Brain SPECT imaging in temporal lobe epilepsy

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Summary. Temporal lobe epilepsy is diagnosed by clinical symptoms and signs and by localization of an epileptogenic focus. A brain SPECT study of two patients with temporal lobe epilepsy, using 99mTc-HMPAO, was used to demonstrate a perfusion abnormality in the temporal lobe, while brain CT and MRI were non-contributory. The electroencephalogram, though abnormal, did not localize the diseased area. The potential role of the SPECT study in diagnosis and localization of temporal lobe epilepsy is discussed.

Key words: Temporal lobe epilepsy – Brain SPECT with HMPAO

The diagnosis of temporal lobe epilepsy is based on clinical symptoms and signs and identification of the epileptogenic focus. Localization of the focus that initiates the seizures is essential for possible future surgical treatment. When in temporal lobe epilepsy, the electroencephalogram (EEG) and computerized tomography (CT) cannot identify the focus, other diagnostic modalities such as single photon emission computerized tomography (SPECT) [1] or positron emission tomography (PET) [2] are used to evaluate functional abnormalities. The SPECT study uses a rotating gamma camera and technetium 99m – hexamethyl-propyleneamineoxime (99m-Tc-HMPAO). The radiopharmaceutical crosses the blood brain barrier and localizes in brain tissue proportionally to regional blood flow [3]. Its brain uptake, slow redistribution and high count rate provide near ideal conditions for the SPECT study. We present two cases of temporal lobe epilepsy with a normal brain CT and inconclusive magnetic resonance imaging (MRI), where the brain SPECT study with 99mTc-HMPAO showed a perfusion defect in the temporal lobe. The localization of the abnormality can therefore permit surgical removal.

Case 1

A 19-year old female was admitted to the neurosurgical department because of intractable epilepsy. At the age of 2 years she suffered from viral meningoencephalitis. Three years later uncontrolled epilepsy was noted. The seizures began with an aura of dizziness and emotional changes, followed by a high-pitched cry with or without a tonic component in the right hand. The attack lasted 1–2 min and was followed by somnolence for 1–2 h. There was no movement of the head and no falling or clonic component.

Multiple EEGs were abnormal but not consistent. A pathological background activity with theta and delta slow waves which were intermittently pronounced was noted on the left side. A CT scan and an MRI study were interpreted as normal. An ASPECT study performed after intravenous injection of 15 mCi of 99mTc-HMPAO showed a perfusion defect in the left temporal lobe area (Figs. 1, 2) compatible with temporal lobe epilepsy. The patient was treated with Tegretol. Olpakin, Luminal, Celontin, Diazox and Idantoin titrated by measurement of the blood levels with only partial control of seizures.

Case 2

A 37-year old female had been suffering over the past 35 years from right focal seizures with secondary generalization, grand mal attacks and absence seizures. She had been treated with Idantoin and Phenobarbital with control of her seizures.

After the age of 21, loss of consciousness, involuntary movements, loss of control over sphincters and automatic movements were also noted with complete amnesia of the event. The attacks appeared about once a week and were partially controlled by Mesantoin, Clonex, Mysoline and Depakine.

General and neurological examinations were normal. Neurobehavioural examination showed parietal defect in
language tasks, memory disturbances and learning disabilities. Repeated EEG and CT scans were normal. An MRI study disclosed mild diffuse atrophy, mainly in the cerebellum, but was otherwise normal. A SPECT study after intravenous administration of $^{99m}$Tc-HMPAO showed decreased perfusion in the left temporal area and the attacks are now controlled by the medication described.

**Discussion**

Temporal lobe or psychomotor epilepsy is characterized by partial complex seizures associated with atrophic scarring of the mesial portions of the temporal lobe. It may appear at any age, but is more prevalent in adolescents and young adults. The frequency of seizure attacks varies widely, is usually unpredictable and requires lifelong treatment.

The diagnosis of epilepsy and its classification requires a search for an identifiable cause. The studies used to evaluate the epileptic patient are directed towards structural changes of the brain (roentgenography) and physiologic or electric activity of the brain, such as the EEG. The identification of the site of onset of temporal lobe seizures and the presurgical evaluation still depend primarily on EEG findings demonstrating abnormalities of neural function, despite the recent interest in the use of imaging techniques to identify the epileptogenic zone [4]. Depth EEG recording has the highest probability of identifying such an area, followed, in order, by the location of interictal epileptic activity on scalp EEG recording, and the location of hypometabolism in PET. The use of depth electrodes exposes those patients not selected for resection to potential injury without any therapeutic effect [4].

Imaging studies are usually supportive rather than primary for the identification of the epileptic foci. Computerized tomography (CT) is non-invasive and reliable for demonstration of brain structure, location and size of the lesions. A subtle enhancement following intravenous contrast infusion may be noted on the side of the epileptic focus [5]. Focal cerebral atrophy or mesial temporal sclerosis have also been described in CT scans [6], which can also serve for measurement of temporal lobe herniations in epileptic patients [7]. Structural changes in the temporal lobe along the tentorial edge suggestive of an element of herniation on the side of the focus have been demonstrated by computer analysis of CT scans following contrast enhancement of cerebrospinal fluid with Metrizamide [8].

The recent development of MRI has led to better structural definition of brain pathology and is likely to replace the CT methods, especially in view of several reports of negative CT scan in patients with partial epilepsy [9]. Moreover patients with a normal CT scan and abnormalities in the temporal region on MRI – namely increased signal intensity of T2 weighted images – have been described [10, 11].

Positron emission tomography (PET) has recently been used to evaluate cerebral blood flow and glucose metabolism and so can provide additional information in the preoperative assessment of patients with intractable seizures [12, 13]. PET can allow examination of cerebral glucose metabolism in humans during epileptic states. In focal temporal lobe epilepsy a local hypometabolic zone using fluorine-18 deoxyglucose (18 FDG) is found interictally, but during a focal seizure glucose utilization in the region may increase 3-fold. These metabolic changes have been closely correlated with scalp-recorded EEG findings of interictal spikes and used in the selection of candidates for focal surgical resection [14]. Thus, although not an absolute indicator of the focus site, these PET findings have been very useful as an adjuvant to EEG studies. The high cost and production complexity limit the routine application of PET systems.

In contrast, $^{99m}$Tc-HMPAO is readily available and its use in brain SPECT imaging has been applied to functional evaluation of various neurological abnormalities such as dementia [15]. It has also been suggested as a tool for guidance to brain biopsy, in view of the discordance between both CT and MRI on the one hand and HMPAO studies on the other [16].

Thus, modern diagnostic means such as SPECT used for observing functional abnormalities, as well as CT and