

Localization of Epileptogenic Focus by Technetium-99m-ECD Brain SPECT in Adult Refractory Partial Epilepsy: Comparison With MRI and Postoperative Results - A Preliminary Report

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Background. The aim of this study was to evaluate the clinical usefulness and accuracy of interictal technetium-99m (Tc-99m) ethyl cysteinate dimer (ECD) single photon emission computed tomography (SPECT) scintigraphy for localizing epileptogenic focus in adults with medically intractable epilepsy.

Methods. We performed interictal Tc-99m ECD SPECT on 10 adults with refractory partial epilepsy and positive electroencephalograms (EEG). All patients underwent preoperative brain magnetic intractable imaging (MRI) and epilepsy surgery.

Results. The results of Tc-99m ECD SPECT scan correlated with MRI findings and postsurgical outcomes. In 9 of the 10 patients, Tc-99m ECD SPECT scan demonstrated abnormally decreased brain blood flow, and in 8 of the 10 patients, MRI showed abnormalities possibly related to epilepsy. Eight patients became seizure-free and 2 patients improved markedly after epilepsy surgery based on the results of Tc-99m ECD SPECT and MRI. In one case (with both positive SPECT and MRI), there was location disagreement. According to the postsurgical evaluation, Tc-99m ECD SPECT scan provided more accurate localization than MRI.

Conclusions. Tc-99m ECD SPECT scan is a more useful and accurate imaging modality than MRI for the detection and localization of epileptic focus in adults with medically intractable epilepsy. (*Mid Taiwan J Med* 2002;7:38-43)

Key words

MRI, refractory partial epilepsy, technetium-99m-ECD SPECT

INTRODUCTION

Epilepsy is a neurological disorder that is more common in children than in adults. Classification of epilepsy is based on clinical events, electroencephalographic characteristics, etiology, pathophysiology, anatomy and age. The International League Against Epilepsy

(ILAE) has classified seizures as partial, generalized and unclassifiable. Correct seizure diagnosis and accurate localization of the epileptogenic focus are necessary in order to ensure that appropriate treatment is given. Brain magnetic resonance imaging (MRI) is the primary procedure for evaluating morphological information as well as detecting alterations possibly related to epilepsy, such as hippocampal sclerosis [1]. However, MRI is normal in up to 37% of patients suffering from epilepsy [2]. Single photon emission computed

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Table 1. The detailed data of patients

Case No.	Age (yrs)	Sex	Symptom/sign (frequency)	EEG	MRI
1	26	Female	Complex partial seizure, (5-10/month)	positive	Sclerosis & gliosis of right hippocampus
2	21	Male	Complex partial seizure, (3-5/month)	positive	Sclerosis of right hippocampus
3	28	Male	Head injury with epilepsy, (7-10/month)	positive	Encephalomalacia in the right frontal lobe
4	28	Male	Complex partial seizure, (5-7/month)	positive	Sclerosis of left hippocampus
5	45	Male	Head injury with epilepsy, (3-5/month)	positive	Brain damage in the left parietal lobe
6	39	Female	Complex partial seizure, (5-7/month)	positive	Sclerosis & gliosis of left hippocampus
7	36	Female	Complex partial seizure, (3-5/month)	positive	Normal
8	29	Female	Complex partial seizure, (3-5/month)	positive	Normal
9	27	Male	Complex partial seizure, (5-7/month)	positive	Sclerosis & gliosis of left hippocampus
10	23	Male	Complex partial seizure, (2-4/month)	positive	Sclerosis & gliosis of left hippocampus

tomography (SPECT) is a functional neuroimaging technique with an established role in the detection of epileptogenic focus in patients with refractory epilepsy [3,4]. Tc-99m hexamethylpropylene amine oxime (HMPAO) and Tc-99m ethyl cysteinate dimer (ECD) are commonly used SPECT brain perfusion imaging agents [5]. In the present study, we used radiopharmaceutical Tc-99m ECD to localize the epileptogenic focus in adults with medically intractable partial epilepsy. Scintigraphic results were compared with MRI findings and postoperative results.

MATERIALS AND METHODS

A total of 10 adults (6 men and 4 women, aged 21–45 years) with refractory partial epilepsy and positive EEG, were enrolled in this study. All patients underwent Tc-99m ECD SPECT scan, brain MRI and epilepsy surgery.

Preparation of a commercially available Tc-99m ECD kit was carried out according to the manufacturer's instructions. Radiochemical purity was at least 90% using thin-layer chromatography. The interictal study was

performed in a dark and quiet room without EEG control. Fifteen to 45 min after intravenous Tc-99m ECD injection (740MBq), SPECT data were obtained using a dual-headed gamma camera (ADAC, Vertex plus) equipped with fanbeam collimators. Data were collected from 64 projections in the 140 keV photopeak over 360° (180° for each head) in 128 × 128 matrices, with an acquisition time of 30 sec/view. A zoom factor of 1.46 was used. Transaxial, coronal and sagittal slices were reconstructed with attenuation correction using a Butterworth filter at the optimum cut-off and order levels were determined by acquisition counts. All Tc-99m ECD brain SPECT images were interpreted separately by at least two experienced nuclear medicine physicians blind to the clinical data. The coronal views were evaluated first, followed by the transverse and sagittal slices. The findings were considered pathological if there were one or more areas of hypoperfusion in the regional brain flow on more than one view or slice and if the observers were concordant in their interpretation.

All patients underwent MRI of the brain

Table 1. The detailed data of patients

Tc-99m ECD	Surgery	Post-op follow-up
Hypoperfusion in the right temporal lobe (moderate)	Right anterior temporal lobectomy	No seizures/ DC of antiepilepsy
Normal	Right anterior temporal lobectomy	No seizures/ DC of antiepilepsy
Hypoperfusion in the right frontal lobe (severe)	Right frontal lobectomy	Improvement (1-2/month)
Hypoperfusion in left inferior temporal lobe (moderate)	Left anterior temporal lobectomy	Improvement (0-1/month)
Hypoperfusion in the left temporal lobe (moderate)	Left anterior temporal lobectomy	No seizures/ DC of antiepilepsy
Hypoperfusion in left inferior temporal lobe (moderate)	Left anterior temporal lobectomy	No seizures/ DC of antiepilepsy
Hypoperfusion in left temporal lobe (moderate)	Left anterior temporal lobectomy	No seizures/ DC of antiepilepsy
Hypoperfusion in left inferior temporal lobe (moderate)	Left anterior temporal lobectomy	No seizures/ DC of antiepilepsy
Hypoperfusion in the left temporal lobe (moderate)	Left anterior temporal lobectomy	No seizures/ DC of antiepilepsy
Hypoperfusion in left inferior temporal lobe (moderate)	Left anterior temporal lobectomy	No seizures/ DC of antiepilepsy

with a 1.5 Tesla Picker Vista superconductive machine (Picker, Cleveland, Ohio, USA) in axial, sagittal and coronal planes. Images were acquired using T1-, T2- and proton density-weighted techniques. A standard epilepsy protocol was applied. According to the results of the protocol and individual clinical data, the need for additional sequences was determined.

RESULTS

Nine patients had positive Tc-99m ECD SPECT findings (frontal lobe in 1 and temporal lobe in 8) and 8 patients had positive MRI results (hippocampus in 6, frontal lobe in 1 and parietal lobe in 1). One patient had a false-negative SPECT image and 2 patients had a false-negative MRI image (Fig. 1). Eight patients

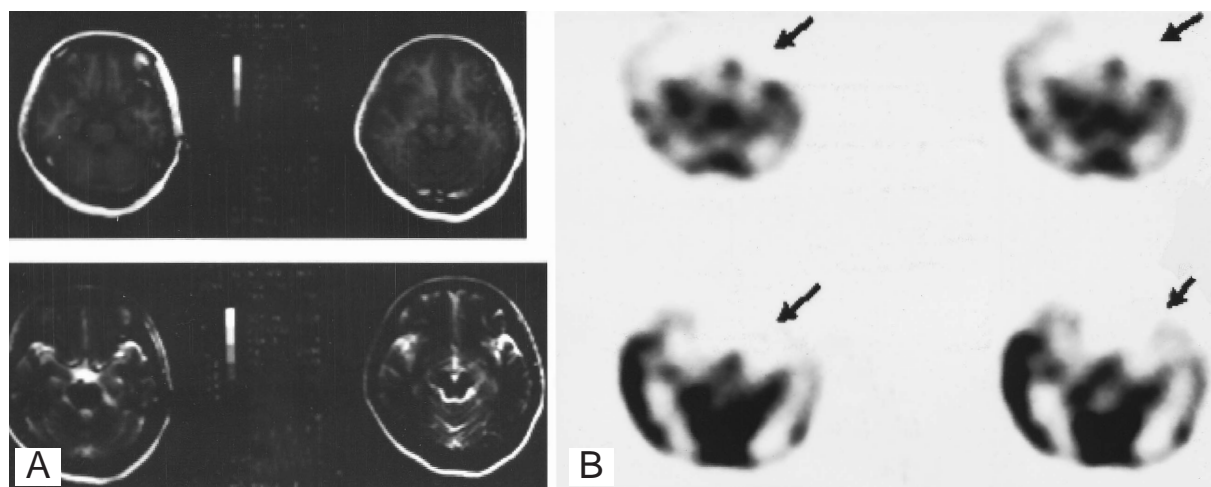


Fig. 1 (case no 7) A: MRI (T1W and T2W) of the brain is normal. B: Tc-99m ECD brain SPECT demonstrates hypoperfusion in the left temporal lobe (arrows).

became seizure-free and 2 patients improved markedly after epilepsy surgery based on the results of Tc-99m ECD SPECT and MRI. In one case with both positive SPECT (hypoperfusion in the left temporal lobe) and MRI (brain damage in the left parietal lobe), there was location disagreement. After epilepsy surgery (left anterior temporal lobectomy) and postsurgical evaluation, it was found that Tc-99m ECD SPECT scan more accurately localized the epileptogenic focus than MRI. No side effects were noted during or after tracer administration, and no scintigraphy-related discomfort was reported (Table 1).

DISCUSSION

Tc-99m HMPAO SPECT imaging has been used to evaluate the interictal period in adults with intractable epilepsy [6-8]. Post-operative evaluations have also been performed with this method [9]. To our knowledge, few studies have been published concerning interictal Tc-99m ECD SPECT scintigraphy in adults with medically intractable epilepsy in comparison with MRI and postoperative results. ECD is an agent for cerebral-blood-flow imaging. It is a neutral lipophilic complex that can be labeled with Tc-99m making it a suitable tracer for evaluating regional cerebral blood flow [10]. The advantages of Tc-99m ECD include fast clearance from blood, high target-to-non-target ratio, early imaging after intravenous injection and high quality SPECT brain images. Management of patients with intractable epilepsy requires objective and precise localization of the epileptogenic focus. It is also needed to restrict surgical intervention to a minimum [11-13].

Several studies [14,15] have clearly proven that interictal brain SPECT scan is superior to MRI studies for detecting brain abnormalities in patients with refractory epilepsy. In this investigation, we used interictal Tc-99m ECD SPECT images to detect abnormalities of brain and to evaluate the clinical role of Tc-99m ECD in patients with medically intractable epilepsy. Tc-99m ECD SPECT scans demonstrated abnormally decreased brain

blood flow in 9 patients, while MRI showed abnormalities possibly related to epilepsy in 8 patients. Tc-99m ECD SPECT scan may be more accurate for localizing the epileptogenic focus than MRI. In accordance with previous publications [16,17], our results confirm that the most frequently involved cerebral lobe is the temporal lobe.

From this preliminary study, we conclude that Tc-99m ECD SPECT scan is a safe and useful imaging method for investigating epilepsy. It is more accurate than MRI in localizing the epileptogenic focus in adults with medically intractable epilepsy. In the future, we will extend the patient numbers to confirm the utility of Tc-99m ECD SPECT brain scan in patients suffering from refractory epilepsy.

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銻-99m-ECD 腦部單光子射出斷層掃描對引起成人局部癲癇症病灶的偵察與核磁共振掃描及手術後結果之比較：一先期報告

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背景 本篇研究的目的是在於評估癲癇發作間期使用銻-99m-ECD 單光子射出斷層掃描對於引起成人癲癇病灶定位之臨床可用性及正確性。

方法 選擇10位腦電圖測定結果是呈陽性的頑強局部癲癇症的病人來做銻-99m-ECD 單光子射出斷層掃描。所有的病人都接受了術前的腦部核磁共振掃描及癲癇手術。

結果 有9位病人，銻-99m-ECD 單光子射出斷層掃描的結果顯示腦部血流有不正常的降低；有8位病人腦部核磁共振掃描的結果顯示出可能和癲癇有關的異常。在癲癇手術後有8位病人被治癒，2位有顯著的改善。有一位其銻-99m-ECD 單光子射出斷層掃描及核磁共振掃描結果皆為陽性但是位置不同。根據手術後的評估銻-99m-ECD 單光子射出斷層掃描比起核磁共振掃描對於癲癇病灶的定位有較高的正確性。

結論 銻-99m-ECD 單光子射出斷層掃描對於偵察成人難治的癲癇病灶之定位比起腦部核磁共振掃描是一個較有用且正確性高的方法。(中台灣醫誌 2002;7:38-43)

關鍵詞

核磁共振，頑強性局部癲癇，銻-99m-ECD 單光子射出斷層掃描

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