Molecular Imaging

Bridging Imaging and Biology

In this issue, Samir Hussein et al present a case of recurrent breast cancer in which anatomical imaging, i.e. mammography, was equivocal, but functional imaging, i.e. Tc-99m sestamibi, detected the recurrent breast cancer which was later confirmed surgically.[1] This is a good example of the utility of functional imaging. We also hope to publish in the next issue the outcome of Oman's *First International Radiology Conference* on the topic of magnetic resonance imaging (MRI) held at Sultan Qaboos University 20-22 February 2008. This conference discussed papers on MRI and functional MRI(fMRI) which is a stepping stone to *molecular imaging*.

Functional imaging has moved forward by leaps and bounds in the last few years. It started off with planar nuclear imaging moving to single photon emission computed tomography (SPECT) and SPECT-CT followed by the introduction of positron emission tomography (PET) imaging. PET functional imaging humbly started with F-18 fluorodeoxyglucose (FDG) and was widely accepted as a major advancement in oncology, cardiology and neurology. However, the demand for non-invasive exploration of the biology of tumours, myocardial metabolism and brain function, led to the invention of other PET imaging agents which explored the molecular events. This further widened the vista of the new science of molecular imaging. For example, in *oncology*, PET imaging using C-11 methionine can study the biological behaviour of protein synthesis in multiplying cancer cells; F-18 fluorothymidine (F-18 FLT) is used for evaluating DNA synthesis in cancer, F18-fluoro-isomidazole for studying hypoxic areas in cancer. In *cardiology*, C-11 palmitate can study the fatty acid metabolism in the myocardium, and C-11 acetate the oxidative metabolism of myocardium. In *neurology*, C-11 methyl-spiperone or F-18-altenserin can study serotonin-2a receptors in the brain, while C-11 raclopride can probe into the behaviour of dopamine D2 in various psychiatry disorders and also monitor their treatment.

Experimentally, molecular imaging used micro-PET for tissue biological studies and for metabolic studies in small animals. After PET and Micro-PET in molecular imaging came *optical imaging* which includes. These are all very useful in imaging biological processes, e.g. the changing concentration of enzymes, but unfortunately, in most cases, they are restricted to small organs or disorders near the surface of the body. Small organs that have benefited include the eye and lately the breast. On clinical trial is equipment such as SoftScan which uses laser light to send pulses of near infrared (NIR) light at four frequencies; the light transmitted through the breast is then detected digitally to create an image.[2] Malignant lesions absorb more light (vascularity) and will appear as dark spots. Another optical molecular imaging technique using NIR light has been incorporated in the breast coil of MRI, thus resulting in fused images of the breast-both MRI and optical images,[3, 4] two very sensitive techniques available in the study of breast cancer and its biology. A third type of molecular imaging using NIR incorporates ultrasound in the same probe giving a fused anatomic/functional image.[5] There are many other new imaging tools and techniques which fall into the category of molecular imaging and explore the biology of disease and normal tissues e.g. humanised antibodies and their fragments as well as some of the fMRI studies: *dynamic contrast-enhanced magnetic resonance imaging* (DCE-MRI) to evaluate tumour angiogenesis, and *integrin-targeted nanoparticles* for MRI imaging of angiogenesis.
In the near future, most of the molecular imaging, including optical imaging and PET, that uses the metabolic-

specific radiopharmaceuticals will be available for phase 3 clinical trials and also for use in clinical practice. It is our responsibility to ensure that the public and in particular our patients in Oman and the GCC countries benefit from these. We need to ensure that these tools and facilities are available in Oman and the Gulf states; get ourselves involved in the available Phase 3 clinical trials and introduce them into our practice as soon as they are available for clinical use. Our patients deserve the best available medical and molecular imaging that is currently available. Those researchers who are involved in the clinical use of molecular imaging or in clinical trials are encouraged to submit their experience/research for publication in SQUMJ. We encourage the invigoration of medical research and its publication in keeping with His Majesty Sultan Qaboos' vision. Let there be a new dawn in bridging medical imaging and biology in this age of 'targeted and personalized therapy'.

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REFERENCES

1 Hussein S, Sawhney S, Al Jarrah A. Tc-99m Tetrofosmin Scintimammography for the Detection of Recurrent Breast Cancer in a Patient with Equivocal Mammography Study. Sultan Qaboos Univ Med J 2008; 8:79-81.

2. Optical Imaging May Improve Breast Cancer Detection. From http://www.cadth.ca/index.php/en/hta/reports-publications/health-technology-update/issue4/optical. Accessed February 2008.

3. Concurrent MR-NIR Imaging for Breast Cancer Diagnosis. From http://www.stinet.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA438601. Accessed February 2008.

4. Breast cancer diagnosis from combined MRI-optics method. From http://www.huliq.com/18532/breast-cancer-diagnosis-from-combined-mri-optics-method accessed on 16th Feb.2008 Accessed February 2008.

5. Optical Imaging Added To Ultrasound Improves Breast Cancer Diagnosis. From http://www.sciencedaily.com/releases/2005/09/050928085420.htm. Accessed February 2008.