Seizure outcome after corpus callosotomy: Prasat Neurological Institute Experiences

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บทคัดย่อ Abstract

Purpose: Corpus callosotomy is an effective surgical treatment for medically intractable generalized seizures, especially in patients presented with drop attack. The aim of this study is to report the seizure outcomes after corpus callosotomy in a tertiary care epilepsy center.

Methods: We retrospectively reviewed the medical records of all patients underwent corpus callosotomy at Prasat Neurological Institute. Only patients with more than 2-year postoperative follow-up were included in the study. Seizure outcome of callosotomy was categorized and analyzed by seizure type, including drop attacks and other kinds of seizures were analyzed.

Results: There were 17 patients in the study during January 2013 and April 2019. Total callosotomy was performed in 3 (17.6%) patients the drop attack seizure-free rate was 33%, and seizure reduction rate was 66.6%. However, partial section yielded a drop attack free rate of 14.3%; the seizure reduction rate was 85.7%. There was no relapse of drop attack in both procedures consisted of partial and total corpus callosotomy.

Conclusions: The study demonstrated the corpus callosotomy which treated effectively for disabling generalized seizures, especially for drop attacks. Total corpus callosotomy was more effective than the partial section in reduce drop attack seizures. However, overall seizure reduction was not different, and no relapse of drop attacks in both procedures.

Keywords: Corpus callosotomy, Seizure outcome, Drop attack, Epilepsy surgery

วัตถุประสงค์: การผ่าตัด corpus callosotomy เป็นการผ่าตัดรักษาผู้ป่วยโรคลมชักที่ดื้อต่อการรักษาด้วยยากันชักที่มีประสิทธิภาพ โดยเฉพาะอย่างยิ่งผู้ป่วยที่มีอาการชักแบบ drop attack ซึ่งงานวิจัยนี้มีเป้าหมายในการศึกษาผลการผ่าตัด corpus callosotomy ที่สถาบันประสาทวิทยา กรมการแพทย์ ที่เป็นศูนย์ระบบประสาท โรคลมชักในประเทศไทย

วิธีการศึกษา: ได้ทำการเก็บข้อมูลย้อนหลังจากแฟ้มเวชระเบียนผู้ป่วยที่ได้รับการผ่าตัด corpus callosotomy ที่สถาบันประสาทวิทยาซึ่งผู้ป่วยต้องได้รับการติดตามผลการผ่าตัดอย่างน้อย 2 ปี ศึกษาผลการผ่าตัดโดยพิจารณาด้านอาการชัก รูปแบบการชัก และอื่น ๆ หลังจากการผ่าตัด corpus callosotomy

ผลของการศึกษา: ทำการศึกษาผลการผ่าตัดในผู้ป่วย 17 ราย ตั้งแต่เดือน มกราคม 2556 ถึง เมษายน 2562 โดยทำการผ่าตัด total corpus callosotomy 3 (17.6%) ราย ผลการผ่าตัด พบ seizure free rate 33.3% และอาการชักลดลง seizure reduction 66.6% ส่วนผลการผ่าตัด partial corpus callosotomy พบว่า seizure free rate 14.3% และอาการชักลดลง seizure reduction อยู่ที่ 85.7% และไม่พบการชัก drop attack ซ้ำทั้งการผ่าตัดทั้งสองวิธี

สรุป: งานศึกษาวิจัยนี้ได้แสดงให้เห็นว่าการผ่าตัด corpus callosotomy เป็นการรักษาที่มีประสิทธิภาพในการรักษาภาวะโรคลมชักที่ดื้อต่อยากันชัก โดยเฉพาะอย่างยิ่งการชักแบบ drop attack อีกทั้งยังพบว่าการผ่าตัดแบบ total corpus callosotomy มี seizure free rate ที่ดีกว่าการผ่าตัดแบบ partial แต่อย่างไรก็ตามในการศึกษาพบว่าการผ่าตัดทั้งสองอย่างมี seizure reduction ที่ไม่แตกต่างและไม่การกลับมาชักซ้ำของ drop attack อีกด้วย

Introduction

In 1940, Erickson et al. reported the spread mechanism of epileptic discharges through the corpus callosum in animal experiments using monkeys.[1] In the same year, van Wagenen and Herren first performed commissurotomy in humans, demonstrating the effectiveness of corpus callosotomy for severe generalized seizures.[2] They splitted various commissural fibers depending on patient seizure characteristics, including the total or partial section of the corpus callosum, the anterior commissure, the massa intermedia or the unilateral fornix. Wilson et al. reported that corpus callosotomy alone is sufficient to improve generalized seizures.[3] Callosotomy has been accepted as an excellent surgical procedure for disabling generalized seizures especially for drop attacks by preventing the rapid spread of epileptic discharges from one hemisphere to another.

Data following corpus callosotomy in Thailand are scarce and difference in outcome of total versus partial callosotomy remains to be elucidated. This study primarily evaluated the impact of the extent of callosal section, seizure outcomes, and patient satisfaction after corpus callosotomy.

Methods

Selection of patients

We retrospectively reviewed the medical records of all patients underwent corpus callosotomy at Prasat Neurological Institute during January 2013 and April 2019. Inclusion criteria were patients with medically intractable generalized seizures, with no discrete seizure foci, no indication for seizure foci resection, whom was treated with corpus callosotomy and was clinically monitored for at least 2 years after the operation. Pa-

tients underwent callosotomy combined with other surgical procedures or less than 2-year follow-up were excluded from the study.

Preoperative evaluation

For pre-surgical evaluation, all of the patients underwent magnetic resonance (MRI) imaging, EEG and 24-hour video EEG.

Seizure types

Seizure types were classified according to the guidelines of the International League Against Epilepsy.[12] In this study, the term "drop attacks" was used to describe sharp falls instead of "astatic seizures" or "atonic seizures". Drop attacks included both atonic, and tonic falls often accompanied by physical injuries. In addition to drop attacks, generalized seizures (tonic or tonic-clonic), atypical absences, complex partial seizures, simple partial seizures and other types of seizures were also analyzed to evaluate the effectiveness of callosotomy.

Extent of callosotomy

The decision to perform total or partial callosotomy depends on age and abnormality detected from preoperative EEG. We preferred to perform partial corpus callosotomy initially and total callosotomy was employed in pediatric cases except for a few cases. We used postoperative MRI to confirm the extent of callosotomy.

Postoperative seizure outcome

Seizure outcomes were analyzed based on the data obtained by outpatients and inpatients records. Seizure outcome was graded depending on postoperative seizure frequency: (a) seizure-free; (b) >90% seizure reduction; (c) 50-90% seizure reduction; and (d) <50% seizure reduction. Moreover outcomes were classified by Engel classification that consisted of 4 classes.[13] We considered a seizure-free state and >90% reduction to be satisfactory seizure outcome.

Patient demographic data, including age, gender, seizure characteristics were collected. Preoperative MRI, EEG, operative note, postoperative MRI and seizure outcome of each patient were reviewed.

Results

Characteristic of patients

Twenty-three patients underwent corpus callosotomy at the Prasat Neurological Institute Hospital during January 2013 and April 2019. Six of 23 patients were excluded from this study; 3 underwent callosotomy combined with other surgical procedures, 1 was complicated with metabolic disorder and 2 had been followed less than 2 years. Seventeen patients were included in the study. (Figure 1)

There were 6 females and 11 male patients. The median age of surgery was 10 years old, range from 6 months to 29 years (mean 11.94 ± 7.13 years), with 11 children (age less than 15 years old) and 6 adult patients. Sixteen patients presented with drop attacks (94.1%) and 10 patients presented with generalized tonic clonic seizure (58.8%). Preoperative EEG showed bilateral synchronized wave in 16 cases (94.1%). One patient (5.9%) had multifocal EEG seizures. The extent of callosotomy evaluated with postoperative MRI showed total callosotomy in 3 patients (17.6%) and partial callosotomy in 14 patients (82.3%).

Table 1 Clinical data of 17 patients

	n (%)	Range	Median (IQR)	Mean ± S.D.
Sex				
Male	11(64.7)			
Female	6(35.3)			
Age at seizure onset (years)		1–22	7.00 (4.00–12.50)	8.76 ± 6.42
Seizure duration (years)		0.3–23	8.00 (5.00–13.00)	
Age at surgery		4–26	10.00 (6.00–17.00)	11.94 ± 7.13
Pediatric patient	11(64.7)			
Adult patient	6(35.3)			
Preoperative seizure type				
Drop attack	16 (94.1)			
GTCS	10(58.8)			
Absence	–			
New seizure postopertively (after disappearance of drop attacks)				
Postural seizure	6(35.3)			
GTCS	1 (5.9)			
EEG abnormality				
Bilaterally synchronized	16(94.1)			
Unilaterally dominant	–			
Multifocal	1(5.9)			
Extent of resection				
Total section	3(17.6)			
Partial section	14(82.4)			
Seizure free				
Seizure free	3(17.6)			
Seizure reduction > 90%	4(23.5)			
Seizure reduction 50–90%	10(58.8)			
Engel classification				
1	3(17.6)			
2	4(23.5)			
3	10(58.8)			
Satisfactory outcome	7(41.2)			
Complication				
EDH	1 (5.9)			
SDH	1 (5.9)			

Table 2 Seizure outcome classified by seizure type after corpus callosotomy

	Seizure-free	Seizure reduction >90%	Seizure reduction 50-90%	Seizure reduction <50%	Total	Seizure-free rate (%)
Drop attack	3	4	9	-	16	18.75
Generalized tonic-clonic	1	4	5	-	10	10

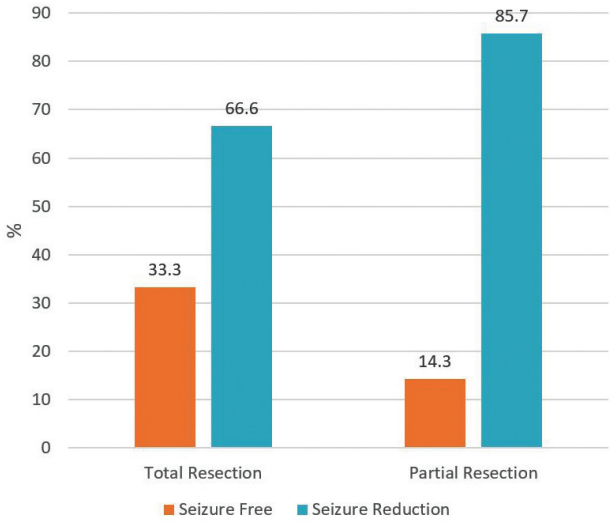

Figure 1 Comparison surgical outcomes between total and partial corpus callosotomy

Seizure outcomes

Seven patients (41.2%) had achieved satisfactory outcome that consist of 3 (17.6%) seizure free, and seizure reduction > 90% in 4 (23.5%) cases, and seizure reduction 50-90% in 10 (58.8%) cases (Table 2). Seizure outcome were determined by Engel classification.[13] The results from this classification consisted of class 1 had 3 (17.6%) cases, class 2 had 4 (23.5%) cases, and class 3 had 10 (58.8%) cases.

Three patients who had total corpus callosotomy were seizure free in 1(33.3%) patient and seizure reduction in 2 (66.6%) patients and 14 patients who had partial corpus callosotomy, outcomes were not different from total corpus callosotomy; 2 (14.3%) patients were seizure free and 12 (85.7%) patients had seizure reduction which this results were shown in Figure 1

Postoperative changes of seizure type

During the postoperative follow-up, there were no drop attack in all 17 corpus callosotomy procedures, but there were 7 patients who had postoperative change of seizure type. Most of the changed seizure type was postural seizure in 6 cases, and the rest was a generalized tonic-clonic seizure.

Surgical complications

There were 2 patients who had major complications from surgery. One patient had an epidural hematoma and another had acute subdural hematoma which required surgery. Both patients had no deficits after hematoma evacuations.

Discussion

The results of this study demonstrated the corpus callosotomy was an effective treatment in for the treatment of drop attacks, and generalized tonic-clonic seizures. There was seizure free in 3 (17.6%) patients, seizure reduction> 90% in 4 (23.5%) cases and seizure reduction 50-90% in 10 (58.8%) cases.

A study by Low and colleagues found that the seizure free rate after corpus callosotomy for treatment drop attacks was 94% and 82.2% at 12 months and 72 months, respectively. In this same study, they highlighted that the relapse rate of drop attacks is lower following total corpus callosotomy compared to partial callosotomy.[16]

According to the previous reported literatures, the relation between seizure outcome and the extent of callosal section has not been established confidently however the extent of section seems to be an important prognostic factor affecting surgical outcome.[11,17,18] The result of this study showed that total callosotomy had better seizure outcome than partial resection but limitation of this study was the small number of patients. Partial section yielded a drop attack free rate of 23.3% and seizure reduction rate was 76.6%. Pinard et al. reported that in West syndrome patients, partial callosotomy for drop attacks were useful in only 3 of 11 (27%) patients, whereas total section was useful in 8 of 9 (89%).[11] Spencer et al. also demonstrated that control of secondarily generalized seizures was effectively achieved in 77% of patients with total callosotomy and only 35% with partial section.[19]

Recently, Maehara and Kawai independently emphasized that the extent of callosal section was significantly related to seizure outcomes.[13,20,21] Maehara et al. reported that satisfactory reduction of drop attacks was obtained in 94% of patients with complete section and 65% with partial section.[20] Kawai et al. proclaimed that within groups who underwent partial callosotomy, the extent of section was also related to the prognosis of seizure free.[21] Oguni et al. reported that anterior 2/3 callosotomy had more excellent seizure outcome than anterior 1/2 callosotomy.[18] In pediatric patients total callosotomy rarely caused neurological complications because they had neuroplasticity recovering process suddenly after this procedure.[22] Therefore, total callosotomy should be applied as the standard treatment for drop attacks, and even in cases undergoing partial section, the maximum range of section should be considered. A systematic review of corpus callosotomy outcomes in pediatric patients reported total corpus callosotomy was significantly more likely to result in a reduction of seizure and the corpus callosotomy is a safe and effective treatment for generalized refractory epilepsy.[23,24]

On the long term follow up, a new type of seizures developed after callosotomy in some cases. Postural seizures were the most common type of newly developed seizures. The mechanism of these freshly developed seizures may reflect the new electrophysiological environment caused by callosal section. Quattrini et al. reported that two different types of fall grew after callosotomy.[25] One example is caused by decreased tonus of the unilateral limbs, which might induce the collapse of the body to the hypotonic side. Another mechanism of less severe fall might be due to a more gradual change in muscle tone to the more abrupt change of muscle tonus that occurred preoperatively.

This was the first study in Thailand that reported the seizure outcome after corpus callosotomy that had follow-up at least two years in patients with intractable epilepsy

Conclusion

These findings confirmed that callosotomy is an effective procedure for the treatment of disabling generalized seizures, especially for drop attacks. Total

corpus callosotomy was more effective than the partial section in seizure free of drop attacks seizure. However, overall seizure reduction was not different, and no relapse of drop attacks in both procedures.

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