

## Special Lecture 4

## ABSTRACT

Local Brain Function Determined by Positron Emission  
Computed Tomography

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We have applied positron emission computed tomography of  $^{18}\text{F}$ -fluorodeoxyglucose (FDG) in order to produce accurate maps of local cerebral glucose utilization in the investigation of local cerebral function.

In normal human volunteers, there are progressive increases in metabolic activity of the visual cortex with progressive increases in the complexity of visual scenes, as well as decreased cortical metabolism associated with lesions of the optic nerve, lateral geniculate body, or optic radiations. Listening to tape recordings causes metabolic activation of the auditory system, and also frontal lobe activation, depending on the level of mentation and memory recall required by the test.

The FDG scans indicated that brain damage after stroke is much more extensive than has been suspected on the basis of x-ray computed tomography. Broad zones of cortex and deep structures such as the thalamus are consistently found hypometabolic after stroke, even though they appear normal in all other radiological studies. This unsuspected deactivation of important parts of the brain is now helping to explain stroke syndromes such as aphasia.

In partial epilepsy, we have found the interictal FDG scan is useful in aiding localization of the dysfunctional cerebral zone most likely to be responsible for seizures in patients being considered for anteria temporal lobectomy. Even though the x-ray CT scan might be completely normal, the site of seizure origin is clearly identified in the brain as a hypometabolic zone. During seizure activity, this hypometabolic zone becomes intensely hypermetabolic. With further development, these ECT studies may help in better categorizing the various forms of disorder and elucidating the basic mechanisms of epilepsy in humans.

In patients with advanced Huntington's Disease, we found the caudate nucleus and putamen were atrophic on x-ray CT scan and hypometabolic on FDG scan, as would be expected. Of greater importance, we have recently found profound hypometabolism in the caudate and putamen in patients with early HD who lack any evidence of atrophy of these structures by x-ray CT scan. In patients with early symptoms, metabolic dysfunction can be demonstrated before bulk loss in the basal ganglia.

Recently we have found that single-photon ECT of  $^{123}\text{I}$ -iodoamphetamine produces cerebral blood flow pictures very similar to those produced by positron ECT of  $^{15}\text{O}$ -Water. These results suggest that the new kinds of knowledge learned with positron ECT in the expensive, sophisticated research center may be extended eventually to patient care in the form of less expensive single-photon ECT technology.