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Generation of Normal HMPAO SPECT Images Using a Subresolution Sandwich Phantom Design

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Aim Use of a normal database in quantitative regional analysis of brain single-photon emission computed tomography (SPECT) facilitates the detection of functional defects in individual or group studies by accounting for inter-subject variability. The ability to simulate normal images would allow various important areas related to the use of normal databases to be studied. These include the optimization of the detection of abnormal blood flow and the portability of normal databases between gamma camera systems. To investigate this further we have constructed a hardware phantom and scanned various combinations of radioactive brain patterns and simulated skull configurations. **Materials and Methods** A subresolution sandwich phantom with a simulated skull was assembled using a high-resolution segmented MR scan printed with a 99mTc pertechnetate-ink mixture and scanned using a double-headed gamma camera with parallel-hole collimators. Various different grey-to-white matter (GM:WM) ratios and aluminium simulated skull configurations were used. The normality of phantom data was assessed using statistical parametric mapping (SPM). The images were compared to a normal database of control subjects using the standard data processing settings. **Results** Normal images were achieved using several combinations of different printouts and simulated skull configurations. Optimal GM:WM ratios were in the range 1.8 to 2.4. **Conclusion** The ability to simulate normal HMPAO SPECT scans has been demonstrated using a subresolution phantom. Further optimization involving different assessment methods and the scanning and assessment of the phantom on different camera systems should further refine the phantom design.

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Optimization of CT Radiation Dose in Paediatric PET/CT protocols

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Aim: Computed Tomography (CT) performed as part of Positron Emission Tomography (PET) acquisitions in Nuclear Medicine is intended mainly for attenuation, correction and anatomic localization of FDG (fluoro-2-deoxyglucose) uptake regions. Most protocols defined by manufacturers use fixed acquisition parameters and consequently, in some cases, radiation dose to patients from CT scan is higher than from injected radiopharmaceutical. We started to image paediatric patients, to whom risks associated with radiation exposure are 2 to 3 times higher than to adults. There are no manufacturer paediatric protocols and undoubtedly we should not use adult protocols. Our main goal is to implement optimized PET/CT protocols in order to achieve dose reduction in paediatric patients. **Materials and Methods**: A retrospective evaluation of the dose delivered by CT to adult patients who performed one PET/CT acquisition in our department was conducted. Information on CT dose given to patients was collected as a function of age, weight and height. These data allowed us to verify that a dose optimization based on individual patient physical characteristics is achievable. A relation between patients' radiation dose and physical characteristics was established and several paediatric protocols have been defined, namely whole body, head and very low dose for children under 5 years old. For head scans CTDIvol and DLP have lower values than those for children. This type of acquisition has different conditions since head dimensions are almost invariable for all patients and we are already using reduced dose protocols. The new paediatric PET/CT protocols are being used, on a regular basis, for all paediatric patients. **Results**: For adults following standard protocol, the average value of CTDIvol (CT Dose Index) is 5,43mGy and of DLP (Dose Length Product) is 614mGycm. CTDIvol accounts for dose due to a single slice and DLP reflects total dose of the entire scan. For children, CTDIvol is 1,84mGy and DLP depends on body scanned length. For whole body acquisitions it has a maximum value of 315mGycm. For our youngest patients, a maximum dose reduction of 67% is achieved through a user defined protocol in which the acquisition parameters (applied beam voltage and tube current intensity) are chosen as a function of patients' age and weight. **Conclusion**: Definition of new protocols considers changes in energy and current intensity of X-ray beam in order to reduce dose to patients when compared to standard protocols. Patient physical characteristics used to decide scanning parameters are age, weight and height.

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Geneva PET/CT facility: Design considerations and performance characteristics of two commercial (Biograph 16/64) scanners

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Aims*:* A new PET/CT scanning facility was recently established at Geneva University Hospital in adjacent rooms within a busy nuclear medicine clinic comprising two dual-modality PET/CT systems with 16 and 64 slice capability. The objective of this work is twofold: (i) to describe site planning and room design considerations including shielding calculations according to Swiss regulatory limits in controlled areas and (ii) to report measured performance characteristics of the PET sub-systems of two LSO-based commercial PET/CT scanners, namely Siemens Biograph HI-REZ 16 and 64, according to NEMA standard NU 2-2001. **Materials and Methods***:* The following parameters were determined: spatial resolution, scatter fraction, sensitivity and count rate behaviour. In addition, the IEC body phantom was used to assess image quality as well as the accuracy of different correction techniques. **Results***:* The amount of lead needed to reduce the intensity of annihilation radiation was substantial for optimal protection of technical staff members; however, the concrete in the floors and ceilings of scanner and uptake rooms provided adequate shielding. The results obtained with the NEMA NU 2-2001 standard measurements showed that both scanners have slightly different, but overall similar performance characteristics (e.g. 4.0 (4.6) mm vs. 4.1 (4.8) mm for the average transverse spatial resolution at 1 cm (10 cm off axis), 4.3 (4.5) cps/kBq vs. 4.4 (4.6) cps/kBq for the sensitivity at 0 cm (10 cm off axis) and 34.6% vs. 33.9% for the scatter fraction) for the Biograph 64 and 16, respectively. **Conclusion***:* Both scanners achieve a very good image quality wealthy in contrast within short acquisition times allowing adequate detectability of small lesions and prominent cardiac imaging with excellent temporal resolution particularly when using the Biograph 64.

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607 – Monday, Oct. 15, 2007, 8:00 am – 9:30 am, Auditorium 10

Clinical Science - Bone & Joint Combined Imaging, SPECT/CT

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The use of off-line fusion of bone SPECT and low-dose CT images in diagnostics & treatment of low back pain

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Aim: We surveyed the use of off-line fusion of bone SPECT and low-dose CT images in patients with low back pain in which the following treatment was determined by the results of our examination. Focal uptake of Tc-MDP is regarded as a sign of pain triggering active degenerative process. **Materials, methods**: We performed off-line fusion of bone SPECT and low-dose CT images in 57 consecutive patients with low back pain, in which clinical neurological symptoms didn't urge an operation. Bone SPECT with 99Tc-MDP was performed on Siemens ECAM camera. Low dose CT images were obtained using double slice CT camera Siemens Emotion Duo either on the day of bone SPECT imaging, or in following days. We asked for information regarding further treatment and its results. **Results**: In 14 patients there wasn't any focal uptake in intervertebral joints or vertebral bodies on SPECT. Those patients were treated conservatively (except for one patient who suffered from spinal stenosis following previous discectomy). In 43 patients there was a positive bone SPECT - seven of them had focal uptake in intervertebral joints, they were treated with a targeted analgesic intraarticular instillation. In 4 of them their condition was relieved, in 3 partly relieved. Twenty pts. with elevated MDP uptake in vertebral bodies underwent an operation (predomionantly a dynamic stabilization of spine - system Dynesis). In 13 pts. the symptoms were relieved, in 6 partly relieved, 1 patient got worse. Four patients are waiting for an operation, 12 patients with positive finding continue with conservative treatment (decision based on their wish or health state). **Conclusion**: Image fusion of bone SPECT and low dose CT images seems to be an efficient method in selection of patients with low back pain who could profit from direct intraarticular analgesic instillation or an operation. SPECT/CT determines joints with active degenerative process and helps to define the extent of dynamic stabilization of spine. We haven't experienced a serious image misalignement due to a different patient position during off-line fusion, however an on-line fusion using a hybrid SPECT/CT camera should be even more precise and reliable.

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The Applicability of SPECT-CT in Directing the Management of Bony Foot and Ankle Pathology

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Introduction: 99m Tc-MDP bone scintigraphy has been, until recently, the best way to functionally image bony pathology of the foot and ankle. The anatomy of this region is, however, relatively complex and this can pose a problem in lesion localisation when using functional, planar images. Hybrid SPECT-CT systems co-register a functional 3D image with the anatomical image from a low-dose CT scan. This can enable more precise localisation of pathology, and often yields additional information in terms of the resulting anatomical changes, allowing a more definitive diagnosis to be made. **Aims**: This study aims to determine how useful SPECT-CT is over conventional planar bone scanning in directing the management of patients with foot and ankle symptoms resulting from infection, inflammation and degenerative changes. **Materials & Methods**: 25 patients (11 female, 14 male) with a variety of foot and ankle symptoms were investigated with both planar 99m Tc-MDP bone scintigraphy and SPECT-CT using a Phillips Precedence system. A NM physician reviewed all the planar bone scan images which were then compared with the SPECT-CT report which was a consensus report by a NM physician and Radiology consultant. Follow up information was then obtained for the patients to see whether the SPECT-CT provided additional information in planning the management for the patients. **Results**: In 20 of the 25 patients (80%), SPECT-CT provided additional information. It enabled more precise localisation of pathology in 16 patients (64%) and provided information about new abnormalities in 10 (40%). In 6 patients (24%), both better localisation was enabled and new pathology found. In 5 patients (20%) there was no additional benefit. Of the 20 patients for whom SPECT-CT was perceived to be beneficial, follow up information was obtained for 19. In 10/19 patients (53%) management was influenced by the additional information yielded by the scan. **Conclusion**: SPECT-CT is beneficial in providing additional information about bony pathology in the foot and ankle, when compared with planar bone scans. It enables better localisation and often exposes new, previously unseen pathology. It is also extremely useful in planning care for patients, guiding management in the majority of cases.

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Wholebody and SPET Bone Scan integrates MRI data in planning percutaneous vertebroplasty for painful vertebral fractures in selected patients

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