Surgery for Temporal lobe epilepsy in children

Abstract

Introduction: This study assessed the efficacy of magnetic resonance imaging (MRI) and single-photon emission computed tomography (SPECT) for localization of foci for performing surgery in children with temporal lobe epilepsy (TLE).

Methods: This prospective study included 12 patients (5 boys, 7 girls, age from 2 to16 years) with a clinical diagnosis of TLE. All patients underwent high-resolution MRI and if no abnormality was identified, SPECT imaging assessed them further. In all patients, visual inspection identified unilateral mesial temporal lesion (MTL). All patients underwent craniotomy and lesionectomy at the side of the MTL.

Results: In eight patients with Class I, and two patients with Class II desired treatment results were achieved postoperatively. All patients survived. Twenty-five percent of the patients experienced improved memory function related to the non-operated side, and 50% experienced a 10% gain in general intelligence quotient status.

Conclusions: In patients with clinically suspected TLE, MRI alone is not able to localize temporal lobe foci correctly and SPECT is very helpful to localize these lesions.

Keywords: Temporal lobectomy, Temporal lobe epilepsy, Child.

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Introduction

Temporal lobe epilepsy (TLE) is a common type of epilepsy in children which is hard to medically control (1). Although a common underlying cause of TLE is mesial temporal sclerosis,

there are also other etiologies known to cause TLE in infants and young children, such as tumors, trauma, cortical dysplasia, and vascular malformations. In infants and young children, motor manifestations are highly noticeable. However, with increasing age, they become less obvious. Additionally, as the child grows older, the complexity of automatisms increases. Furthermore, the clinical manifestations in childhood and especially in adolescence resemble the same as those of the adult population (1,2). In children with intractable TLE, anterior temporal lobectomy may result in better success in surgery outcome than amygdalohippocampectomy. If on magnetic resonance imaging a focal brain lesion is present, it acts as one of the most reliable independent predictors which predicts for good outcomes after the surgical operation to control the seizure.

Functional and structural neuroimaging techniques are increasingly essential in assessment of epileptic patients for localizing of the seizure foci as well as understanding pathophysiology, prognosis and prediction of outcome after epilepsy surgery. Interictal and ictal single photon emission computed tomography (SPECT) imaging of cerebral blood flow are both implemented for this purpose.(3) They should be interpreted in the context of clinical, electrographic, and magnetic resonance imaging data. Hyperperfusion is generally associated with ictal activity and hypoperfusion with interictal deactivation.

PET has wider research applications, particularity when used with ligands for neurotransmitter receptors or inflammatory processes (4).

The most important factor that predicts of improved psychosocial outcome and better quality of life as well as a lower proportion of disability among children is having a seizure-free status. Since during infancy and early childhood the brain is more plastic, recovery happens faster. Contrary to having a seizure-free status, a long epilepsy duration is a risk factor that is important

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for surgically refractory seizures. As a result, medically intractable TLE patients should undergo surgery at the earliest time possible (1,2).

Methods

In a prospective pilot study from year 2009 to 2014 (five years), 12 patients (5 boys, 7 girls, ages from 2 to 16 years) with a clinical diagnosis of medically refractory temporal lobe epilepsy (TLE) diagnosed by pediatric neurologist, were included in the study at Ghaem Hospital of Mashhad University of Medical Sciences. All patients underwent magnetic resonance imaging (MRI). If MRI did not reveal any abnormality in the patient, single-photon emission computed tomography (SPECT) imaging was performed. Unilateral mesial temporal lesion (MTL) was diagnosed by SPECT images. Interictal preoperative electroencephalography (EEG) was performed for all patients and pre-operative and after a year of post-operative neuropsychological testing were also performed. Both EEG as well as neuropsychological

Table 1. Surgery results for children with temporal lobe epilepsy (TLE) (n = 12)

examinations were implemented in a blinded manner. During the process of decision-making related to surgery, these data were not taken into account. Surgery was performed at the side of the MTL, when all patients underwent craniotomy and lesionectomy on that side. The outcomes for surgery were rated as Class I (seizure-free or simple partial seizures only), Class II (>/= 90% improvement), and no change. The follow-up period ranged from 12 to 48 months (mean 24 ± 5 months [±SD]). After operation, no prolonged video-EEG monitoring was performed for any of.the patients. Also, no positron emission tomography, Wada testing, or single-photon emission computerized tomography were performed after operation

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Post-operation	Number of Patients	Age Range (years)
Class I	8	
Class II	2	2 – 16
No change	2	

Results

Eight patients were categorized as Class I, and two patients were categorized as Class II post-operation (Table 1). There was no mortality in these series. Except for two patients who underwent surgery in the dominant temporal lobe, a verbal memory decline occurred there was no postoperatively cognitive decline. The post-operative MRI revealed posterior temporal cortical damage in these two patients. Twenty-five percent of the patients experienced improved memory function related to the non-operated side, and 50% experienced a 10% gain in general intelligence quotient status.

Discussion

The most common type of medically intractable epilepsy in adults is temporal lobe epilepsy (TLE), however in children, only about 20% of epilepsy cases are originated from the temporal lobe. TLE can be treated through surgical procedures. Furthermore, the most common underlying cause of TLE is mesial temporal sclerosis (MTS, also called hippocampal sclerosis) which is observed in almost 81% of all cases (1).

In children and adolescents with intractable seizures, favorable surgical outcomes following temporal lobectomy have been reported in previous studies (5,6). Additionally, for young children, it is much more difficult to perform pre-surgical evaluations compared to older patients.

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There are only limited number of studies performed on the postoperative cognitive and/or memory outcomes in children. This is because of low frequencies of complaints about memory problems and measurement scale limitations (6).

Clinical characteristics of children undergoing temporal lobe surgery, including seizure types, histopathology, electroencephalogram (EEG) findings, and postoperative seizure as well as neuropsychological outcomes, may provide important information on the suitability of surgery for TLE.

MTS has been considered a progressive disorder which is characterized by medically intractable seizures, loss of memory, and variable behavioral changes. Temporal lobectomy is a significantly better treatment in such cases, compared to continued antiepileptic drugs (AED) therapy. Therefore, it is better to avoid postponing pre-surgical evaluation when medical intractability has been established. Moreover, since children with intractable seizures show intellectual decline over time, it is suggested that surgery at earlier stage may reduce the severity of cognitive impairment (7).

In children with intractable seizures, temporal lobe surgery has been shown to be safe and effective (8,9). Wiebe et al. confirmed the effectiveness of anterior temporal lobectomy (ATL) in a randomized controlled trial, for adults with intractable TLE seizures (8). Their study showed that post operation, 58% of patients in the surgical group became seizure-free compared to only 8% in the medical group. Hemb et al. found that TLE surgery is able to keep patients seizure free for almost up to two decades. (10). In a study performed at the Cleveland Clinic Foundation, similar results were obtained. This study revealed that 74% of pre-adolescents and 80% of adolescents after temporal lobe surgery became seizure-free (7).

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Another study of 52 children and adults with medically intractable TLE demonstrated that 63.2% (12/19) of the children and 72.7% (24/33) of the adults achieved the seizure-free outcomes postoperatively (9).

The follow-up studies in adults and children showed that as the postoperative time increased, a decline in seizure-free rates occurred (12, 13,14). In a study that reviewed 325 adults and pediatric patients retrospectively, a decrease in the seizure-free rate after temporal lobectomy was found from 61% at 1 year to 41% at 10 years (12). A similar study indicated that 67% of patients were seizure-free during the 10 to 20-year period of post-surgery (13). Additionally, the outcomes were better in patients with tumors or cavernous angioma compared to those with other histopathologies (12).

Following temporal lobectomy, cognitive functioning may be at risk. Decrease in verbal memory may happen due to left-sided resections, while right-sided surgery may affect spatial memory and learning. Following surgery, approximately 30-60% of patients who undergo left-sided (speech dominant) resection experience a substantial decline in verbal memory (15). On the other hand, postoperative improvement in verbal memory may happen to patients who have undergone right-sided surgery, although some may exhibit a decline. There is a greater risk for postoperative memory decline in patients with higher pre-surgical abilities (15).

Stable verbal memory scores 6 months after the left-sided surgery as well as improved scores after right-sided resection have been shown in a study that evaluated children after temporal lobe surgery (9). Children, compared to adults, can more quickly and completely recover from lost cognitive function (16). Although in previous studies in children, decrease in postoperative verbal memory has been found three months after surgery, obvious recoveries were observed within just one year after surgery. On the other hand, in adults with left-sided resection, level of

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verbal memory one year after surgery was remarkably worse than that of their pre-operative examination (16). In a study which had a follow-up duration of shorter than 2 years, no improvements in intellectual functioning were found (17). This finding suggests that for cognitive recovery, a longer period is required.

The results of the long-term follow-up of 42 children were reported in a study by Skirrow et al. (18). The children had undergone temporal lobe surgery and were followed for an average period of 9 years. After a follow-up period of more than 5 years, a significant increase in intelligence quotient (IQ) was found in the surgical group, while the non-surgical control group did not show this increase. Better psychosocial outcomes were also observed in the surgical group including better quality of life. Additionally, children with lower preoperative IQs showed better postsurgical cognitive improvements in previous studies (18,19).

Various predictors of postoperative memory outcome include preoperative memory level, the side of resection, extent of MTS, duration of epilepsy and Wada test results for language lateralization and memory deficits (19,20,21). Binder et al found the predictive factors of memory decline including good preoperative performance, left dominance on the Wada test, and late age at onset of epilepsy.

Conclusion

To localize temporal lobe foci in patients with clinically suspected TLE, MR imaging alone is not able to correctly localize it and SPECT is very helpful to localize this lesion.

In children, a safe and effective procedure to control the seizure for intractable epilepsy is temporal lobe resection. Due to the shorter epilepsy duration and greater plasticity of the brain in children compared to adults, the success in children is higher. It is worth knowing that when the

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procedure is performed in the dominant hemisphere, there is a risk of language deficits. Additionally, in children, the effects of frequent seizures and taking AEDs on the developing brain can be disruptive and result in brain damage and progressive mental handicap. As a result, to improve long-term prognoses, early diagnosis of intractable epilepsy and referral for surgical treatment are critical.

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