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Long-term follow-up of seizure outcomes after corpus callosotomy

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ABSTRACT

Purpose: Corpus callosotomy can be an effective surgical treatment for medically intractable generalized seizures, particularly for drop attacks. We studied long-term seizure outcomes after callosotomy, mainly focusing on drop attacks as the seizure type.

Methods: This study reviews 78 patients who underwent callosotomy and were followed up for more than 3 years after surgery. Seizure outcome of callosotomy was analyzed for seizure type, including drop attacks and other types of seizures.

Results: The followed-up time ranged from 3 to 13 years (mean; 7.0 $\pm$ 2.9 years, median; 8 years). When callosotomy was total section, drop attack seizure-free rate was 90%. However, partial section yielded a drop seizure-free rate of only 54%. Thirty-five of the 46 (76%) patients who were free of drop attacks 6 years after callosotomy had no relapse thereafter. Relapse of drop attacks was also significantly different depending on the range of callosotomy. With total section, only 7% showed relapse of drop attacks. On the contrary, patients with partial section had a 31% relapse rate. In 21% patients, postural seizures newly developed after callosotomy.

Conclusions: These findings confirmed that callosotomy is the treatment of choice for disabling generalized seizures, especially for drop attacks. Total section is far more effective than partial section in terms of control of drop attacks and prevention of seizure relapse. However, new types of seizure could occur after callosotomy. When newly developed postural seizures were very severe, patients may fall due to sudden torsion of body, but the entire process of falling was not as sudden as that observed during previous drop attacks.

1. 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 callosotomy for severe generalized seizures.[2] They split various commissural fibers depending on patient seizure characteristics, including 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] Today, it is generally recognized that callosotomy can bring a good surgical result for disabling generalized seizures by preventing the rapid spread of epileptic discharges from one hemisphere to another. Especially callosotomy has been confirmed to be remarkably effective for drop attacks.[4–11] However, literature describing long-term seizure outcomes following callosotomy is still scarce, and whether there is any difference between the effects of total and partial section over the long term still remains to be elucidated. This study evaluated on the long-term effects of callosotomy on various types of seizures and the relapse rate of drop attacks, especially focusing on differences in the effect of the extent of callosal section.

2. Methods

2.1. Selection of patients

To facilitate understanding, Fig. 1 graphically illustrates the patient selection process described below. We performed corpus callosotomy to treat intractable generalized seizures in 171 patients at the Tokyo Metropolitan Neurological Hospital between January 1991 and December 2004. Eighty-two of 171

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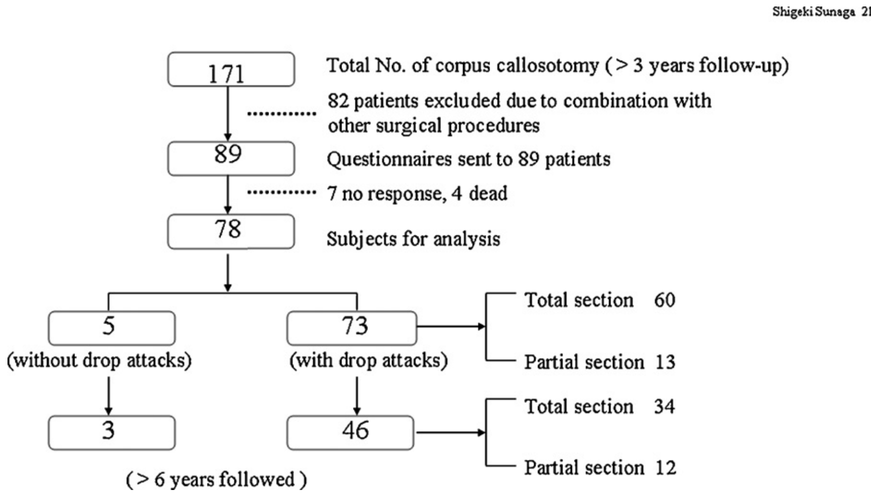

Fig. 1. Summary of the patient' selection process in this study.

patients were excluded from this study because they underwent callosotomy combined with other surgical procedures. As a result, 89 patients were selected as subjects of this study. All of the patients had been followed for more than 3 years, and all of them had a history of disabling generalized seizures without discrete foci and were not indicated for focus resection.

2.2. Preoperative evaluation

For presurgical evaluation, all of the patients underwent neuroimaging magnetic resonance (MR) imaging, single-photon emission CT (SPECT) and repeat scalp EEG. When EEGs were recorded, sleep was induced by drugs and anticonvulsants were decreased if there was no risk of seizure status.

2.3. Seizure types

Seizure types were classified according to the guidelines of the International League Against Epilepsy.[12] But in this paper the term "drop attacks" was used to describe abrupt 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 effect of callosotomy.

2.4. Extent of callosotomy

Total callosotomy was basically employed in pediatric cases except for a few cases, as no chronic disconnection syndrome had been reported in children.[13] In adult cases, the extent of callosotomy was determined based on the range of abnormality on scalp EEG. If abnormal areas covered the whole brain area, total callosotomy was performed even in adults.

2.5. Postoperative seizure outcome

Seizure outcomes were analyzed based on the data obtained by questionnaires sent to the patients' parents or attending physicians. The seizure outcome was graded as follows, depending on postoperative seizure frequency and severity: (a) seizure-free; (b) >90% seizure reduction; (c) 50–90% seizure reduction; and (d) <50% seizure reduction. We considered a seizure-free state and >90% reduction to be satisfactory seizure reductions. For statistical analysis, chi-square test and Fisher's exact probability test were applied.

3. Results

3.1. Characteristics of patients

Eighty-two of 89 patients responded to the questionnaires. Four patients died and their data were excluded from this study. The causes of death in these four patients were as follows; drowning in bathtub in two, status epilepticus of generalized seizures due to suddenly discontinuing medication in one, and presumably due to SUDE (sudden unexpected death of epilepsy) in one. The clinical data of the remaining 78 patients were shown in Table 1. The patients were followed for 3–13 years with a mean of 7.0 ± 2.9 years (median; 8 years). They consisted of 50 men and 28 women with a mean age of

Table 1
Clinical data of 78 patients

	n (%)	Range	Mean ± S.D.
Sex			
Male	50 (64)		
Female	28 (36)		
Age at seizure onset (year)		0–31	3.4 ± 4.0
Seizure duration (year)		0–38	11.6 ± 8.7
Age at surgery (year)		0–39	14.4 ± 9.5
Pediatric patients	51	≤16	8.5
Adult patients	27	17–39	25.3
Preoperative seizure type			
Drop attack	73 (41)		
GTCS	45 (25)		
Absences	32 (18)		
Complex partial	14 (8)		
Simple partial	15 (8)		
New seizures postoperatively (after disappearance of drop attacks)			
Postural seizure	15/73 (21)		
GTCS	19/73 (26)		
EEG abnormality			
Bilaterally synchronized	66 (85)		
Unilaterally dominant	5 (6)		
Multifocal	7 (9)		
Extent of resection			
Total section	63 (81)		
Partial section	15 (19)		

GTCS: generalized tonic-clonic seizure; S.D.: standard deviation.