

ABSTRACTS

Abstracts of Invited Lectures and Oral Presentations at the Radiographers' Session (R)

R-001**Basic Concepts of PET Imaging**

Dr. Butch Magsombol

Department of Nuclear Medicine & PET, SGH, Singapore

Positron emission tomography (PET) is a technique in which a computer generated image is produced through the detection of annihilation photons that are emitted when radionuclides introduced into the body decay and release positrons. Integrated PET/CT allows morphological and functional imaging to be carried out in a single procedure. It has been shown to be more sensitive and more accurate for lesion localisation and characterization than PET and CT acquired separately. For the past few years PET/CT has been gaining more importance in oncologic imaging as well as in cardiology. The most commonly used tracer at present is the glucose analogue ^{18}F FDG (fluorodeoxyglucose). The main objective of this lecture is to provide targeted audience the basic concepts involved in PET /CT from radiopharmacy, patient preparation, scan acquisition to processing and display of images. It also aims to familiarize non-users of PET/CT the clinical indications and most common pitfalls of this imaging modality. General issues on radiation safety and exposure will be likewise addressed.

R-002**Current Trends and Future Perspectives in Nuclear Medicine and PET Imaging**

S. Somanesan

Department of Nuclear Medicine & PET, Singapore General Hospital, Singapore

This presentation will cover the latest developments and new approaches in SPECT and SPECT/CT gamma camera instrumentations and PET/CT scanner developments inclusive of PET detector, TOF technology and improvements to processing software. The advances in SPECT are directly tied to improving the quality and accuracy of the acquired projections through better instrumentation including solid state detectors, new scintillates and photon transducers and better correction and processing algorithms. The advances in PET/CT are possible with the developments in PET detector technology and PET reconstruction algorithms resulting in high resolution images that reveal small tumors & allow for accurate quantification of biologic processes. The technological challenges faced by NM hybrid imaging shall also be discussed.

R-003**Nuclear medicine digital archive with series routing. An initial experience.**

Misra, Ramesh

Medical Informatics, IS Department, MOH Holdings, Singapore

Objectives: Most Nuclear Medicine departments archive DICOM screen captures. SGH Department of Nuclear Medicine and PET installed an archival solution meeting the requirements of IHE profile of "Nuclear Medicine Archive Manager". The ability of the archive to route at series level was harnessed to improve clinical workflow. Materials and Method: All studies are sent to the archive. An intelligent engine reads the incoming study metadata information and routes them at "series level" to predetermined workstation(s) for review, processing or to burn to media. DICOM Query / Retrieve of the Archive can be performed. The Archive is "vendor neutral", "scalable", "dual homed redundant configuration" and is further backed up on tape archive media. Any compatible DICOM Q/R workstation can be attached on the Nuclear Medicine network, making it possible to view or process studies on any platform / workstation. Results: The on-line archive has met the department's long term archival needs and has automated a range of manual time consuming processes. Routing at series level reduces incidence of wrong or incomplete images being sent to workstations, including external systems. Totally Networked and integrated to multi-modality equipment also means viewing and reporting from any workstation. The feature of "Unattended Burning" of CD or DVD media is now possible for patient CD resulting into a professional production CD. Conclusion: A Nuclear Medicine Routing Engine and Digital Archive is now an essential aspect of clinical efficiency for data management in a sophisticated and ever expanding multi modality Nuclear Medicine department.

R-004**Intra-Arterial CTA using a hybrid angiography-CT System**

Padre CG, Yeo CWK., Ocfemia S, Muthupalani, Tay KH, Lo HG

Interventional Radiological Centre, Dept of Diagnostic Radiology, Singapore General Hospital

Objective: This paper aims to highlight our initial experience with intra-arterial CT Angiography (IA-CTA) using a hybrid angiography-CT system and the challenges faced by the radiographer. Materials and methods: Between

July 08 and Jan 09, a total of 912 cases were performed in the hybrid Angiography-CT system. The system comprises the Toshiba Aquilion 16 MDCT and the Toshiba Infinix VC-1 flat panel angiographic unit. IA-CTA was performed in 30 out of the 912 cases. The procedures in which IA-CTA was performed in addition to conventional catheter angiography included transarterial chemo-embolisation or radio-embolisation of liver tumors (n=21), embolisation of mesenteric arteries for gastrointestinal bleeding (n=3), bronchial artery embolisation (n=4) for hemoptysis, pulmonary artery thrombolysis for pulmonary embolism (n=1), embolisation of arteriovenous malformation (n=1). Modifications of standard CTA scan parameters need to be made as the IA-CTA is acquired by direct intra-arterial contrast injection via selective catheterization of the arteries. Modification to contrast media dilution was also necessary to reduce streak artifacts. Results: The cross sectional CT images provided additional information over the conventional catheter angiographic images. The level of safety and accuracy of the interventions as well as operator confidence in performing the interventions were increased as a result. Specific details with regards to acquisition protocols and contrast media dilution used will be presented. Pitfalls encountered will be highlighted for discussion. Conclusion: The use of IA-CTA in selected angiographic procedures has improved the safety and accuracy of the interventions. Optimization of scan protocol for IA-CTA is necessary for high quality CTA images.

R-005

Contrast-enhanced ultrasound of focal liver lesions: correlation with CT, MRI and histopathological findings

Ooi CC¹, Low SCA, Lombardo P², Schneider-Kolsky M², Lo RHG¹, Lim SY¹, Abu Bakar R¹

¹ Department of Diagnostic Radiology, Singapore General Hospital, Singapore

² Department of Medical Imaging & Radiation Science, Monash University, Australia

Objective: The purpose of this study was to assess the diagnostic accuracy of contrast enhanced ultrasound (CEUS) in the characterisation of focal liver lesions (FLLs) as compared to histopathology, CT, MRI or follow-up as the gold standard. Materials and methods: This study retrospectively reviewed the radiological and clinical outcome of 82 FLLs in 73 patients who underwent CEUS of the liver from January 2006 to December 2008. All patients were referred for CEUS following identification of one or more FLLs on baseline US, CT or MRI. CEUS was performed with 2.4-4.8 ml boluses of SonoVue (Bracco, Italy) using a low-mechanical index (MI) mode. The CEUS diagnosis was compared to that of histopathology or other imaging modalities and clinical follow-up of at least 12 months as standard of reference. Results: Of the 82 FLLs, 48 were malignant and 31 were benign. Three

indeterminate lesions on CEUS were excluded from our statistical analysis. CEUS correctly identified 43 malignant FLLs, with final diagnosis confirmed by histopathology in 13 lesions and clinico-radiological follow-up in 30 lesions. 29 lesions were correctly identified as benign on CEUS, with all these lesions confirmed on clinico-radiological follow-up. CEUS demonstrated a sensitivity of 89.6% and a specificity of 93.5% in the detection of malignancy, with overall accuracy of 91.1% (p<0.0001). Conclusion: Our initial experience showed that CEUS is highly accurate in characterizing malignant and benign FLLs. CEUS may be recommended as an alternative first-line imaging technique for further characterization of indeterminate FLLs detected on routine unenhanced US.

R-006

Development of accredited data acquisition protocols for personalized dosimetry in therapeutic nuclear oncology

Antonio Lou

Department of Nuclear Medicine, Fremantle Hospital, Western Australia, Australia

Objectives: Formal accreditation of all nuclear medicine and radiology practices in Australia has recently been mandated by the Australian Government. All nuclear medicine protocols must now be standardized and approved by the accreditation body such as NATA (National Association of Testing Authorities). This report outlines the drafting of new protocols for data acquisition for accurate quantitation and calculation of individual patient dosimetry for therapeutic nuclear oncology. Materials and Methods: The Senior Nuclear Medicine Imaging Technologist and Quality Manager, reviewed existing protocols and rewrote them in accordance with NATA standards. The roles of the imaging technologist, nurse, physicist and nuclear medicine physician are clearly defined in the comprehensive protocols. Examples will be demonstrated for ¹³¹I-Rituximab for radioimmunotherapy of lymphoma and ¹⁷⁷Lu-octreotate radiopeptide therapies of disseminated neuroendocrine tumours to illustrate protocol development to ensure safe, effective, nuclear medicine therapy. The developmental steps for each data acquisition protocol included radionuclide maps incorporating; system calibration, phantom studies, pilot clinical studies, validation, dosimetry calculations of radiation absorbed dose and critical organs, protocol refinement and final approval and accreditation. Results: Approved standardized protocols were developed for accurate data collection for individual patient dosimetry and in respect to I-131, Lu-177, Sm-153 and Re-188 pharmaceuticals were subsequently approved by NATA. Conclusions: Practical standardized protocols have been developed to NATA specifications in respect of both research and clinical application in therapeutic nuclear oncology, which are translatable throughout Asia and Oceania.

ABSTRACTS

R-007**Using Teaching & Learning to build an organization of leaders and environment of growth**

Gary Tan

Manager, Department of Diagnostic Radiology, Singapore General Hospital

It is widely acknowledged that management of human intangible assets is much more critical and challenging than managing physical assets in the department. Hiring the right people is therefore the fundamental step to creating a high performance team. Following the fundamental step of getting the right people into the right job, the next critical step is teaching and learning. Studies have shown that new staff that are properly trained and welcomed at the beginning of their careers feel good about their choice of employer, fit in quickly with peers and colleagues and readily contribute new ideas. They would also speak well of the organization to friends and family. This paper presents a discussion model and provides a development framework of how teaching and learning can be employed to develop both new and existing employees to build an engaging organization of leaders in environment of growth. Leadership competencies positively influence the workplace culture; maintain and reinforce the advancement of the organization as a centre of excellence.

R-008**Imaging paradigm: from CT/ MRI to PET and the future of SPECT in radiation oncology**

Ng SY, Yee PB

Department of Radiation Oncology, National Cancer Centre Singapore.

Objective: This paper aims to highlight the increasing use of nuclear medicine imaging and its advantages in the field of radiation oncology. **Background:** Recent advances in all imaging modalities provide with more than just anatomical representation of human body but biological and mechanistic data as well. In nuclear medicine, PET and SPECT are widely used now in the management of cancer. This advancement has significantly influenced diagnosis and treatment of cancer.

Anatomical (CT/MRI) Vs Functional Imaging (PET/SPECT): The major limitation for cross sectional imaging technique (CT/MRI) is the inability to distinguish benign from malignant disease. Moreover, it does not able to separate "normal" post-radiation changes from active tumour. PET is generally more sensitive and specific than CT for the detection of nodal metastases, which track closely on the metabolic activity rather than on anatomical parameters. **Nuclear Medicine Applications in Oncology:** 1) Detection of primary disease and secondary metastases, 2) Staging of tumour, 3) Treatment design: delineation of biological target volume and hypoxic cell, 4) Evaluation on post-radiation response

Limitations: Higher radiation exposure to patients, false

readings and abnormal variation in tracer uptake are the main deterrents.

Future Development: The use of MR spectroscopy in providing mechanistic information will increase the specificity for antitumor treatment. Molecular imaging is poised to become the future of nuclear medicine. It detects characteristic molecular events in the human body specific for diseases leading to the early diagnosis, treatment, or even prevention of cancer.

R-009**Our experience and new technique using the robotic assisted arm angiography system in the interventional radiology**

Peter Yang Chu Chun, Loke Jiun Siong, Eric Tan Ian Wong Sai Yan, P Chandra Mohan, Tay

Kiang Hiong, Tan Bien Soo, Lim Eng Hoe Winston.

Interventional Radiological Centre, Department of Diagnostic Radiology, Singapore General Hospital, Singapore

Objective: To share our experience of using the Cone beam CT function and Intelligent guiding, piloting function of new robotic assisted arm angiography system in the vascular or non-vascular Intervention procedure. **Materials and methods:** From Nov, 2008 to present, more than 1237 variety interventional cases was performed by using the new robotic arm DSA system (Artis Zeego, Siemens), we had performed the Cone beam CT and Intelligent guiding, Intelligent pilot function to more than 56 different cases included 18 cases of the TACE (Transarterial Chemo-Embolisation), 28 cases of SIR-Spheres Microspheres treatment, 2 cases of Uterine Fibroid Embolisation (UFE), 3 cases of Musculoskeletal Biopsy and 4 cases of spinal nerve block injection, 1 case of Pre-Intracranial coil Embolisation planning. **Results:** The Cone beam CT function can provide cross section images (Axial and Coronal) through some easy step of this robotic assisted arm DSA system to provide the single or dual volume rotational DSA and 3D and CT image reconstructed. Those information were useful to differentiate the supplied vessel position and lesions location during the head or body vascular interventional procedures. Also the intelligent guiding and piloting function were increased accuracy of the interventional procedure. **Conclusion:** The Cone beam CT function not only to provide the satisfied imaging information of the region of interest, also easy to apply to every required cases. Other new techniques (I guiding & I pilot) also very useful in our experience.

R-010**Diagnosis of Deep Venous Thrombosis as a Cause for Suspected Pulmonary Embolism: Can Indirect CT Venography Replace Lower Extremity Venous Sonography? -Analysis of current literature**

CR Liang, MC Kok, P Chen
Department of Diagnostic Imaging,
National University Health System, Singapore

Aim: Lower extremity venous sonography (LEVS) is the current and widely accepted standard for diagnosis of lower extremity DVT. With the development of MSCT, indirect CT venography (iCTV) has been proposed as an accurate alternative for diagnosis of DVT. The aim of this essay is to compare the accuracy, safety and cost-effectiveness of iCTV with that of LEVS and to determine whether iCTV can replace LEVS, for the diagnosis of DVT as a cause for suspected PE. **Methods:** A literature search using various database platforms, for English language publications was performed. Only studies and meta-analyses evaluating the roles of iCTV, LEVS, or comparing iCTV in the overall detection of DVT with LEVS from the year 1998 to 2009 were included. Only MSCT was considered. The specificity, sensitivity, positive predictive value (PPV), negative predictive value (NPV) and interobserver agreement of iCTV were evaluated by comparing with LEVS. **Results:** Compared with LEVS, iCTV has high sensitivity and PPV, very high specificity and NPV. iCTV also has moderate to good interobserver agreement. However, iCTV is believed to be more costly than LEVS, and it requires patients to undergo more radiation exposure. **Conclusion:** The use of iCTV can replace LEVS for most patients undergoing CTPA to detect DVT as a cause for suspected PE.

R-011

Sonographic appearances of benign and malignant thyroid nodules

Abu Bakar R, Ooi CC, Kho YY, Lo HG
Department of Diagnostic Radiology, Singapore General Hospital, Singapore

Objective: The objective of this presentation is to discuss and describe the sonographic appearances of benign and malignant thyroid nodules that are commonly seen at our centre, and to determine if these appearances are in coherent with those described by other centres. We also explore the sonographic appearances criteria used to differentiate malignant from the predominantly benign nodules as practiced in other centres so that we are better able to recognise these appearances for recommendation for ultrasound-guided FNAC in our own setting. **Methods:** We present the common sonographic appearances of thyroid nodules of various pathologies that we have seen during the period June 2006 to December 2009. All pathologies of these thyroid nodules have been either histologically or surgically proven. All histologically proven thyroid nodules have had ultrasound-guided FNAC performed by our interventional radiologists team. **Results:** Echogenicity, echotexture, shape, presence or absence of calcifications, solid or cystic, and the presence of comet tails are the most commonly used criteria to differentiate malignant from benign nodules. **Conclusions:** The

sonographic appearances of the histologically proven benign and malignant lesions that we see commonly at our centre are in coherent with those described by other centers.

R-012

The Distance Assisted Training for Nuclear Medicine Professionals: The Philippine Experience

Dr. Orestes P. Monzon, Philippines

The Distance Assisted Training for Nuclear Medicine Professionals is a project of the IAEA, initiated under the RCA Programme RAS 6/029 for lack of opportunities for formal education in the field of Nuclear Medicine Technologists in many countries in the Asia and Pacific Region. Initially it was offered for Medical and Radiologic Technologists working in the Nuclear Medicine department, but later expanded to other nuclear medicine professionals to include – Medical Physicists, BS graduates in Chemistry, Pharmacy and Biology and Training Residents in Nuclear Medicine.

The following countries are involved in the DAT program: China, Thailand, Philippines, Malaysia, Indonesia, Myanmar, Pakistan, Sri Lanka, India, Vietnam, Latin American countries, Japan, Singapore, South Africa. The DAT is a work in progress, being started in many countries and translated to local languages.

There are now two DAT programs prepared by experts in Nuclear Medicine, headed by Ms. Heather Patterson and Mr. Brian Hutton (Australia): (a) The DAT Part I - a 12 Training Modules on General Nuclear Medicine, a 2 year course.

In the Philippines the DAT is a joint effort of the Philippine Nuclear Research Institute (National Responsible Authority), The Philippine Society of Nuclear Medicine (Specialty Society), the Philippine Heart Center and the University of Sydney. We have conducted two successful courses in 2002-2004 with 21 graduates and in 2006-2009 with 12 graduates. The Guidelines require the Member States establish an infrastructure needed to conduct a sustainable training program in their own countries. Two countries in Asia are already self sustaining which means they can run this program on their own – Thailand and the Philippines.

The RCA Member States also have expressed the need to provide training on PET, PET/CT and SPECT/CT as a result of the recent developments in Nuclear Medicine, as an extension of the RCA Project on Distance Learning, hence the (b) DAT Part II - a new 4 Training Modules on SPECT CT / PET CT, a 1 year course. The Philippines will start the DAT Part II Programme in March/April 2010, jointly with Singapore, as we have a small population of nuclear medicine professionals involved with SPECT CT, PET and PET CT.

The DAT can now be accessed on line, hence the new name, DAT On Line, www.datnmt.org The DAT course have helped a lot in the progress of Nuclear Medicine in the Philippines, as no other Course is being offered by Hospitals or Universities in the country.