Endoscopy-Assisted Interhemispheric Transcallosal Hemispherotomy: Preliminary Description of a Novel Technique

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BACKGROUND: Various hemispherotomy techniques have been developed to reduce complication rates and achieve the best possible seizure control.

OBJECTIVE: To present a novel and minimally invasive endoscopy-assisted approach to perform this procedure.

METHOD: Endoscopy-assisted interhemispheric transcallosal hemispherotomy was performed in 5 children (April 2013-June 2014). The procedure consisted of performing a small craniotomy (4 × 3 cm) just lateral to midline using a transverse skin incision. After dural opening, the surgery was performed with the assistance of a rigid high-definition endoscope, and bayoneted self-irrigating bipolar forceps and other standard endoscopic instruments. Steps included a complete corpus callosotomy followed by the disconnection of the hemisphere at the level of the basal nuclei and thalamus. The surgeries were performed in a dedicated operating room with intraoperative magnetic resonance imaging and neuronavigation. Intraoperative magnetic resonance imaging confirmed a total disconnection.

RESULTS: The pathologies for which surgeries were performed included sequelae of middle a cerebral artery infarct (n = 2), Rasmussen syndrome (n = 1), and hemimegalencephaly (2). Four patients had an Engel class I and 1 patient had a class II outcome at a mean follow-up of 10.2 months (range, 3-14 months). The mean blood loss was 80 mL, and mean operating time was 220 minutes. There were no complications in this study.

CONCLUSION: This study describes a pilot novel technique and the feasibility of performing a minimally invasive, endoscopy-assisted hemispherotomy.

KEY WORDS: Drug-resistant epilepsy, Endoscopic approach, Hemispherotomy, Transcallosal

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WHAT IS THIS BOX?
A QR Code is a matrix barcode readable by QR scanners, mobile phones with cameras, and smartphones. **The QR Code above links to Supplemental Digital Content from this article.**

Functional hemispherotomy is considered to be an effective procedure for patients with drug-refractory epilepsy due to a panhemispheric pathology. Hemispherotomy under the umbrella of epilepsy surgery has been considered to have one of the best outcomes when performed in children with appropriate surgical indications.[1-8] In the literature, seizure freedom as a result of hemispheric resection and disconnective procedures is reported to vary from 54% to 89%.[4,8-17] Such procedures have been mostly indicated in children with severe catastrophic epilepsy with either congenital or acquired hemispheric pathologies.[1-8,11,14,18-20] When first introduced, hemispherectomy was associated with significant complications (some fatal) in both short- and long-term cases (due to hemosiderosis, which occurs due to the dead space produced by removal of the entire hemisphere).[1,21,22] Various modifications were proposed to counteract this. Adams[1] suggested decreasing the cerebrospinal fluid (CSF) cavity by plugging the foramen of Monro with muscle, then suturing the dura mater to the falx and tentorium to create a large extradural space rather than a CSF-filled space. Peacock suggested placement of a shunt or drain in the cavity to drain out the blood. Ignelzi and Bucy[23] proposed a hemidecortication procedure

ABBREVIATIONS: BKT, Binet Kamat Test of Intelligence; **CBCL,** Child Behavior Checklist; **PedsQL,** Pediatric Quality of Life Inventory; **SD,** standard deviation

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to reduce blood loss. However, the major breakthrough came in 1983 when Rasmussen[21] introduced functional hemispherectomy based on the partial excision of certain areas and disconnection of the major lobes. This led to use of the term *hemispherotomy* instead of *hemispherectomy*, which was first suggested by Olivier Delalande in 1992.[24] Further evolution led to the development of 2 basic procedures. A vertical approach was suggested by Delalande et al[8,10,11] and a peri-insular approach was suggested by Villemure et al.[14-16,25,26] Most of the modifications are based on these 2 procedures.[13,17,27-33] Although the largest series reported were based on peri-insular hemispherotomy, the Engel class I results by the either peri-insular or vertical procedure (including the largest reported by Holthausen et al[30,34]) have varied from 54% to 89%.[4,8-17] Delalande and Dorfmuller[8] reported an outcome of

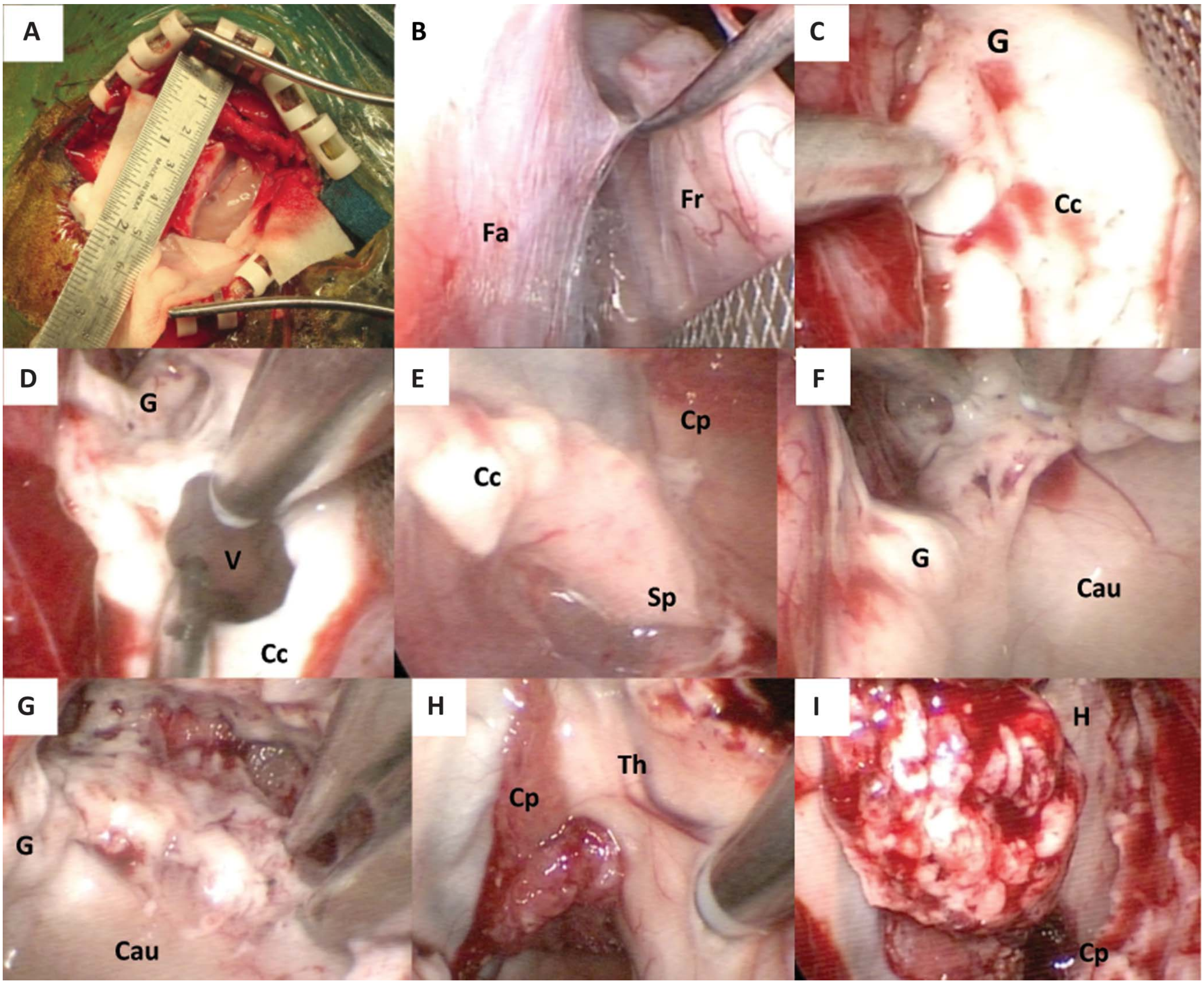

FIGURE 1. *Surgical technique. A transverse skin incision is made. A small craniotomy 4 × 3 cm in size is made just lateral to the midline (**A**). Using a brain spatula, the brain is retracted laterally under endoscopic guidance, and adhesions are carefully dissected (**B**). The first step is corpus callosotomy (step I): a complete corpus callosotomy is performed, starting from genu (**C**). The corpus callosotomy is next extended to the body of the callosum. It is preferred that callosal division is opened into the ventricle of the affected side, in this case, the right ventricle (**D**). At the end, the splenium is divided to complete the callosal division (**E**). The next step is anterior and middle disconnection (step II). The anterior disconnection is started at the junction of the head of the caudate nucleus (**F** and **G**) and genu (**F** and **G**). The disconnection goes down to the frontal base and up to the anterior skull base at the level of the base of the clinoid process and the lesser wing of the sphenoid until the arachnoid is exposed (**G**). The disconnection then proceeds laterally, curving around the caudate body and continuing posteriorly to perform the disconnection lateral to the thalamus at the level of the atrium (**H**). The disconnection is carried vertically downward until the temporal horn is reached (**I**). This marks the end of step II. Cau, caudate nucleus; Cc, corpus callosum; Cp, choroid plexus; Fa, falx; Fr, frontal lobe; G, genu; H, hippocampus; Sp, splenium; Th, thalamus; V, ventricle.*

77% (Engel class I) in their series. They believed that their technique was better because it involved a cortical pathway avoiding major blood vessels, as well as a trajectory with landmarks easily identified by surgeons. Overall, it is important to realize that a complete hemispheric and insular disconnection[9,35] is required to achieve the best possible seizure outcome.

We present a novel pilot technique consisting of an endoscopy-assisted approach using a small craniotomy (4 × 3 cm). The approach involves a route through the interhemispheric transcallosal corridor to achieve a hemispheric disconnection. To date, there has been only 1 study of endoscopy-assisted hemispherotomy described in the literature, and this was a cadaveric concept study.[36] Our technique is the first of its type to be described in the literature in terms of both concept and clinical application.

METHODS

The patient was placed in a supine position with the head slightly flexed and in a neutral position. A transverse skin incision was marked over the coronal suture, and a 4 × 3-cm flap was raised just lateral to the midline with the medial border just over the lateral part of the sagittal sinus. The sagittal sinus was exposed by only 1 to 2 mm. Neuronavigation was used in all the cases to mark the exact position of the bone flap and to avoid major vein drainage. Mannitol infusion was started just before the skin incision to provide a lax brain. The craniotomy was performed using a high-speed drill (Figure 1A). The dura was opened in a C-shaped manner with the base over the sinus. The medial margin of the hemisphere was retracted using a brain retractor. A rigid 0-degree high-definition pituitary endoscope (Karl Storz) was then brought in and the rest of the surgery was carried out under its visualization (Figures 1 and 2) (see also **Video, Supplemental Digital Content 1**, which demonstrates an endoscopy-assisted transcallosal hemispherotomy, http://youtu.be/kA-Qf79qFWY). We preferred to use the endoscope with the left hand as a free-hand tool. The endoscope may also be supported by an assistant or held with a holding device. Self-irrigating bayoneted bipolar forceps was used with the right hand. We have found that this acts as both a hemostatic and dissecting tool. The irrigation from the bipolar forceps aided with general irrigation as well. The medial part of the hemisphere was dissected from the falx (Figure 1B) under endoscopic guidance, and the corpus callosum was exposed.

The entire surgery was carried out in 3 basic steps: (1) complete corpus callosotomy, (2) anterior and middle disconnection, and (3) posterior disconnection. These steps are outlined in the **Video** (**Supplemental Digital Content 1**, http://youtu.be/kA-Qf79qFWY) as well (Figures 1-3).

First, the corpus callosum was exposed from the genu to the splenium. We have found the endoscope advantageous in performing this exposure because the scope can be angled both anteriorly and posteriorly to achieve this. Using the bipolar forceps and dissectors, both of the A2s of the anterior cerebral artery were separated to expose the corpus callosum. The

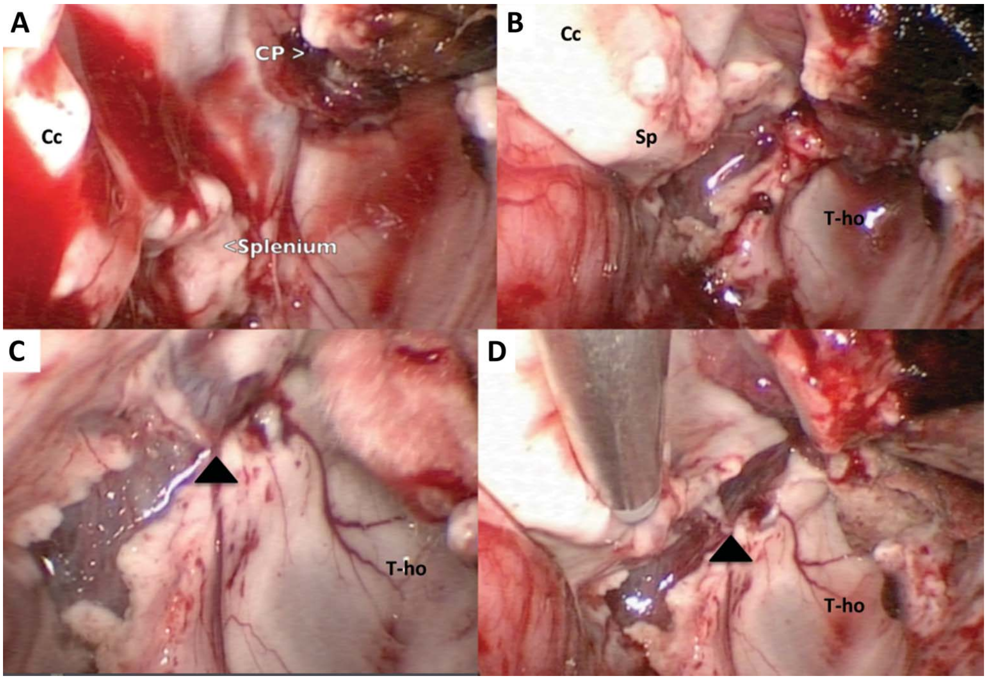

FIGURE 2. *Posterior disconnection (step III). This is a short disconnection that connects the splenium and the choroid plexus curving around the posterior part of the choroid fissure (**A**). Once performed, the arachnoid may be seen under this (**B**). It is also important to disconnect a small bridge of parenchyma, which is under the splenium. This step may be better visualized using an endoscope (arrowhead, **C**). The arrowhead in both **C** and **D** shows the same position, and passing the endoscope down shows the additional bridge of tissue, which may be visualized (**D**). Cc, corpus callosum; CP, choroid plexus; Sp, splenium; T-ho, temporal horn.*

corpus callosum was exposed more on the side of the affected hemisphere (rather than in the midline) so that on opening it, the surgeon could enter the ventricle of the affected hemisphere. Once the corpus callosum was exposed, the corpus callosotomy was performed with the aid of bipolar forceps and microscissors (Figures 1C-1E). The anterior part was divided first, followed by the genu to just above the anterior commissure. Corpus callosotomy was then continued posteriorly to divide the splenium. Compared with the microsurgical approach, we have found the endoscopy-assisted approach provided better visualization (see **Video, Supplemental Digital Content 1**, http://youtu.be/kA-Qf79qFWY). This advantage was particularly evident when dividing the terminal part of the splenium.

After a complete corpus callosotomy, the anterior and middle disconnection was carried out. An anterior and middle disconnection starts at the beginning of the genu of the corpus callosum and passes on to the floor of the anterior skull base at the level of the lesser wing of the sphenoid and the planum, first passing anteriorly to the head of the caudate nucleus, then curving lateral to it and passing posteriorly, where it joins the body of the lateral ventricle with the temporal horn and terminates at the atrium, just lateral to thalamus (Figure 1F). The anterior disconnection starts at the genu. Disconnection is carried out from the surface until the anterior skull base over the lesser wing of the sphenoid and the planum is reached. Neuronavigation was used to reach this bony landmark. Once reached, the resection was carried out to the posterior part of the gyrus rectus, as is the case in the standard vertical hemispherotomy approach. At this stage, the anterior cerebral arteries and distal part of the optic nerve may be visualized through the arachnoid. The disconnection next proceeded laterally from just anterior to the caudate head to the lateral part of the lesser wing of the sphenoid, and then turned posteriorly to reach the sphenoid ridge (Figure 1G). The middle cerebral artery was visualized at the level of the sphenoid ridge. The anterior disconnection completes at the middle cerebral artery and disconnects the frontal lobe. The middle disconnection starts at the sphenoid ridge. The disconnection was next continued posteriorly. The bulk of the basal nuclei lies here. The middle disconnection was then completed by dividing laterally to the thalamus, laterally to the choroid fissure, and at the atrium (Figure 1H). Division may be carried out at the level of the atrium both superiorly and posteriorly until it is completed, and the temporal horn is connected with the body of the lateral ventricle (Figure 1I). This procedure disconnects the amygdala, hippocampus, and anterior temporal connections.

The posterior disconnection involves division of a short segment of tissue consisting of the posterior part of the fornix, which mostly lies between the choroid plexus at the atrium and the posterior-most part of the splenium (Figure 2A). The division is performed up to the underlying arachnoid. Caution must be exercised because the Galenic veins lie just underneath (Figure 2B). There is usually a small piece of tissue present under the choroid plexus that may easily be missed. The endoscope has been particularly useful to visualize and divide this portion. Figure 2C shows the view with a 0° scope. Further visualization of the tissue is possible with the use of a 30° scope (Figure 2D; the arrow shows the same position here as in Figure 2C). The posterior division completes the disconnection of the rest of the temporal lobe (also see Figure 3 for a schematic diagram).

We first attempted this surgical procedure in atrophic hemispheres. Once we became acquainted with the landmarks, we next proceeded to attempt it for other indications, such as Rasmussen syndrome and then hemimegalencephaly. It is also important for the surgeon to suction out adequate tissue from the area of the disconnection. This allows adequate

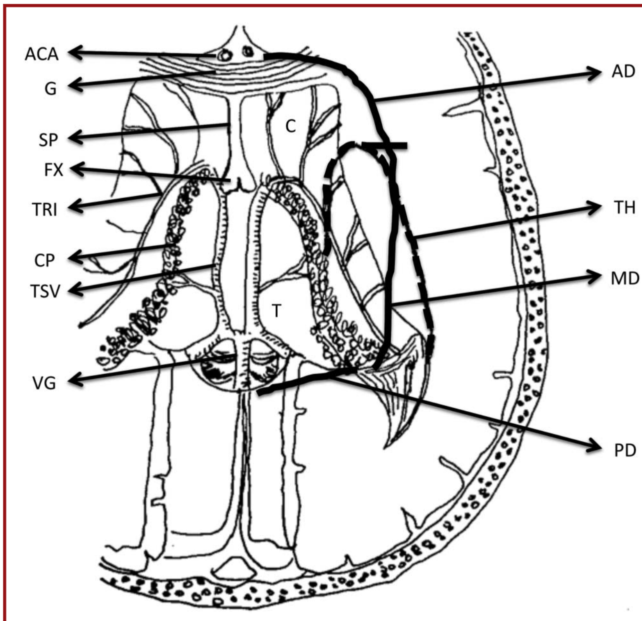

FIGURE 3. *Schematic diagram showing the anterior, middle, and posterior disconnections after performing a complete corpus callosotomy. Anterior disconnection starts at the genu, passes laterally anterior to the caudate head, and then runs lateral to it until it reaches the temporal horn of lateral ventricle. The branches of middle cerebral artery seen at the sphenoid ridge just before reaching the temporal horn should be carefully preserved. The middle disconnection starts at the level of temporal horn, passes lateral to basal nuclei and thalamus, and ends at the atrium just lateral to the point where the choroid plexus turns from the body of the lateral ventricle to the temporal horn. The posterior disconnection is a short segment that starts just medial to the choroid plexus and connects the splenium medially. ACA, anterior cerebral artery; AD, anterior disconnection; C, caudate head; CP, choroid plexus; FX, fornix; G, genu; MD, middle disconnection; PD, posterior disconnection; T, thalamus; TH, temporal horn; TRI, tributaries of thalamostriate veins; TSV, thalamostriate vein; SP, septum pellucidum.*

visualization of the disconnection on magnetic resonance imaging (MRI). Because this was a pilot study, all the patients underwent immediate postoperative MRI in the operating room to confirm a complete disconnection. In addition, following the previously mentioned guidelines regarding visualization of clear anatomic parameters, such as the bone at the lesser wing of the sphenoid at the anterior skull base, the arachnoid and the falx provided definitive input to the surgeon regarding the completeness of the disconnection. Postoperative MRI also provided the surgeon with feedback regarding the feasibility of the surgical procedure using the endoscope.

After the surgery, the dura was closed first. An intraventricular drain was left inside for the next 24 to 48 hours to drain the blood-stained CSF. The drain was removed earlier if the CSF completely clear or removal was delayed up to 72 hours if the CSF remained blood stained.

Seizure outcome was assessed using the Engel classification.[37] Other clinical assessments included gait, motor, and sensory function; developmental milestones; language; and psychomotor development. Neuropsychological assessment was performed using the Binet Kamat Test of Intelligence (BKT), Child Behavior Checklist (CBCL), and Pediatric Quality of Life Scale. The BKT was used for assessing patient's cognition, whereas the CBCL and Pediatric Quality of Life Scale[38] were used for assessing behavior abnormality and quality of life, respectively.[39-42] Statistical analysis was performed using the Wilcoxon signed rank test, which is a nonparametric test similar to the paired *t* test in parametric methods. This method was applied to compare 2 sets of scores that come from the same study subjects. Follow-up MRI was scheduled to be performed 3 months after the study.

RESULTS

This study was prospective and observational in nature (April 2013-June 2014). Of the 5 patients (3 boys), 4 underwent a right and 1 underwent a left endoscopy-assisted hemispherotomy. The mean ± standard deviation (SD) age at seizure onset was 1.46 ± 0.92 years (range, 0.3-2.5 years). The mean ± SD age at surgery

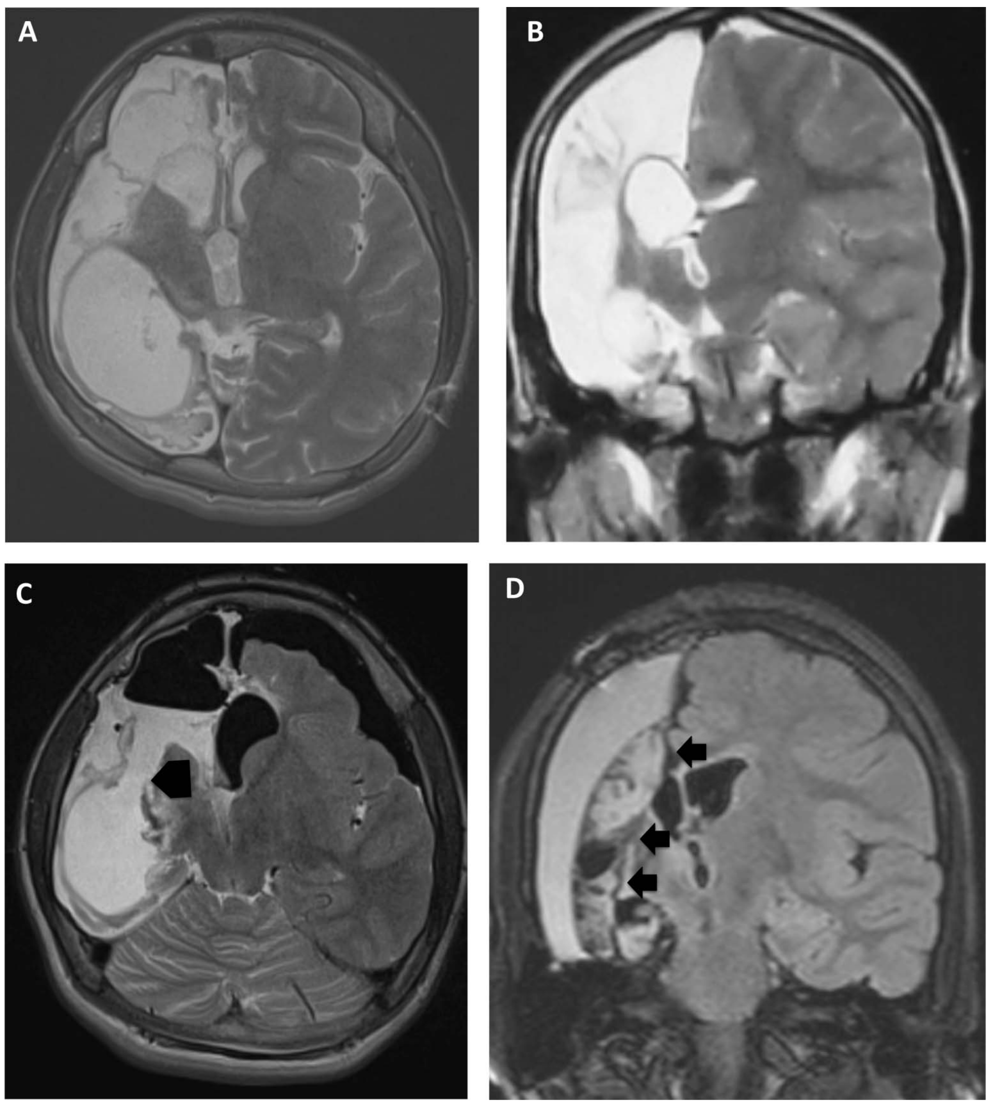

FIGURE 4. *A 13-year-old boy in whom a middle cerebral artery infarct developed 3 months after birth. He started having seizures at 1 year of age, which gradually increased in frequency and intensity. At the time of surgery, the patient experienced 34 episodes per day (with at least 1 generalization). Magnetic resonance imaging showed evidence of an old infarct and cortical atrophy (***A***, axial, T2 sequence;* **B***, coronal, T2 sequence). After endoscopic surgical disconnection (***C** *and* **D***), the patient was seizure free with an Engel class I outcome until the last follow-up.* **C***, magnetic resonance imaging was performed immediately after surgery in the operating room. It shows an axial T2 sequence (compare with* **A***). The arrowhead shows the site of disconnection.* **D***, magnetic resonance imaging was performed at 3-month follow-up (compare with* **B***). Arrows indicate the line of disconnection. The patient had a subdural hematoma, which was asymptomatic.*

was 9 ± 5.1 years (range, 0.4-13 years). The mean ± SD frequency of seizures was 11.25 ± 15.1 per day, excluding 1 patient who presented with status epilepticus. The pathologies included post-infarct epilepsy (2), Rasmussen syndrome (1), and hemimegalencephaly (2) (Figures 4-7). One patient with hemimegalencephaly, a 3-month-old girl, demonstrated seizures at 2

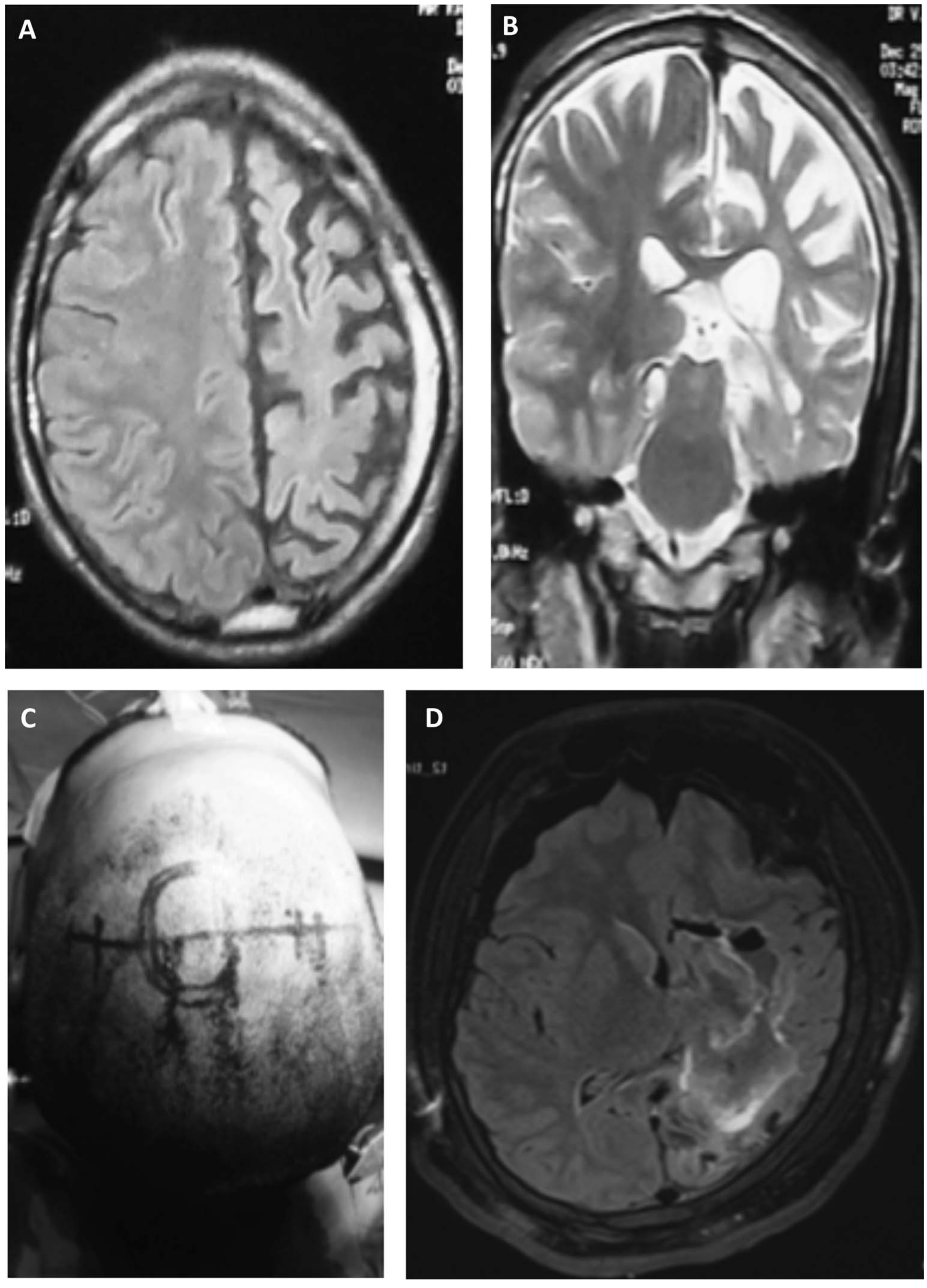

FIGURE 5. **A-C**, *endoscopy-assisted approach in a patient with Rasmussen syndrome (***A***, axial fluid-attenuated inversion recovery (FLAIR) sequence;* **B***, T2 coronal, T2 sequence;* **C***, the size of craniotomy).* **D***, axial FLAIR sequence performed at 3-month follow-up showing the endoscopic disconnection.*

months of age that progressively increased in both frequency and intensity. MRI performed at an outside hospital showed hemimegalencephaly on the right side with cortical atrophy on the left side (Figures 6A and 6B). The primary pathology could not be diagnosed at the hospital, and the child was continued on antiepilepsy drugs. The condition progressively deteriorated, and status epilepticus ultimately developed, with the infant having to be intubated and electively ventilated. The infant was referred to our institution at this stage. Repeat MRI was performed at our hospital at this time, showing severe progression of epileptic encephalopathy in the form of severe cortical atrophy on the healthy side (Figures 6C and 6D). An emergency endoscopy-assisted hemispherotomy (Figures 6E and 6F) was performed on the right side (with a minimal blood loss of 20 mL). The child became seizure free the next day and was gradually weaned off the ventilator and extubated. Although the child was seizure free at 14 months of age, all the milestones were severely delayed.

Apart from this case, 2 other cases were post-infarct epilepsy (Figure 4). Both were ideal startup cases in which to use the endoscopy-assisted procedure. The procedure for the cases of Rasmussen syndrome (Figure 5) and hemimegalencephaly (Figures 6 and 7) were performed once the concept, safety, and feasibility of the procedure were demonstrated in the atrophic cases. The details of all the patients are given in Table.

Two patients had prolonged fever (1-2 weeks). CSF counts and cultures were negative. All investigations for blood and urine were negative. After 1 week of antibiotics, fever was treated symptomatically with paracetamol and cold sponging when required. The mean ± SD blood loss was 80 ± 48.4 mL, and mean ± SD operating time was 220 ± 42 minutes. None of the

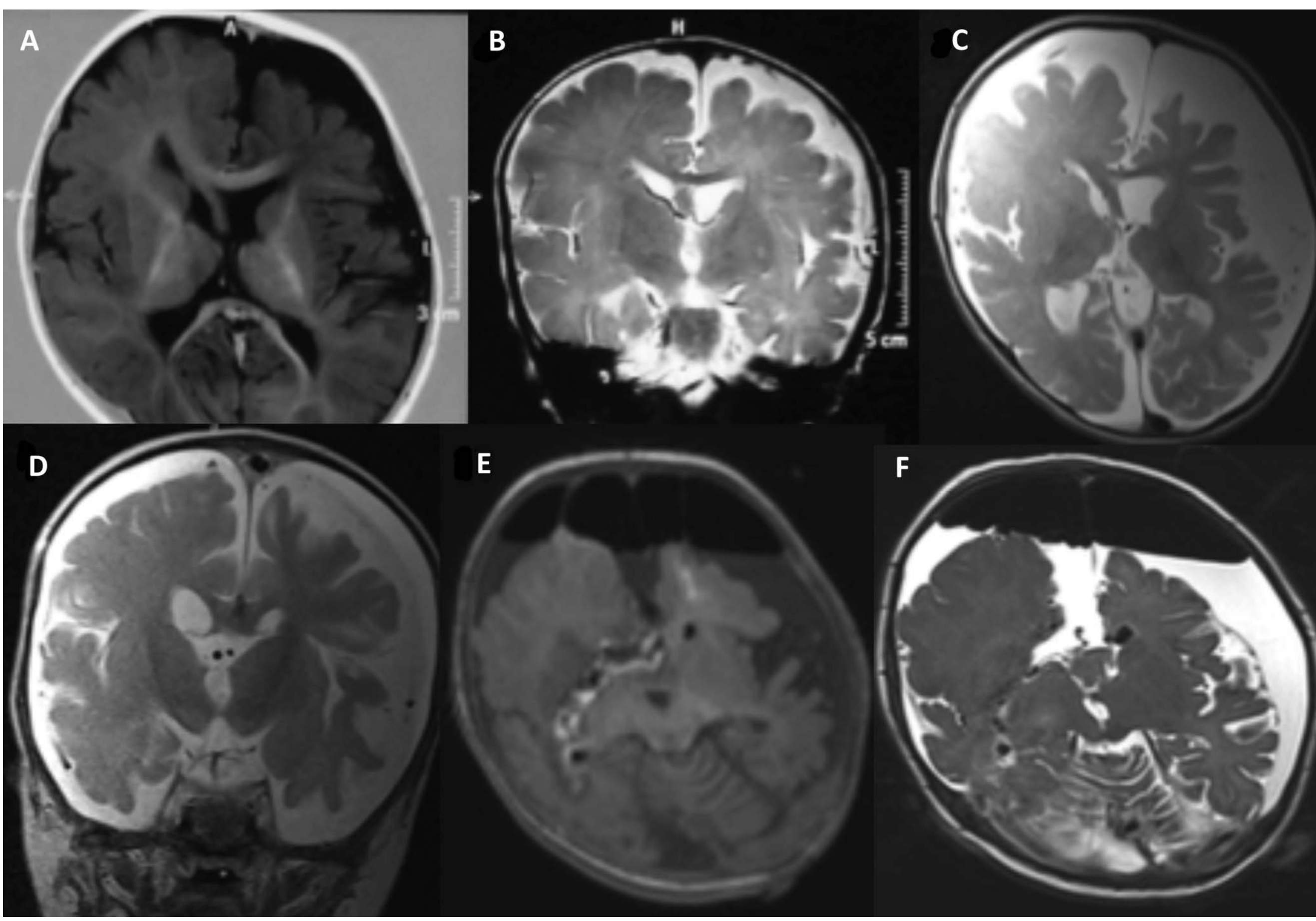

FIGURE 6. **A-D**, *a 3-month-old infant presenting with status epilepticus with evidence of right-sided hemimegalencephaly and severe cortical atrophy on the healthy side caused by epileptic encephalopathy. The first magnetic resonance imaging (MRI) (***A***, axial T1 sequence;* **B***, coronal T2 sequence) was performed in at an outside hospital where she was then treated with antiepileptic drugs. However, her condition progressively worsened, and status epilepticus developed 2 weeks before she was referred to our hospital. She was transferred to our hospital on a ventilator. Repeat MRI (***C***, axial, T2 sequence;* **D***, coronal T2 sequence) showed severe atrophy of the left side of the normal brain because of encephalopathy.* **E**, **F**, *after surgical disconnection (***E***, axial, T1 sequence;* **F***, axial T2 sequence). Both MRI scans were performed in the operating room immediately after the surgical procedure. The child was seizure free, but had severe delay in cognitive development (see text).*

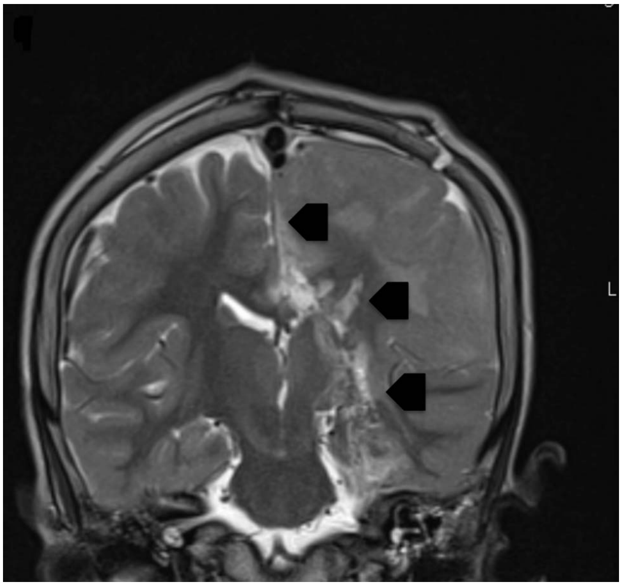

FIGURE 7. *A patient with hemimegalencephaly who underwent an endoscopy-assisted hemispheric disconnection (arrowheads). Because of severe cortical anomalies and loss of normal anatomic architecture, an endoscopy-assisted approach was used via a cistern-to-ventricle access route, allowing a complete disconnection. An endoscopy-assisted interhemispheric approach allows corpus callosotomy to be performed more easily, unlike the transcortical approach described by Delalande.*

patients required any blood transfusions. The mean hospital stay was 8.5 days.

Follow-up ranged from 5 to 14 months with a mean ± SD of 11 ± 4.1 months. Four patients had an Engel class I outcome and 1 had a class II outcome (hemimegalencephaly). The mean ± SD BKT score before surgery was 63 ± 12.64 and 63.25 ± 4.99 at follow-up (normal range, 85-100). The improvement was not significant ($P = .05$).

The mean ± SD total behavior problem score for the CBCL was 60.5 ± 1.91 at follow-up (the preoperative score was 69.0 ± 5.5 [$P = .078$, not significant]; normal range score <60).

Total health score of Pediatric Quality of Life Inventory (PedsQL) score (normal range, 0-100; mean in a normal population, 65.4) improved significantly for all the patients except for the patient presenting with status epilepticus (the mean ± SD preoperative score was 36.56 ± 9.54 and the mean ± SD postoperative score was 74.28 ± 5.81, $P = .043$, $z = -2.023$). The improvement was significant in all PedsQL domains (physical health summary: preoperative, 28.12 ± 15.30; postoperative, 77.06 ± 15.60; and psychosocial health summary: preoperative, 42.24 ± 10.94; postoperative, 73.12 ± 4.44). The infant with status epilepticus was seizure free, but had severe mental retardation. Her preoperative PedsQL score was 35 and postoperative score was 45 at follow-up.

TABLE. Summary of the Patients (n = 5)[a]

Patient	Age at Surgery, y	Sex	Age at Onset, y	Frequency of Seizures per day	Seizure Semiology	Blood Loss, mL	Operating Time, min	Blood Transfusions	Duration of Hospital Stay, d	Pathology
1	13	Male	2.5	34	Focal	60	280	None	7	Post infarct
2	12.8	Male	2.2	3	Focal with generalization	70	220	None	7	Post infarct
3	10	Female	0.8	3	Focal, tonic spasms	100	180	None	10	Rasmussen syndrome
4	0.4	Female	0.3	Status	Status	20	180	None	7	Hemimegalencephaly
5	9	Male	1.5	5	Focal with generalization	150	240	None	12	Hemimegalencephaly
Mean ± SD	9 ± 5.1		1.46 ± 0.92	11.2 ± 15.1		80 ± 48.4	220 ± 42	None	8.6 ± 2.3	

[a]SD, standard deviation.

DISCUSSION

Hemispherotomy can achieve excellent outcomes when performed in optimally indicated patients.[3,6-8,10,14,16,18,20,28,35,43-53] Since the introduction of functional hemispherectomy by Rasmussen, morbidity and mortality have steadily decreased.[8,10,11,13,14,28,43-47,54] However, this procedure still cannot be considered as a trivial surgery because most of the surgeries are performed in children who cannot tolerate blood loss and are prone to other perioperative morbidities such as hypothermia, electrolyte disturbances, and other problems associated with pediatric patients.

With improvements in optics, endoscopic hardware, intraoperative MRI, and neuronavigation techniques, as well as increased availability of high-resolution monitors, it becomes important to apply these techniques for epilepsy surgery and especially hemispherotomy.

The hemispherotomy described by Delalande et al[8,10,11] and Villemure et al[14,16,26] involves a large craniotomy. After these studies, Schramm et al[13,54] described a minimally invasive technique via a smaller craniotomy.

However, the technique described by Delalande et al has the definite advantage of performing hemispheric disconnection via an avascular route. Performing surgery via an interhemispheric corridor (a modification of the Delalande technique) involves a cistern-to-ventricle route and provides a better prototype for an endoscopy-assisted surgery.

The only endoscopic technique for hemispherotomy was described by Bahuleyan et al.[55] In this study using in 5 cadavers, an endoscopic disconnection was performed via 2 ports (ie, via the frontal and parietal burr holes). Although this technique was innovative, it had the following serious shortcomings: (1) ventricular access was difficult, especially in patients with small ventricles; (2) there were limitations of the existing hardware for endoscopes, which do not allow effective hemostasis via a single port for expected bleeding for this type of surgery; and (3) the technique had not been translated into actual use because the literature documents a sense of "discomfort" that surgeons may have in its use.

After an examination of these issues, existing literature, and as well as their own experience,[28,56] we decided that the best option for endoscopic hemispherotomy would be endoscopy-assisted surgery using the interhemispheric route and a small craniotomy.

An interhemispheric endoscopy-assisted hemispherotomy has the advantage of providing cistern-to-ventricle access. This is unlike the technique described by Delalande et al,[8,10] which consists of parenchyma-to-ventricle access. This is in contrast to the concept described by Bahuleyan et al,[36] in which ventricular access would be difficult in small ventricles. The use of neuronavigation would provide optimal guidance to ensure a complete disconnection. This would be a particular advantage in the minimally invasive approach described here.

However, a word of caution is in order. Beginners are advised to first use an endoscope via a larger craniotomy. The size of the craniotomy may be reduced once the surgeon has gained enough confidence in using this technique. Likewise, it is also advised to use this technique first in atrophic pathologies with dilated ventricles.

It is also important to identify the site of craniotomy properly. MRI will help identify the presence of large bridging veins, and the site of craniotomy should be positioned away from these to prevent injuring them or creating difficulty while retracting the hemisphere. Most of the technical challenges in using the endoscope are related to the equipment itself. The learning curve would be easier for a surgeon who has experience in the use of the endoscope in pituitary and skull base surgeries. If an epilepsy surgeon does not have adequate experience with endoscopy, it may be useful to seek the help of a colleague who is more accustomed to this procedure. The presence of a self-cleaning lens with irrigation, a good endoscope holder, and, last but not least, an assistant who has reasonable experience would be very useful in making the learning curve less steep.

Limitations

We do acknowledge the main shortcoming of this study (ie, small cohort and a short follow-up). However, the objective of this study was to demonstrate the feasibility, safety, efficacy, and techniques of this procedure.

CONCLUSION

In this pilot study, we demonstrated a novel clinical procedure whereby an endoscopy-assisted hemispheric disconnection was performed in 5 patients without any morbidity. The study demonstrated the feasibility, safety, and advantages of this procedure.

Disclosures

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