hot or cold area with somewhat disernible anatomy, and grade 3 an excellent demonstration of the anatomy. The relative diagnostic specificity of SPAS, SSS, and PS was 1.35 ± 0.76, 1.63 ± 0.55, and 2.93 ± 0.61, respectively. The difference between each display method was highly significant with an especially high value for PS.

The second-stage study involved the sorting out of diagnostically significant findings of various bone and joint diseases, with an emphasis on the differential diagnosis of metastatic cancer, compression fracture, infections, spondylosis, end-plate based vertebral sclerosis, facet syndrome of the spine. The PS findings were analyzed also in arthritides, osteitis, transient synovitis, avascular necrosis of the hip, fractures, meniscus tear of the knee joint and such relatively rare diseases as chondromalacia patellae, slipped femoral epiphysis, Stieda-Pellegrini's disease, and others. At the same time those PS findings were correlated with x-ray findings in each disease. The importance of different projections to localize more specifically the pathologic change to a definitive anatomical site of the skeletal system was emphasized.

The use of PS resulted in significant improvement of the specificity of scintigraphic findings. The anatomical structures such as the pedicle, facet joint, neural arch, and spinous process of the vertebra and the epiphysis, physeal line, metaphysis, subchondral bony layer, and the joint cavity of the hip, knee, ankle, and other joints were distinctly discerned. In summary (1) The PS image was roughly comparable to that of x-ray and (2) PS was an easily practicable solution to the problem of the nonspecificity of multihole-collimator planar image. Therefore PS should be a part of scintigraphic examination when differential diagnosis is critical and a scintigraphic machine dedicated solely to PS imaging is to be developed to save time and reduce radiation hazards.

《招待講演》

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 neuronuclear 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, Tc-99m HM-PAO, 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 situation (1).

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 response (2).

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 delivered (3). We have also demonstrated new anatomical detail of the pyramidal lobe.

In lung tumours perfusion studies with Tc-99m 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 rates (4). Currently we are using quantitative SPECT to study the effect of vasoactive drugs on lung perfusion. Hydralazine has been shown to improve lung tumour 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 patient (5). SPECT has proved particularly useful for demonstrating the vascularity of haemangiomas—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 therapy (6).

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 promise (7). As diagnosticians become more familiar with interpretation of SPECT images and techniques the use of SPECT should increase more rapidly in the future.

Selected references from the
Royal Marsden Hospital Group

1. Yanch JC, Irvine AT, Webb S, Flower MA: Deconvolution of emission tomographic data: a clinical evaluation. Brit J Radiol **61**: 221–225
2. Babich JW, Keeling F, Flower MA, Whitton A, Fielding S, Fullbrook A, Ott RJ, McCready VR: Initial experience with Tc-99m HM-PAO in the study of brain tumours. Eur J Nuclear Medicine **14**: 39–44, 1988
3. Webb S, Flower MA, Ott JJ, Broderick MD, Long AP, Sutton B, McCready VR: Single photon emission computed tomographic imaging and volume estimation of the thyroid using fan-beam geometry. Brit J Radiology **59**: 951–955, 1986
4. Rowell NP, McCready VR, Tait D, Flower MA, Cronin B, Adams GE, Horwich A: Technetium-99m HMPAO and SPECT in the assessment of blood flow in human tumours. Br J Cancer **59**: 135–141, 1989
5. Ott RJ, Flower MA, Khan O, Kalirai T, Webb S, Leach MO, McCready VR: A comparison between 180 and 360 data reconstruction in single photon emission computed tomography of the liver and spleen. Brit J Radiology **56**: 931–937, 1983
6. Hinton PJ, Fielding SL, Moyes J, Meller ST, McCready VR: Quantitative dosimetry for diagnostic and therapeutic I-131 MIBG in neuroblastoma. Presented at the European Congress of

Nuclear Medicine, Budapest, 1987
7. Webb S, Ott RJ, Flower MA, McCready VR, Meller S: Three dimensional display of data obtained by single photon emission computed tomography. Brit J Radiol **60**: 557–562, 1987

《招待講演》

SPECT Functional Brain Imaging: The American Experience

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In the 1960's, radionuclide brain scanning was one of the most commonly performed nuclear medicine procedures.

The radiopharmaceutical crossed the blood-brain barrier only in areas where abnormalities existed. This sensitive, but extremely nonspecific, procedure was made obsolete when x-ray computerized axial tomography (CT) was introduced in 1974. More recently, magnetic resonance imaging (MRI) has provided another exquisite anatomic imaging tool for the neurologist and neurosurgeon.

The field of neuronuclear medicine was revived with the advent of positron emission tomography (PET) in a limited number of centers both in the United States and abroad. Regional cerebral blood flow and glucose metabolism could be mapped with the use of ^{14}F-fluorodeoxyglucose (FDP). Clinicians started to appreciate that this new exciting modality could supply useful information about function that was not available from the anatomic imaging modalities, CT and MRI.

More recently, receptor-based radiopharmaceuticals have provided valuable insight into many neuropsychiatric problems, including drug and alcohol addiction, movement disorders and dementia.

Despite its great contribution, PET scanning's limited availability has been a major drawback. It, therefore, has been of considerable importance that single photon radiopharmaceuticals were developed for use with conventional Anger scintillation cameras with rotating detector heads (SPECT). This has now brought functional brain imaging technology into the realm of the community nuclear medicine practitioner. The first available agent was ^{123}I-IMP (iodoamphetamine). Most SPECT experience has been gained with this agent. Its initial distribution in the brain is closely related to cerebral blood flow, and it remains "fixed" in the brain long enough to allow commonly used rotating gamma cameras (or dedicated head units) to complete the tomographic study. An interesting phenomenon observed with IMP is its ability to change its distribution on delayed 3 to 4 hours in a manner somewhat analogous to the "redistribution" seen on thallium myocardial perfusion studies. This appears to provide useful prognostic information in patients with cerebrovascular disease. A second radiopharmaceutical, ^{99m}Tc-HMPAO, also has been recently approved for use in the USA by the Food and Drug Administration (FDA). The agent offers the advantages associated with the technetium label, but does not re-distribute as the IMP does.

There are several areas that are actively being investigated with SPECT functional brain imaging in the United States. These will be briefly summarized:

1) CEREBROVASCULAR DISEASE—Perfusion abnormalities can be defined within hours after the onset of symptoms, whereas two days or longer may pass before CT abnormalities may be detected. Reperfusion may provide positive prognostic information that may assist in the decision making process for endarterectomy or bypass surgery when large vessel disease is present. Functional abnormalities out of proportion to what CT or MRI is showing often are demonstrable on SPECT studies.