Technical Aspects of SPECT/CT – Identifying and Avoiding Pitfalls and Artefacts

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SPECT/CT scanning now contributes significantly to the diagnosis and treatment planning for the patient particularly in the oncology setting.

Through the superimposition of functional and anatomic images, the emerging single dataset has the advantage of precise localisation of the radiopharmaceutical distributions. This development in single session scanning is not without its drawbacks however. This review aims to identify some pitfalls with the intention of avoiding and reducing these in clinical practice.

Indeed the various lists of artefacts associated with CT and SPECT individually is known, the opposite is the case with SPECT/CT.

The technical set-up of the scan can be the source of much of the artefact creation. Software corrections can be introduced to resultant images reducing effects of these artefacts however as operators, it is imperative that from the onset, there is accuracy in all technical aspects of scanning. Good patient preparation is therefore key as is correct patient positioning for the scan with adequate comfort and support for the patient throughout. It is then essential that scan parameter selection is optimised.

This will lead to the minimisation of some of the following negatives of SPECT/CT. Misregistration that may occur between the CT and SPECT data. Patient motion, whether it is voluntary or involuntary or respiratory. Metallic objects inside or outside the patient causing artefacts. Truncation artefacts, artefacts caused by CT noise, patient size, thick CT slices and finally the consequence of choosing to raise or lower the arms of the patient.

The CT component to the SPECT/CT scan has a dual purpose. As well as providing anatomic information for localisation it also works as the attenuation correction for the SPECT data.

CT scans are more rapid than the conventional transmission sources. The attenuation map is of higher quality than that obtained from the sealed transmission sources. For the CT scan to be used for the purposes of attenuation correction, the pixel values must be scaled to match attenuation coefficients appropriate for the radiopharmaceuticals being imaged. However a pitfall of the SPECT/CT systems is that many of these systems incorporate a non-standard CT scanner, which doesn't have the same imaging capabilities as stand alone scanners. This review will outline the knock-on effect of this.

In conclusion, although it is 'state of the art' technology, there are pitfalls to be aware of. It may result in unnecessary duplication of CT scans which is a radiation burden to the patient and a breach of the ALARA principle. All issues discussed have consequence to the patient and the resultant image and indeed the PACS system but can be avoided depending on how we choose to approach the technical aspects and practical set-up of the scan. This review will help to identify guidelines for SPECT/CT imaging that may assist in preventing such issues and avoiding such artefacts in the future.

References

1. Patton JA et al. SPECT/CT Physical Principles and Attenuation correction. J Nucl Med Technol 2008; 36:1-10.
2. Van Dalen JA et al. Multimodality nuclear medicine imaging: artefacts pitfalls and recommendations. Cancer Imaging 2007; 7 (1):77-83.
3. Ganasegaran G et al. Patterns, variants, artefacts and pitfalls in conventional radionuclide bone imaging and SPECT/CT. Semin Nucl Med 2009 Nov; 39(6):380-95.
4. Christian PE, and Waterstram-Rich KM (2012) Nuclear Medicine and PET/CT, Technology and Techniques. 7th Edition. Elsevier Mosby.