Temporal Lobectomy for Intractable Complex Partial Seizures in Pediatric Patients

PONGSAKDI VISUDHIPHAN, M.D.*,
ANANNIT VISUDTIBHAN, M.D.*,
JIRAPORN LAOTHAMATAS, M.D.***,
TAWEESAK JANWITYANUJIT, M.D.**
SIRA BUNYARATAVEJ, M.D.**,
SURANG CHIEMCHANYA, M.D.*,
PRASERT SARNVIVAD, M.D.**,

Abstract

Fourteen children, 7 boys and 7 girls, who failed conventional medical treatment for complex partial seizures underwent anterior temporal lobectomy at Ramathibodi Hospital, Bangkok, Thailand, from July 1993 to June 1998. The mean age at onset of patients was 6.7 years old and the mean duration of seizures before surgery was 6.4 years. The age of patients at surgery ranged from 8 to 22 years old. These patients had had limited presurgical evaluation which included video-electroencephalography (EEG), magnetic resonance imaging (MRI) and single photon emission computed tomography (SPECT). All patients demonstrated concordant among clinical symptoms, EEG, MRI and SPECT on the same side of the temporal lobe. Ten and 4 patients had unilateral and bilateral temporal lobe lesions respectively. The operations were done on the left in 10 patients and on the right in 4 patients. Seizure free after $^1/_2$ - 5 years of follow-up was obtained in 70 per cent of patients which included 9 of 10 patients with unilateral temporal lesion and 1 of 4 patients with bilateral temporal lesions. The rest of the patients showed marked reduction of seizures except for one patient with bilateral lesions in whom only 50-70 per cent reduction was obtained. Marked improvement of behaviour was also observed in 70 per cent of patients. Resected brain specimens revealed mesial temporal sclerosis, gliosis, tumors and cavernoma in 6, 5, 2 and 1 patients respectively.

Key word : Epilepsy, Temporal Lobe Epilepsy, Intractable Complex Partial Seizure, Temporal Lobectomy

* Department of Pediatrics,
** Department of Surgery,
*** Department of Radiology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand.

Epilepsy is a common neurological disorder in pediatric practice. Despite the availability of new drugs for epilepsy, several children continue to experience medically resistant and debilitating seizures[1,2]. Children with medically resistant seizures that persist into adolescence often experience psychosocial deterioration and medical morbidity[3]. When medical therapy fails and seizures persist, surgery can sometimes be offered[4-6].

Surgically remediable seizures most often arise from a temporal lobe, and temporal lobectomy is the operation most often performed to treat refractory epilepsy[7,8]. The efficacy of pediatric temporal lobectomy for seizure control is equivalent to the adult experience, with approximately 60 to 80 per cent of the candidates becoming seizure-free[4,5, 9,10].

The appropriate presurgical evaluation process is essential to select patients who would benefit and eliminate those for whom it would not be helpful or even harmful[11-13]. For standard temporal lobe resection, the presurgical evaluation needs only to determine that habitual seizures are originating within the boundaries of the intended excision and that the structure of the contralateral mesial temporal lobe can support memory[8,13,14].

Ramathibodi Hospital is the first institution in Thailand to initiate temporal lobectomy for intractable complex partial seizures in pediatric patients. The first temporal lobectomy was performed in July 1993. Up to the present, 14 patients have been operated on. Experience of temporal lobectomy at our institution is described.

PATIENTS AND METHOD

Patients with refractory epilepsy were evaluated for temporal lobectomy at the Department of Pediatrics, Ramathibodi Hospital between July 1993 and June 1998. Fourteen patients met the criteria for inclusion in this study. All patients had intractable complex partial seizures with or without secondary generalized seizures. Medical failure was defined as a lack of therapeutic response to monotherapy with conventional antiepileptic drugs and the combination of at least two drugs. All patients had experience of over one year of seizures (at least twice or more monthly prior to surgery) and did not have a persistent interictal psychosis.

Special attention of history was paid to the characteristics and consistency of the initial event or aura. Since aura reflects the epileptiform activation of nerve cells close to the discharging focus. The symptom sequence through which the seizures evoked was ordinarily stereotyped. Historical information in some patients was later compared with the patients' actual behavior during seizures monitored on routine and or video-EEG.

All patients had a scalp electroencephalography (EEG) recording. The scalp electrodes were placed according to the international 10-20 system using the collodion technique. EEG was performed interictally in wakefulness and sleep at least twice within two weeks. These samples ranged from 10-15 minutes in length. Video-EEG monitoring was obtained for all patients to analyze interictal EEG and ictal semiology. Patients who had interictal spikes in either one or both temporal regions were included in this study.

Neuroimaging was an important part of the presurgical evaluation of our patients. All patients had magnetic resonance imaging (MRI) studies prior to surgery. The relevant findings were the presence of an abnormal lesion either in one or both temporal lobes. In addition, interictal single photon emission computed tomography (SPECT) was performed in all of them which included the ictal phase in the last four patients. The studied patients had to have concordant clinical symptoms, EEG, MRI and SPECT findings located on the same side of the temporal lobe. Patients suspected of having additional nontemporal lesion, either because of having extratemporal interictal spikes or an imaging studies showing a nontemporal lesion were excluded.

All patients had anterior temporal lobectomy performed under general anesthesia. Ten resections were from the left temporal and four from the right. Extent of resection as measured from temporal tip along the superior border was 4 cm. Then complete removal of hippocampus and amygdala were performed.

RESULTS

Fourteen children (seven boys and 7 girls) underwent temporal lobectomy. The age of onset of patients ranged from 4 months to 12 years (mean = 6.7) and the duration of seizures before surgery ranged from 1 $^{1}/_{2}$ to 15 years (mean = 6.4). Three patients had had febrile convulsions during infancy. Ten patients had unilateral temporal lobe lesions; seven on the left and three on the right. The other four patients had bilateral temporal lesions which

were predominant on the left lobe in three and on the right in one patient. Unilateral temporal lobectomy was performed on the left side in ten and on the right side in four patients. There were neither mortality nor morbidity except in one patient who had superior homonymous quadrantanopsia. At follow-up from 1/2 to 5 years, nine out of ten children who had exclusively unitemporal foci were seizure-free (90%) and another patient had marked decrease of seizure attacks (10%). Only one out of four children who had bilateral temporal foci was seizure-free, two children had a greater than 75 per cent reduction of seizures, the other patient had 50-75 per cent reduction of seizure attacks.

Antiepileptic drugs were gradually tapered off after two years of seizure-free interval in three patients. Postoperative evaluation of behaviour status by means of patients' interviewing revealed substantial improvement in psychosocial function which included better self-esteem, greater self-confidence and improved mood in 10 patients. Two patients showed minimal improvement. The other two patients who had bilateral temporal lesions (No. 3, 13) showed no significant improvement of either psychosocial or academic functions. One of these patients (No. 3) had had intractable seizures since he had viral encephalitis at the age of 6 years. The other (No. 13) who was mildly mentally retarded had had intractable seizures since he was 3 years old.

The clinical summary and histopathologic abnormalities of the resected temporal specimens are shown in Table 1. Six children had findings consistent with mesial temporal sclerosis. Five children exhibited gliosis and the other three children harboured ganglion cell tumor, dysembryonic neuroectodermal tumor (DNET) and cavernoma respectively.

DISCUSSION

Temporal lobectomy in children and adolescence is a safe and effective procedure for the treatment of intractable temporal lobe epilepsy[4,5]. The majority of our patients resulted in becoming seizure-free which is comparable to that reported in Western countries[4,5,9,10].

Complex partial seizures seldom recede spontaneously and often resist medical treatment [15,16]. About twenty to sixty per cent of patients are not satisfactorily controlled with antiepileptic drugs. Some studies have shown more favorable evolutions, but they have not vigorously excluded benign partial epilepsies.

Early attempts to subclassify temporal lobe seizures based on analysis of videotaped events has provided some controversial results. It is now recognized that most temporal lobe seizures begin in the mesial temporal structures[15,16]. This observation, combined with other factors that include distinctive hippocampal pathology, has been classi-

Table 1. Patients' summary.

Case No.	Sex	Age at onset (yr)	Age at surgery (yr)	Side of lesion	Side of lobectomy	Histopathology	Duration of follow-up (yr)	Outcome
1	M	4	13	R	R	MTS	5 1/2	Seizure free
2	M	12	14	L	L	MTS	5	Seizure free
3	M	6	13	Bilat	L	Gliosis	3	>75% reduction
4	M	9	11	Bilat	L	MTS	2	>75% reduction
5	F	12	14	R	R	Ganglioglioma	1 1/2	Seizure free
6	F	7	22	L	L	MTS	1 1/2	>95% reduction
7	F	7	9	L	L	Gliosis	1 1/2	Seizure free
8	F	7	9	L	L	MTS	1 1/2	Seizure
9	F	4/12	8	L	L	DNET	1 1/2	Seizure free
10	F	10/12	14	Bilat	L	Ectopic neurons, gliosis	1	Seizure free
11	M	9	18	L	L	Gliosis	1	Seizure free
12	M	11	13	L	L	Cavernoma	1	Seizure free
13	M	3	12	Bilat	R	Ectopic neurons, gliosis	1/2	= 50% reduction
14	F	6	13	R	R	MTS	1/2	Seizure free

MTS = mesial temporal sclerosis, DNET = dysembryonic neuroectodermal tumor

fied by some epileptologists as a syndrome of medial temporal lobe epilepsy (MTLE). This syndrome includes mesial temporal sclerosis (MTS) as an essential anatomical substrate. It is not surprising that seizures with the same typical characteristics can be seen in patients with hamartomas, gliomas, and vascular malformations involving mesial temporal structures[15].

Temporal lobe epilepsy frequently responds well to initial medical treatment for many years. Once seizures return, usually in adolescence, very high levels of antiepileptic drugs may be effective. This results in intolerable side effects and fails to control seizures[16]. Patients who are medically refractory will have a relatively poor prognosis with medical treatment[15,16]. Seizures often become worse and interictal behavioural disturbance can ensue. These patients should be considered for surgical intervention. Surgical treatment, on the otherhand, has been reported to abolish all disabling, complex, partial seizures in 60-80 per cent of patients with medically failed temporal lobe epilepsy[4,5, 9,10].

Presurgical evaluation for temporal lobectomy can usually be achieved noninvasively with video-EEG monitoring, MRI, neuropsychologic evaluation and often functional imaging with either PET or SPECT[8]. However, with limited facilities, it was possible to perform temporal lobectomy in our selected patients with reasonable safety. All of our fourteen patients had presurgical evaluation by careful clinical analysis, video-EEG monitoring, MRI and SPECT examinations.

Aura preceeding complex partial seizures is not rare. Harbord and Manson found aura in 51 (81%) of their 63 children[1]. Blume et al took histories which disclosed an initial simple partial component in 13 of 14 cases; each aurae implicated the limbic system[11,14]. By far the most common type of aura is a visceral sensation, usually in the epigastrium. Other frequently described aura such as deja vu, micropsia, macropsia, fear, and olfactory hallucination do occur. The objective manifestations often begin with motor arrest, staring, and pupillary dilatation. More often semipurposeful coordinated motor activities (automatisms) are observed. Unilateral tonic or dystonic posturing of the legs and even the face contralateral to the side of onset is considered a lateralizing sign. Contralateral ictal paresis has recently been reported as a reliable lateralizing sign[15].

Careful clinical evaluation of fourteen patients in this study implicated either or both temporal lobes as epileptogenic lesions. Whereas, video-EEG and MRI findings indicated from which temporal lobe the seizure arose. The consequent findings of the above mentioned investigations, in addition to the abnormalities of SPECT in the same side of the temporal lobe obviated our need for further invasive and expensive presurgical investigations.

Almost all temporal lobectomies performed before the late 1970's involved a generous lateral temporal neocortical resection, which was either standard or determined by intraoperative electrocorticography (ECoG) spikes and limited by essential cortex such as language and visual fields. The volume of medial hippocampus, parahippocampus and amygdala removed was extremely variable and surgeon dependent[8,17].

In Sperling's series, anterior temporal lobectomy in the nondominant hemispheres was excised to the section line measured 5 to 5.5 cm from the temporal tips, and 4.5 to 5 cm from the temporal tip in the dominant hemisphere. The amygdala and anterior 1.5 to 2 cm of hippocampus were removed by suction in the early patients and en block fashion in later patients[18].

In the late 1970's, based on invasive electrophysiology and pathology, subtotal temporal resection was performed[8,17]. In many epilepsy centres, surgical resection is now limited to the involved mesial temporal structures. Surgery consists of removal of the amygdala and hippocampus, as well as a small portion of the temporal pole, leaving the lateral temporal neocortex intact.

Temporal lobectomy of fourteen patients in our study was limited to resection of a small portion of the temporal pole, as well as amygdala and hippocampus. At least 70 per cent were seizure-free without significant neurological defects despite temporal lobectomy in the dominant hemisphere in ten patients. The best results were observed in the patients who had only unilateral temporal lobe lesion.

Mesial temporal lobe epilepsy is a prototype of surgically remediable syndrome, which has a characteristic presentation and a specific pathophysiologic basis. This disorder is a common form of epilepsy and one of the most refractory to medical treatment. Seizures usually begin in the first decade of life and characteristically become intrac-

table as early as adolescence. The risk of irreversible psychosocial consequences for patients with intractable seizures is great. Most patients with this condition, however, can be easily identified as potential candidates for surgery by the presence of temporal interictal spikes on EEG, hippocampal atrophy on high-resolution MRI and temporal-lobe interictal hypoperfusion or ictal hyperperfusion on the SPECT. Anterior mesial temporal-lobe resection offers a 70 to 80 per cent chance of cure[8,19-21].

(Received for publication on January 7, 1999)

REFERENCES

1. Harbord MG, Manson JI. Temporal lobe epilepsy in childhood: reappraisal of etiology and outcome. Pediatr Neurol 1987;3:263-8.
2. Hauser WA, Hesdorffer DC. Epilepsy: frequency, causes and consequences. New York: Demos Press, 1990.
3. Lindsay J, Glaser G, Richards P, Ounsted C. Developmental aspects of focal epilepsies of childhood treated by neurosurgery. Dev Med Child Neurol 1984;26:574-87.
4. Davidson S, Falconer MA. Outcome of surgery in 40 children with temporal-lobe epilepsy. Lancet 1975;2:1260-3.
5. Duchowny M, Levin B, Jayakar P, et al. Temporal lobectomy in early childhood. Epilepsia 1992;33: 298-303.
6. Falconer MA. Temporal lobe epilepsy in children and its surgical treatment. Med J Aust 1972;1: 1117-21.
7. Engel J Jr. Epilepsy surgery. Curr Opion Neurol 1994;7:140-7.
8. Engel J Jr. Surgery for seizures. N Engl J Med 1996;334:647-52.
9. Meyer FB, Marsh WR, Laws ER Jr, Sharbrough FW. Temporal lobectomy in children with epilepsy. J Neurosurg 1986;64:371-6.
10. Wyllie E, Comair YG, Kotagal P, Raja S, Ruggieri P. Epilepsy surgery in infants. Epilepsia 1996;37: 625-37.
11. Blume WT, Kaibara M. Localization of epileptic foci in children. Can J Neurol Sci 1991;18:570-2.
12. Saint-Hilaire JM, Richer F, Turmel A, Rouleau I, Bouvier G. Relative localizing value of common tests used in the preoperative investigation of epileptic patients. Can J Neurol Sci 1991;18:598-600.
13. Sperling MR, O'Connor MJ, Saykin AJ, et al. A noninvasive protocol for anterior temporal lobectomy. Neurology 1992;42:416-22.
14. Blume WT, Girvin JP, McLachlan RS, Gilmore BE. Effective temporal lobectomy in childhood without invasive EEG. Epilepsia 1997;38:164-7.
15. Engel J Jr, Williamson PD, Wieser HG. Mesial temporal lobe epilepsy. In: Engel J Jr, Pedley TA, eds. Epilepsy: a comprehensive textbook. Philadelphia: Lippincott-Raven, 1997:2417-26.
16. Williamson PD, Engel J Jr. Complex partial seizure. In: Engel J Jr, Pedley TA, eds. Epilepsy: a comprehensive textbook. Philadelphia: Lippincott-Raven, 1997:557-66.
17. Doyle WK, Spencer DD. Anterior temporal resections. In: Engel J Jr, Pedley TA, eds. Epilepsy: a comprehensive textbook. Philadelphia: Lippincott-Raven, 1997:1807-17.
18. Sperling MR, O'Connor MJ, Saykin AJ, et al. A noninvasive protocol for anterior temporal lobectomy. Neurology 1992;42:416-22.
19. Berkovic SF, Newton MR. Single photon emission computed tomography. In: Engel J Jr, Pedley TA, eds. Epilepsy: a comprehensive textbook. Philadelphia: Lippincott-Raven, 1997:969-75.
20. Cascino GD. Structural brain imaging. In: Engel J Jr, Pedley TA, eds. Epilepsy: a comprehensive textbook. Philadelphia: Lippincott- Raven, 1997: 937-46.
21. Walczak TS, Jayakar P. Interictal EEG. In: Engel J Jr, Pedley TA, eds. Epilepsy: a comprehensive textbook. Philadelphia: Lippincott-Raven, 1997: 831-48.

การผ่าตัด temporal lobectomy ในผู้ป่วยเด็กที่เป็นโรคลมชักชนิด complex partial ซึ่งดื้อต่อยากันชัก

พงษ์ศักดิ์ วิสุทธิพันธ์, พ.บ., สิระ บุณยะรัตเวช, พ.บ.**,*
อนันต์นิตย์ วิสุทธิพันธ์, พ.บ., สุรางค์ เจียมจรรยา, พ.บ.*,*
*จิรพร เหล่าธรรมทัศน์, พ.บ.***, ประเสริฐ ศัลย์วิวรรธน์, พ.บ.**,*
*ทวีศักดิ์ จันทร์วิทยานุชิต, พ.บ.***

ระหว่างเดือนกรกฎาคม 2536 ถึงมิถุนายน 2541 ที่ โรงพยาบาลรามาธิบดี มีผู้ป่วยเด็ก 14 คน (ชาย 7 คน และหญิง 7 คน) ซึ่งเป็นโรคลมชักชนิด complex partial ซึ่งดื้อต่อยากันชัก ได้รับการรักษาโดยการผ่าตัด anterior temporal lobectomy อายุของผู้ป่วยขณะได้รับการผ่าตัดระหว่าง 8–22 ปี เริ่มมีอาการชักเมื่ออายุเฉลี่ย 6.7 ปี และมีอาการชักมาแล้วก่อนการผ่าตัดเฉลี่ย 6.4 ปี ผู้ป่วยได้รับการซักประวัติและตรวจร่างกาย ตรวจคลื่นสมอง video-EEG, magnetic resonance imaging (MRI), single photon emission computed tomography (SPECT) ผู้ป่วยที่ได้รับการผ่าตัดต้องมีผลการตรวจทั้งหมดซึ่งบ่งชี้ว่าเป็นความผิดปกติของ temporal lobe ข้างเดียวกัน พบว่าผู้ป่วยมีความผิดปกติที่ temporal lobe ข้างเดียว 10 คน และผิดปกติทั้ง 2 ข้าง 4 คน เป็นการผ่าตัด temporal lobe ข้างซ้าย 10 คน ข้างขวา 4 คน พบว่า ติดตามหลังการผ่าตัดนาน $^1/_2$–5 ปี มีผู้ป่วยที่ไม่มีอาการชักอีกร้อยละ 70 ซึ่งพบในผู้ป่วยที่มีความผิดปกติที่ temporal lobe ข้างเดียว 9 ใน 10 คน และในผู้ป่วยที่มีความผิดปกติของทั้ง 2 ข้าง มีการชักลดลงร้อยละ 50–75 พฤติกรรมของผู้ป่วยดีขึ้นอย่างมากในร้อยละ 70 ของผู้ป่วยที่รับการผ่าตัด พบว่าผลการตัดชิ้นเนื้อจาก temporal lobe เป็น mesial temporal sclerosis, gliosis เนื้องอก และ cavernoma ในผู้ป่วย 6, 5, 2 และ 1 คน ตามลำดับ

คำสำคัญ : โรคลมชัก, โรคลมชักของกลีบเท็มโปรัล, โรคลมชักชนิดคอมเพล็กซ์ พาร์เชียว ซึ่งดื้อต่อยากันชัก, การผ่าตัดสมองส่วนกลีบเท็มโปรัล

* ภาควิชากุมารเวชศาสตร์,
** ภาควิชาศัลยศาสตร์,
*** ภาควิชารังสีวิทยา, คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี, มหาวิทยาลัยมหิดล, กรุงเทพฯ 10400