



Surgery for Temporal Lobe Epilepsy in Children

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ARTICLE INFO

Article type

Case series

Article history

Received: 10 May 2017

Revised: 26 Jul 2017

Accepted: 11 Aug 2017

Keywords

Child

Temporal lobectomy

Temporal lobe epilepsy

ABSTRACT

This study aimed to assess the efficacy of magnetic resonance imaging (MRI) and single-photon emission computed tomography (SPECT) in localizing epileptic foci in children with temporal lobe epilepsy (TLE). This prospective study was conducted on 12 patients including five males and seven females aged between 2 and 16 years old with a clinical diagnosis of TLE. All the patients underwent high-resolution MRI and if no abnormality was identified, SPECT was used for further assessment. In all the patients, visual inspection identified unilateral mesial temporal sclerosis, and the patients underwent craniotomy and lesionectomy.

According to the results, eight patients were categorized in class I and two cases were classified as class II, and all the patients survived. About 25% of the patients showed adequate memory function on the non-operated temporal lobe, and general intelligence quotient increased by 10% in 50% of the patients.

According to the results, in patients with clinically suspected TLE, MRI alone is not able to localize the epileptic foci correctly, and SPECT can be helpful to localize these lesions.

Please cite this paper as:

Faraji-rad M, Tohidi H, Faraji-rad E. Surgery for Temporal Lobe Epilepsy in Children. *Rev Clin Med.* 2017;4(4):176-179.

Introduction

Temporal lobe epilepsy (TLE) is a common type of epilepsy in children, which is difficult to control by medication (1). The generally known underlying cause of TLE is mesial temporal sclerosis (MTS). However, there are other etiologies for TLE in infants such as tumors, trauma, focal cortical dysplasia, and vascular malformations. In infants and toddlers, motor manifestations are highly noticeable, which become less obvious by increasing age.

Additionally, as the child grows older, the complexity of automatisms increases. Furthermore, clinical manifestations in childhood and especially in adolescence resemble those seen in adult population (1,2). In children with intractable TLE, the rate of operation success in anterior temporal

lobectomy is more than amygdalohippocampectomy. If the magnetic resonance imaging (MRI) findings demonstrated a focal brain lesion, it would act as one of the most reliable independent predictors of surgical outcomes.

Functional and structural neuroimaging techniques are increasingly used in the assessment of epileptic patients for localizing the seizure foci, as well as understanding pathophysiology and prognosis, and predicting surgical outcomes. To reach this goal, cerebral blood flow is assessed by ictal and interictal single photon emission computed tomography (SPECT) imaging (3). The results obtained by these methods should be interpreted in the context of clinical, electrographic, and MRI data.

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Hyper and hypoperfusion are generally associated with ictal and interictal discharges, respectively. Positron emission tomography (PET) has wider research applications, particularly when used with ligands for neurotransmitter receptors or inflammatory processes (4). Seizure-free status is the most important predictor for improved psychosocial outcome and quality of life, as well as low proportion of disability among children.

Neuroplasticity decreases by age; therefore, faster recovery is expected during infancy and early childhood. Nonetheless, intractable seizure is a risk factor for refractory epilepsy. As a result, patients with medically intractable TLE should undergo surgery as soon as possible (1,2).

Case series

This prospective pilot study was conducted on 12 patients entailing five males and seven females, who aged between 2 and 16 years old with medically refractory mesial TLE confirmed by a pediatric neurologist. This study was carried out in Ghaem Hospital affiliated to Mashhad University of Medical Sciences, Mashhad, Iran, from 2009 to 2014.

All the patients underwent MRI scanning, and if MRI did not reveal any abnormality, SPECT was performed. Unilateral MTS was diagnosed by SPECT imaging. Interictal preoperative electroencephalography (EEG) was performed for all the patients in addition to pre- and post-operative (one year later) neuropsychological tests. Both EEG and neuropsychological examinations were accomplished in a blinded manner.

These data were not taken into account during the process of surgical decision-making. All the patients underwent craniotomy and lesionectomy at the side of the MTL. The surgical outcomes were categorized to three classes including class I (seizure-free or simple partial seizures only), class II (worthwhile improvement [$\geq 90\%$]), and no worthwhile improvement. The follow-up period ranged between 12 and 48 months, with mean and standard deviation of 24 ± 5 months. Moreover, at the post-operative phase, no continuous video-EEG monitoring, PET, Wada test, or SPECT was performed.

Given the surgical outcomes, eight patients were categorized in class I and two subjects were in class II (Table 1). No mortality occurred in any of the patients. No postoperative cognitive dysfunction was observed among the patients except for two patients who underwent dominant TLE surgery and experienced a verbal memory decline. In these two patients, the postoperative MRI revealed a posterior temporal cortical damage. About 25% of the patients showed adequate memory function

on the non-operated temporal lobe, and general intelligence quotient (IQ) increased by 10% in 50% of the patients.

Table 1. Surgical results for children with temporal lobe epilepsy

Post-operation	Number of patients	Age range (years)
Class I	8	2-16
Class II	2	2-16
No change	2	2-16

Discussion

TLE is the most common type of medically intractable epilepsy among adults; however, only about 20% of childhood seizures are originated from the temporal lobe. Furthermore, the most frequent cause of TLE is MTS, also known as hippocampal sclerosis. This condition was observed in almost 81% of all TLE cases (1). TLE can be treated through surgical procedures.

According to the literature, satisfactory surgical outcomes were observed in children and adolescents who underwent temporal lobectomy (5,6). Additionally, for toddlers, it is much more difficult to perform pre-surgical evaluations compared to older patients. There are only limited number of studies performed to assess postoperative cognitive or memory outcomes in children, which might be due to low prevalence of memory problems and the limitations of existing measurement scales (6).

Clinical characteristics of children undergoing TLE surgery including seizure types, histopathology, EEG findings, postoperative seizure, and neuropsychological outcomes may provide important information on the effect of surgery on TLE.

MTS is considered as a progressive disorder, which is identified by medically intractable seizures, memory deficit, and behavior changes. The outcomes of temporal lobectomy was significantly better than antiepileptic drugs (AED) treatment. Therefore, it is recommended to postpone presurgical evaluation in case of medical intractability. Moreover, children with intractable seizures show intellectual decline over time; accordingly, surgery is the gold standard of treatment at earlier stages to reduce the severity of cognitive impairment (7).

It is indicated that TLE surgery is a safe and effective method to treat children with intractable epilepsy (8,9). Wiebe et al. conducted a randomized controlled trial and confirmed the effectiveness of anterior temporal lobectomy in adults with intractable TLE (8). According to the results of the mentioned study, 58% of the patients in the surgical group became seizure-free compared to only 8% of the cases in the medical group.

Hemb et al. found that TLE surgery was able to

keep patients seizure-free for almost up to two decades (10). This result was consistent with the results obtained by a study performed in the Cleveland Clinic. The mentioned study revealed that 74% of pre-adolescents and 80% of adolescents became seizure-free after TLE surgery (7).

Another study conducted on 52 children and adults with medically intractable TLE demonstrated that 63.2% of the children and 72.7% of the adults became seizure-free after the operation (9).

Follow-up studies of adults and children showed that the probability of recurrence increased after several years of operation (11-14). A retrospective review of 325 adult and pediatric patients revealed that the seizure-free rate after temporal lobectomy changed from 61% (at one year postoperation) to 41% (at 10 years postoperation) (12). A similar study indicated that 67% of patients were seizure-free during the 10 to 20 years after surgery (13).

Additionally, the outcomes were more satisfactory in patients with tumors or cavernous angioma compared to those with other histopathologies (12). TLE surgery may impair memory, generally verbal memory and spatial learning disorders may happen following left- and right-sided temporal lobe resection. Approximately 30%-60% of the patients who undergo left-sided (speech dominant) temporal lobe resection experience a substantial decline in verbal memory (15). On the other hand, postoperative improvement in verbal memory may happen in patients who underwent right-sided surgery; however, several patients may exhibit a decline. There is a greater risk for postoperative memory decline in patients with poorer presurgical mood (15).

A study was conducted to evaluate postoperative outcomes in children and revealed an improvement in verbal memory scores six months after the left-sided surgery and spatial memory after the right-sided resection (9). Cognitive dysfunctions resolve more quickly and completely in children in comparison to adults (16). Although previous studies on children demonstrated a postoperative verbal memory decline after three months of surgery, significant recoveries were observed within the first postoperative year.

Nevertheless, in adults with left-sided resection, the level of verbal memory one year after surgery was remarkably worse than that of their preoperative examination (16). In a study with a follow-up duration of shorter than two years, no improvement of intellectual functioning was found (17). Therefore, a longer follow-up interval is required for cognitive recovery.

Skirrow et al. carried out a study on the results of a nine years follow-up of 42 children underwent

TLE surgery and showed a significant improvement in IQ after a follow-up period of more than five years in the surgical group, while the non-surgical control group did not show this increase (18). Furthermore, psychosocial outcomes such as quality of life were more acceptable in the surgical group in comparison to the control group. Given the evidence, children with lower preoperative IQ levels showed better postsurgical cognitive improvements (18,19).

Various predictors of postoperative memory outcome including preoperative memory level, the side of resection, extent of MTS, the duration of epilepsy, and Wada testing for the determination of language and memory lateralization (19-21). Binder et al. found the predictive factors of memory decline including good preoperative performance, left-hemisphere language dominance according to the Wada test, and adult age of seizure onset.

Conclusion

To localize temporal lobe foci in patients with clinically suspected TLE, MRI 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 seizure for intractable epilepsy is temporal lobe resection. Due to the shorter epilepsy duration and greater neuroplasticity in children compared to adults, the success in children is more probable. It is worth mentioning that when the procedure is performed in the dominant hemisphere, there is a risk for language impairment. Additionally, in children, the effects of frequent seizures and taking AEDs on developing of the brain can be disruptive and result in the brain damage and progressive mental retardation. As a result, to improve long-term prognosis, early diagnosis of intractable epilepsy and referral for surgical treatment are critical.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Williamson PD, French JA, Thadani VM, et al. Characteristics of medial temporal lobe epilepsy: II. Interictal and ictal scalp electroencephalography, neuropsychological testing, neuroimaging, surgical results, and pathology. *Ann Neurol*. 1993;34:781-787.
2. Faraji M, Ashrafzadeh F, Faraji rad S. Epilepsy surgery in children. *Iran J Child Neurology*. 2009;3:7-14.
3. Spencer SS. The Relative Contribution of MRI, SPECT, and PET Imaging in Epilepsy. *Epilepsia*. 1994;35:572-589.
4. Theodore WH. Presurgical Focus Localization in Epilepsy: PET and SPECT. *Semin Nucl Med*. 2017;47:44-53.
5. Mohamed A, Wyllie E, Ruggieri P, et al. Temporal lobe epilepsy due to hippocampal sclerosis in pediatric candidates for epilepsy surgery. *Neurology*. 2001;56:1643-1649.
6. Clusmann H, Kral T, Gleissner U, et al. Analysis of different types of resection for pediatric patients with temporal lobe

- epilepsy. *Neurosurgery*. 2004;54:847-559; discussion 859-860.
7. Wyllie E, Chee M, Granström ML, et al. Temporal lobe epilepsy in early childhood. *Epilepsia*. 1993;34:859-868.
 8. Wiebe S, Blume WT, Girvin JP, Eliasziw M. Effectiveness and Efficiency of Surgery for Temporal Lobe Epilepsy Study Group. A randomized, controlled trial of surgery for temporal-lobe epilepsy. *N Engl J Med*. 2001;345:311-318 .
 9. Lee YJ, Kang HC, Bae SJ, et al. Comparison of temporal lobectomies of children and adults with intractable temporal lobe epilepsy. *Childs Nerv Syst*. 2010;26:177-183.
 10. Hemb M, Palmmini A, Paglioli E, et al. An 18-year follow-up of seizure outcome after surgery for temporal lobe epilepsy and hippocampal sclerosis. *J Neurol Neurosurg Psychiatry*. 2013;84:800-805.
 11. Schmidt D, Stavem K. Long-term seizure outcome of surgery versus no surgery for drug-resistant partial epilepsy: a review of controlled studies. *Epilepsia*. 2009;50:1301-1309.
 12. McIntosh AM, Kalnins RM, Mitchell LA, et al. Temporal lobectomy: long-term seizure outcome, late recurrence and risks for seizure recurrence. *Brain*. 2004;127:2018-2030.
 13. Benifla M, Rutka JT, Otsubo H, et al. Long-term seizure and social outcomes following temporal lobe surgery for intractable epilepsy during childhood. *Epilepsy Res*. 2008;82:133-138.
 14. Josephson CB, Dykeman J, Fiest KM, et al. Systematic review and meta-analysis of standard vs selective temporal lobe epilepsy surgery. *Neurology*. 2013;80:1669-1676.
 15. Dulay MF, Levin HS, York MK, et al. Predictors of individual visual memory decline after unilateral anterior temporal lobe resection. *Neurology*. 2009;72:1837-1842.
 16. Gleissner U, Sassen R, Schramm J, et al. Greater functional recovery after temporal lobe epilepsy surgery in children. *Brain*. 2005;128:2822-2829.
 17. Jambaqué I, Dellatolas G, Fohlen M, et al. Memory functions following surgery for temporal lobe epilepsy in children. *Neuropsychologia*. 2007;45:2850-2862.
 18. Skirrow C, Cross JH, Cormack F, et al. Long-term intellectual outcome after temporal lobe surgery in childhood. *Neurology*. 2011;76:1330-1337.
 19. Freitag H, Tuxhorn I. Cognitive function in preschool children after epilepsy surgery: rationale for early intervention. *Epilepsia*. 2005;46:561-567.
 20. Binder JR, Sabsevitz DS, Swanson SJ, et al. Use of preoperative functional MRI to predict verbal memory decline after temporal lobe epilepsy surgery. *Epilepsia*. 2008;49:1377-1394.
 21. Skirrow C, Cross JH, Harrison S, et al. Temporal lobe surgery in childhood and neuroanatomical predictors of long-term declarative memory outcome. *Brain*. 2015;138:80-93.