Furthermore, we will maintain the A to Z Mini Course, focusing this time on cardiac imaging. We are thinking of incorporating PACS into the session, to put radiologists in the real-life situation of writing reports or examining a patient, not just with a few uninteresting images. We also hope to use information taken from CT or MR. This should be interesting and interesting from the practical point of view, because participants will see how a specialist deals with patients on a daily basis. An additional Mini Course will be dedicated to controversies in breast imaging which is a challenging topic.

ECRT: Recently the ECR has focused on both multidisciplinarity and interactivity. Do you plan to increase time slots for these topics?

JIB: Yes, we will try to encourage all kinds of multidisciplinarity and interactivity. We will have three multidisciplinary sessions on liver tumours, an increasing problem around the world. One session will be dedicated to hepatocellular carcinoma, another to metastases and the last one to cholangiocarcinoma.

These sessions will see hepatologists, oncologists, pathologists, radiologists and surgeons discussing issues regarding the management of patients with liver cancer in the hospitals where they work together.

Moderators will have an important, interactive part in the organisation of the sessions. They will not just introduce the speakers, they will also need to interact. All sessions within the categorical courses will conclude with cases. Some will be discussed between the speakers, or the moderator will present some representative pictures from these lectures.

In general, I would like to include the cases used during the sessions in some of the eLearning tools offered by the ESR. Sometimes you encounter some very interesting cases, which you would like to discuss later, but they are no longer available. Having the ability to see them later would further improve interactivity.

ECRT: You were chairman of the Electronic Presentations Online System (EPOS) scientific exhibition last year. What do you think of the format of the exhibition at the ECR?

JIB: I am really looking forward to the live poster discussions we introduced last year. Being able to ask the author about this or that is very important. The ECR is excellent, its programme is second to none and the city is perfect, everywhere you around you can find quality. I imagine that sponsorship will increase.

ECRT: The global financial crisis has not spared Europe and the pressure on healthcare budgets has increased. Do you think this will impact on the ECR in the future in terms of sponsorship?

JIB: If you provide something worthwhile they will endorse it. The ECR is excellent, its programme is second to none and the city is perfect, everywhere you around you can find quality. I imagine that sponsorship will increase.

ECRT: We will welcome Chile and South America at our meeting this year. What do you do when you are not speaking at the coming ECR?

JIB: When I was in my third year of medical school I discovered that I should study architecture. I have always been interested in dimensions, lines and structures. But I soon marvelled at the many parallels between architecture and radiology.

Moreover, during my residency, I found that I could navigate through the dimensions, work with my hands and interact with anatomy very quickly and creatively. That was in 1982, when I was working as an interventional radiologist in Houston, U.S. Within a week, I knew this was what I had to do. The work done in intervention radiology can have a great, important and direct impact on the patient.

JIB: We will welcome Chile and South Africa. I wanted to have another South American country, as so many people speak Spanish in America, including the United States. The Radiological Society of Chile will focus on local ongoing radiological research. The Radiological Society of South Africa will focus on local issues such as tuberculosis and AIDS, and I am sure we will learn a lot from them. The Spanish Radiological Society will present a session entitled imaging: essential tool from diagnosis to treatment.

We have also invited the European-African Hepato-Pancreato-Biliary Association to join us for sessions on pancreatic cystic neoplasms. This society is mainly run by surgeons but they are multidisciplinary, they understand the treatment of tumours in a multidisciplinary concept. This fits perfectly with our thinking. The sessions are likely to see hepatologists and surgeons, as well as radiologists.

ECRT: The ESR is a very well balanced programme.

JIB: Absolutely. When you go to the congress, you feel like you’re with your radiological family. It’s very special to be here. I’m very happy. My first ECR was in 1991, and I’ve been coming to all the congresses since then, except in 2007, when I was taking my examination to become professor. ECR 2012’s scientific programme is excellent and the sessions on radiofrequency ablation have been particularly stimulating for me. Vienna is a very pleasant city and it has become even more beautiful over the past few years.

ECRT: What do you do when you are not speaking at the ECR?

JIB: Well, I spend a lot of time working, I enjoy the great outdoors, and Middle-age and Romanesque art. I love to combine these interests by visiting Romanesque churches in the countryside, for instance in Castilla and Navarra, or by walking along St James’ Way (Camino de Santiago de Compostela), which crosses the university campus of Pamplona. I wish I had more time to do this. It is fascinating to visit monuments that have been seen by millions of people over the centuries.

ECRT: Are you glad you came back to Vienna this year?

JIB: Absolutely. When you go to the congress, you feel like you’re with your radiological family. It’s very special to be here. I’m very happy. My first ECR was in 1991, and I’ve been coming to all the congresses since then, except in 2007, when I was taking my examination to become professor. ECR 2012’s scientific programme is excellent and the sessions on radiofrequency ablation have been particularly stimulating for me. Vienna is a very pleasant city and it has become even more beautiful over the past few years.

Goodman captivates ECR attendees with insight and historical anecdotes on venous thromboembolism

By Philip Ward

Describing the current situation, Goodman noted that progress has occurred in nuclear medicine, with three-tier reporting, SPECT imaging, and clot tagging. MRI will continue to get better and better, while CT there has been a dramatic decrease in radiation, decreased noise, and increased spatial resolution. In terms of treatment, no one size fits all, says the professor.

Small pulmonary emboli represent a particular challenge. A CT pulmonary angiogram (CTPA) is too sensitive because it detects too many small PEs. Conversely, in the mid-1990s, CTPA was too insensitive because it missed small PEs.

Subsegmental PE may not need anticoagulation, particularly if there is risk of contraindication to anticoagulation, no DVT, no long-term risk factors, and good cardiovascular reserve. Major triggering factors include surgery, trauma, and being bed-ridden. Minor triggering factors are obesity, contraceptives, pregnancy, long flights, and immobilisation, he said.

In Europe, the earliest reference to venous thromboembolism is thought to be around 1220 in France, when DVTs were described in an illustrated manuscript. In the 1560s, it is thought that Henry VIII of England suffered from a DVT due to trauma, and Mary Queen of Scots had a DVT during pregnancy.

In 1761, Giovanni Morgagni, the Italian anatomist and father of modern anatomical pathology, referred to large clots in the lung. Sometime between 1820 and 1840, Larenz and Cruveilhier of France described pulmonary emboli. In the 1850s, Rudolf Virchow of Germany wrote about ‘traid: stasis-trauma-hypercoagulability’ and embolism.

“It’s very appropriate that this lecture is named in honour of Dr. Röntgen, the father of medical imaging and all of us,” Goodman said.
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Rigorous investigation using MR imaging can prove crucial for locating endometriosis

By Frances Rylands-Monk

While in most cases not life-threatening, endometriosis has a substantial impact upon women’s quality of life and may sometimes be the cause of infertility. Radiologists involved in the diagnosis of suspected endometriosis are strongly urged to make a checklist of areas needing investigation when presented with such cases.

This plea came from speaker Prof Karen Kinkel, head of female imaging at the Institute of Radiology, Clinique des Grangettes, Geneva, Switzerland, in her talk about diagnosing endometriosis through imaging, which formed part of Sunday’s categorial course on the female pelvis.

“You should always check the area behind the cervix, in between the start of both ureteroscral ligaments,” she told delegates. She illustrated her point with an asymmetrical image in the true uterine, the ligaments presenting as small and normal on the right side but thickened on the left side, which was not normal.

Endometriosis can go deeper, low down through the posterior vaginal cuff coming from the retroperitoneal area to the anterior rectal wall. Anterior deep endometriosis should also be looked for around the bladder and the uterus, with imaging showing bladder wall thickening, if present.

“Those types of lesions cause chronic pelvic pain. In fact, the type of pain can give you a hint about the area the endometriosis might be,” Kinkel said in the session moderated by Prof. Veronika Gazhonova, chair of the radiology department, United Hospital and Polyclinique, Geneva, Switzerland, at the President Medical Centre, Moscow.

Linking symptom to location, Kinkel cited dysmenorrhoea as a product of adhesions in Douglas’ pouch. Dyspareunia, on the other hand, could be caused by endometriosis in the ureteropelvic region and the posterior uterus rather than adhesions in the vagina.

Painful defecation during menstruation could also stem from endometriosis in the vagina or Douglas’ pouch, while bowel adhesions often caused non cyclic pain. Lower urinary tract symptoms clearly pointed to potential endometriosis in the bladder, Kinkel concluded.

Ultrasound is the first line tool for diagnosing endometrioma (endometriosis of the ovaries) and bladder endometriosis. MRI, however, had the highest sensitivity to identify all lesion locations on the checklist, and the status of lesions should be checked in all three orientations at T2.

“Radiologists should use rectal contrast if the patient complains about painful defecation during menses, but remember that lesions are often dark at T2 and not seen in fat-saturated T1 except for in the abdominal wall,” she said.

Radiologists play a vital role in distinguishing atypical endometriomas from ovarian cancer or cystic teratoma which required vastly different management. Endometriomas will show a diffuse low level internal echo and hyperechoic foci in ultrasound while cystic teratomas is quite different, according to Kinkel.

“Cystic teratoma have layered lines and dots, fat fluid levels, and isolated bright foci with acoustic shadowing, and are easy to distinguish from endometriomas,” she said.

Ruling out differential diagnoses of ovarian cancer could be achieved through colour Doppler imaging, which in endometrioma would show negative for vessels. Conversely, complex ovarian cysts with a solid portion could be deemed highly suspicious for cancer if vessels could be visualised inside the mass with colour Doppler imaging.

Speaking about the acute female pelvis Dr. Evis Sala, lecturer in radiology at Cambridge University and radiologist at Addenbrooke’s Hospital, Cambridge, reviewed the like-like or fishnet appearance of the haemorrhagic cyst on ultrasound, and the gray-scale ultrasound

features in ovarian torsion that include the ‘string of pearls’ sign, free pelvic fluid and an extra-ovarian echogenic, target-like mass, or twisted vascular pedicle.

“Ultrasound is generally preferred as a first step as it is more sensitive to vascular flow within the ovary. Gray scale findings of enlarged ovary with multiple peripherally placed small follicles are diagnostic,” she elaborated. “Difficulty arises with masses and compressed ovary, or with persistent flow. To avoid missing torsion, maintain a high index of suspicion and be willing to accept some negative laparoscopic.”

She also outlined the advantages of MRI in the pregnant patient with acute or subacute symptoms. MRI is safe in the second and third trimesters and is highly accurate for characterising indeterminate adnexal lesions found on ultrasound, she said.

Completing the session, Dr. Thomas Krouncke, radiologist at the Charité Hospital, Berlin, provided an update on image-guided therapy for leiomyomas, the most common benign uterine tumours that affect women between the ages of 40 and 60. Rarely life-threatening, symptoms can range from severe menorrhagia, uterine fibroid, urinary frequency to infertility. Although there were uterus-sparing options available, hysterectomy remained the most frequent treatment, Krouncke told delegates.

His talk covered the appearance of leiomyomas on both ultrasound and MRI and moved on to innovative treatments currently in clinical practice such as MIB-guided focused ultrasound (MRgFUS), uterine-sparing resection and uterine fibroid embolisation (UAE).

“MRI plays a key role for assessment of extent of disease and treatment stratification,” said Krouncke concluding the session. “The spectrum of therapeutic options for symptomatic leiomyomas has broadened, and now individualised therapy with MRgFUS and UAE is emerging as an alternative to surgery.”

Romania remains proud of country’s past and present radiological heritage

By Frances Rylands-Monk

Leading radiologists from Romania stepped up to the podium on Sunday as the third guest country of the ESR meets’ Sessions.

ECR President and session co-chair Prof. Lorenzo Bonomo told delegates that he was happy to invite Romania given their past loyalty to ECR and current radiological progress.

“Romanian radiologists have been numerous at ECR since the very beginning. ESR recognises the high quality of Romanian radiology,” Bonomo said.

Standing in for Prof. George Iana, president of the Romanian Society of Radiology who could not be present at Sunday’s session, Prof. Dumitru Duda, vice rector and professor of radiology at the Medical University of Cluj Napoca co-chaired the meeting with speaker Prof. Mircea Buruian, chair of the radiology and imaging department at the University Emergency Hospital, Targu Mureș.

The current role of the Society is aimed at community binding and development, promoting national group experience and as a social player and defender of specialty members,” Duda told delegates, pointing to the society’s focus on liver and breast cancer diagnosis and treatment.

Challenging the advance of radiology in Romania are the existing problems of under-staffing due to medical migration of both doctors and technicians and lack of available procedures and trained personnel, specialists in particular. In addition, healthcare systems, both state owned and private, suffer from insufficient regulation and inefficiency. Statistics about the age, number and geographical distribution of machines are still emerging.

Despite these setbacks, between 2006 to 2011, radiologists at SUUB, Bucharest, the biggest interventional centre in Romania, undertook 125 aneurysm embolisations, 365 vertebroplasty procedures, and between 2002 and 2011, 5,000 uterine fibroid embolisations. Such procedures have an impact on the lives of 2,500 patients every year, according to Duda.

Romanian’s current radiologists have much to thank their predecessors for, according to speaker Prof. Mircea Buruian, chair of the radiology and imaging department at the University Emergency Hospital, Targu Mureș.

“Romania was among the first countries in the world to substantially contribute to the development of radiology,” said Buruian, paying homage to Romania’s long list of radiology pioneers and doctors in the nineteenth and early twentieth centuries.

One such pioneer Prof. Dragomir Hurezucescu, a Romanian physicist and inventor, whose special interest in electrostastics led him to build experimental equipment to measure static electricity, created a very sensitive electroscope in 1894 which proved to be useful for studying the phenomenon of ionisation caused by different radioactive substances. The machine was patented in 1894 by the French Society of Physics and demonstrated by Alvegott and Chaubad to become the favourite equipment of other experimenters of the time, such as Marie and Pierre Curie, and Henri Becquerel.

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\(^*\)This product is under development and is not yet commercially available in the U.S. Due to regulatory reasons, future availability cannot be guaranteed.
European Diploma in Radiology opens new horizons for residents and trainees

By Mélisande Rouger

Young radiologists from over 20 countries will take the European Diploma in Radiology (EDiR) exam today at ECR 2012, indicating the appeal of this international examination among the new generation of radiologists. Introduced last year at the ECR, the diploma aims to harmonise education throughout Europe by testing candidates on their general knowledge of radiology. Board certified radiologists and residents in their final year may take the exam, which should boost their careers.

It is also advisable for practising radiologists with teaching responsibilities, as they can better relate to their trainees, according to one diploma holder.

“I thought it would be good to take the diploma so that I could relate to my trainees, according to one diploma holder.

The bag has been well-received by congress attendees, and they seem to enjoy attaching the subspecialty and ESR promotional pins, which have been distributed around the congress. “One of the good things about the subspecialty is that the ECR is becoming greener. “It’s the first bag we’ve ever had made out of natural material. It’s more environmentally friendly,” said Kriegbaum.

“This grey eco-friendly bag is not the only initiative that represents the ECR organisers’ growing awareness of environmental issues, as they have reduced the number of pens distributed at this year’s ECR to just 3,000, all of which have been made from recycled beverage cartons. Another move was the decision to issue paper bags at the free publication areas.

“It would be a shame if a congress as innovative, important and large as the ECR didn’t go green,” remarked Ms. Kriegbaum.
Hot Shots from Day 4
Intraoperative imaging brings benefits with wide changes

CT proves superior, but is not totally dominant in renal tract imaging

Hybrid and functional techniques pull ahead in musculoskeletal race

By Frances Rylands-Monk

Major developments in visualising tumour biology before and during treatment are likely to have a substantial impact on selecting, monitoring and guiding a specific therapy in individual patients with musculoskeletal (MSK) neoplasms—and because developments are happening so quickly, the contents of today’s special focus session are highly relevant to all practising radiologists, according to speakers.

The current role of MRI in managing patients with MSK tumours is clear due to the published literature, but for newer techniques, this is not the case, explained Prof. Hans Bloem, head of imaging at Leiden University Medical Center, The Netherlands. Although it is important to engage gene expression and imaging of tumour biology have become more developed, researchers must prove their efficacy before they can ultimately be cost effective and have an impact on patient survival and well-being or morbidity.

The specific guidelines for staging MSK tumours are not yet fully accepted for breast cancer, (see image). The combination of high contrast and spatial resolution has made MRI the primary tool in local staging. Dynamic gad-chelate-enhanced MRI allows assessment of vascular forces in developing cost-effective strategies targeting the vascular system, and diffusion imaging can be used for detecting metastases. “We’ll have to see if diffusion MR or FDG/PET will become the standard for detecting metastases, and the race is on,” Bloem said. “It is of paramount importance that radiologists and molecular medicine physicians combine these forces in developing cost-effective strategies using various imaging techniques.”

Innovations in imaging have led to new techniques such as PET/CT, which has been developed to improve not only a specific region but also can offer efficient whole-body studies for staging.

Roeland Bonald, of Memorial Sloan Kettering Cancer Center, the moderator of this morning’s special focus session, noted, “The drawbacks of the advanced techniques are that they are not always available and the radiologist does not always know the impact of them,“ said Prof. Joan C. Vilanova, head of imaging at Clinica Girona, Spain, the moderator of this morning’s special focus session. “It is hard to produce clear guidance as it is difficult to achieve a consensus. One of the objectives of the session, besides reviewing the latest approaches to MSK work-up, is to improve and update the guidelines in line with new imaging techniques.”

It will be up to doctors how they translate these guidelines to their own practices.

PET/CT is good for whole-body scanning, but as not all big hospitals have it, radiologists should know how to perform whole-body MRI with almost the same accuracy. Doctors must adapt and optimise existing resources to improve the diagnosis and produce meaningful reports from a clinical perspective,” he noted.

Today’s session promises to provide exciting answers to frequently asked questions. “Speakers will elucidate on issues such as if there is suspicion of recurrence, should radiologists use PET/CT or MRI? Other techniques such as diffusion-weighted imaging (DWI) used together with conventional sequences improve diagnosis and can give information in one scan or ultrasound has yielded a suspicious finding. In addition, MRI can evaluate not only a specific region but also can offer efficient whole-body studies for staging.”

Bloem’s department also relies heavily on PET/CT. “The combination of high contrast and spatial resolution has made MRI the primary tool in local staging. Dynamic gad-chelate-enhanced MRI allows assessment of vascular forces in developing cost-effective strategies targeting the vascular system, and diffusion imaging can be used for detecting metastases. “We’ll have to see if diffusion MR or FDG/PET will become the standard for detecting metastases, and the race is on,” Bloem said. “It is of paramount importance that radiologists and molecular medicine physicians combine these forces in developing cost-effective strategies using various imaging techniques.”

Although not yet fully accepted for MSK work up, emerging hybrid techniques such as PET/CT continue to grow in importance for evaluating previously treated MSK lesions for recurrence, as well as distant metastatic disease. Where histology is already known, PET using FDG is sensitive to significant abnormal metabolic activity and can prove invaluable for determining whether or not there is a presence of residual, recurrent tumour. Furthermore, for evaluating the effects of new drugs, PET detects chemotherapy-induced shut down of tumour metabolism.

However, information gained from PET must be combined with the radiological component of CT to avoid diagnostic mistakes, according to Vilanova. “For instance, FDG/PET might show metabolic activity on bone fibrous dysplasia. On a patient being staged for a malignant tumour, it could be misinterpreted as bone metastases instead of a fibrous dysplasia, if PET imaging is not evaluated combining the CT or plain film,” he explained (see image). Recently, Bloem’s department collaborated with the chemistry research group to bring PET imaging from the preclinical to the clinical stage in breast cancer patients for local staging, in particular lymph nodes. “It was a big step to move from animal model research to breast cancer patients. It is a relatively small step to extend research now to MSK,” he said.

More detailed information about current and future clinical applications of PET/CT and scintigraphy will be covered by Dr. José García, radiologist at PET/CT Center, CTEIR, Barcelona, Spain, while Prof. Carla Martín, radiologist at Cattedra di Radiologia ‘R’ – DICMIE, Genoa, Italy, will talk about diagnostic development and potential of ultrasound.

Remaining challenges are notably the personalised implementation of biomarker imaging in the clinical arena and development of software platforms to analyse, integrate and quantify these huge data sets. Multifunctional imaging, in combination with integrated quantitative data analysis, is required to phenotype cancers to allow meaningful reports from a clinical perspective,” he predicted.

Special Focus Session
Monday, March 5, 09:45-10:00, Room A
SF 1/6a: The role of advanced imaging in musculoskeletal neoplasms

- Chairman’s introduction
  J.C. Vilanova, Girona/ES
- Advanced MR techniques
  J.L. Bloom, Lasker/NY
- PET/CT and scintigraphy
  J. García, Barcelona, Spain
- Sonography: diagnostic developments
  C. Martín, Genoa/IT
- Panel discussion: The reliance guidelines of the imaging techniques on the management of MSK neoplasms

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Remaining challenges are notably the personalised implementation of biomarker imaging in the clinical arena and development of software platforms to analyse, integrate and quantify these huge data sets. Multifunctional imaging, in combination with integrated quantitative data analysis, is required to phenotype cancers to allow personalised effective treatment. For this to happen, radiologists need to embrace the current preclinical possibilities and bring them to the clinical arena by focusing on how to image tumour biology. In addition, they need to work together with engineers to develop automated data analysis, according to Bloem. “At this stage, the huge step towards functional imaging requires new skills. The people who will do this are the radiologists of tomorrow,” he predicted.
It’s time to get better informed about neonatal chest emergencies

By Rebekah Mean

Thoracic trauma in children often results in significant morbidity and mortality, making it vital for radiologists to know what to look for. Cases are usually seen in a polytrauma context, according to Dr. Marta Lobo, from the department of radiology at the Hospital de Santa Maria in Lisbon, Portugal. Blunt trauma accounts for most cases, resulting from road traffic accidents and pedestrian injuries. Common problems include pulmonary contusion, rib fractures, pneumothorax, and haemothorax.

“Different patterns of injury are seen in children due to anatomical and physiological differences, and these should be recognised,” said Lobo, who will be presenting at this afternoon’s refresher course, ‘Chest imaging: What to use and when to use it.’

Chest radiography is the first and most important imaging modality, she said. Radiologists should use multidetector CT for severe chest injuries, and/or polytrauma. It is also very important to adopt specific protocols for children, because what may be appropriate for adults may not necessarily be applied to children. Other common paediatric incidents requiring emergency imaging include foreign body inhalation, which has potentially serious or even fatal consequences, and therefore a good clinical history is the key to diagnosis, she noted.

Many infants are born with conditions causing respiratory distress, noted Dr. Anne Paterson, consultant radiologist at the Royal Belfast Hospital for Sick Children, Belfast, U.K. The major difference between these infantile conditions relates to the underlying pathologies. Significant problems for the pre-term infant are infection, surfactant deficiency disease (idosupraventricular distress syndrome, IRDS), and complications of the latter’s therapy, such as barotrauma to the lungs and pulmonary haemorrhage. Clinically, pre-term infants become sick more quickly, and their symptoms and signs, tachypnoea, suprasternal and/or intercostal recession and cyanosis are more exaggerated.

Term infants often encounter problems due to conditions such as meconium aspiration syndrome, air leaks/pneumothorax, infections and other difficulties secondary to structural lung lesions.

Due to the improvement in antenatal sonography and echocardiography, many structural lung and cardiac lesions are detected antenatally, therefore an infant’s delivery can be planned – either by Cesarean section or induced labour if necessary, she noted. Paterson stated, “From a radiologist’s point of view, the increased information we receive from antenatal ultrasound and antenatal MR studies prepares us for the birth of such babies, but there is also an increasing number of post-natal imaging on often asymptomatic babies, utilising all modalities.”

In addition, the increased information received from antenatal ultrasound and antenatal MR studies assists clinical colleagues and the infant’s parents, and helps to plan follow-up care of the children. It is hoped that many of these very sick infants will be born in specialist units, but that is not always the case, as antenatal and postnatal care is not equal the world over, she added.

Neonatologists in the Belfast unit have seen an increase in the number of surviving babies born at less than 1 kg. Likewise, the number of infants born with congenital anomalies in Northern Ireland has increased in recent years, with post-surgical infants accounting for around 5% of the unit’s patient throughput. “Regular multidisciplinary meetings with neonatologists, paediatric surgeons, medical geneticists, paediatric pathologists and paediatric radiologists are key to the success of these early interventions to plan the immediate care of infants who are due to be born in the near future. This type of communication is incredibly important to everybody, because we work closely together as a team,” she explained.

“The treatment given to an individual infant will obviously depend upon the underlying cause. In some cases, therapy will be medical, relying on for example drug therapy for pneumonia and respiratory support,” stated Paterson. “Specialised circulatory assistance, such as barotrauma to the lungs and pulmonary haemorrhage, are not insignificant mortality rates.”

Chest radiograph of 24-week gestation infant. There is diffuse air space disease in both lungs, in keeping with severe surfactant deficiency disease. (All images provided by Dr. Anne Paterson)

Chest radiograph shows the left haemothorax filled with multiple air-filled loops of bowel, and contralateral shift of the heart and mediastinal structures. The stomach remains in the abdomen. Little aerated right lung is seen. The appearances are classical of a left-sided congenital diaphragmatic hernia of Bochdalek.
Radiology in Iceland – a small country with big possibilities

By Marianna Garðarsdóttir

Since the economic crisis, which began in the autumn of 2008, healthcare in Iceland, as everywhere, has suffered. Due to the economic situation there have been serious cuts to the number of health care in both the public and the private sector. The situation may have reached a dangerous height, but recent economic prospects point towards a recovery in the country’s economy for 2012.

One factor regarding the economy is the education of radiologists and the specialized training of doctors as a whole. There is a medical department at the University of Iceland where medical students are required to receive their education and a university hospital where many radiologists begin their training, but in order to complete their training in any medical specialty Icelandic physicians are required to complete their training abroad. Many physicians move to Scandinavia or other countries in order to complete their training in any medical speciality Icelandic physicians are offered not only from malignant conditions but also from the treatment itself, “said Professor Peter Brader, who will coordinate the course at the ECR. “In cancer therapy, we need to be aware of the consequences treatments may have. They can lead to direct and indirect results coming not only from malignant conditions but also from the treatment itself,” said Professor Peter Brader, Vienna General Hospital (AKH) in Austria.

Radiotherapy, chemotherapy, and novel oncologic drugs such as targeted neuroproteins are all associated with side effects. The Refresher Course will review the whole spectrum of these mediators and complications in three organ systems: the abdomen, thorax, and central nervous system (CNS).

In cancer patients opportunistic lung infections, for instance fungal, are more common, potentially lethal, and sometimes linked to other infectious conditions in the CNS. To determine whether a complication is related to therapy or not, radiologists must first examine the treatment options and pay particular attention to which treatment is being given to their patients at the time of the examination. Good communication between radiologists and clinicians is crucial.

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There are currently 60 radiologists employed in a field that requires close to 20 per 100,000 inhabitants. At the moment there are more than 20 Icelandic radiologists living abroad, nearly half of those 20 are currently training to be specialists. In the coming years many radiologists will retire (at least 35 in the next 20 years) and two few are currently being trained. Since the economic crisis in 2008 no Icelandic radiologist has returned home after completing their training abroad. To complicate the situation even further no positions are open, even though there is a need for more people due to the ever increasing number of radiological examinations being performed every year.

But in the middle of a crisis you can also find some opportunities. In Iceland there has been an ongoing population-based study since 1967, the Reykjavik Study. This study is being conducted by the Icelandic Heart Association (IHA) which is a non-profit institute that was founded in 1964 to battle cardiovascular diseases in Iceland. The purpose of the IHA is to conduct research into the causes of heart disease, educate the public about the prevention of cardiovascular diseases and provide individual risk evaluations. Over the last 40 years, the IHA has conducted large-scale studies of over 30,000 men and women born in Iceland between 1907 and 1935. The latest stage of the Reykjavik Study is the Age, Gene/Environment Susceptibility – Reykjavik Study (AGES-REYKJAVIK) and the sample is drawn from the original Reykjavik study population-based cohort.

The AGES-REYKJAVIK study was designed to examine risk factors, including genetic susceptibility and gene/environment interaction, in relation to disease and disability in old age. This is a collaborative study between the National Institute on Aging (NIA), National Institute of Health (NIH) and the IHA. The study included baseline examinations of nearly 6,000 individuals from the years 2002 to 2006 and a five-year follow-up of 4,000 of the same individuals in 2007–2011. The study is multidisciplinary, providing detailed phenotypes related to the cardiovascular, neurocognitive (including sensory), and musculoskeletal systems, and to body composition and metabolic regulation. Relevant quantitative traits, subclinical indicators of disease, and medical diagnoses are identified by using biomarkers, radiology, and other physiologic indicators. The research has focused on the multiplicity of causes of disability in old age including heart disease, high blood pressure, and Alzheimer’s. The AGES–REYKJAVIK cohort, with cardiovascular risk factor assessments earlier in life and detailed late-life phenotypes of quantitative traits, will create a comprehensive study of aging nested in a relatively genetically homogeneous older population. This approach should facilitate identification of genetic factors that contribute to healthy aging as well as the chronic conditions common in old age. The radiology department at the IHA is dedicated to epidemiological research using quantitative imaging techniques with MRI, CT, DTI and ultrasound. The department runs a comprehensive image post-process-
“The OR (operating room) of the new millennium is likely to be a hybrid OR, which means something in between a radiological suite and a conventional surgical room,” remarked Prof. Andrea Pietrabissa, director of general surgery, Polyclinico San Matteo at the University of Pavia, Italy. “That shift has already occurred with vascular surgery, where endovascular techniques are quickly changing surgical practice.”

Today, intraoperative imaging is mostly limited to C-arm x-ray and ultrasound; use of intraoperative CT and MRI is restricted due to environmental constraints and incompatibility with the use of metal-based surgical instruments. However, more integration between preoperative studies and intraoperative views is already possible, and technical fusion of these should be considered when designing new operative rooms.

“These steps represent the bricks upon which intraoperative navigation can be built,” stated Pietrabissa. “We should also consider robotic surgery as the main IT revolution that has already occurred in general surgery ORs. This technology incorporates several new features, including the possibility to fuse images, and that of remote tutoring and counselling.”

Integrating the OR with IT systems can have a positive impact on many aspects of surgery, including its safety. Efficient handling of the flow of data about the individual patient by OR personnel is crucial in avoiding human error and limiting damage when errors do occur. Risk managers know that a digital OR is a much safer place than a paper-based OR, he commented.

“Intraoperative imaging has become steadily more popular since the early 1980s. For instance, intraoperative ultrasound of the liver is now routinely used to identify the limits of liver tumours, and to detect the main intra-hepatic vessels. Laparoscopic ultrasound is also widely used to stage gastrointestinal cancer and to detect occult pancreatic and liver tumours.

“Both diagnosis and treatment are today image-based and driven,” explained Pietrabissa. “Most of our patients undergo ultrasound, CT, MRI, or a combination of these exams before their surgery, not only to diagnose the underlying disease, but also for the purpose of accurately planning the procedure.”

In addition to providing practical information about intraoperative imaging, this morning’s refresher course will demonstrate how the adoption of digital image management by disciplines and departments outside of radiology for their own clinical purposes is gathering momentum. Large-scale, multidisciplinary image-sharing across and beyond campuses puts novel requirements on PACS solutions, and it also raises the key question of how images should be managed effectively. The course aims to summarise the current controversy, present various approaches to PACS design and architecture, and help build an understanding for advanced data management, as well as concrete technical, legal, and workflow aspects.

In many healthcare systems, PACS solutions have widely replaced conventional film-based technology and workflow in radiology departments and imaging centres. Image acquisition and reading have gone digital during the past few years. The trend towards image-sharing with other colleagues is a logical extension of this process.

Interventional suites provide a perfect example of the crucial role image-based diagnostic and therapeutic workflows have started to play. Image management can significantly support positive outcomes; on the other hand, it is a highly cost-intensive component in clinical settings. In order to ensure that investments will meet growing demands, and implementations will indeed help optimise workflows, decision makers in care provider organisations need an understanding of workflows and information and communication technologies for image management.

Communication, simulation, visualisation, and navigation of images are becoming essential features in the planning and implementation of complex PACS infrastructures in support of diagnostic and intervention procedures. “While the full possibilities of multidisciplinary image-sharing within health care settings are being further explored, it is now increasingly common to see intense cooperation between radiologists and other clinicians for planning and guiding interventions,” noted Prof. Heinz U. Lemke, who will be chairing the course. He is research professor of radiology, University of Southern California, Los Angeles, and professor of computer assisted surgery at the University of Leipzig in Germany and director of the International Foundation for CARS (Computer Assisted Radiology and Surgery).

During the course, “New PACS architectures: decoupling image management from image navigation,” the lecturers will give insights into image sharing, from hospital-based PACS applications to remote consultation, with specific reference to the support of surgeons regarding training and intraoperative guidance.
CT urography is becoming an increasingly popular technique for the assessment of haematuria—barring the renal tract for many urologists and ultrasound still have a complementary role to play in imaging the renal tract.

“The majority of general radiologists will deal with every day practice with patients referred for imaging, having presented to their general practitioners or urologists with haematuria,” noted Dr. Sami Mossa, consultant radiologist at Western General Hospital, Edinburgh, U.K. “There is a need to draw a simple algorithm for imaging of these patients that will make use of valuable and scarce resources. The investigations need to be cost-effective and safe and have a satisfactory clinical yield.”

Haematuria is a common clinical problem with innumerable aetiologies, ranging from benign, inconsequential conditions to life-threatening urinary tract malignancies. The reported prevalence is between 0.3% and 21%.

When planning an investigation, it’s important from the start to differentiate between macroscopic and microscopic haematuria, according to Mohamad Moussa, a speaker at this morning’s special focus session. Other important factors include the patient’s age and gender, but by no means the only relevant factors. Microscopic haematuria is often the result of urinary tract infection, renal stone disease or medical renal conditions. Malignancies of the renal tract can present with microscopic haematuria, but this is less common, he explained. Macroscopic haematuria, on the other hand, carries a higher risk of urothelial malignancy, as well as renal trauma.

Intravenous urography (IVU) and ultrasound have been the main imaging modalities for investigating the renal tract for many years. The ability of IVU to demonstrate the whole of the urinary tract on a single image initially made it very popular among urologists and clinicians, but multidetector CT and MRI – with the ever increasing speed of image reconstruction – has resulted in the relegation of IVU from a first-line examination, he said.

The ability of ultrasound to characterise tissues, particularly renal cysts, suggests that it will continue to have an important complementory role in the assessment and follow-up of cystic renal masses. The internal structure of septated cysts is very often unclear on CT, but become much more evident with ultrasound,” he commented. “There has been a recent tendency amongst urological surgeons to observe small renal masses less than 2 cm in diameter, and ultrasound would be an excellent modality for following up these patients and to monitor the growth of these masses, rather than subjecting patients to repeat CT examinations. The large number of masses, rather than subjecting patients to repeat CT examinations, will continue to have an important complementary role in specific circumstances, or if CT and MRI are not readily available. The main aim of his presentation is not to try to revive the role of IVU and ultrasound, but merely to try to identify if they still have a role in imaging the renal tract, particularly in relation to haematuria.

IVU has well-known limitations due to large body habitus, overlying stool and bowel gas, and over supposition, according to Prof. Dr. Mustafa Özmen, from the department of radiology, Hacettepe University, School of Medicine, Ankara, Turkey, another speaker at today’s session. The technique has a limited ability to detect small renal masses and urinary calcifications or extrarrenal abscesses. Studies have shown IVU is insensitive for detecting upper-tract neoplasms, and it fails to detect up to 60% of tumours in patients with haematuria.

For a comprehensive evaluation of the upper urinary tract, CTU is an excellent modality for following up these patients with microscopic haematuria. Approximately 5% of patients with asymptomatic haematuria, and up to 22% with gross haematuria, have bladder cancer. CTU can have a high specificity in detecting urothelial neoplasms, and the negative predictive value varies between 95% and 99%. Therefore, CTU is the preferred imaging modality for the evaluation of haematuria, especially in high-risk groups and in patients older than 40 years of age with microscopic haematuria. Özmen has shown a series of slides illustrating the major pitfalls of CTU in technical failure, and technical optimisation is important and should be tailored to characteristics of the patient, he added. For satisfactory opacification of urinary tract, technique should be optimised.

The yield of CTU is highest in patients with macroscopic haematuria. Approximately 5% of patients with asymptomatic haematuria, and up to 22% with gross haematuria, have bladder cancer. CTU can have a high specificity in detecting urothelial neoplasms, and the negative predictive value varies between 95% and 99%. Therefore, CTU is the preferred imaging modality for the evaluation of haematuria, especially in high-risk groups and in patients older than 40 years of age with microscopic haematuria. Özmen has shown a series of slides illustrating the major pitfalls of CTU in technical failure, and technical optimisation is important and should be tailored to characteristics of the patient, he added. For satisfactory opacification of urinary tract, technique should be optimised.

Using 3-D multiplanar imaging techniques, CT urography can clearly demonstrate multifocal transitional cell carcinoma lesions (arrows), and shows excellent anatomical detail. (Provided by Prof. Dr. Mustafa Özmen)

“We have adapted our age-based algorithm for the CT urographic assessment of haematuria,” Özmen commented. “The risk of urinary tract malignancy is extremely low in younger patients. Therefore, when we identify a stone in the urinary tract during an unenhanced phase, we don’t proceed with the enhanced series. If no stone is identified in the urinary tract, the split bolus technique is preferred in younger patients, where nephrographic and urographic images are combined in a single acquisition. Patients older than 40 years with macroscopic haematuria, or patients with high risk factors for malignancy, should always undergo triple-phase CTU, whether or not there is a stone in the urinary tract.”

In recent years, significant radiation dose reductions have been achieved in CT, and he thinks low mA and low kV imaging are central to dose reduction. Also, mA modulation on the x-axis and z-axis adapted to a patient’s body habitus during scanning provides further dose reduction. Adaptation of iterative reconstruction techniques can allow 30–60% dose reductions compared to CT images reconstructed by the back projector. Özmen concluded that “Standardisation of CTU protocols is also an important issue today. Large scale studies are needed.”

Clinical Corner
The use of imaging in asthma remains, for now at least, confined to the most severe cases. Various international guidelines recommend chest x-rays for investigating atypical asthma, and although CT offers far greater levels of anatomical detail, the modality is used primarily in severe or difficult-to-treat cases and for differential diagnosis, and obtaining a definitive diagnosis of asthma remains challenging. “It’s not so easy to eliminate other conditions – that’s why you do CT,” noted Prof. Pierre-Yves Brillet, a radiologist from Ariana Hospital, Bobigny, France, adding that the difficulty stems in large part from uncertainties in defining the pathology of the condition, and in further compounds by its sheer variability. “Asthma is not a disease – it’s more a kind of syndrome.”

Brillet is part of a line-up of speakers who will provide a refresher course this afternoon on analysing and reporting phenotypes in obstructive airway disease. In asthma, phenotyping is a really hot topic, he noted. Previously, asthma was considered a relatively homogeneous condition, characterised by mast cell- and eosinophil-mediated inflammation and responsiveness to corticosteroids. Age of onset, level of lung function, degree of airflow obstruction, responsiveness to bronchodilator therapy, gender and predisposition to hypersensitivity are all now regarded as distinguishing features.

Establishing firm, predictive criteria based on imaging data remains very much a work-in-progress. For chronic obstructive pulmonary disease (COPD), it is quite clear, but for asthma it remains to be confirmed, according to Brillet. The available clinical data are insufficient, because a quantitative understanding of the relationship between CT data and clinical findings is not sufficiently robust. Imaging, therefore, is not yet useful for the clinical management of the condition. Clinical questionnaires and objective lung function tests remain the standard methods, although they are limited by the inevitable ‘black box’ picture they provide. Nonetheless, it is important, however, for eliminating other potential diagnoses. The list of conditions that can masquerade as severe asthma is long. It includes, but is not limited to, tuberculosis, vocal cord dysfunction, COPD, cystic fibrosis, persistent bronchiolitis and inhaled foreign bodies.

Moreover, asthma can be accompanied by complications, such as emphysema (particularly in smokers with asthma) and bronchiectasis. The latter requires the elimination of allergic bronchopulmonary aspergillosis, an inflammation caused by Aspergillus infection. CT is the gold standard for investigating and quantifying emphysema, airway wall thickening and air trapping. It can be used to distinguish emphysema-predominant COPD from airway-predominant COPD, and thus guide clinical care.

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Molecular imaging: researcher foresees upcoming clinical application in myocardial failure

By Mélisande Rouger

The landscape of molecular imaging has changed over the past two years, with advances having been made in image-guided drug delivery, gene-based therapy and cellular therapies. In the context of myocardial infarction, cell-labelling techniques have shown no adverse effects and have improved the efficiency of treatment.

The recent development of cell-labelling techniques using iron oxide magnetic nanoparticles has confirmed the role of imaging in monitoring cellular therapies. In particular, researchers have been able to develop high resolution cellular imaging, using cryoprobes in high magnetic fields. This combination enables high resolution imaging with a sharp definition of cells in a given organ.

The procedure we have made over the past two years is by labelling macrophages in an ischaemic pad of a rat's foot, we could clearly see the colonised cells and the ischaemic territory, “said Professor Olivier Clément, a radiologist working at University Hospital Georges Pompidou in Paris, France.

Projects such as the European Network for Emission and Tracking (ENET), coordinated by the European Institute for Bio-medical Imaging and Research and funded by the EU (www.enet-ei.org), have played a major role in this progress, the researcher underlined.

These techniques have shown no adverse effects on cell proliferation and function- alities while conferring magnetic properties on various cell types. The magnetic labelling of living cells creates opportunities for numerous biomedical applications, such as individual cell manipulation and magnetic control of cell migration.

Clément and his team are currently working on facilitating cell-homing in myocardial infarct cellular therapy, by placing an external magnet over the heart to create a local field gradient which induces magnetic targeting.

“We have been working on a study to improve cell-homing in the heart and suc- ceeding in having more cells when using a magnet. We still haven’t been able to show a therapeutic effect with this technique but other studies have, and they could show a long-term effect, including scar reduction,” he said.

Intracellular heating will, probably soon, become a field of investigation for many researchers. With this method, one will be able to kill cancerous cells and tumours or liberate drugs contained in a liposome or nanoparticle. With a magnet, you can drag the liposome exactly where you want it; to a tumour, for instance. Then, you just have to heat the liposome, using external micro- waves, after which it will break and allow for chemotherapy. This is still a concept, but it could become a third application in the short-term,” Clément said.

The transition of these techniques into clinical practice remains a long-term prospect. Many things are still to be done, including toxicity tests. On the bright side, cellular therapies such as blood transfusion and bone marrow transplant already work without image-based monitoring.

Molecular imaging should, however, prove very useful for tissue transplants and regeneration, by showing exactly what happens.

“It is not clear at all whether the injected cells will replace organ function, for instance in myocardial failure. A cell can also trigger signals that help the heart to function better. In this case imaging helps us understand exactly what happens,” said Clément, who foresees its upcoming clinical application in the heart.

“The horizon of magnetic techniques has not been reached,” Clément concluded. “Imaging can significantly improve the accuracy of treatment,” said Dr. Michal Neeman, a researcher working on the development of reporter genes for MRI at Weizmann Institute in Rehovot, Israel.

Reporter genes encode proteins which can be detected by imaging and act as a surrogate for the activity of a particular promoter area. For example, reporter genes are used to follow the activation of tumour-associated fibroblasts as they penetrate tumours, and follow the expression of angiogenic and lymphangiogenic growth factors by tumours.

Different reporter genes have been developed to allow detection by different imaging modalities. The most common reporter genes are the fluorescent and bioluminescent proteins that emit light and can be detected using sensitive cameras. Reporter genes are now also available for nuclear imaging and MRI. “I believe the next steps will be to prove efficacy and safety in specific diseases,” Neeman concluded.

The first success story is the treatment of haemophilia B, as shown by a study recently published in the New England Journal of Medicine by researchers at University College London and St. Jude Children’s Research Hospital in the US (www.nejm.org).

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Clinical Corner

The Slovak Radiological Society

A young society built upon great tradition

By Jozef Biklický

The practice of medicine in Slovakia can be traced back to the year 1095, when King Ladislau founded the St. Ladislau Hospital, which, unfortunately, no longer exists. There is a long history of medical practice within the greater Bratislava area (formerly known as Pressburg) with hospitals such as the Brothers of Mercy, founded by Cardinal Stéphane in 1672, and the St. Elisabeth Hospital, which, unfortunately, no longer exists.

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Spinal intervention: imaging leads the way

By Mélanide Rouget

Back problems affect an ever-increasing population worldwide. Some benign pathologies may become life impairing and require much more than pain killers to cope with. More serious conditions, such as bone metastasis, may also be extremely painful and must be adequately treated.

Interventional radiology currently offers a wide range of non-invasive treatments that can really improve patients’ quality of life. Image guidance combined with contrast enhancement is paramount to viewing the progression of the needle in the body, even for procedures involving benign pathologies. Specialists will present the latest developments and indications for IR techniques during a dedicated session this afternoon.

Herniated disk is a common pathology that has a strong impact on patients’ quality of life. The burden on a country’s social and economical systems is very heavy, with repeated and often long work absences. As the disk dissolves itself in two to four years, many treatments are conservative and focus on easing the pain. Anti-inflammatory and other analgesic treatments are the first step taken to curb episodic crises.

“We know that time plays in our favour, so we try to treat patients with the least aggressive therapy possible,” said Dr. Xavier Buy, an interventional radiologist at Strasbourg University Hospital in France.

A further step, in case of failure, is to inject anti-inflammatory drugs directly in contact with the nerve, using a needle and image guidance. This procedure, known as infiltration, is the core business of interventional radiology in the treatment of herniated disk. “It is a very safe method, and one advantage is that the drug only targets the nerve, unlike oral drugs that may affect the whole body,” said Buy, whose team performs an average of a dozen infiltrations per month.

GPs, rheumatologists and other specialists may also carry out infiltrations. However, interventional radiologists using MR, CT or fluoroscopy combined with contrast enhancement can more safely and precisely control the placement of the needle. This last point is absolutely crucial, Buy insists. Without imaging and contrast injection, serious complications may occur, as they recently did in France.

“The French Ministry of Health issued a warning. Five patients received lumbar spine steroid infiltrations and became paraplegic, probably because doctors accidentally injected the drug in the artery that feeds the spinal cord. This artery can, in exceptional cases, go very low in the lumbar canal. They blocked it with drugs, and as a result these people can’t walk anymore. This is a tragedy,” he said.

One of the many challenges linked to infiltrations is the absence of procedure standardisation. Image guidance and assessment of the proper needle position for contrast injection should be standard practice, particularly for foraminal injections, but many doctors over the past 40 years have been injecting drugs based on previous imaging alone.

“Control quality is not the same from one procedure to the other, making it difficult to evaluate literature. We think some people did infiltrations the bad way. The standard method would be to systematically control where the needle is by inject- ing contrast media before corticoids. When performing a foraminal approach, the needle tip should stay in the low and posterior part of the foramen. One millimetre may change it all,” said Buy, who hopes to see standardisation coming soon.

A risk radiologists should be aware of is puncturing patients who have already had spine surgery. Surgery scars may complicate the introduction of the needle, as new vessels may communicate with the spinal cord. Fibrosis can potentially complicate the procedure. CT, enhanced with contrast media, is the best modality in this case, as it offers more precise control than MR or fluoroscopy for spinal infiltrations,” he said. Infiltrations have very good results in most patients and can be repeated up to four times a year if necessary.

If the treatment fails, radiologists will then try to decompress the disk by performing a percutaneous nucleotomy, but only in selected patients and for contained disk hernias. Nucleotomy is performed either by introducing a chemical substance able to eat up the disk or using a claw to scratch the disk and release pressure. Thermal techniques using radiofrequency coablation (RFC) or laser are also very efficient. The idea is to pulverise a small volume of the nucleus to provide decompression. Heat also modifies nerve terminals and biochemical factors inside the disk, so it has an analgesic effect. “Thermal tech- niques are the ones we prefer using. They allow both a mechanical and thermal effect,” Buy said.

“The difficulty is in placing the heat source right at the heart of the disk, so as not to damage the surrounding tissues or verte- brae. Image guidance is also required, most often with fluoroscopy; the most comfort- able technique to adequately place the laser and RFC fibres in the disk,” according to Buy.

Radiologists should remember they should avoid treating a whole disk but just a small part. “The risk for arthrosis would be too high if the whole disk were to be removed, because vertebral plates would rub against each other.”

One should also not underestimate the sufferers’ psychological distress, which pushes them to ask for radical methods. “We often need to calm down impatient patients, who want to get rid of the whole disk, and make them understand that a less invasive therapy such as infiltration might be more appropriate,” he said.

Fluoroscopy ablation is a good application for image-guided spine interventions, whether they are curative or palliative treatments.

Thermotherapy uses image guidance and thermostats placed on the tumour to make sure the surrounding tissues are not exposed to temperatures above 45 degrees Celsius, which would be too high.

Radiofrequency ablation (RFA), micro- waves or lasers are used in combination with CT, fluoroscopy or MR monitoring, and they target the tumour with a heat of 55 degrees.

More and more centres also offer cryo- therapy, in which the tumour is frozen using gas decompression. Argon is the most commonly used gas, and its temper- ature can sink to as low as -183 degrees. Strasbourg University Hospital was the first European centre to ever use cryotherapy in interventional radiology in 2007.

“Cold is very interesting, and its big advantage over heat is that it is visible. It is clearly identifiable on MR or CT scans, so it gives an added level of precision to the pro- cedure,” said Prof. Afshin Gangi from the University Hospital Strasbourg, a leading expert in IR treatment of bone metastases.

Fluoroscopy, CT and MR may be used to guide both techniques. MR thermom- etry is especially good with cold, and gives a signal up to 15 degrees. “One does not need to place a thermometer inside, which is quite an advantage. And of course it is non-ionising,” Gangi said. Fluoroscopy is often coupled with CT. This alliance is particularly efficient for very small masses. Whatever the modality, image-guided procedures are increasingly being performed not only to destroy the tumour but also to ease the pain. Radiologists are increasingly called upon to treat symptoms and tumour-induced consequences, such as pathologic fractures. They may inject acrylic cements to both consolidate the vertebra and ease the pain. This might be a softer treatment for fragile patients than surgery, according to Gangi.

“Surgery is usually the last treatment to remove all metastases but it might complicate fragmented in frag patients. Vertebroplasty is expensive but crucial in palliative treatment of metastatic vertebra, and we perform this procedure in a large number of patients. Then we might perform RFA or laser or cryotherapy,” he said.

Interventional spinal surgery and radiotherapy are all key treatments in oncology. The multidisciplinary approach guarantees that patients are given the best chance possible.

Clinical Corner

Special Focus Session

Monday, March 5, 16:00–17:30, Room F2
SF 19: Spinal intervention

▶ Chairman’s introduction
  T. Saharia, London/UK
▶ Herniated disk
  A. B. Rouget, Strasbourg/FR
▶ Vertebroplasty
  A.D. Keiski, Athens/GR
▶ Treatment of neoplasm
  A. Tang, Strasbourg/FR
▶ Facet pathology
  N. Makadon, London/UK
▶ Panel discussion:
  What are the new advances in the above fields that may change current practice?
Digital radiography exhibitors put renewed emphasis on portability

By John Bonner

Mobile x-ray systems that can be manoeuvred in and out of tight corners, low-cost and robust patient monitors and these challenging economic times, and an improved approach to mammography – these aspects are visible to all delegates when studying the new offerings in digital radiography (DR) that are on display in the ECR technical exhibition.

Sectra sold MicroDose, its digital mammography technology, to Philips last year but that does not mean that the Swedish company has abandoned its interest in women’s health, the original focus of its research efforts. On the contrary, Sectra is still active in the field, concentrating on providing software solutions for the problems facing other DR companies in providing more clinically powerful yet cost-effective services.

In particular, the company is helping to advance what is arguably the most significant development in mammography screening since digital x-ray systems became widely available more than a decade ago. As its name implies, breast tomosynthesis is rather like a combination of traditional 2D radiography and 3D computed tomography in which a series of around 15 images is taken through a limited arc rather than a full 360 degrees. ‘One of the problems with digital mammography is the effects of overlaying tissues,’ noted Mats Bjornemo, director of product marketing with Sectra. ‘During the screening, you ask the woman to move away from the mammography unit and it takes a normal hand x-ray. That is sent to our online imaging lab where we do a bone mineral density analysis. So we return an osteoporosis risk assessment for that woman at the same time as her breast cancer screening. This brings better economic benefit to the health of women being screened.’

Following the acquisition of the MicroDose system, Philips has begun further development of a system on a technology that already offers high clinical performance combined with a reduced risk to the health of women being screened. ‘This is a quick, convenient and comfortable mammography solution with up to 50% reduced radiation exposure, as compared to other full-field digital mammography systems,’ said Kim Holtrum, general manager of Women’s Healthcare at Philips. ‘What differentiates our system from all the other systems on the market is its image quality and its photon-counting technology. It is thanks to this unique detector system that we achieve this significant dose reduction without compromising clinical image quality.’

The vendor is concentrating on developing solutions for some of the more challenging cases that present in a screening programme, notably women with unusually dense or fatty breast tissue. ‘The photon-counting technology used by MicroDose allows for single-shot spectral image acquisition, which is currently under development. The spectral information would come as a bonus to the normal mammogram since it is acquired in the same exposure, without compromising image quality or increasing dose. The radiologist will thus be able to obtain additional information from the mammogram without additional radiation dose and additional exposure time,’ she explained.

When caring for patients who are too sick to be moved to the radiology department, hospital staff are now demanding the same performance from mobile digital x-ray machines that would be expected from the main unit. At the ECR, two leading manufacturers are both demonstrating advanced mobile workstations that they are ‘calling a radiology room on wheels.’

GE Healthcare is displaying its Optima XR220axm system, a compact mobile machine that can reportedly acquire fast, low-dose images for physicians working in the accident and emergency unit, intensive care and or other challenging clinical settings. At the core of the system is the Flashpad wireless digital detector that aims to provide the productivity, image quality and functional- ity of a radiology room at the point of care. It offers a number of practical advantages, including fewer delays due to shorter boot-up times, automatic charging and easy storage.

Carestream is exhibiting its DRX-Revo- lution system, which will be commercially available from mid-2012. The unit is both smaller than its predecessors and easier to manoeuvre through the crowded corridors of a busy modern hospital. The unit is powered by two independent drive motors and can be turned on the spot through a 360-degree turn – although such sudden changes of direc- tion may be unnecessary as the machine has an automatic collapse feature which gives the operator a much clearer view of the way ahead. Despite its relatively small size, the machine has been designed with plenty of storage space built into the bodywork, according to Jane Grimley, European marketing manager for Carestream’s digital radiology business. ‘There are places to keep all the materials that a radiographer is likely to need on the ward – such as pens, paperwork, sanitisers, gloves, etc. – and which may result in wasted time if they have to go looking for them. So the technician has everything that he or she needs immediately at hand, which is why we are calling it an x-ray room on wheels,’ she noted.

Similar very practical considerations lie behind a recent offering from Siemens. As part of its Agenda 2013 initiative, created in response to the increased cost pressures fac- ing healthcare providers around the globe, the company has launched its Multix Fusion radiography system. This product is designed to allow small and medium-sized hospitals to deploy technology already proven in high-end systems at a time when every investment decision has to be justified. It is a high-tech solution for a tight budget, explained Alexander Prowell, marketing manager for Siemens’ DR business. ‘The system supports the full spectrum of clinical applications, but is much more affordable than comparable predecessor models, she added. It also features components that until now were only offered in the upper systems and other urinary tract contrast media acquisition. General radiographic examinations of the thorax, pelvic region, and extremities can be performed, and the device can be used for orthopaedic surgical procedures.

During the ECR, Toshiba is promoting a new five-axis C-arm with automatic synchro- nisation of flat panel detector and collimator rotation, along with a capability to move the ceiling-mounted C-arm not only longitudi- nally but also laterally. This brings better patient access, according to the vendor. The Infinix VC is available with two different flat panel detector sizes: 30x40cm for general angio applications and 30x30cm for mixed applications.
Retrofit wireless flat panel detector boosts European mobile x-ray

By Theo Ahadome, Stephen Holloway, Carly Reed

The newest generation of wireless flat panel x-ray and retrofit FPDs are designed to offer faster processing and longer battery life. Yet, their greatest benefit is that their internal components, but their method of application. The most notable beneficiary: mobile x-ray systems. The technology of wireless FPDs for x-ray usage has been available for the last few years. A higher price tag and risk of drop damage or theft damaged market confidence initially. Yet, the first generation of wireless panels has been deployed in new mobile x-ray systems, providing a recipe for market success.

Uptake of wireless FPD x-ray systems has also been facilitated by the development of retrofit solutions, allowing the upgrade of existing analogue mobile x-ray systems. More recently, retrofit solutions have overcome initial teaching problems and are compatible with a variety of brand systems at a lower price.

In the current economic climate, the popularity of retrofitting is rapidly increasing, offering digital capability to users who would be unable to purchase full DR mobile systems.

The market for mobile x-ray in Western Europe has previously experienced a slow transition to digital. Many hospitals and clinics commonly upgraded to digital for room-based x-ray systems, as the relative return on investment (ROI) from increased scan efficiency and patient throughput justify the initial outlay. For mobile x-ray, this was rarely the case. The emergence of wireless panels and retrofit FPDs has already changed this view. Now hospitals can upgrade well-maintained analogue mobile x-ray systems at limited cost. In small clinics with small budgets, panels can also be shared between rooms and mobile systems, providing far greater flexibility.

Consequently, the future outlook for the EMEA mobile x-ray market looks very positive (see figure). While accounting for less than 10% of total revenues in 2011, market growth is forecast to exceed 10% annually over the next three years. Driving this trend is a raft of new systems released in the last year from major x-ray manufacturers looking to maximise growth in order to counter poorer market performance in other x-ray segments. Increased competition between suppliers will also prompt aggressive pricing; ongoing decline in flat panel detector component pricing will further exacerbate this trend.

The impact of these new systems in clinical settings is clearly positive; radiographers will no longer have to shuttle between patient beds and processing rooms, increasing exam efficiency. Wireless panels simplify patient positioning during exams, as panels are not tethered. Digital FPD solutions also boast dose reduction benefits, especially important in clinical settings outside the radiography suite. Combined, these features not only improve workflow, but improve standards and safety for the patient and radiographer.

The revolution taking hold of the mobile x-ray market is not founded on ground-breaking and expensive new technology. Instead, significant change and improvement is being achieved by utilising existing technology and adapting it for use in novel new ways. Manufacturers of mobile x-ray systems have taken notice of the current challenges affecting the modern hospital and radiographer, and produced solutions that address these challenges. As a reward, a strong demand for these new solutions will provide welcome respite in troubled times.

The authors are market analysts in the medical imaging and healthcare IT research groups at InMedica. InMedica is a leading provider of market research and consultancy in the medical electronics industry (www.in-medica.com).

EBIR presents IMAGINE

After last year’s success, EBIR is again hosting the IMAGINE Workshop, this year under the heading ‘Novel technology that shapes radiology’. The sessions will feature research institutes, university groups and research departments of industrial companies, presenting novel and exciting technological developments in the field of diagnostic and interventional radiology. The presenters of the workshops were invited to introduce their work in EBIR Today.

Advances in MRI-guided therapy of cancer

By Klaas Nicolas, Gustav Strijkers, Holger Grull

Recent years have seen tremendous developments in the use of imaging techniques for improving the efficacy of therapeutic intervention during the treatment of cancer. This article highlights some of the recent advances in image-based diagnostics and image-guided therapy of cancer that were achieved by the Department of Biomedical Engineering at Eindhoven University of Technology (TU/e).

Several of these developments were accomplished jointly with the Department of Bio-Molecular Engineering at Philips Research in Eindhoven, the Netherlands. Soon, the biomedical imaging facilities of TU/e and Philips Research will be merged at the High-Tech Campus in Eindhoven. The integration of the imaging facilities of the two institutions will lead to the establishment of state-of-the-line infrastructure for translational multi-modality imaging. The infrastructure is comprised of equipment for in vivo studies on laboratory animals with high-field MR imaging and spectroscopy, micro-FTC, micro-SPICT, micro-CT, optical imaging, and intravital microscopy. While a whole-body 3.0 Tesla MR scanner can be used for rodent models, a smaller instrument is equipped with a clinical High-Intensity Focused Ultrasound (HIFU) system. State-of-the-art facilities are also available for radiochemistry of nuclear probes as well as cell culture, immunochemistry, and supporting technologies.

Imaging techniques play a key role in the development of improved diagnostics and innovative therapies for cancer. In particular, MRI has much to offer. For diagnostics and treatment of cancer, MRI can be used: (a) to localise and characterise the tumour prior to treatment, (b) to monitor delivery of drug carriers to the malignancy in case of chemotherapy of cancer, (c) to navigate and sometimes even full control therapeutic interventions, such as High-Intensity Focused Ultrasound treatment for thermal tumour ablation, (d) to steer HIFU-induced drug release from thermo-sensitive carriers, combined with measuring local drug deposition, and (e) for longitudinally monitoring therapy efficacy. Here, we report advances in MRI for each of these uses, employing rodent cancer models, paramagnetic liposomes as drug carriers, molecular imaging probes, and MRI-guided HIFU for temperature elevation. Mild hyperthermia is used to open temperature-sensitive drug-loaded liposomes, while a large tumour temperature elevation is employed for direct tumour cell kill.

Pre- and post-treatment tumour characterisation

We have developed a multi-parametric MRI toolkit for pre-treatment tumour characterisation and therapy follow-up, which involves perfusion and diffusion-weighted imaging, T1 and T2 mapping, and MTR as well as vascular status, using DCE-MRI. Imaging data are among others analysed with the use of an unsupervised ISODATA technique, to assess therapy effects. In addition, molecular MRI techniques for visualising tumour-associated biomarkers, e.g. angiogenic activity, were developed. As an example, Figure 1 shows tumour angiogenesis-specific MRI using integrin-targeted paramagnetic liposomes. In this setting MRI is employed for the evaluation of angiogenic activity at the whole-tissue level. Microscopic analyses demonstrated that the liposomal contrast agent indeed adheres to tumour vascular endothelium.

Drug carrier delivery

MRI provides several tools for monitoring the delivery of therapeutic agents to tumour malignancies. Recently, paramagnetic liposomes loaded with an anti-cancer drug were used to quantify carrier delivery to the tumour and to relate this to therapy efficacy.

MRI-guided HIFU

MRI provides unique tools for temperature mapping with the proton resonance frequency method. Feedback control of HIFU-induced temperature changes was implemented on a
The Virtual Imaging Platform makes image simulation widely available

By Tristan Glatard

Obtaining reference images is useful for testing imaging techniques, evaluating image analysis algorithms and study pathologies, but real-world acquisitions are expensive, need expertise, generally provide no ground-truth, and can be invasive. Virtual images are a possible alternative which require significant computing power and storage, but real-world acquisitions are expensive, need expertise, and provide no ground-truth. Virtual images are therefore useful for testing imaging techniques, evaluating image analysis algorithms and study pathologies.

Digital models of the human body are prerequisites for generating realistic virtual images. In addition to properly capturing the geometry and movement of the structures of interest, these models also have to include the physical parameters involved in image simulation, for instance magnetic properties for MRI, echogenicity for ultrasound, chemical composition for CT, and radioactivity for PET. Two approaches are possible for obtaining such models. First, physical parameters can be extracted directly from a (real) image, for example, the density of a tissue can be used to generate a CT image, and the density of a tissue can be used to generate an MRI image. Second, physical parameters can be estimated from a (real) image, for example, the density of a tissue can be estimated from an MRI image, or the density of a tissue can be estimated from an ultrasound image.

Simulations require substantial computing power and storage, and accessing simulated images. To this end, semantic annotations have been added to the VIP platform to enable users to define simulation scenes, launch simulations, and access simulated images.

The accompanying poster to this presentation is published in EPOS™ and can be accessed online at myESR.org/EPOS. The poster (C-1936) is titled ‘Advances in MRI-guided therapy of cancer’.

Klaas Nicolay, Gustav Strijkers and Holger Grull work at the Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven/NL.

Definition of an echocardiography simulation in the VIP interface.

Echocardiography simulated on a heart model extracted from an MRI sequence.

The accompanying poster to this presentation is published in EPOS™ and can be accessed online at myESR.org/EPOS. The poster (C-2041) is titled ‘Multi-modality Virtual Imaging Platform for the evaluation of image analysis algorithms’.

Tristan Glatard works at CREATEIS in Villeurbanne/FR.

1 http://www.espr.eu
2 http://vip.creatis.insa-lyon.fr

Conclusions
MRI offers a broad range of tools to advance the diagnostics and the treatment of cancer by providing refined tumour characterisation tools and by providing guidance for the optimisation of therapeutic interventions. This type of research offers important guidelines for the translation of innovative image-guided anti-cancer therapies from the preclinical level to the clinical setting.

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1 http://www.espr.eu
2 http://vip.creatis.insa-lyon.fr
Leopold Museum
Egon Schiele, Self-portrait with peacock vest, 1911 © Ernst Ploil
An extendable multimodal cardiac analysis plug-in for OsiriX

By Markus Hüllebrand, Anja Hennemuth, Daniel Messroghli, Titus Kühne

Congenital and acquired heart diseases are one of the major causes of death in the West. Over the last few years a wide variety of new imaging techniques have been developed, which are used for diagnostics and therapy planning. These techniques provide information on cardiac function, physiology and anatomy and come with specialised software tools to derive quantitative information from the new image types.

In order to benefit from the complementary information provided by different methods and for the comparison of established and new techniques, it is necessary to explore and analyse the available data through an integrated approach. Thus, we developed a concept, which allows the integration of new image data types and corresponding analysis steps into a framework, which is especially suited to cardiac applications.

For the purpose of providing a framework for the clinical research community, we developed a freely available open-access software platform with a rapid development environment, which is especially suited to cardiac applications. OsiriX is a well-known open-source PACS workstation, which is widely used for the management and visualisation of medical images in clinical research. Through a plug-in mechanism additional features can be integrated into the graphical user interface and it also allows access to required DICOM and image information from OsiriX.

However, when it comes to more complex image processing, the management and advanced visualisation techniques of multi-dimensional images, such as 4D phase contrast (PC), magnetic resonance imaging (MRI), or data structures and advanced visualisation techniques (flow visualisation, path lines, etc.), only one other image processing platform provides advanced capabilities. Thus, we combined the OsiriX data management and plug-in environment with the MeVisLab development environment for advanced image processing and visualisation tools (www.mevislab.de). MeVisLab was extended to provide a comprehensive analysis of spatio-temporal relations of different image data types, but also the combined analysis of multiple modalities can be combined such as perfusion MRI, late-gadolinium enhanced MRI, and angiographies.

The described features have been developed in an OsiriX plug-in in cooperation with radiologists and cardiologists from the German Heart Center, Berlin, Germany and researchers from Fraunhofer MEVIS, Institute for Medical Image Computing, Bremen, Germany. The current version of the programme will be presented at the IMAGINE Workshop presented by the European Institute for Biomedical Imaging Research (EIBIR).


Markus Hüllebrand, Anja Hennemuth, Daniel Messroghli, Titus Kühne work at Fraunhofer MEVIS, Institute for Medical Image Computing, Bremen/DE and German Heart Center Berlin/DE.
Diffusion and functional MRI are relatively new MRI modalities that provide an enormous amount of information on fibre connections between different parts of the brain and the activity patterns within these parts. Diffusion MRI (dMRI) measures the tiny thermal motions of water molecules in tissue, which is a diffusion process. In fibrous tissue, like brain white matter, the path of a water molecule over time is not the same in all directions, but forms an ellipsoid. With dMRI we can measure in each voxel the diffusion tensor (DTI), from which the three axes of the ellipsoid can be computed. The longest axes of ellipsoids in adjacent voxels can be concatenated to represent the trajectory of the fibre bundles: this is called MRI tractography.

Despite the fact that the resolution is still coarse, and only the orientations of the fibres are measured (i.e., no distinction is made between efferent and afferent projections), MRI tractography can be of great help for neurosurgeons in surgical planning and navigation. Furthermore, counting the number of fibre connections between brain regions can give a measure of structural connectivity. Complementary to dMRI, functional MRI (fMRI) highlights active regions in the gray matter of the cerebral cortex. This is based on changes in the magnetic field caused by the increased oxygen supply in the capillaries near active neurons. Patterns in brain activity can be compared across brain regions to give us a measure of functional connectivity.

Technically, tractography and connectivity analysis have developed to a mature state, but clinical applications are still sparse. At the Image Science & Technology institute at Eindhoven University of Technology in the Netherlands, in collaboration with Maastricht University Hospital and Kempenhaeghe Epilepsy and Sleep Expertise Centre, we have successfully developed interactive visualisation of highly complex functional tractography and connectivity data has the potential to contribute to more precise and safer neurosurgical procedures. We also studied the functional connectivity of the STN by measuring the correlation of the functional activity between the STN and the rest of the brain, based on resting state BOLD fMRI. This study also showed high motor connectivity in the lateral STN, while the medial part exhibited higher functional connectivity to the limbic system.

Another application is the tractography-guided planning for epilepsy surgery. In patients with severe epilepsy, when drugs no longer help, surgical resection of the epileptic focus may be considered. When this concerns the anterior part of the temporal lobe, the operation may result in the serious loss of a quarter of the visual field, due to damage to the anterior part of the optic radiation (i.e., Meyer’s loop). In order to specifically find this optical tract, the location of the calcarine sulcus in the visual primary cortex was located using functional MRI, by presenting a checkerboard stimulus. In addition, the lateral geniculate nucleus in the thalamus was segmented manually. Seeding the fibre tractography from these regions allowed the reconstruction of the optic radiation, with delineation of the foveal and upper and lower visual hemisphere optic tracts separately. We are currently studying dMRI-seeded tractography in patients with good-eyesight but with serious brain malformations.

For research purposes, including the projects mentioned above, we have developed several dMRI visualisation and analysis tools. New mathematical algorithms were developed to denoise, segment, and structure the fibre bundles. For the much more complex high-angular resolution diffusion imaging (HARDI) data we exploit high-order tensor calculus and contextual reasoning. Interestingly, the required 3D mathematical reasoning is based on 2D functional models of early mechanisms in our visual perception. The ‘DTITool’ software developed at IST/e is a versatile DTI/HARDI analysis and visualisation tool, accelerated by consumer graphics hardware. Fibre tracking, fibre clustering, and many more forms of interactive and precise visualisation of tracts are incorporated. We are currently adding uncertainty visualisation.

In conclusion, the development of new computer vision methods to analyse and interactively visualise highly complex functional tractography and connectivity data has the potential to contribute to more precise and safer neurological procedures.

By Ellen J.L. Brunenberg, Chantal M.W. Tax, Pauly Ossenblok, Evert van Aart, Veerle Visser-Vandewalle, Bart M. Ter Haar Romeny, Anna Vilanova

Structural connectivity of the (manually segmented) STN voxels. Note the strong connections to the (pre-)motor cortex (indicated by ‘sma’ in the figures).

Meyers loop helps in planning the resection depth in mediotemporal epilepsy surgery.

The accompanying poster to this presentation is published in EPOS™ and can be accessed online at myESR.org/EPOS. The poster (C-0755) is titled ‘Diffusion Weighted Imaging Guided Surgical Applications’.

Ellen J.L. Brunenberg, Chantal M.W. Tax, Bart M. Ter Haar Romeny, Evert van Aart, and Anna Vilanova work at the Eindhoven University of Technology, Eindhoven/NL. Veerle Visser-Vandewalle works at Maastricht University/NL, and Pauly Ossenblok at Kempenhaeghe Epilepsy and Sleep Expertise Centre, Heeze/NL.
Musculoskeletal ageing, a technological renaissance

Using advanced imaging and physiological modelling technologies to predict the risk of bone fracture in osteoporotic patients

By Marco Viceconti

In spite of the social importance of musculoskeletal ageing conditions (over €20b spent in Europe annually to treat osteoporotic fractures alone), the rate of innovation in this sub-domain of medicine has been frustratingly slow over the last five years, in terms of both pharmaceutical and technological innovation. A strange ‘spiral of death’ has made clinicians tepid about innovation in this field which has resulted in the biomedical industry moving research and development investment elsewhere. Of course, one trend nurtures the next in a process that has been heading towards complete stagnation.

However, a renaissance could be around the corner for technologies aimed at musculoskeletal diseases, as policy-makers realise the tremendous cost of care which these can incur. A recent study[1] found a statistically significant difference between the three most commonly used bisphosphonates only after the cohort was properly corrected for member characteristics. Another issue is that the end-point for most clinical trials is often very distant, with considerable associated costs.

A possible solution to this complex problem might emerge from a combination of innovative imaging technology and breakthrough physiological modelling. After nearly four years of research partially funded by the EC, the VPHOP consortium has developed an imaging and modelling technological pathway that could radically change the way we deal with osteoporotic fractures. The VPHOP consortium has been developing a personalised multiscale modelling technology capable of accounting for the most important mechanical processes affecting the patient’s risk of experiencing an osteoporotic fracture. The personalised models account for the whole body, organ, tissue, and cellular level interactions and are able to predict progressive changes to tissue properties, structure and, ultimately, fracture risk over time, as well as how pharmacological and interventional treatments might modify these risks.

The VPHOP modelling system is paired with a new generation of imaging and biomedical instrumentation technologies capable of collecting the most important information required for initialising personalised models, under the tight constraints of clinical applications, which impose low radiation dosages and moderate costs. One of them is the EOS-QT research prototype developed by EOS Imaging[2]. Founded by the Physics Nobel winner G. Charpak, EOS imaging has developed a complete orthopaedic imaging solution which enables the simultaneous acquisition of two full-body x-rays at very low radiation dose and provides a 3D bone-envelope image of the skeleton in the weight-bearing position. Based on this commercial product, the research prototype developed in the framework of VPHOP allows further measuring of bone mineral density. By combining this information with the personalised 3D envelope of the skeleton, the EOS-QT prototype will ultimately allow 3D densitometry mappings to be used in the VPHOP modelling.

The radical innovation of the VPHOP is the integration. Following the Virtual Physiological Human vision, we use multiscale modelling as a means to account for the systematic interaction of processes that occur at radically different space-time scales, achieving a level of knowledge integration that can drastically improve the predictive accuracy.

By using VPHOP technology, evaluation of the absolute risk of bone fractures will be much more accurate than a prediction based on external and indirect determinants, as currently takes place in clinical practice. These predictions will be used to improve the diagnostic accuracy of clinical standards and to provide the basis for an evidence-based prognosis with respect to the natural evolution of the disease, pharmacological treatments, and/or preventive interventional treatments aimed at selectively strengthening particularly weak regions of the skeleton.

“This is a truly personalised and predictive line of attack against the disease, which should considerably improve the accuracy with which we estimate the risk of osteoporotic fracture, by accounting for molecular, anatomical, biomechanical, and neuromotor determinants in an integrated fashion,” said Prof. René Rizzoli (Université De Genève), clinical leader of the VPHOP project.

For more information: http://www.vphop.eu

The accompanying poster to this presentation is published in EPOS[3] and can be accessed online at myESR.org/EPOS. The poster (C-0830) is titled ‘Image-based, personalised and multiscale modelling to predict the risk of fracture in osteoporotic patients: the VPHOP integrated project.’

Marco Viceconti is professor at the Dept. of Mechanical Engineering, University of Sheffield/UK and VPHOP Project Coordinator.

http://www.vphop.eu/presentations/27142501


Multiscale modelling approach, Cristofolini L et al (2008), Multiscale investigation of the functional properties of the human femur, Philos Transact A 365:3319-41

The accompanying poster to this presentation is published in EPOS and can be accessed online at myESR.org/EPOS. The poster (C-0830) is titled ‘Image-based, personalised and multiscale modelling to predict the risk of fracture in osteoporotic patients: the VPHOP integrated project.’

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The VPHOP modelling system is paired with a new generation of imaging and biomedical instrumentation technologies capable of collecting the most important information required for initialising personalised models, under the tight constraints of clinical applications, which impose low radiation dosages and moderate costs. One of them is the EOS-QT research prototype developed by EOS Imaging[2]. Founded by the Physics Nobel winner G. Charpak, EOS imaging has developed a complete orthopaedic imaging solution which enables the simultaneous acquisition of two full-body x-rays at very low radiation dose and provides a 3D bone-envelope image of the skeleton in the weight-bearing position. Based on this commercial product, the research prototype developed in the framework of VPHOP allows further measuring of bone mineral density. By combining this information with the personalised 3D envelope of the skeleton, the EOS-QT prototype will ultimately allow 3D densitometry mappings to be used in the VPHOP modelling.

The radical innovation of the VPHOP is the integration. Following the Virtual Physiological Human vision, we use multiscale modelling as a means to account for the systematic interaction of processes that occur at radically different space-time scales, achieving a level of knowledge integration that can drastically improve the predictive accuracy.

By using VPHOP technology, evaluation of the absolute risk of bone fractures will be much more accurate than a prediction based on external and indirect determinants, as currently takes place in clinical practice. These predictions will be used to improve the diagnostic accuracy of clinical standards and to provide the basis for an evidence-based prognosis with respect to the natural evolution of the disease, pharmacological treatments, and/or preventive interventional treatments aimed at selectively strengthening particularly weak regions of the skeleton.

“This is a truly personalised and predictive line of attack against the disease, which should considerably improve the accuracy with which we estimate the risk of osteoporotic fracture, by accounting for molecular, anatomical, biomechanical, and neuromotor determinants in an integrated fashion,” said Prof. René Rizzoli (Université De Genève), clinical leader of the VPHOP project.

For more information: http://www.vphop.eu

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Marco Viceconti is professor at the Dept. of Mechanical Engineering, University of Sheffield/UK and VPHOP Project Coordinator.

http://www.eos-imaging.com

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The Osteoporotic Virtual Physiological Human – VPHOP

Eos-imaging.eu
European Congress of Radiology

ECR
2013

Vienna
March 7–11
Radiology must prepare for new developments and adopt solutions to preserve leading role in diagnostic work-up

By Mélisande Rouger

ECR Today met with incoming ESR President, Professor Gabriel Krestin, from Rotterdam/NL, to discuss the challenges awaiting European radiology in the face of increased competition and economic gloom.

ECR Today: What are your plans and ambitions for the ESR presidency? Gabriel Krestin: I am happy and proud to have been a member of the Executive Council since the creation of the ECR, and to have been able to closely observe and partially contribute to its development and successes over the last 20 years. The ESR is now the largest radiological community in the world, and is strongly involved in all aspects of radiological practice. The society has matured over the years and tackled a huge number of issues, it has also raised awareness about the importance of medical imaging in Europe and beyond. It is thanks to my visionary and hard-working predecessors that I have the opportunity to provide over a very professional organisation, with a highly efficient office, and offering a number of important products to benefit our members, such as the ECR, the journals European Radiology and Insights into Imaging, the European School of Radiology, and many more that are probably less visible and less well-known: newsletters, social media, electronic case material and educational videos, and so forth.

Additionally, the ESR tries to represent and defend the interests of European radiologists at the level of the European Union. The number of activities is overwhelming and the work done by our officers, committees, and working groups is extensive and endless, and particularly our office in Brussels.

During my presidency, I intend to further improve the structure of the ESR and increase the involvement of our society with the many members representing us who are involved in performing their tasks. To this end, the next General Assembly, will be adapted by our General Assembly, opening our society to partner disciplines. I strongly believe in multidisciplinary collaboration for the benefit of medical imaging as a discipline. This way, I hope that we will further strengthen the role of the ESR and its impact on the European political and scientific arena.

Additionally, we need to continue and expand many of the activities initiated by my distinguished predecessors: the European Diploma must be embedded into an independent legal structure, our intensified involvement with European Union bodies needs our almost permanent presence and an independent legal structure, our intensified cooperation with other radiological organisations (EBR) and which contributes so much to prevention, early detection, and therapy as medical imaging. We will have to defend our turf by being available, ready to respond to these challenges. Particularly, the recent trend of converging laboratory medicine with imaging is like no other clinical profession: it is involved with the treatment of almost every patient and has undergone amazing development over the past 10 years. Radiology contributes to what we call ‘personalised medicine’ by helping to provide the right treatment to the right patient, in the right place, and at the right time.

ECRT: You founded the European Institute for Biomedical Imaging Research (EIBIR), which coordinates projects like the European Network for Cell Imaging and Tracking (ENCITE), and you are currently the Chairman and ESR representative at the EIBIR General Meeting. With your expertise in this field, what do you foresee for future trends in European radiology? GK: Radiologists in general tend to complain and become pessimistic when talking about the future. However, over the past 30 years during which I have been a radiologist, our profession has experienced different periods of success. I am sure that this will continue if all radiologists contribute by becoming valuable contributors for our colleagues in other clinical specialties. Some of our activities and services may become commodities in the years to come, but there is no other field of medicine that is as dynamic, as broad, involved in all diseases, where the importance of imaging is so clear and where there is no other field of medicine that is as dynamic as, broad, involved in all diseases, and which contributes so much to prevention, screening, diagnosis and therapy as medical imaging. Imaging contributes to the understanding of anatomy, physiology, and pathophysiology, by making complex structures and processes visible and thus understandable. As the old Chinese proverb says, “an image is worth more than a thousand words”.

ECRT: What are the challenges faced by European radiology today? GK: The European situation in Europe is also affecting our profession. Healthcare budgets, research agendas, training, and education are all impacted and under pressure. I am aware that the ESR, as the main voice of radiology in Europe, is an important but technological development is often seen as a core driver. We have to explain and prove the health and economic benefits that such techniques provide for healthcare. A large number of research groups and institutions, EIBIR active network member, have already benefited from this expertise. Testimonies from many members prove that EIBIR was not only a timely initiative, which has been recognised in the meantime by many official European authorities and serves as an example of multidisciplinary collaboration, but it was also a much needed ally for scientists, allowing them to concentrate on their work while offering assistance in fulfilling the cumbersome administrative burdens connected to most European grant projects. The intention of the ESR, and mine as its president, will be to make EIBIR even more successful and guarantee the sustainability of the organisation even in economically difficult times. To this end, the contributions of many active network members will be needed, and I hope that they will continue to participate in collaborative projects and start new initiatives in yet unexplored fields of medical imaging innovation.

ECRT: How would you encourage medical students to choose radiology as their specialty? Why is radiology an interesting field? GK: Medical students, and particularly the best among them, should become the focus of our interest in the coming years. Attracting them to the dynamic field of imaging is one of our major goals. In many undergraduate curricula, radiology and medical imaging are underrepresented. The ESR Education Committee Working Group on Undergraduate Training has clearly formulated suggestions on how to tackle this situation. However, the ESR should do more in order to raise the interest of students in our profession. We are thinking about new programmes to attract students to our field. I think that all the ESR committees, and particularly our institutional members, should be involved in the creation of such programmes.

As for the medical students, I can only convey that they should try to get involved with imaging as early in their training as possible: there is no other field of medicine that is as dynamic, as broad, involved in all diseases, and which contributes so much to prevention, screening, diagnosis and therapy as medical imaging. Imaging contributes to the understanding of anatomy, physiology, and pathophysiology, by making complex structures and processes visible and thus understandable. As the old Chinese proverb says, “an image is worth more than a thousand words”.
The creation of the European Board of Radiology (EBR)

By András Palkó, ESR President

The ESR recently founded the European Board of Radiology (EBR) in Barcelona, Spain. This independent body has been created to organise activities that can no longer be directly performed by the society. The main activity that will be transferred to this independent body is the administration of the European Diploma in Radiology (EDiR); future activities, such as accreditation, will be defined later. Representation at the European Union level, borrowing from the successful structure and experience of the ESR, could be offered by the EBR to third parties in the future, as well as the organisation of meetings and subspecialty diploma programmes.

The motivation behind the creation of the EBR was mainly the belief that the various educational services and activities of the society, and its subspecialty societies, as well as the definitions of European training standards in the form of the ESR European Training Curriculum, should be separate from the provision of examinations and certification. The same situation applies to the potential introduction of subspecialty diplomas in the future.

Also, in regards to potential accreditation activities, which may be performed by this new body, it is vital to avoid any conflicts of interest. The ESR should not and will not accredit its own or its subspecialty societies’ annual meetings, ESOR educational activities and cannot act as an independent accreditation body for training providers and institutions.

Why Barcelona? Barcelona has excellent flight connections to the rest of Europe and it is, undoubtedly, a beautiful city. In the future, radiologists will look forward to taking the European Diploma examination in this wonderful Mediterranean setting.

The exam will continue to be held in Vienna during the ECR for the foreseeable future, as well as at several national society meetings. However, Barcelona has been selected as another regular venue for examinations in the near future.

The well-established and strong collaboration between the ESR and SERAM, the Spanish Radiological society, is an ideal basis for such an undertaking.

The ESR will remain represented and connected to the EBR through its Board of Directors and therefore, the two bodies will liaise in the future. The representation of national and subspecialty societies within this body is vital and has been integrated into its structure. The office of the EBR has already been set up and the first employees have started work in Barcelona. The structure and statutes have already been defined and the first meeting of the EBR board was held during ECR 2012.

The ESR considers this a huge step, together with national and subspecialty societies, towards strengthening its role within the field of radiology in Europe and worldwide.

ESR Diploma promotes standardisation of radiology training

A medium to long-term goal of the European Society of Radiology is the standardisation and promotion of high standards of radiology training in Europe. This ambition has been pursued through initiatives including the elaboration of an agreed syllabus and support of a training assessment programme. The development of a Europe-wide diploma in radiology is a natural progression for this strategy.

Essential to the success of this venture is the production of high quality and robust evaluation of radiological knowledge, which has the active support of national and subspecialty constituent societies of the ESR. The knowledge requirements for success in the examination are outlined in the European Curriculum in general radiology (revised version March 2011). The questions and clinical images used in the examination cover all subspecialties. The selection of examination material is carried out by experienced educators in regio of international repute, with the active participation of the subspecialty societies through their self-assessment representatives.

The technology employed in the examination is web-based and interactive; reflecting workplace practice in a modern radiology department.

An oral examination component assesses not just knowledge, but competence and decision-making ability.

NEXT DATES:

May 24, 2012: Granada, Spain
June 30, 2012: Dubrovnik, Croatia

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The material and response pattern for each examination question, and the case material employed is analysed after each examination session by an expert. In addition, feedback is welcome from all the candidates. This information is used by examiners in planning subsequent examination sessions. So far a success rate of approximately 77% has been recorded, which is in line with well-established national examinations.

In the future it is planned for examination material to be made available to prospective candidates on the ESR website, and that in addition to an annual examination at the ECR, there will be one other examination session taking place annually and coinciding with national society meetings.

Though at present the examination has no regulatory implications, the diploma is endorsed by the UEMS and may, in the future, fill a vacuum which presently exists in regard to professional assessment and training recognition in the context of European transnational medical migration. Collaboration with national societies will be a major focus of future plans. Through such cooperation the overall aim and strategy for EDR is the elaboration of a pan-European agreed standard of knowledge and competence for independent radiology practice throughout Europe.
ESOR pioneers discuss the past, present and future of the European School of Radiology (Part II)

By David Ziska

A special anniversary brochure was created to celebrate the fifth anniversary of the European School of Radiology (ESOR). A number of key people involved with ESOR were interviewed about its effect on the past, present and future of radiological education.

After five successful years of uninterrupted growth and investment in radiological education in Europe and beyond, we took the opportunity to bring together the founder and the pioneering members who established ESOR to one table and talk to them about their past experiences and their hopes for the future of the programme.

We spoke to the educational director of ESOR, Professor Borut Marincek, ESOR President, Professor Nicholas Gourtsoyiannis, co-organiser ESOR member and ECR 2009 Congress President, András Palkó, co-organiser ESOR member and current ECR President 2010, Professor Andreis Palkó, co-organiser ESOR member and ECR 2010 Congress President, Professor Malgorzata Szczersko-Trojanowska, and we all supported ESOR with great dedication from the very beginning.

This is the second part of the round table discussion; the first part was published in Sunday’s issue of ECR Today.

In the early days ESOR was focused on two crucial goals: to raise standards in the field of professional radiology and to assist in harmonising radiological education. Are those goals now fulfilled or is there work left to do?

Nicholas Gourtsoyiannis: To begin with, these two goals are multifaceted; they are addressed to tens of thousands of radiologists and they have to confront long established interests. In the next five years ESP will support the implementation of the European Training Curricula in various European countries. ESOR is helping young radiologists to obtain the knowledge and skills needed to fulfil the requirements of tomorrow.

You have accompanied the development of ESOR over the last five years; what are your personal wishes and hopes for the future of radiological education and where do you expect ESOR to be in another five years?

Nicholas Gourtsoyiannis: Education will undoubtedly continue to play an ever important and instrumental role in securing the future of radiology, within a changing and challenging environment. The vision, however, of radiological education has to be widened.

The exponential growth of training requirements, resulting from unparalleled image resolution and display, the advent of molecular imaging, nanotechnology, ultra-structural, functional and quantitative diagnostics and the integration of structural and functional information, all need to be accommodated.

As imaging has become fundamental to most clinical diagnoses and central to modern patient care, additional needs have to be addressed through education; the need for radiologists to create added value as clinicians, the need to become fully integrated into patient management and to become indispensable to multi-disciplinary teams.

Education for radiologists has to expand to areas beyond clinical competency, in order to enhance our identity, to cover quality management, research methodologies, ethics, communication, teaching and leadership skills.

As we move steadily to a ‘Digital Native’ Community how to teach is becoming more and more of a central question. Should we continue to ‘spoon-feed’ or instead promote the exposure of independent learning and problem solving?

I believe that ESOR will play a leading role in the next five years through its visionary leadership of our practising community. It will continue to work successfully as the main European engine within the multi-parametric issue of harmonising radiological training in Europe. Anchoring within our society its through long term partnerships, ESOR will establish itself as the greatest provider of radiological education in the world.

András Palkó: I am convinced that ESOR will become an integral part of ESOR activities in the future and its role will be further strengthened by the very recent launch of the European Diploma in Radiology, the preparation for which may require even more systematic training of potential candidates, in which the School should find a role. The enthusiasm of the faculty and the local organisations, together with the coordination of the ESOR staff, and the support of the industry should all help to ensure its success over the next five years.

Borut Marincek: I believe that equipping the course meeting rooms with individual laptop workstations would enhance the experience of the ESOR programmes and would be very beneficial to the attendees. I expect that in five years time, ESOR will be the leading institution in radiological education, not only in Europe, but around the world.

Malgorzata Szczersko-Trojanowska: Over the next five years I hope to see ESOR increase its capacity to serve the educational needs of junior radiologists and the development of our specialty. I also hope that the school’s activities will spread and become available in many more countries outside Europe, as more and more national societies from other continents will take an interest in inviting ESOR to their countries.

I trust that due to the input of so many enthusiastic people and the demand from the trainers, ESOR will continue to expand and its activities by offering new educational opportunities.
In order to highlight for you, our readers and ECR participants, some of the most exciting articles published in European Radiology during 2011, we asked our section editors for their expert opinion by selecting what they believe to be the most groundbreaking developments in their field.

### European Radiology – Highlights 2011

**Mark Davies** is Consultant Radiologist at the Department of Radiology at the Royal Orthopaedic Hospital in Birmingham, U.K., and European Radiology section editor for musculoskeletal. For ECR Today he chose the abstract briefly explaining his reasons for doing so.

There were 44 musculoskeletal related articles published in European Radiology in 2011. Arguably, the most thought provoking paper was written by Koster et al. The authors investigated potential prognostic factors for the onset or progression of osteoarthritis using follow-up MRI one year after acute knee trauma. They found that bone marrow oedema at baseline MRI was strongly predictive of new onset or progression of osteoarthritis. Therefore bone mar row oedema should not be dismissed as just self-limiting bone bruising in the context of trauma.

**Henrik S. Thomsen** performed to evaluate prognostic factors for the onset or progression of osteoarthritis after trauma: MRI follow-up in general practice. After one year was assessed.

**Rahel Kubik-Huch** is Professor of Radiology and Head of the Department for Medical Services at the Kantonsspital Baden, Switzerland, and European Radiology section editor for urogenital. For ECR Today she chose the abstract below and briefly explains his reasons for doing so.

In patients with prostate cancer, MRI is gaining increasing recognition when it comes to localisation of tumours, as well as local staging, which allows for improved treatment selection and planning. In the future, this imaging technique could play an increasing role in the currently evolving approach of actively surveying localised prostate carcinoma as an alternative to immediate treatment.

Whereas the anatomic T2-weighted sequence with its excellent spatial resolution is well suited to detecting hypointense tumour foci within the hypertense peripheral zone of the prostate, as well as extra cap sular spread in more advanced disease, cancer in the central or transition zones is often difficult to discern especially when it coexists with benign prostatic hyperplasia. Therefore, complementary functional imaging techniques such as dynamic contrast-enhanced MRI, MR spectroscopy and diffusion-weighted imaging (DWI) were investigated.

DWI exploits the random motion of water molecules and reflects tissue cellularity. Due to more recent technical advances, DWI has been used, increasingly, in the abdomen and pelvis. In prostate imaging, the signal intensity of the normal prostate gland is very similar, it is often not suppressed by DWI, even when using high b-values of around 1000 sec/mm2. Normal prostate tissue could then obscure tumour foci.

In this study, the authors explored its higher b-value. As a result of their study, they included a total of 201 patients, they demonstrated that the addition of diffusion-weighted images with a b-value of 2000 sec/mm2 to morphologic T2-weighted images is superior to DWI with lower b-values and can improve the diagnostic performance of MRI in prostate cancer detection. The results of their study might therefore contribute to a further increase in the therapeutic impact of MRI in patients with prostate carcinoma.

**Ultra-high-b-value diffusion-weighted MRI imaging for the detection of prostate cancer:** evaluation in 201 cases with histopathological correlation


**Purpose:** To assess the diagnostic performance of diffusion-weighted magnetic resonance (MR) imaging (DWI) for prostate cancer detection, using different b-values.

**Methods:** A total of 201 patients who underwent MR imaging before total prostatectomy were evaluated. MR images were independently assessed by three radiologists. Three combinations of sequences were separately evaluated, as follows: group 1 [T2-weighted images (T2WI) alone], group 2 (T2WI and DWI with a b-value of 1,000 sec/mm2), group 3 (T2WI and DWI with a b-value of 2,000 sec/mm2).

**Areas covered:** The sensitivity, specificity, and diagnostic performance parameters were determined.

**Results:** The sensitivity, specificity, and AUC for the detection of prostate cancer were as follows: 52.2%, 80.7%, and 0.694 in group 1; 61.2%, 82.6%, and 0.755 in group 2; 73.2%, 89.7%, and 0.842 in group 3. Group 3 achieved the highest diagnostic performance, followed by group 2 (P<0.05). In the transition zone, the specificity was lower (P<0.001) for group 2 (82.8%) than for group 1 (86.2%).

**Conclusion:** The addition of diffusion-weighted images with a b-value of 2,000 sec/mm2 to DWI can improve the diagnostic performance of MR imaging in prostate cancer detection.

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myESR.org
SERAM looks back on a successful 2011 and keeps on moving in 2012

By Joaquín Forte

The 31st National Congress of SERAM will take place from May 25 to 28, 2012, in the beautiful city of Granada, this year focusing on functional imaging in oncology. It includes two pre-congress monographic sessions:

- Head and neck radiotherapy
- Technician’s course, which will include subjects related to quality control, dose management, image post-processing techniques, education and training

More information on the society can be found at www.seram.es

Radiology in Greece and its role in the healthcare system

By Kiriakos A. Stringaris

The health system in Greece falls into the category of mixed-model healthcare. Notably, the National Health System is based both on social insurance and the private sector; they work in tandem, to a certain extent, to provide health services, pharmaceutical medication, and hospital care. This involves funding, as well as the provision of technical infrastructure.

According to official data, approximately half of health expenses are covered by the state (52.8% of the total) and the remaining half is covered by private insurance [data OECD 2006]. The cost of social insurance constitutes approximately 25 to 30% of the public expenditure on health, while the remainder comes from direct and indirect taxation.

The National Health System’s (NHS) hospitals are funded by government state funds with planned and controlled budgets. The funding of hospital care is formally done through a contract system, which means that health insurance institutions cover hospital care expenses for those insured by the NHS (Professor A. Stringaris, 2009). Generally, state/public expenditure on health possess the majority of hospital beds (69%), than the average (8.9%) of other countries in Overall, state/public expenditure on health constitutes, in total, of 319 state, university and military hospitals and 2,100 public health medical centres with approximately 24,728 doctors and 41,760 nurses [data Greek National Statistical Organisation 2004].

The total number of doctors in Greece is estimated to be approximately 64,000. Of those, 11% are unemployed while 14% only work part-time. The total number of certified radiologists numbers 1,800, while there are about 500 radiologists in training. In Greece, radiotherapy and nuclear medicine are distinct specialties which are separate from radiology.

Greece has seven medical schools with radiology faculties (two in Athens and one in Thessaloniki, Patras, Ioannina, Iraklion, Larissa and Alexandroupoli) which are affiliated with university hospitals. Regarding installed imaging systems, the private sector has the majority. For instance, 76% of CT units, 84% of mammography units and 86% of MRI units are installed in private health service institutions [data from the Scanner Magazine 2009]. According to the OECD a considerable increase in the number of available imaging systems was noted during the last decade. Specifically for the year 2005, there is an official figure of 28 CT units per one million people [in comparison with 20.2 for other OECD countries] and 13.2 MRI units per one million people [in comparison with 11 for other OECD countries]. It is a fact that this number today is considerably higher. In addition, it should be mentioned that quite recently there has been a trend towards progressive digitalisation of all radiological departments in the country.

The specialty of radiology in Greece is practiced by board certified doctors. Radiologists are trained for a total of five years, which covers all sectors of imaging and interventional techniques. Training is provided by certified state and university hospitals. In order to become a specialist, written and oral examinations are required, which are administered by three-member state committees of evaluation upon completion of five years of training, during which a specific number of procedures and radiological examinations must be completed.

Recently, the supreme scientific organisation of Greece has recognised the subspecialties of interventional radiology and neuroradiology, which are practised in specialised centres. Paediatric radiology should be next. Seventy percent of ultrasound examinations are conducted by radiologists. The remaining scans are carried out by doctors from other specialties, relevant to the organ under examination. In every NHS radiology department there is a director or chairman, consultants for subspecialities and modalities, as well as radiologists in training. The radiologists working in the NHS hospitals are full-time, with the right to receive private patients at the hospital in the afternoon. Academic and military radiologists and radiologists appointed by insurance institutions have the right to practice private medicine.

Greek radiologists are officially represented by the Hellenic Radiological Society, the European Society of Radiology, the Professional Society of Radiologists, and the College of Radiology. Greek radiologists are also represented by elected members of European scientific societies including the ESR, EANR, ESUR, CIRSE, EBR, EBRP, and others. During 2006 the Greek radiological community produced 632 publications and during 2007 this increased to 763, according to PUB MED. At the annual ECR congress, Greece is usually one of the top ten countries with the most scientific abstracts and posters [A. Karantanas, MIR 2008].

More information on the society can be found at www.helrad.org
Meet the eighth muse in one of Vienna's unique theatres

By Michael Crean

Nobody loves drama more than the Viennese, and they have a wealth of magnificent theatres in which to showcase their love affair with the dramatic arts. Within the German-speaking world and has bred some of the greatest talent in the business. Johann Nestroy, Arthur Schnitzler, Hermann Bahr, and Thomas Bernhard all worked in Vienna and helped elevate it to its privileged position as the centre of German language theatre. The city’s theatre-goers. The so-called ‘Viennese class’ at the Burgtheater, located in the city’s famous Ringstraße (a wide boulevard around the city centre) and is the second oldest theatre in the world, after the Comédie Française in France. The theatre moved to its current premises on the Ringstraße in 1888, but when it originally opened in 1748 it was located within the Hofburg Palace. At the time, Emperor Franz Joseph I decreed that plays were not to contain any sad scenes or said a word, so as not to depress the city's theatre-goers. The so-called ‘Viennese endings’ led to many familiar works being revised, such as Hamlet and Romeo and Juliet. Nonetheless the theatre went on to set standards in German theatre and today the Burgtheater’s unique style and language remain the major trends in German theatre. During ECR 2012, the Burgtheater has an interesting programme, including ‘Das weite Land’ by Arthur Schnitzler, on February 28 and March 1; ‘Eine Mittsommernachts-Sex-Komödie’ by Woody Allen on March 4; and ‘Das blonde Geschehen’ by Botho Strauss, all of which come without Joseph II. ‘Viennese endings’, as they happily ended along with his reign.

The Akademietheater was founded in 1893 and is located in Vienna’s third district. As great as the Burgtheater is, its actors longed for a smaller, more intimate theatre for certain productions. In 1922, they got what they wanted and the Akademietheater became an affiliate of the Burgtheater. Its opening performance was Goethe’s ‘Iphigenie auf Tauris’ and after the Second World War it reopened with an acclaimed production of Henrik Ibsen’s ‘Hedda Gabler’. It is one of the most prominent theatres in the German-speaking world and has been the recipient of many awards. During this year’s ECR the theatre happens to have some wonderful performances on its programme. On March 3, Anton Chekov’s ‘Platonov’ will be performed at the theatre, as well as Thomas Bernhard’s ‘Ein Pfickl kompliment’ on March 5.

While Vienna’s blue bloods enjoyed the performances of the Burgtheater, some Viennese citizens felt that a more accessible theatre was needed for the wider public. Among the proponents of this new theatre were the dramatist Ludwig Anzengruber, Anzengrubner and the furniture tycoon Michael Thonet. The Akademietheater was founded in 1893, in the seventh district of Vienna, and its name roughly translates as the People’s Theatre, which reflects its purpose, to extend theatrical performances to the general public. It was also the first theatre built to new safety regulations, after fires in both Vienna and Nice, making it a building of some architectural interest. The theatre hosts a mixed programme of classic plays and contemporary dramas. For those in Vienna during ECR 2012, the theatre is putting on performances of Bertolt Brecht and Kurt Weill’s ‘Die Dreigroschenoper’, from February 29 to March 4, Arthur Schnitzler’s ‘Der einsame Weg’, on March 6; and Martin Sperl’s ‘Tagesszenen aus Niederbayern’ on February 28 and March 5.

Another well-established institution in Viennese theatre is the Theater in der Josefstadt, which opened in 1832, in Vienna’s eighth district, Josefstadt. There has been a theatre at this site since 1788, which further illustrates Vienna’s long theatrical heritage. The opening of the theatre in 1832 was accompanied by an overture by Beethoven, who conducted it himself on the day. In 1834, a balcony was added to the theatre's premises and Johann Strauss held dances every week. Prior to the 20th century, the theatre was mainly host to opera and operettas; however, it developed into one of Vienna's main dramatic theatres. The theatre focuses on contemporary interpretations of classic plays, particularly Austrian drama, making it the perfect place for visitors to become acquainted with Austrian theatre. During the course of ECR 2012, visitors can catch a production of Peter Schaffer’s ‘Amadeus’, which was also adapted into an acclaimed film, on March 4, as well as Odon von Horváth’s ‘Geschichten aus dem Wiener Wald’ which will be performed on February 29, and March 5, 6, 7, 10 and 11.

Visitors to Vienna are not limited to classical theatre; they can also experience independent and original productions at the Rabenhoef Theatre located in Vienna’s third district. The theatre occupies a former festival hall in an apartment complex built to house workers in the inter-war period. The theatre has a wide selection of performances, such as urban folk theatre, political satire, children’s theatre, musicals and even baroque opera. The theatre was even awarded the Nestory Prize, the most prestigious award in Austrian theatre. Many Austrian TV and film personalities perform at the theatre including one of Austria’s most popular comedy acts, ‘Sternmatt and Grissemann’. The programme during ECR 2012 should prove to be of interest to attendees as, from February 27 to 28, the ‘edutainment’ show ‘Science Busters’ will be running, which is performed by two well-known Austrian scientists; the budding radiologist could learn a thing or two while also having a laugh.

Given Vienna’s diverse, cosmopolitan character it’s no surprise to learn that it also has a popular and dynamic English language theatre: Vienna’s English Theatre, located in Vienna's eighth district, opened in 1963, founded by a couple, Franz Schaffranek, an Austrian director, and Ruth Brinkmann, an actress and graduate of the Yale School of Drama. The theatre has hosted a number of European and world premiers which have strengthened its reputation. It also has French and Italian productions, making it a truly cosmopolitan theatre reflecting the city’s diverse populace and its location at the crossroads of Europe. The theatre is the perfect place to discover everything German-language theatre has to offer, and for those not yet familiar with the language the city even has a first-rate English language theatre. The dramatic arts are alive and well in a city which has always had a thriving theatre scene and it would be a shame to spend time in Vienna, without visiting one of its historic or avant-garde theatres.
Platonov by Anton Chekhov
© Georg Soulik / Burgtheater
What’s on today in Vienna?

**Theatre & Dance**

Bitte note that all performances, except at Vienna’s English Theatre, are in German!

- **Akademietheater**
  1030 Vienna, Luthstraße 1
  phone: +43 1 51444 4 445
  www.burgtheater.at
  20:00 Einfach kompliziert by Thomas Bernhard

- **Burgtheater**
  1010 Vienna, Dr. Karl-Lueger-Ring 2
  phone: +43 1 51444 4 445
  www.burgtheater.at
  19:30 Das blinde Geschehen by Stefan Strauß

- **Rabenhof**
  1030 Vienna, Rabenpasse 3
  phone: +43 1 712 82 82
  www.rabenhof.at
  20:00 Lisa by Thomas Gläser, the story of a female heavy criminal as told by a monologue by her next (male) victim

- **Theater Drachengasse**
  1010 Wien, Fleischmarkt 22
  www.drachengasse.at
  20:00 Donnas Traum Musical Theatre by Alexander Pukelka

- **Konzerthaus (Classical Music)**
  1030 Vienna, Luthergasse 28
  www.konzerthaus.at
  19:30 Les Musiciens du Louvre – Grenoble, conductor Marc Minkowski
  F. Schubert

- **Musikverein (Classical Music)**
  1010 Vienna, Bösendorferstraße 12
  www.musikverein.at
  19:30 Kammerakademie Potsdam, conductor Trevor Pinnock
  Emmanuel Pahud, flûte
  J. Haydn, C.P.E. Bach, J.J. Quantz

- **Volksoper**
  1050 Vienna, Währingerstraße 78
  www.volksoper.at
  19:30 Carmen Burana Ballet with music by Carl Orff, Claude Debussy, Maurice Ravel

- **Wiener Staatsoper – Vienna State Opera**
  1010 Vienna, Opernring 2
  19:30 Simon Boccanegra by Giuseppe Verdi, conducted by Patrick Gainer, with Ombretta Monozilio, Ferruccio Furlanetto, Francesco Meli, Marina Poplavskaya

- **Porgy & Bess (Jazz)**
  1010 Vienna, Neuer Markt 11
  www.porgy.at
  20:30 Mikhail Alperin Solo

- **Szene Wien (Alternative Music)**
  1110 Vienna, Hauffgasse 26
  www.szene-wien.com
  20:00 Locos