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

Leonard M. FREEMAN, M.D.

Professor of Nuclear Medicine and Radiology, Albert Einstein College of Medicine and Director, Department of Nuclear Medicine, Montefiore Medical Center, Bronx, New York 10467

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.

2) SEIZURE DISORDERS—A considerable number of patients with medically intractable seizures have negative CT and MRI studies. SPECT has been extremely successful in identifying epileptogenic foci, primarily by demonstrating decreased tracer localization during the intellectual period. When studied during or immediately following seizure activity, increased activity may be identified. Correlation with electroencephalographic (EEG) results has been excellent. Neurosurgical procedures have been facilitated with the results of these SPECT studies.

3) DEMENTIA—SPECT imaging already has already made great strides in assisting in the often difficult differential diagnosis of Alzheimer's disease (AD), multi-infarct dementia (MID) and depression. AD characteristically demonstrates bilateral posterior parietal hypoperfusion, whereas MID typically shows scattered focal defects. Depression can be associated with a normal study or some frontal perfusion loss. The therapeutic implications are different for these various disorders. Some early work suggests that studies in some family members of AD patients may show early perfusion changes.

4) PSYCHIATRIC DISORDERS—SPECT imaging may prove to be one of the most significant advances in psychiatric diagnosis in the next decade. Some interesting pattern of differential diagnosis have evolved. Many schizophrenics have shown increased basal ganglia concentration. Those with associated auditory hallucinations have had temporal lobe localization as well. Major depressive disorders often have decreased frontal and basal ganglia perfusion. The potential of utilizing SPECT imaging to monitor the results of drug intervention is currently being explored.

5) AIDS RELATED DEMENTIA—Scattered and diffuse cortical abnormalities have been identified and provide substantial assistance in confirming CNS involvement by the virus.

6) OTHER AREAS such as head trauma and cerebral involvement in systemic disorders, such as lupus, have been studied and have shown interesting and clinically useful findings.

In summary, radionuclide brain has returned to its appropriate niche as a functional imaging modality. The important biologic and physiologic information it supplies concerning regional brain perfusion and metabolic function is proving to be highly complementary to the anatomic detail supplied by CT and MRI. As already has occurred with PET imaging, future developments in single photon receptor oriented radiopharmaceuticals should allow for greater specificity of findings and understanding of the various disorders affecting the central nervous system.