Posterior callosotomy using a parietooccipital interhemispheric approach in the semi-prone park-bench position

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A 2-stage corpus callosotomy is accepted as a palliative procedure for patients older than 16 years with, in particular, medically intractable generalized epilepsy and drop attack seizures and is preferable for a lower risk of disconnection syndrome. Although the methods by which a previously performed craniotomy can be reopened for posterior callosotomy have already been reported, posterior corpus callosotomy using a parietooccipital interhemispheric approach with the patient in a semi-prone park-bench position has not been described in the literature. Here, the authors present a surgical technique for posterior callosotomy using a parietooccipital interhemispheric approach with a semi-prone park-bench position as a second surgery. Although this procedure requires an additional skin incision in the parietooccipital region, it makes the 2-stage callosotomy safer and easier to perform because of reduced intracranial adhesion, less bleeding, and an easier approach to the splenium of the corpus callosum.

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KEY WORDS posterior corpus callosotomy; surgical approach; epilepsy surgery; surgical technique

CORPUS callosotomy is accepted as a palliative procedure for patients with, in particular, medically intractable generalized epilepsy and drop attack seizures. Although a 1-stage total corpus callosotomy can be performed in patients younger than 16 years, a 2-stage corpus callosotomy is preferred for patients older than 16 years given its lower risk for disconnection syndrome.¹⁴ At some institutions, posterior corpus callosotomy has been performed when the efficacy of anterior corpus callosotomy was insufficient.^{1,8–10,13} We have performed a second surgery for total callosotomy in cases that showed little or no clinical improvement in the 6-month follow-up after anterior partial callosotomy. The previous skin incision and craniotomy were generally reopened in the second surgery;⁶ however, difficulties have been associated with this dissection because of intracranial adhesion, which is often observed following surgical intervention, and because of the long distance to the splenium of the corpus callosum, especially in adult cases. On the other hand, the shorter distance to the splenium in a posterior corpus callosotomy with a parietooccipital interhemispheric approach permits a safer, more precise dissection. Here, we present, as a sec-

ond surgery, a technique for posterior callosotomy using a parietooccipital interhemispheric approach with a semi-prone park-bench position.

Methods

In this retrospective study, we searched our institutional database for patients with epilepsy and drop attack seizures who had undergone anterior corpus callosotomy and an additional posterior corpus callosotomy for residual seizures in the period from 1999 to 2013. Patients with follow-up periods shorter than 3 months were excluded from our analysis. Magnetic resonance imaging was performed after surgery to evaluate the complete division.

Surgical Techniques

Magnetic resonance venography was performed in all cases preoperatively to determine which side was favorable for approach. The nondominant venous side was selected as the approach side; for example, when bridging veins were dominant in the right side, the left side was regarded as the approach side.

ABBREVIATION VNS = vagus nerve stimulation.

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After the induction of general endotracheal anesthesia, the patient was secured in a Mayfield head holder and placed in the semi-prone park-bench position lying on the approach side (Fig. 1a). An inverted-U-shaped skin incision was made in the parietooccipital region, and a rectangular bone flap was elevated to expose the paramedian non-venous-dominant hemisphere as well as the superior sagittal sinus. The craniotomy was roughly centered 4 cm above the inion, with an anteroposterior dimension of approximately 6 cm and a mediolateral dimension of approximately 4.5 cm (Fig. 1b). A C-shaped dural incision was made while taking care to preserve the veins, and the interhemispheric fissure was approached via sharp microdissection along the parietooccipital sulcus as a guide to the splenium (Fig. 1c). After reaching the splenium, the pericallosal cistern was opened to expose the corpus callosum. With the use of bipolar cautery and Optoirrigator

suction, the corpus callosum was dissected along the midline anteriorly with the line of dissection extending to the posterior edge of the dissected anterior corpus callosum (Fig. 1d) and posteriorly until the vein of Galen and the internal cerebral veins could be visualized via the arachnoid (Fig. 1e). After the total corpus callosotomy was completed (Fig. 1f), closure was conducted in the usual manner.

Results

Sixty-five epilepsy patients with drop attack seizures underwent corpus callosotomy (91 operations). Patients were clinically followed up for 3–6 months. Posterior corpus callosotomy was additionally performed in 26 of the 65 cases because of residual drop attack seizures. All operations were performed safely. Magnetic resonance imaging after surgery showed complete division of the corpus callosum in all cases. Complications were observed

FIG. 1. **a:** The patient was secured in a Mayfield head holder and was placed in the semi-prone park-bench position lying on the approach side. **b:** An inverted-U-shaped skin incision was made in the parietooccipital region. Craniotomy was roughly centered 4 cm above the inion, with an anteroposterior dimension of approximately 6 cm and a mediolateral dimension of approximately 4.5 cm. **c:** Approach into the interhemispheric fissure via sharp microdissection along the parietooccipital sulcus as a guide to the splenium. **d:** The corpus callosum was divided anteriorly with the line of dissection extending to the posterior edge of the dissected anterior part of the corpus callosum. **e:** After the posterior part of the corpus callosum had been divided, the vein of Galen and internal cerebral veins could be visualized via the arachnoid. **f:** Completion of a total corpus callosotomy. Figure is available in color online only.

in 3 of the 26 cases: 2 cases of transient disconnection syndrome including aphasia and left-sided apraxia and 1 case of epidural abscess. Individual patient information, including complications, is summarized in Table 1.

Discussion

There are 2 palliative surgeries for medically intractable epilepsy and drop attack seizure: corpus callosotomy and vagus nerve stimulation (VNS). It is true that corpus callosotomy is associated with a higher risk for complications and that VNS is less invasive and reversible with fewer serious complications; however, corpus callosotomy is equally or more efficacious than VNS for primarily generalized seizure and drop attack seizure.^{3,7,11} Complications associated with corpus callosotomy include hydrocephalus, meningitis, and cerebral edema,⁵ although acute disconnection syndrome and split-brain syndrome are the most problematic complications following total callosotomy. Previous studies have suggested that 1-stage total callosotomy should be avoided if patients are older than 10 years of age¹² and that 2-stage corpus callosotomy is preferable for a lower risk of disconnection syndrome.¹⁴ Although the methods by which a previously performed craniotomy was reopened for posterior callosotomy have been reported,⁶ the posterior corpus callosotomy using a parietooccipital

interhemispheric approach with the patient in a semi-prone park-bench position has not been described. The posterior interhemispheric approach in a lateral position has been described as effective for exposing lesions in the posterior midline with reduced bleeding, shorter operative durations, decreased postoperative cerebral edema, and improved visual outcomes.² The benefits of the parietooccipital interhemispheric approach were as follows. Since venous pressure was lower in the semi-prone park-bench position than in the prone position, intraoperative bleeding could be minimized. Positioning the patient lying on the approach side allowed the occipital and parietal lobes to fall aside with the aid of gravity,¹⁵ and both cerebral hemispheres could be separated with minimum retraction, which reduces the incidence and severity of long-lasting disconnection syndrome.⁴ The craniotomy was centered on the parietooccipital sulcus to reach the splenium in the shortest distance, and the corpus callosum could then be more safely and precisely divided (Fig. 2). Although this procedure poses a cosmetic problem because of the additional skin incision in the parietooccipital region, it is a safe and effective way to perform 2-stage corpus callosotomy without any morbidity such as disconnection syndrome. The advantages and disadvantages associated with this procedure have been outlined in Table 2.

TABLE 1. Individual patient information, including complications*

Case No.	Age at Op (yrs), Sex	Seizure Etiology	Seizure Type	Complications
1	16, M	Unknown	Multiple seizure type w/ drop attack	None
2	18, M	Frontal arachnoid cyst	Drop attack	None
3	24, M	Unknown	Drop attack	None
4	23, F	Unknown	Drop attack, CPS	None
5	24, M	Cortical dysplasia	Multiple seizure type w/ drop attack	Transient disconnection syndrome
6	42, M	Lennox-Gastaut	Drop attack, tonic seizure	None
7	19, M	Unknown	Drop attack, tonic seizure	Transient disconnection syndrome
8	26, M	Unknown	Drop attack, tonic seizure	None
9	43, F	Lennox-Gastaut	Drop attack	None
10	17, F	Unknown	Drop attack	None
11	14, M	Hypoxic ischemic encephalopathy	Absence, tonic seizure	None
12	25, F	Chromosome aberration (15 trisomy)	Drop attack	None
13	12, M	Lennox-Gastaut	Drop attack	None
14	30, F	Lennox-Gastaut	Drop attack	None
15	26, F	Unknown	Drop attack	None
16	16, M	Progressive myoclonus	Myoclonus, tonic seizure	None
17	33, F	Progressive myoclonus	Myoclonus, tonic seizure	None
18	23, M	Acute encephalitis	Drop attack	None
19	28, M	Hypoxic ischemic encephalopathy	Drop attack	None
20	52, M	Lennox-Gastaut	Drop attack	None
21	35, F	Lennox-Gastaut	Absence, tonic seizure	None
22	31, M	Unknown	Drop attack, myoclonus, GTCS	Epidural abscess
23	21, F	Unknown	Drop attack, tonic seizure, absence	None
24	37, M	Lennox-Gastaut	Drop attack	None
25	30, M	Lennox-Gastaut	Drop attack	None
26	43, M	Lennox-Gastaut	Drop attack	None

CPS = complex partial seizure; GTCS = generalized tonic-clonic seizure.

* All patients were right handed.

TABLE 2. Advantages and disadvantages of each position for posterior callosotomy

Position	Advantages	Disadvantages
Supine	No additional skin incision; less blood loss	Difficult to dissect because of postoperative adhesion & long distance to ampulla of corpus callosum
Prone	Easy to dissect because of short distance to ampulla of corpus callosum & less adhesion	Additional skin incision; more blood loss because of higher venous pressure
Semi-prone park-bench	Easy to dissect because of short distance to ampulla of corpus callosum & less adhesion; less blood loss	Additional skin incision

FIG. 2. Drawing of the surgical approach. A and B show the approaches to the splenium of the corpus callosum from the frontal region and the parietooccipital region, respectively. The distance to the splenium of the corpus callosum is shorter in B than in A. Copyright Michiharu Morino. Published with permission.

Conclusions

Posterior callosotomy using a parietooccipital interhemispheric approach with the patient in the semi-prone park-bench position makes 2-stage callosotomy safer and easier to perform.

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Conception and design: Ito. Acquisition of data: Niimura, Takamizawa, Shimizu. Analysis and interpretation of data: Ito. Drafting the article: Ito. Administrative/technical/material support: Morino. Study supervision: Morino.

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