SPECT/CT Instrumentation – From Installation to Application
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Innovations in system design, new radioisotopes and developments in reconstruction software are fundamental to the success of Nuclear Medicine. The biggest advancement over the last few years has been the introduction of hybrid systems capable of combining functional and anatomical images due to the addition of CT technology. SPECT-CT imaging is bedding down into clinical practice and bringing single photon imaging back into the limelight and out of the shadows of PET. A hybrid gamma camera acquires co-registered SPECT and CT images, individual SPECT and CT images and can also use the CT data for attenuation-corrected nuclear medicine images.

Currently on all hybrid systems marketed functional imaging is provided by a dual- headed, flexible angled SPECT camera with state of the art detectors. The performance specification for SPECT imaging matches that available for non-hybrid systems and is well understood by the Nuclear Medicine Specialist. In contrast the CT influences installation and application depending on the CT specification. Therefore, these characteristics must be studied in detail and discussed at length before purchase.

All vendors offer "multiple slice" CT. However this definition does not give an indication to the exact functionality and potential of the scanner. This can only be understood by scrutinising in detail parameters such as slice thickness, range of mAs and flexibility of setup. All systems are capable of producing CT using low mAs with more than adequate image quality for attenuation correction purposes and adequate image quality for anatomical localization. But only some are flexible enough to produce CT images of diagnostic quality that are comparable to those produced by the CT scanner in your Radiology department. Hybrid systems with the complexity to perform a full range of CT protocols that produce image quality at a diagnostic level are no doubt more flexible and have the benefit that the patient may only require one visit to one department to complete their imaging investigations.

But flexibility comes with financial and logistical implications. The high end system is likely to cost at least twice that of a standard gamma camera. Whereas the less flexible a system is the closer the price will be to that of a standard gamma camera. The price of adapting a room designed for a nuclear medicine camera to one able to house a full blown CT may add an extra 20% to the cost. This is incurred due to the possible need for added room shielding, structural work because of extra weight, sophisticated air conditioning and the requirement for a separate control room.

After installation equipment is commissioned, a process when performance parameters are measured, staff trained and protocols setup. Hybrid systems with fixed CT and limited capability will not require much extra knowledge beyond that already available. Therefore, the time required for the new system to be part of the imaging team would not be much more than for a simple gamma camera and the whole process shouldn’t be too tasking for the professionals in Nuclear Medicine. However a system with diagnostic CT will require staff with specialist knowledge of this modality not only during the testing process but also for setting up protocols. It may be that the team locally will have this knowledge, particularly if the system is being installed in a radiology department where experts from all modalities are available. For others knowledge must be gained by attending courses and observing the practice of CT colleagues. Training is required for technologists with no previous experience so they can setup the patient, understand the selection of CT protocol and have enough theoretical knowledge and practical experience to be competent to press the button and exposure the patient to the extra radiation from the CT. Training programs at degree and postgraduate levels are just starting to incorporate the knowledge required for SPECT-CT but it will be several years before these are established. However with careful planning and well thought out training programs hybrid imaging incorporating high end CT can be established within several months even in departments with no previous history of imaging at this level.

The set up parameters for the CT not only affect the image quality but also the radiation dose received by the patient. Fixed, low end CT systems expose the patient to a few extra mSv above that for the radionuclide imaging. If the CT is set to produce images that are of a diagnostic quality the patient will be exposed to three of fours times this amount. European legislation requires this exposure to the justified. It is, when the clinical indications for scanning are clearly within the scope of the scanning protocol.
chosen. The ability of the operator to directly influence the radiation dose to the patient by the choice of CT setup parameters is one of the fundamental reasons why operators of hybrid systems must have specific training in CT.

Hybrid gamma cameras are an exciting addition to the existing portfolio of equipment in Nuclear Medicine. The choice of SPECT-CT system for a department must be made on the clinical requirements. However as the specification affects many aspects of installation and application these must all be carefully considered so that the benefits are balanced against extra cost and risk.

References
3. Initial clinical experience with a hybrid multi-row detector SPECT/CT system (Symbia T6, Siemens Medical Solutions). Jeremy Steed1 and Bohdan Bybel1 J Nucl Med. 2006; 47 (Supplement 1):530P