# The Abstracts of

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Editor's Note:
The abstracts have been edited and formatted to the extent considered necessary for readers' assistance and to fit into the journal's requirements. The views expressed/ implied and the general style adopted remains however, the responsibility of the authors.

## Abstracts of Invited Lectures

### I-001
### Road to Molecular Imaging: Historic and Basic Considerations

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The road to the current status of development of molecular imaging goes back to the discovery of x-rays by Roentgen in 1895 which was followed by several developments in developing morphologic imaging. US was found in the 1950's while CT was in 1970's and MRI in the eighties. Radioactivity, the basis of physiologic imaging, was discovered in 1896 by Becquerel. Gamma camera was found in 1950's which was developed progressively later on with SPECT capability and multi-head detectors. Positron emission tomography signaled the main birth of molecular imaging which was further strengthened by merging morphologic and functional modalities, use of newer radiotracers and addition of functional MR and MR spectroscopy. Functional capability of US along with nanotechnology based and optical imaging have added to the scope of molecular imaging technology. Molecular imaging can be defined as visualizing normal and abnormal cell functions in vivo by utilizing biochemical or pharmacological probes. The instruments utilized for such imaging were summarized including mainly PET or PET/CT, SPECT, functional MRI, nuclear magnetic spectroscopy, ultrasonography, optical imagers and nanotechnology based imaging devices. Molecular imaging helps individualize patient management and is applied in the areas of cancer diagnosis and treatment, planning radiation therapy to help define the ports and minimize the effects on normal surrounding tissue, cardiac diseases, and neuropsychiatric disorders as well as in infection and drug development.

### I-002
### Kaiga H-3 and London Po-210 deliberate radiation poisonings: Medical and security implications

**Prof Alan Perkins**
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The poisoning of more than 90 workers with radioactive tritium at the Kaiga nuclear power plant on the west coast of India was a pertinent reminder of the serious nature of deliberate radiation poisoning. H-3 decays producing 0.0057MeV beta particles and has a physical half-life of 12 years. Evidence of tritium ingestion was noticed on 24 November 2009 after abnormal levels of the radionuclide were found in the urine of 92 plant workers. The plant managers admitted to the incident only after it caused public concern and had been reported in the media. Once discovered management did not report the event to the police for a week. It is thought that the perpetrator added the tritiated water through the 'overflow tube' of the drinking water container. The Nuclear Power Corporation India Ltd. (NPCIL), which operates the Kaiga reactors, stated that two workers received a dose exceeding 30 mSv. The police are not convinced that this was the first occurrence of its kind at Kaiga!

In the UK in 2006 the death of Alexander Litvinenko on 23 November 2006 had previously elevated the prospect of a deliberate radiation poisoning from a theoretical possibility to a reality. This was an unprecedented event in the UK that was certainly not the work of an amateur assassin, and it is possible that there have been previous killings of this nature outside the UK. Po-210 is a highly toxic radioactive heavy metal with a half-life of 138 days that decays giving off 5.3MeV alpha particles having a range of 40-50mm in tissue. The poison was probably administered in a small volume of liquid or as a solid powder added to a cup of tea. Dispersal of the material resulted in widespread contamination that was detected across London and on British Airways flights to the east. Following the event the main task of the UK Health Protection Agency was of contamination monitoring and reassurance of the general public. The surreptitious nature of this act almost escaped detection. The fact that the nature of the poison was not known until the time of Alexander Litvinenko's death and that it was not detected by the medical team for a number of weeks after admission to hospital indicates the difficulty in detecting alpha radiation.

The illicit uses of radioactive materials in the above incidents raise important security issues. Most countries have high security control over radionuclide production sites and transportation. In India questions are being raised concerning security of radioactive sources and the monitoring of radiation workers. In the UK security has been increased in hospital nuclear medicine departments in view of the potential terrorist use of radioactivity for construction of a “dirty bomb.

In 1995 the International Atomic Energy Agency (IAEA) set up a database to monitor unauthorized possession, use and transport of nuclear and radioactive material. A technical security report published by the in 2006 stated that by the end of 2005 there were 823 cases of nuclear smuggling most with criminal intentions.

## I-003

## An Update on Molybdenum Supplies and Alternatives

Prof Alan Perkins
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The molybdenum supply disruptions throughout 2009 have adversely affected patient services in many countries throughout the world including the UK, the majority of Europe, the USA and Canada. In the UK the supply of molybdenum to some hospital departments has been down to 30% of normal levels. As a result departments have had to adapt to make the most effective and efficient use of limited supplies. Reduced availability of Mo-99 has necessitated the production of contingency plans for dispensing and clinical handling of Tc-99m.

The major national and international nuclear medicine societies have produced a number of recommendations to optimize and share best practice. These include:

- Patient scheduling should be reviewed to make best use of limited supplies.
- The efficiency of radiopharmacy dispensing operations should be maximised.
- Enhanced sharing of Tc-99m generators is required.
- Other tracers such as Tl-201, In-111, I-123 and F-18 should be used where appropriate.
- Make best use of equipment and resolution recovery software to achieve results using lower amounts of administered radioactivity.

For the foreseeable future production of molybdenum will be limited by the small number of ageing reactors. March 2010 will be a critical time when the NRU reactor at Petten will shut down for maintenance. It is hoped that the Chalk River Plant will be back in production by this time, but any delay will be a severe blow to the nuclear medicine community and the patients we serve, since this will result in two major producers simultaneously out of action. There are some other research reactors that may be of potential use such as the MURR reactor in USA, RA-3 reactor in Argentina, CARR and CFER reactors in China, Dhruva reactor in India, ETRR-2 reactor in Egypt and the GAS-MPR reactor in Indonesia, but these will have to be modified to GMP production standards. The construction of new reactors requires significant time and investment as witnessed by the failed MAPLES reactor project. The future options are based on either Mo-99 production or the direct production of Tc-99m. There are two basic technological approaches. The main options are given below:

***Reactor production technologies***

1. Conventional U-235 fission: *Neutron + U-235 --> Mo-99 + neutrons + other fission products*
2. Neutron activation of Mo-98: *Neutron + Mo-98 --> Mo-99*

***Accelerator production technologies***

1. Linear accelerator photo-fission of U-238: *Photon + U-238 --> Mo-99 + neutrons + other fission products*
2. Mo-100 transmutation: *Photon + Mo-100 --> Mo-99 + neutron*
3. Direct cyclotron production of Tc-99m: *Proton + Mo-100 --> Tc-99m + 2 neutrons*

Clearly there remains an urgent need for investment and the development of secure and reliable technologies for future medical molybdenum and technetium supplies.

## I-004

## Lymphoscintigraphy of extremities

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The lymphatic system is a component of both the circulatory system and the immune system. Lymphoedema is a swelling of the soft tissue caused by abnormal quantity of lymph due to various etiologies impairing the lymphatic transport. It can be primary or secondary. Lymphoscintigraphy (LSA) offers objective evidence to distinguish lymphatic pathology from other causes of edema. It has various clinical applications such as localization of lymph nodes (SLN and for RT), investigating the cause of lymphoedema and assessment of results of therapeutic interventions. Lymphatic dysfunctions include multiple channels, asymmetric flow patterns, delay or absent visualization of regional lymph nodes, dilated or tortuous channels, diffuse flow, dermal backflow and flow through the deeper lymphatic system. With the help of these patterns LSA grading is possible. Quantitative LSA enhances the diagnostic difficulties of borderline cases. It is possible to confirm the etiology on the basis of functional patterns exhibited in the images.LSA can be used as an authentic simple non invasive screening tool in the diagnosis to help in instituting a suitable form of therapy, to highlight the existence of subclinical and atypical filarial lymphoedema and in follow up.

## I-005

## PET *and* Receptor Imaging

Professor Adil AL-Nahhas
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There have been major developments in the last 2 decades in nuclear medicine with the development of new receptor imaging for NET and rapid proliferation of PET imaging.

Receptor Imaging: relies on presence of receptors, which are protein molecules embedded in the plasma membrane, or the cytoplasm of a cell, to which a specific kinds of signaling molecules (peptide, neurotransmitter, hormone, drug or toxin) may attach.

After binding, the receptor undergoes 3D conformational changes initiating a response except for antagonist ligands, which blocks receptors. Many functions of the human body

are regulated by these receptors responding uniquely to specific molecules.

Somatostatin Receptor Imaging, using $^{111}$In-octreotide, has been used since early 1990s to detect NET. However it has certain limitations including impaired visualization of small and deeply seated lesions even with SPECT

Functional PET Imaging: Most diseases are functional in nature and structural changes follow later. The assessment of malignant disease with cross-sectional imaging relies on size, which is not accurate. The current PET tracer is $^{18}$F-FDG which accumulates in neoplastic tissues as a function of increased expression and activity of glucose transporter proteins and glucose phosphorylation enzyme hexokinase due to increased anaerobic metabolism in cancer cells. Unfortunately, $^{18}$F-FDG has low sensitivity to a number of tumours due to reduced rate of growth and high differentiation. Its specificity is reduced when infection is present.

Combination of Receptor and PET Imaging: $^{68}$Ga has a T1/2 of 68 min and is produced from a $^{68}$Ge-$^{68}$Ga generator with a high positron yield reaching 89%. It is labeled with DOTATATE with a high affinity for SSR-2. This combines receptor and PET imaging with potential benefit from therapy with Yttrium-90 or Lutetium-177-labelled DOTATATE.

We have found $^{68}$Ga-DOTATATE more sensitive in detecting larger number of lesions compared to octreotide and MIBG. The Uptake is probably higher in more malignant lesions.

A number of comparative studies will be demonstrated.

Conclusion: $^{68}$Ga-DOTATATE provides high affinity receptor imaging *and* an excellent positron emitter. It is available 24/7/360 from a generator and is versatile to label with different peptide & molecules to detect a wide range of malignant lesions.

## I-006

## Radionuclide imaging in Paget's disease of Bone

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The radionuclide 99mTc-MDP bone scan is useful in the assessment of patients with suspected Paget's disease (both for diagnosis and to define the extent). The majority of patients with Paget's disease have polyostotic disease (65% to 90%). The radionuclide bone scan is a simple way to evaluate the whole skeleton and has shown a greater sensitivity for detecting affected sites than radiographic skeletal surveys (1,2). In patients with polyostotic disease, it is common to see multiple sites of involvement with varying degree of activity/intensity.

In the vertebrae, the characteristic finding is of abnormal tracer accumulation throughout the vertebra, affecting the body and posterior elements, including the spinous and transverse processes. The skull may show a different pattern with grossly avid uptake or a ring of increased activity only in the margins of the lesion, representing what is recognised radiologically as osteoporosis circumscripta.

It is important to be able to accurately evaluate the extent of disease and response to treatment. However, the role of the bone scan with regard to treatment is not well defined. A radionuclide bone scan can be obtained approximately 3 to 6 months after therapy and it is important to note that pagetic lesions may often respond in a heterogeneous manner, even in individual patients (3,4).

Persistent active disease evident on bone scan could be an indication for more aggressive therapy in selected cases to achieve an optimal clinical result although there is no evidence to support such an approach. It is important to be aware that the bone scan appearances can be unusual and bizarre after successful bisphosphonate treatment, with resultant heterogeneous uptake sometimes-mimicking metastatic disease.

The radionuclide bone scan may occasionally identify complications of Paget's disease. Although osteosarcoma complicating Paget's disease is very rare (less than 1%) (5,6), clues that sarcomatous change, may include a change to heterogeneous and irregular uptake within an area of bone, perhaps with some photon-deficient areas corresponding to bone destruction. Overall, the radionuclide bone scan is not reliable in the diagnosis of skeletal complications of Paget's disease and complementary radiological correlation is often necessary.

In general, 18-Fluorodeoxyglucose (I8F-FDG) PET can differentiate benign from malignant tissue in many tumours. In principle, I8F-FDG could be a useful tool in distinguishing the benign changes of Paget's disease from associated osteosarcomas (7). Cook et al. have reported that Paget's disease of bone is not associated with abnormal I8F-FDG uptake in the majority of patients and there is potential for identifying associated sarcomas. However, it is important to be aware that some FDG uptake may be seen in patients with more active Paget's disease (7).

$^{18}$F-fluoride PET is reported to be useful to measure the activity of Paget's disease of bone and as a promising non-invasive tool to monitor the therapeutic efficacy of bisphosphonate regimens in Paget's disease (8) but essentially provides the same information as a conventional bone scan. Overall, this presentation will cover incidence, pathophysiology and the role of conventional radiological and radionuclide techniques in imaging Paget's disease of Bone,

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## I-007

## $^{68}$Ga-DOTATATE VS $^{123}$I-MIBG in Neural Crest Tumours

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Introduction: Neural crest tumours (NCT) originate from adrenal (Pheochromocytoma) or extra adrenal (paraganglioma) tissue and produce symptoms related to excessive catecholamine production. The presence of mutations, particularly those associated with SDHB can lead to the development of malignant forms of paraganglioma. Early detection of these lesions can improve management and is currently only available through genetic screening of family members aged<50 years. Imaging with MIBG has been used with success but suffers of certain limitations, particularly in the detection of malignant lesions and metastatic spread. $^{68}$Ga-DOTATATE has shown promising results in these tumours.

Aim: To evaluate the performance of $^{68}$Ga-DOTATATE and $^{123}$I-MIBG in the detection of Pheochromocytoma and paraganglioma and assess whether $^{68}$Ga-DOTATATE is more sensitive in lesions with higher malignant potential

Methods: 12 patients (M=10, F=2; age range 20-71 y) with NCT underwent cross sectional imaging, $^{123}$I-MIBG SPECT and $^{68}$Ga-DOTATATE PET studies from April 2005 to November 2009. All examinations took place within 6 months of each other (ranges 8–180 days). The site and number of lesions were recorded and intensity of uptake quantitatively assessed using target to non-target ratios. Correlation with SDHB tests was performed in those below the age of 50 years.

Results: $^{68}$Ga-DOTATATE detected more extra adrenal primary tumours and metastases and showed more lesions (29) than 123I-MIBG (7). T/N ratios in $^{68}$Ga-DOTATATE scans were much greater than in $^{123}$I-MIBG scans (mean 87.8 vs. 16.2) with much better resolution. There was a higher incidence of SDHB positive tests in patients with positive 68Ga-DOTATATE.

Conclusion: $^{68}$Ga-DOTATATE PET is superior to $^{123}$I-MIBG in the detection of metastatic NCT. There is a possible link between positive SDHB mutation and tumour accumulation of $^{68}$Ga-DOTATATE.

## I-008

## Current status and future direction of musculoskeletal hybrid imaging

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Bone scintigraphy is used as a common screening test for suspected bone metastases because of its high sensitivity, availability, low cost, and ability to scan the entire skeleton. Historical data and clinical experience has established bone scintigraphy as the reference standard in the search for skeletal metastatic disease and many indications have become established for benign skeletal disorders. In recent years technetium-99m ($^{99m}$Tc) labeled diphosphonates have become the most widely used radiopharmaceuticals, particularly $^{99m}$Tc methylene diphosphonate (MDP). Improvements in gamma camera design, including the increased availability of tomographic scintigraphy (single photon emission computed tomography, SPECT) and recently multislice SPECT/CT, have also helped nuclear medicine techniques, which provide functional information and maintain their clinical utility in spite of the major advances in cross-sectional anatomical imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI).

SPECT/CT: Nuclear medicine has entered a new era of multimodality imaging. Dedicated multislice single-photon emission computed tomography/computed tomography (SPECT/CT) cameras are relatively new additions to the diagnostic armamentarium in nuclear medicine. The integration of SPECT and CT provides precise anatomical localization and may enable characterization of abnormalities identified on planar or SPECT imaging by providing structural information by CT.

PET/CT: In recent years, there has been increasing interest in the use of positron emission tomography (PET) tracers in the investigation of various aspects of skeletal disease (especially in the diagnosis of bone metastases). Prostate cancer is now established as the “classic” cancer with false negative results on $^{18}$FDG-PET. In breast carcinoma, the literature is far from clear as to whether $^{18}$FDG PET is more sensitive than the conventional bone scan in identification of bone metastases. However, early observations in the use of this technique in women with metastatic breast cancer showed that significantly more bone metastases are

detected compared to $^{99m}$Tc MDP scintigraphy. Recent reports on use of 18F-labeled NaF (18F-PET) in detection of bone metastases is encouraging and has been shown to be significantly more accurate in detecting bone metastases than $^{99m}$Tc-MDP scans. However, it is difficult to differentiate benign from malignant $^{18}$F-fluoride uptake. The high sensitivity of $^{18}$F-fluoride for both benign and malignant lesions may pose a diagnostic dilemma

Hybrid imaging with SPECT/CT and PET/CT is not only a fascinating and exciting but also challenging to optimize the combination of functional information and anatomical localization. In general, majority of the studies support the usefulness of SPECT/CT for improving diagnostic accuracy and increasing the confidence in interpreting the scans. Overall, this presentation will cover various techniques and tracers used in radionuclide bone imaging.

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## I-009

## Recent Developments in Multimodality Instrumentation

Prof. David W Townsend, PhD

Structural imaging modalities such as Computed Tomography (CT) and Magnetic Resonance (MR) have been the mainstay of biological and medical imaging for over a century. However, while structural changes may suggest the presence of disease, functional changes are more sensitive indicators of early-stage pathology, and with cancer, early detection is the key to a favorable prognosis. Since molecular imaging offers the potential to quantitatively image functional changes *in vivo*, it is assuming an increasingly important role in the identification, staging and re-staging of human disease. Specifically, Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) are sensitive techniques to map human physiology non-invasively through the use of high-resolution imaging devices and appropriate radioactively-labeled biomarkers. However, such metabolic maps do not offer the structural detail associated with anatomical imaging techniques such as CT and MR and therefore dual modality devices such as PET/CT, SPECT/CT or PET/MR that combine both structural and functional information offer a more complete and accurate assessment of the status of disease. Within the past decade, the development, introduction and rapid adoption of dual modality imaging technology has significantly impacted the medical imaging field. This lecture will describe recent developments in multimodality instrumentation for the imaging of human disease, with particular emphasis on cancer.

## I-010

## A Review of Small Field of View Gamma Cameras for Intra-Operative Imaging

Prof Alan Perkins
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Over the past 50 years nuclear medicine has benefitted from a range of static and mobile imaging equipment mostly designed and operating on the original Anger camera principle. Over recent years however the use of mobile cameras has declined and manufacturers have concentrated on the development of the more complex and larger hybrid imaging devices. More recently advances in detector designs have led to the introduction of pixilated scintillators, position sensitive photomultipliers and solid state detectors. In particular the solid-state semiconductors cadmium telluride (CdTe) and cadmium zinc telluride (CZT) are capable of high sensitivity and high-energy resolution imaging using small, low profile imaging devices. This has resulted in the introduction of dedicated organ specific cameras using moving arrays and flat panel detectors for applications in cardiac and breast imaging.

Similar developments in detector design and construction have led to the production of low cost, portable small field of view gamma cameras, commonly comprising a small detector head weighing about 2 kg that may be either hand held or mounted on a small dedicated stand similar to the angel poise" lamp The final configuration of small gamma cameras varies, but most use removable pin hole, parallel hole or coded aperture collimators. Mini cameras typically have a useful field of view varying from 3 to 5 cm either square or circular. The camera is generally coupled to a dedicated image acquisition/display module or a lap top computer using a single USB cable port. A selection of such systems is given in Table-1.

These compact low profile mini cameras are capable of high resolution imaging at sub-mm spatial resolution using the commonly available tracers (For example Tc-99m, In-111, and I-123). Testing and evaluation of the physical characteristics of such devices requires the use of small dedicated mini phantoms.

Handheld and portable mini gamma cameras have primarily been developed to replace hand held probes for pre-surgical and intra-operative lymphoscintigraphy for the detection of sentinel lymph nodes. Applications include

melanoma, breast, penile, vulval and head and neck cancer, as well as guiding the excision of bone tumours and small organ imaging such as thyroid, lacrimal drainage and also small animal imaging.

Current technical progress is now at the stage where "the camera on a chip" is a real possibility for advancing the role of nuclear medicine in surgical exploration, intensive care monitoring and point of care testing.

Table 1. Some of the main small field of view systems recently developed for intra-operative use.

| Camera / Manufacturer | Detector/collimator | FOV |
|---|---|---|
| **eZ-scope**<br>Anzai Instruments, Japan | CdZnTe<br>coded aperture collimator | 3.2 x<br>3.2cm |
| **Mini Gamma camera**<br>IntraMedical Imaging<br>Los Angeles California | NaI<br>Pb collimator | 5.5cm dia |
| **POCI**<br>IMNC-CNRS Paris | CsI(Na)<br>Pb collimator | 2.0cm dia |
| **CarolIRes**<br>Inst P Hurbert Curien,<br>Strasbourg | 2mm thick GSO:Ce scintillation<br>crystal<br>Hamamatsu 64 channel PSPM<br>tube | 5.0 x<br>5.0cm |
| **MGC500**<br>TeraRecon, San Mateo, CA | CdTe<br>Tungsten collimator | 4.5x4.5cm |
| **Minicam**<br>EuroMedical, Le Chesney | CdTe<br>Pb collimator | 4.9 x<br>4.9cm |
| **Minicam 2**<br>EuroMedical, Le Chesney | CdTe<br>Pb collimator | 4.0 x<br>4.0cm |
| **Sentinella**<br>OncoVision, Valencia | CsI(Na) | 3.0x3.0cm |

## I-011

## International Collaboration Opportunities towards Quality and Safety in Radiology

Prof. Lawrence LAU
International Radiology Quality Network, Australia

Radiology is indispensable in health care and saves lives. Radiology workers play key roles in the diagnostic and treatment teams. Despite the workplace challenges resulting from workforce shortage, workload increase and finite resources, radiology workers are interested in and committed to improve daily practice. They support professionalism, the primacy of patients and deliver what is the best for the patient within their abilities and means. There are many stakeholders around the world working towards quality, safe and appropriate use of radiology. To achieve this goal, a diversified range of expertise and resources are required which are often beyond the means of a single organization. Concerted efforts are needed. Collaboration is strength, adds value and provides synergy. Some examples of the actions undertaken by UN agencies, international and national professional organizations, research institutions and academic institutions are presented. These include the IAEA, IARC, ICRP, IRPA, IRQN, ISR, ISRRT, UNSCEAR, WHO etc. An awareness and implementation of these actions of will minimize duplication of efforts and promote better practice, respectively. Many of these actions will impact on radiation workers in their daily work. As end-users, they should be aware of these actions and apply the available evidence-based tools to change and improve practice. They could also actively contribute to the development, trial and implementation of these actions at practice, local, national and international levels. These concerted efforts will lead to better quality, safer and more appropriate use of radiology.

## I-012
## Recent Advances in Radiotherapy in Lung Cancer

Prof. Bin S. Teh M.D.
Professor and Vice Chair, Department of Radiation Oncology, The Methodist Hospital Cancer Center, The Methodist Hospital, Houston, Texas, USA.

Recent advances in radiation oncology in the management of lung cancer include stereotactic body radiation therapy (SBRT) and intensity modulated radiation therapy (IMRT). These advances are the results of advances in imaging, technology in radiation oncology and the multidisciplinary approaches in the management of lung cancer. IMRT is used for locally advanced unresectable lung cancer and SBRT is beneficial for early stage lung cancer especially in the medically inoperable patients. The presentation will address the various aspects of IMRT and SBRT including patient setup and immobilization, tumor/organ motion, 4DCT, dose fractionation schemes, dosimetric parameters and normal tissues constraints as well as the incorporation of PET/CT in treatment planning and response assessment. Various image guidance tools and IGRT treatment machines will be addressed including Helical Tomotherapy. Clinical outcome data including both toxicity and tumor control will be presented.

## I-013
## Radiofrequency ablation of lung tumours

Dr Peter Y.T.Goh
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Radiofrequency ablation is an effective minimally invasive treatment modality for small solid tumours. It is a local ablative technique, which employs thermal destruction of tumour cells using electrical energy delivered at the frequency of radio waves. To date, the largest experience has been in the treatment of primary and secondary liver malignancies. Its role in treating hepatomas is well established. It is also being used effectively in the treatment of solid malignancies of the kidney and for pain control in painful bony secondaries. There is now a growing body of literature documenting the efficacy of RFA in the treatment of lung lesions, both primary and secondary. Results overall are excellent. RFA tends to be more efficacious in the treatment of lung lesions than the liver mainly because the lung parenchyma does not conduct heat away as easily as the liver and also because it is less vascular than the liver. The main complication encountered with the lung, as with any percutaneous lung biopsy, is pneumothorax. Although the pneumothorax rate is relatively high ( up to 30%), the rate of intervention for the treatment of such pneumothorices remains low. Other complications include cavitation and abscess formation, broncho-pleural fistula formation, pain, pleural effusion and haemoptysis. In general, the complication rates are considered low. Overall, the procedure is well tolerated and the results are extremely encouraging. An added attraction to the procedure is that it is easily repeated.

## I-014
## $^{90}$Y-Microspheres in the Treatment of Liver Tumours

Professor Adil AL-Nahhas, Imperial College, London

Primary Liver Tumours are common malignancies with unsatisfactory treatment and bad prognosis with HCC among the 10 most common cancers. Aetiology related to the incidence of hepatitis B virus with highest incidence in SE Asia and Africa. Secondary Liver Tumours are most common tumours of the liver, commonly from GI tract via the portal venous system but other metastases from lung, prostate, breast, pancreas, stomach, kidney, cervix, and ovary.

Treatment options

Surgical resection is the treatment of choice if functional reserve is adequate but only 5-10% is candidates for potentially curative resection due to advanced disease. Post resection 5-year survival in HCC is ~50%

External Beam Radiation Therapy has a limited role in the treatment of liver tumours due to damage to normal liver parenchyma and to surrounding organs

Systemic Chemotherapy is generally ineffective in HCC with short duration response rate of < 20%. Similar results in liver metastasis with survivals of ~ 12 months and partial response of 20% to 30%

Other methods like RFA, Cryo and Laser therapy have their own limitation

$^{90}$Y-Microspheres

Provides a method of selectively irradiating tumour cells due to preferential blood flow via hepatic arteries to malignant deposits, which supply 80-90% of tumour blood flow. The portal vein supplies mostly the healthy liver tissue.

Contraindications

- History of external beam radiotherapy
- Ascites or clinical liver failure
- Hepatopulmonary shunt > 20%
- Pre-assessment angiogram demonstrating significant reflux of hepatic arterial blood to the stomach, pancreas or bowel
- Disseminated extra-hepatic disease

Methodology

Diagnostic Angiography

Assess the visceral arterial anatomy & identify vessels that may cause reflux and vascular embolisation performed to prevent microspheres reaching non-target organs

Assessment of Hepatopulmonary shunt

This is used during angiography by injecting $^{99m}$Tc-MAA in the hepatic arteries and quantitating degree of shunt to lungs

Dose Calculation

Depends on several factors:

- Tolerance of the liver to ionizing radiation
- The magnitude of liver involvement: Greater bulk = more blood flow= more effect
- Degree of hepatopulmonary shunt: More shunt = smaller dose

Complications:

- Abdominal pain, fever and nausea.
- Pain that does not remit may suggest pancreatitis cholecystitis, peptic ulceration
- Radiation Pneumonitis
- Radiation Hepatitis

Our Experience:

Between June 2004 and December 2009

- 85 patients (F=41, M=44)
- Age range 35-78 years
- 6 patients received 2 treatments
- Treatment was well tolerated
- Improved quality of Life and Survival
- Nine Patients had complications all resolved with appropriate measures
- Follow up with PET is better than CT

Conclusion:

- 90Y-Microspheres is a good treatment for unresectable extensive liver tumours
- Needs careful patient selection that involves various specialities
- Complications are relatively few and avoidable with appropriate measures
- Has been shown to improve QOL and reduce tumour size and metabolic activity
- Improvement in survival but patients die from progression elsewhere

## I-015

### Colonography in National University Hospital (NUH), Singapore

Dr Bertrand Ang
Consultant, Department of Diagnostic Imaging, NUHS, Singapore

Colorectal cancer is one of the leading causes of cancer deaths in Asian population. Conventional colonoscopy (CC), the reference standard for evaluation of the colon has poor patient acceptance. CT Colonography has been established as a valuable tool for screening for intermediate and large sized colonic polyps however, carries the risk ionizing radiation. In this talk, we present out preliminary result of a prospective study comparing MRC with CC as reference standard. Sixty-six patients underwent MRC followed by CC on the same day. All patients underwent standard bowel preparation for the CC. Patient then reported to the CC suite for an optical colonoscopy which was performed on the same day. The endoscopist performing the colonoscopy recorded the location and size of the colorectal lesions detected. Two radiologists blinded to endoscopic findings read in consensus the findings on MRI and recorded the abnormalities as well as extracolonic findings. The MRC and CC results were available in 64 patients. On per patient basis, the accuracy of MRC for detecting all polyps was 87.5%; for polyps $\geq$ 6mm the accuracy was 98.4%. In CC incomplete cases MRC did not detect any colonic lesions. The sensitivity of MRC for demonstrating polyps $\leq$5mm is very low in our study and is similar to that reported in literature. However the accuracy of MRC for detection of clinically significant polyps ($\geq$ 6mm) is higher. MR Colonography is feasible and preliminary results in our Asian population are similar to those in Western population. The study results are encouraging and provide motivation for study of a larger group of patients for determining the accuracy of MRC.

## I-016

### PET-CT in Colonic Malignancies

Dr. Anthony Goh
Senior Consultant & Head, Department of Nuclear Medicine, SGH, Singapore

## I-017

### Breast Cancer – A Surgeon's Point of View

Dr. Tan Yah Yuen, KK Breast Unit, KKWCH, Singapore

Breast cancer is currently the most common cancer in women in Singapore and many developed countries. Curative treatment involves surgical extirpation and often adjuvant modalities such as chemotherapy, radiotherapy and hormonal manipulation are also employed. As medical technology advances, improvements in diagnostic capabilities and surgical treatment of breast cancer result in less invasive procedures that are more cosmetically and functionally acceptable. These include image guided biopsies, breast conservation surgery and sentinel lymph node biopsy. Such procedures often require a multidisciplinary approach in planning and execution; radiological input constitutes an important arm of this approach. The talk will discuss, through case studies, how radiology contributes to the diagnosis, surgical planning and treatment of breast cancer.

## I-018

### Cardiac MRI and its applications to the clinician

Dr Lynette Teo
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The introduction of cardiovascular magnetic resonance (CMR) imaging has changed the practice of cardiology by enabling anatomical and functional imaging of the heart and vessels. This complements existing non-invasive imaging modalities of echocardiography and nuclear cardiology. For cardiac radiologists to be relevant to the needs of cardiologists and cardiothoracic surgeons, one has to understand what clinicians want. This talk will go

through the basic anatomy, imaging planes and imaging sequences for cardiac MRI. Examples relating to coronary artery disease, cardiomyopathy and congenital heart disease will be discussed in relation to other imaging modalities.

## I-019

## Radionuclide therapy for bleeding joints in hemophilia-A review

Emerita Andres-Barrenechea, MD, FPCP, FPSNM
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The efficacy of radiosynovectomy has been proven by several studies and work in the past, including my experience. It can preserve function in hemophilic arthroses. This review will include the prevalence and incidence of hemophilia worldwide taking into account our potential patients for radiosynovectomy. The World Hemophilia Foundation has predicted 25% of all hemophiliacs will have hemarthroses. It will also discuss several studies done considering the various indications and contraindications, ideal radiopharmaceutical to be used, advantages and disadvantages as well as success rate of the procedure among hemophiliacs.

Radiosynovectomy (RSV) or radiosynoviorthesis is the intraarticular injection of radioactive colloids to create fibrosis of the hypertrophic and highly vascularized synovium. It is a locally acting treatment for hemophilic arthropathy (HA).

The accepted biological mechanism by which the radionuclides function involves the absorption by superficial cells of the synovium. Beta radiation leads to coagulation necrosis and sloughing of the cells, destroying diseased pannus and inflamed synovium. With the direct irradiation, it is expected that the regenerating synovium, after destruction, will be free of the disease.

Hemophilia is a congenital blood disease, sex-linked trait that cause coagulation defects because of lack of Factor VIII (Hemophilia A) and Factor IX (Hemophilia B). Abnormal bleeding is usually at the musculoskeletal level. Hemarthroses or intraarticular hemorrhage is the most common musculoskeletal manifestation of hemophilics. They arise from the subsynovial venous plexus where a lack of thromboplastic activity has been demonstrated. Treatment options include transfusion of antihemophilic factor (AHF), which is quite expensive and temporary; surgical, which is bloody; and chemical synovectomy, which is done repeatedly, and quite painful and irritating.

Radiosynovectomy has to be considered the initial procedure of choice for the treatment of patients with repeated hemarthroses in hemophiliacs since they are at poor risk for surgery. This will likewise prevent sequelae of several major bleeds thereby preventing deformity in the joints. Likewise, there is less need for future Factor VIII replacement if not at all. The other advantage is that RS allows agents that can have a systemic effect to act in a localized manner thereby preventing systemic effects.

Radiation synoviorthesis is a very effective procedure that decreases both the frequency and the intensity of recurrent bleeds related to synovitis. The procedure should be performed as soon as possible to minimize the degree of articular cartilage damage. It can also be used in patients with inhibitors with minimal risk of complications. On the average, the efficacy of the procedure ranges from 76% to 80%, and can be performed at any age. The procedure slows the cartilaginous damage which intra-articular blood tends to produce in the long term. After 30 years of using radiation synovectomy worldwide, no damage has been reported in relation to the radioactive materials. Primary prophylaxis and radioactive synoviorthesis are the best ways that we have today of protecting against hemophilic synovitis and arthropathy of the joint.

It is apparent that from this review together with my personal experience that radiosynovectomy has an important role to play in providing effective treatment for hemophilic arthroses. Radiosynovectomy is an established and efficacious therapy for the treatment of bleeding joints in hemophilia.

## I-020

## Diagnosis of Skeletal Infection: A Correlative Imaging Approach

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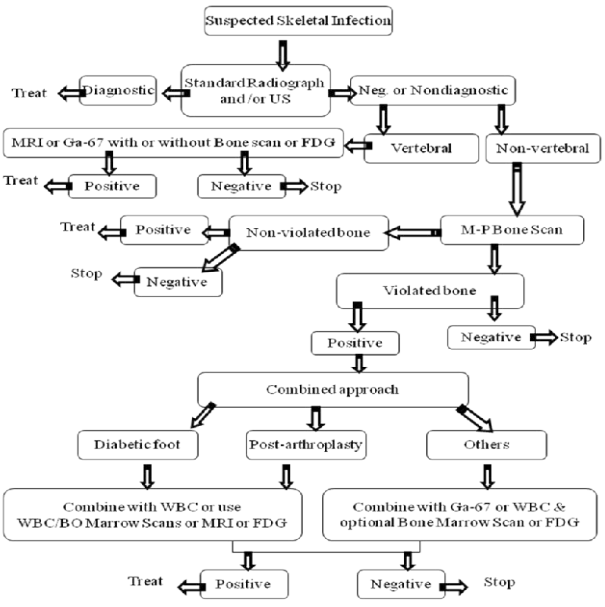
Many factors affect the strategy for diagnosing skeletal infections. Understanding the pathophysiology of different variants of skeletal infections, advantages and limitations of different imaging modalities, site and duration of suspected infection and availability of resources and expertise. The following is an algorithm representing strategy for diagnosis of skeletal infections by imaging.



**I-021**

## Current status and future direction of musculoskeletal hybrid imaging

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Bone scintigraphy is used as a common screening test for suspected bone metastases because of its high sensitivity, availability, low cost, and ability to scan the entire skeleton. Historical data and clinical experience has established bone scintigraphy as the reference standard in the search for skeletal metastatic disease and many indications have become established for benign skeletal disorders. In recent years technetium-99m ($^{99m}$Tc) labeled diphosphonates have become the most widely used radiopharmaceuticals, particularly $^{99m}$Tc methylene diphosphonate (MDP). Improvements in gamma camera design, including the increased availability of tomographic scintigraphy (single photon emission computed tomography, SPECT) and recently multislice SPECT/CT, have also helped nuclear medicine techniques, which provide functional information and maintain their clinical utility in spite of the major advances in cross-sectional anatomical imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI).

**SPECT/CT:** Nuclear medicine has entered a new era of multimodality imaging. Dedicated multislice single-photon emission computed tomography/computed tomography (SPECT/CT) cameras are relatively new additions to the diagnostic armamentarium in nuclear medicine. The integration of SPECT and CT provides precise anatomical localization and may enable characterization of abnormalities identified on planar or SPECT imaging by providing structural information by CT.

**PET/CT:** In recent years, there has been increasing interest in the use of positron emission tomography (PET) tracers in the investigation of various aspects of skeletal disease (especially in the diagnosis of bone metastases). Prostate cancer is now established as the "classic" cancer with false negative results on $^{18}$FDG-PET. In breast carcinoma, the literature is far from clear as to whether $^{18}$FDG PET is more sensitive than the conventional bone scan in identification of bone metastases. However, early observations in the use of this technique in women with metastatic breast cancer showed that significantly more bone metastases are detected compared to $^{99m}$Tc MDP scintigraphy. Recent reports on use of 18F-labeled NaF (18F-PET) in detection of bone metastases is encouraging and has been shown to be significantly more accurate in detecting bone metastases than $^{99m}$Tc-MDP scans. However, it is difficult to differentiate benign from malignant $^{18}$F-fluoride uptake. The high sensitivity of $^{18}$F-fluoride for both benign and malignant lesions may pose a diagnostic dilemma

Hybrid imaging with SPECT/CT and PET/CT is not only a fascinating and exciting but also challenging to optimize the combination of functional information and anatomical localization. In general, majority of the studies support the usefulness of SPECT/CT for improving diagnostic accuracy and increasing the confidence in interpreting the scans. Overall, this presentation will cover various techniques and tracers used in radionuclide bone imaging.

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