

## Molecular imaging

At the RSSA/SGR meeting last August at Spier, we were treated to a fascinating presentation by an ex-Capetonian, Professor Jonathan Kruskal (Harvard), that included an *in vivo* video of liver tumour deposition and angiogenesis in a rat model. As we watched tumours grow from a single cell and observed the angiogenesis, we were reminded that the future of imaging lies not in the anatomical depiction of tumours already containing millions of cells but in molecular imaging techniques.

Medical imaging has been through revolutions before. The discovery and harnessing of X-rays allowed images of the inside of the living human body for the first time, and there seemed to be no limit to the body spaces into which radiologists could introduce positive or negative contrast agents to better delineate anatomy. Cormack (ex UCT) and Hounsfield shared a Nobel Prize for the mathematics which facilitated the development of CT. The subsequent refinements, which lead to modern multidetector CT scanners, have revolutionised this technology so that we are able to acquire 3-D submillimetre isometric datasets which can be sliced, diced and modelled, cut away, rotated and viewed. Software can now take us on virtual journeys through bronchi, colons and vessels. Images can be enhanced by the administration of contrast agents and temporal changes in contrast density be mapped, but the images remain anatomical maps of the body according to the attenuation of radiation.

MRI has allowed us to map the density and behaviour of perturbed precessing protons in bodies placed in a magnetic field. Imaging sequences continue to be modified to produce exquisitely detailed anatomical images. We are able to interrogate chemical composition and metabolism with MR spectroscopy and functional imaging techniques. Advances in nano- and microparticle contrast have potential to expand clinical molecular imaging beyond the current techniques of SPECT and PET. Ultrasound allows real-time imaging, but molecularly targeted microbubbles represent a new strategy. Targeted contrast agents will pave the way for targeted therapeutic delivery. Non-ionising techniques such as MRI/MRS, optical imaging, ultrasound and hybrid technologies are suited to early disease detection and screening.

The new frontier is molecular imaging (MI), and a revolutionary new chapter in the history of medical imaging is about to be written. At the end of it, we will all wonder how we ever practiced medicine without MI as the new technology ushers in more personalised treatments.

Will radiologists be at the forefront of developments in MI and, more specifically, are there young South African radiologists who will embrace the challenge of new technology and enter this exciting field? There are those who make things happen, those who watch things happen, and those who wonder what happened! Good luck.

**Clive Sperry**  
*President, RSSA*

## SAMSIG seeks growth

*Dr Mark Velleman*

SAMSIG (the South African Musculoskeletal Imaging Group) was established in October 2005, with the aim of promoting musculoskeletal

radiology among radiologists and interested disciplines in South Africa; it is an official subgroup of the RSSA. The majority of members come from the RSSA, but membership is open to all clinicians with an interest in imaging.

The current committee comprises Dr Richard De Villiers (chairman), Dr Mark Velleman (vice-chairman), Dr Ralph Posner (treasurer), Dr Graeme Thompson (secretary), Dr John Zietkiewicz (IT), and regional contacts Dr Peter Mercouris (KZN/central region), Dr Andrew Van den Heever (Western Cape) and Dr Mark Velleman (northern region). The group holds yearly meetings to run concurrently with the South African Sports Medicine Association Congress, where possible. The most recent meeting took place from 4 - 8 October 2010 at Chobe, Botswana, in the form of a well-filled 3-day conference devoted to high-level MSK imaging with interactive case presentations by delegates from around the country as well as Australia and the USA. Attendance was fully subscribed.

Interaction between presenters and delegates was encouraged and proved to be very successful. Case studies were also shown by delegates for further discussion, and were equally popular. Feedback on the lectures was most positive, and all the delegates were keen to return for the next meeting in two years' time.

The social programme included morning game drives, fishing trips and sunset river cruises, and a visit to the local school which was well received by the locals. Most of the delegates came with their children and spouses who took part in the social activities and could enjoy day trips too. During the concluding dinner, some of the children spontaneously joined the traditional dancers on stage, epitomising the success of the event. All look forward to the 2012 SAMSIG meeting, the idea being to again host it in a safari-like setting; the venue has yet to be finalised.

Further information is on the website [www.samsig.co.za](http://www.samsig.co.za).



## Report-back by 2009 RSSA Travel Award Winner

*Pieter Janse van Rensburg*

I used the 2009 RSSA Travel Award to attend the 8th Interventional MRI Symposium held on 24 - 25 September 2010 in Leipzig, Germany. The scope of the symposium was quite wide, with the main topics being intraoperative MRI; thermometry; laser, RF and cryoablation therapy; cellular therapies and targeted drug delivery; MR-guided high-intensity focused ultrasound (HIFU); biopsy and vascular applications.

It was clear to me that many of the percutaneous interventions performed commonly under ultrasound or CT guidance, can quite easily be adapted to MRI-guided procedures. An open MRI is ideally suited for many of the more complex procedures, but there were many presentations where interventions were guided by short-bore conventional closed magnets. Therefore, MR-guided interventions are well within reach of radiologists who perform percutaneous biopsies under ultrasound or CT guidance in South Africa, and the transition to performing such a procedure should be relatively straightforward, given the availability of the correct MR-compatible needles and related equipment.

Another interesting aspect was the application of intraoperative MRI, currently mostly used during neurosurgical procedures such as tumour resections and deep brain stimulator implantations. One of the common reasons for incomplete tumour resection is that the brain shifts during surgery. An intra-operative MR system therefore allows the radiologist to identify residual tumour while the patient is still within the operating room under general anaesthetic and guide the surgeon accordingly. These fused or shared MR and neurosurgical suites are going to be mainstream in the first world very soon, and South Africa is sure to follow this trend.

MR-guided HIFU is probably the most revolutionary technology that I witnessed at the symposium. The basic concept involves a special ultrasound transducer that is embedded into an MR table.

The ultrasound beam is then focused analogously to a magnifying glass focusing the sun's rays to a point. The intense heat generated by the focused ultrasound causes protein denaturation, irreversible cell damage and coagulative necrosis at specific target locations. It is used thus to ablate neoplasms within the body. MR is the ideal modality to guide and monitor the HIFU ablation of tumours because not only does it provide high-detail anatomical data on the target, but it also provides accurate thermometry to measure the local temperature at the target and so allows safe execution of the procedure. HIFU is used to ablate tumours without any physical transgression of the patient's skin, so it is a non-invasive therapy that radiologists will perform. Current and quite established applications are the ablation of uterine fibroids and small breast carcinomas, as an alternative to lumpectomy. Other potential applications are the ablation of liver tumours, prostate carcinoma and bone lesions. It is my opinion that MR-guided HIFU is a ground-breaking technology that radiologists should embrace.

The role that MR will play in molecular imaging was also discussed, and it is very promising. Alginate-poly-L-lysine-alginate (APA) microcapsules can be used to encapsulate stem cells that contain a gene that expresses luciferase, which can be used for bioluminescence imaging. However, the gene can also express truncated thymidine kinase for PET imaging. The same APA microcapsules can also be used to encapsulate perfluorobromide (PFOB-APA), which is useful because the fluorine is visible on  $^{19}\text{F}$  MRI and the bromide is visible on X-ray. Consequently, X-ray, MR, PET and bioluminescence imaging can all play a role in visualising these APA capsules and therefore will be helpful in confirming whether a certain gene or stem cell therapy has been successful or not.

Leipzig has a rich heritage and a beautiful old inner city which is a joy to explore by foot or bicycle. Famous residents include Johan Sebastian Bach, Gottfried Leibniz, Felix Mendelssohn and Felix Bloch.

I thank the RSSA for this opportunity and their continued support.