

CLINICAL APPLICATIONS OF SPECT WITH SPECIAL REFERENCE TO ONCOLOGY

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Single photon emission tomography SPECT has been used in nuclear medicine since the early 1960's when Kuhl and Edwards developed a rectilinear scanning system for use in neutronuclear medicine. Tomography is now used extensively for diagnosis by ultrasound, x-ray CT scanning and magnetic resonance imaging. The improvement in quality of the images is due to the enhanced contrast produced by the tomographic technique. Radioisotope emission tomography has special problems which are produced by the low information density in the images. However recently several developments have occurred which have greatly enhanced the value of SPECT in clinical practice. New radiopharmaceuticals have been become available which concentrate to relatively high levels in the pathology than in the normal surrounding tissues. Examples include mIBG, Tc99m HMPAO, labelled antibodies and of course bone imaging agents. Radioisotope imaging equipment has improved dramatically with the development of high resolution stable detectors with good uniformity, fast computing and good operator interactive displays. The result has been a great improvement in the clinical images from tomographic examinations which are available in seconds after the acquisition has been completed. However these results can only be obtained with the application of good quality control and the correct use of filters to match the clinical situation¹.

Emission tomography is used for diagnosis and research in most organs of the body.

In the brain it is used mainly for the study of perfusion using HM-PAO. Abnormalities due to vascular problems and tumours can be clearly seen. We have documented the patterns of perfusion in brain tumours and the changes in perfusion of brain tumours as radiotherapy and chemotherapy produces a response².

In the thyroid gland we have used SPECT to provide data on radiation dosimetry to correlate the clinical effect of radioiodine therapy with the dose delivered³. We have also demonstrated new anatomical detail of the pyramidal lobe.

In lung tumours perfusion studies with Tc99m HM-PAO have shown large areas with under perfusion which presumably influence the oxygenation and accessibility of chemotherapeutic agents explaining at least in part the poor response rates⁴. Currently we are using quantitative SPECT to study the effect of vasoactive drugs on lung perfusion. Hydralazine has been shown to improve lung tumor perfusion by 30%. This may prove to be of value in improving the uptake of diagnostic and therapeutic agents.

Studies with emission tomography and Gallium 67 are proving useful in the elucidation of masses near the hilum due to the lymphomas. This technique has proved to be particularly useful in evaluating masses after therapy.

In the liver SPECT has improved the detection rate for space occupying lesions. We have demonstrated the improved contrast which can be achieved by using 180 degree rotation centred around the right side of the patient⁵. SPECT has proved particularly useful for demonstrating the vascularity of haemangliomas — a difficult differential diagnosis for ultrasound where this lesion can mimic metastases.

Parenchymal lesions of the kidney can be imaged more clearly using SPECT especially during and after infections. The results are complementary to ultrasound where scarring may be difficult to image.

Although bone scintigraphy can detect abnormalities long before plain x-rays, the use of SPECT can improve the visualisation of abnormalities especially in the deeper areas of the body. These include the lumbar spine, pelvis and maxillofacial region.

Techniques where the lesion: background ratio can be low such as in antibody imaging and white cell scintigraphy for infection can be greatly improved by using SPECT. Lesions which are barely visible on planar imaging can be seen clearly on the SPECT study. Similarly in mIBG studies the lesions are more obvious using SPECT and in addition radiation dosimetry studies can be performed more accurately predicting which tumours are likely to respond to radioiodine therapy⁶.

CONCLUSION

Technical advances should ensure that SPECT will continue to improve in quality and clinical value. Perhaps the greatest current problem lies in the interpretation of the mass of three dimensional information. Techniques being developed to view this information in a dynamic three dimensional display show promise⁷. As diagnosticians become more familiar with interpretation of SPECT images and techniques the use of SPECT should increase more rapidly in the future.

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