Endoscopic-Assisted (Through a Mini Craniotomy) Corpus Callosotomy Combined With Anterior, Hippocampal, and Posterior Commissurotomy in Lennox-Gastaut Syndrome: A Pilot Study to Establish Its Safety and Efficacy

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BACKGROUND: Corpus callosotomy is a palliative procedure especially for Lennox-Gastaut semiology without localization with drop attacks.
OBJECTIVE: To describe endoscopic-assisted complete corpus callosotomy combined with anterior, hippocampal, and posterior commissurotomy.
METHODS: Patients with drug refractory epilepsy having drop attacks as the predominant seizure type, bilateral abnormalities on imaging, and moderate to severe mental retardation were included. All underwent a complete workup (including magnetic resonance imaging).
RESULTS: Patients (n = 16, mean age 11.4 ± 6.4 years, range 6-19 years) had a mean seizure frequency of 24.5 ± 19.8/days (range 1-60) and a mean intelligence quotient of 25.23 ± 10.71. All had syndromic diagnosis of Lennox-Gastaut syndrome, with the following etiologies: hypoxic insult (10), lissencephaly (2), bilateral band heterotropia (2), and microgyria and pachygyria (2). Surgery included complete callosotomy and the section of anterior and posterior commissure by microscopic approach through a mini craniotomy (11) and endoscopic-assisted approach (5). Complications included meningitis (1), hyperammonemic encephalopathy (2), and acute transient disconnection (5). There was no mortality or long-term morbidity. Mean follow-up was 18 ± 4.7 months (range 16-27 months). Drop attacks stopped in all. Seizure frequency/duration decreased >90% in 10 patients and >50% in 5 patients, and increased in 1 patient. All patients attained presurgical functional levels in 3 to 6 months. Child behavior checklist scores showed no deterioration. Parental questionnaires reported 90% satisfaction attributed to the control of drop attacks. The series was compared retrospectively with an age/sex-matched cohort (where a callosotomy only was performed), and showed better outcome for drop attacks ($P < .003$).
CONCLUSION: This preliminary study demonstrated the efficacy and safety of complete callosotomy with anterior, hippocampal, and posterior commissurotomy in Lennox-Gastaut syndrome (drop attacks) with moderate to severe mental retardation.

KEY WORDS: Anterior commissure, Commissurotomy, Corpus callosotomy, Drop attacks, Epilepsy surgery, Lennox-Gastaut syndrome, Pediatric, Posterior commissure

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ABBREVIATIONS: AC, anterior commissure; **ACT,** anterior commissurotomy; **CBCL,** child behavior check list; **CC,** corpus callosotomy; **HC,** hippocampal commissure; **HCT,** hippocampal commissurotomy; **IQ,** intelligence quotient; **PC,** posterior commissure; **PCT,** posterior commissurotomy

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Corpus callosotomy (CC) is aimed to reduce the burden of seizures in patients with nonlocalizing bihemispheric epilepsy like Lennox-Gastaut syndrome (LGS) with drop attacks.[1-4] The extent of CC remains controversial. Many authors advocate anterior CC only to prevent disconnection syndromes, while compromising the seizure outcome.[3,5] About one-third of patients undergoing anterior callosotomy have seizure recurrence necessitating a second surgery to complete the callosal sectioning.[1,2,6-13]

A complete CC, while being more effective, is still considered as a palliative procedure.[6,9] Studies that have compared anterior CC, staged CC, and single-stage CC have found that single-stage CC does not have higher complications.[6,9]

Commissural sectioning (ACT, anterior commissurotomy; HCT, hippocampal commissurotomy; and PCT, posterior commissurotomy) was tried in the late seventies with success but was abandoned because of morbidities (mostly related to disconnection) in a few cases.[19] In animal models, division of corpus callosum has been useful in the management of secondarily generalized epilepsies, but there is a lack of homogeneity in experimental studies to see the effect of anterior hippocampal and posterior commissurotomy on the generalization of discharges.[20]

The current study includes patients who had severe LGS with disabling drop attacks. All had moderate to severe mental retardation. Hence, we assumed that a CC with anterior, hippocampal, and posterior commissurotomy might not result in a significant morbidity, while providing them the best possible option for seizure freedom by providing a complete "interhemispheric disconnection."

Currently, CC is being increasingly replaced with vagal nerve stimulation,[21-27] mostly because the former is considered as a palliative "destructive" surgery. More recent studies have demonstrated that after CC, in some patients, there is a better localization of the epileptogenic focus.[25-27] A "better" interhemisperic disconnection may thus provide a better outcome of surgery. To the best of our knowledge, we have not come across an article that has combined a complete CC with ACT, HCT, and PCT. In addition, this is the first article in the literature to describe an endoscopic-assisted approach.

METHODS

This is a prospective, observational study. The study was approved by the institute's ethics committee, performed according to the guidelines of Medical Research Council. The data in this prospective study were collected from October 2012 to December 2013. All patients underwent a presurgical evaluation that included video electroencephalography and magnetic resonance imaging (3T epilepsy protocol MRI), as already described in earlier studies.[28-32] Single-photon emission computed tomography interictal and ictal and positron emission tomography were performed where necessary. Magnetoencephalography was performed in the last 5 cases.

Inclusion criteria included patients with LGS with multiple drop attacks as the predominant seizure type along with no single lateralization/localization of epileptiform zone/network; drop attacks as predominant seizure type; intelligent/social quotients less than 50; high seizure frequency defined as at least 1 to 2/day; and parental consent for the procedure.

Neuropsychological and Behavioral Evaluation

All patients were assessed for social quotient using the Vineland Social Maturity Scale. For seizure outcome characterization and parental satisfaction, the scale adopted by Iwasaki et al[33] was used. Child behavior check list (CBCL) score (ASEBA, Inc.) was adopted for behavioral assessments (113 items for parents). CBCL scores >60 indicated borderline or at-risk children, whereas scores >64 indicated significant clinical behavioral problems.

Surgical Technique

The patient was placed supine, neutral with head fixed in a head clamp. A small 5- to 6-cm transverse skin incision was placed a centimeter in front of the coronal suture, the craniotomy was 4 × 3 cm longitudinal (Figure 1). The final site of the craniotomy was determined by using neuronavigation (to avoid veins). All surgeries were performed in an operating room with an intraoperative MRI. Following dural opening, interhemispheric fissure was accessed and cisternal cerebrospinal fluid was released to make the brain lax. The first 11 cases were performed under a microscope with additional help from an endoscope. The last 5 cases were performed with endoscopic assistance only through a mini craniotomy (see **Video**, **Supplemental Digital Content**, http://links.lww.com/NEU/A786). Once the corpus callosum was sectioned completely, the septae on either side of the cavum were separated. First, the anterior commissure (AC) was divided. The hippocampal commissure (HC) was divided by separating the septae and following it posteriorly. The HC is located at the level of the posterior part of the body of CC or just in front of the splenium. The PC is the last to be divided. It is located over the dorsal and superior part of the third ventricle. This may be divided by using microscissors. Once divided, the aqueduct becomes clearly visible (Figure 1; see also the **Video**, **Supplemental Digital Content**, http://links.lww.com/NEU/A786). All patients were put on a ventilator for at least 24 hours after surgery. This was to avoid any immediate postextubation morbidity, because all the patients were quite sick and mentally retarded with several seizures a day. All underwent immediate postoperative MRI and a postoperative computed tomography scan within 6 hours after surgery.

Outcome Assessment

All patients were assessed at 3, 6, 9, and 12 months initially and then every 6 months. Routine EEGs were performed at 3 months and later on as per the clinical decision of the neurologist 1 year later. Detailed neuropsychological assessments were conducted at 1 year. Seizure outcomes were recorded at last outpatient follow-up. Postoperative MRI was performed once immediately at the time of surgery and then scheduled on follow-up between 3 to 7 months (Figure 2).

RESULTS

Demographics

Sixteen patients (mean age: 10 ± 5.9 [range 2-25], 11 males) were recruited. Seizure onset was <1 month after birth in 8 patients, and, in all others, seizure onset ranged from birth to 5 years (mean 22.48 ± 31.77 months). Mean duration of epilepsy was 10 ± 6.4 years. The mean seizure frequency was 24.5 ± 19.8/day (range 1-60). Drop attacks were present in all along with tonic seizures (11), tonic-clonic (10), absence (2), myoclonic seizures (2), and focal dyscognitive seizures (2). Syndromic diagnosis of LGS (with multiple seizure semiologies) was made in all patients. Etiological cause included previous hypoxic insult in 10 patients (forceps delivery, meconium aspiration, hypoglycemia, and low birth weight with breech presentation), and lissencephaly, bilateral band heterotropia,

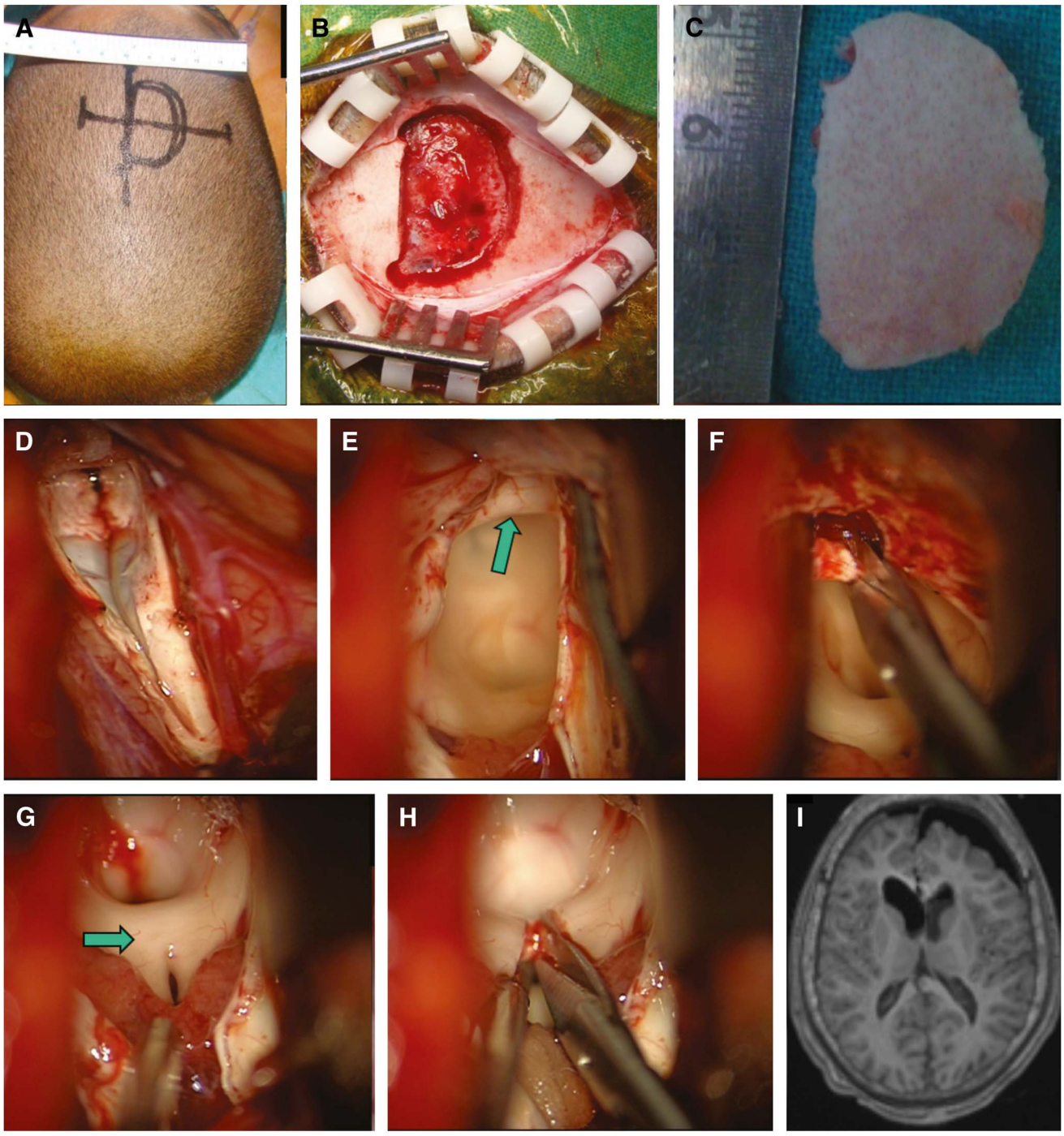

FIGURE 1. *Figure shows the stepwise execution of the procedure from skin incision (A), craniotomy (B), and bone flap size (C) followed by sectioning of corpus callosum (D). After completing the complete section of corpus callosum, anterior (E) and posterior (G) commissures were identified (arrows) and sectioned respectively (F, H). Postoperative magnetic resonance imaging shows sectioned corpus callosum (I) and posterior commissure. Color version available online only.*

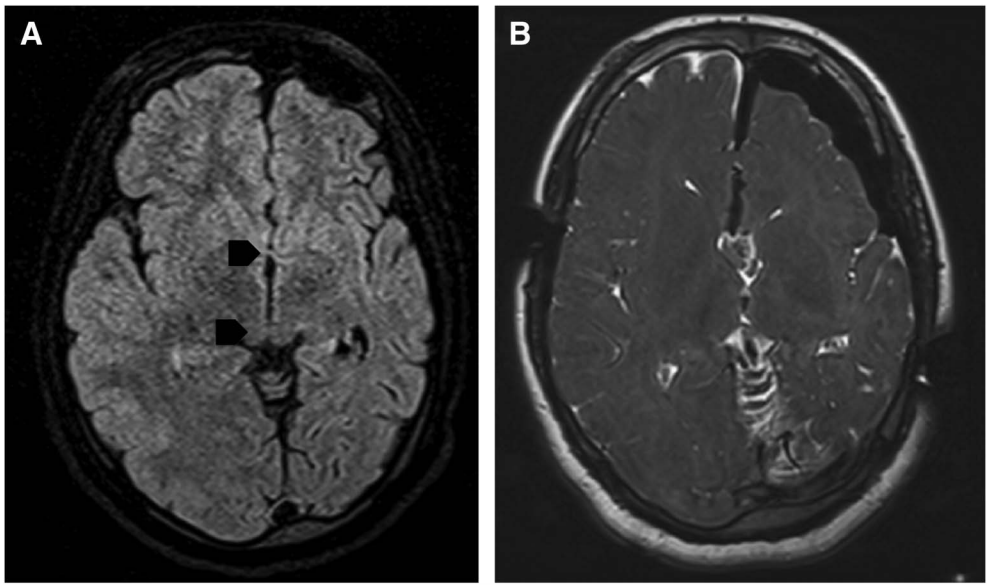

FIGURE 2. *A 13-year-old boy presented with 5 to 10 episodes/day since 4 months of age (case 6, Tables 1 and 2). MRI (A) showed severe bilateral pachygyria/microgyria with asymmetric hemispheres (right > left). An endoscopic-assisted corpus callosotomy along with anterior commissurotomy, hippocampal and posterior commissurotomy (B) was performed. Following the procedure, the drop attacks subsided completely.*

and microgyria/pachygyria in 2 patients each (Table 1). Change in the type of seizures was encountered in 9 patients. On admission, profound mental retardation with intelligence quotients (IQ) <20 was encountered in 7, severe mental retardation (IQ 20-34) was encountered in 7, and moderate mental retardation (IQ 35-49) was encountered in 2 patients (Tables 1 and 2).

Surgical Details

Eleven patients underwent complete CC, ACT, HCT, and PCT through a mini craniotomy (4 × 3 cm) with both microscopic and endoscopic assistance. Five patients underwent surgery with endoscopic assistance only through a mini craniotomy. No intraoperative complications were noted. The average stay in the intensive care unit was 2 days, median 2, with a range of 1 to 5 days. The mean blood loss was 85 ± 24.5 mL. The mean duration of microscope surgery was 153 (±27) minutes vs 124 (+29) minutes for endoscopic-assisted surgery (average for all surgeries: 144 minutes + 30 minutes). The duration of the first 3 endoscopic surgeries was comparable to the microscopic surgeries. Most of the time was lost in setting up endoscopic equipment rather than the actual surgery. The duration of the last 2 endoscopic surgeries reduced significantly (Table 1). It should be also mentioned that, in all microscopic surgeries, the endoscope was used along with the microscope. In Table 1 it is interesting to note that the duration of case 16 is almost half of that of case 1.

Seizure Outcomes

Mean follow-up was 18 ± 4.7 months (range 15-26 months). There was a complete improvement in drop attacks in all patients. Significant decrease (>90%) in seizure frequency was noted in 10 patients, moderate reduction (>50%) in 5 patients, whereas increased seizure frequency was seen in 1 patient (Table 2). Decrease in frequency was observed in all types of seizures in these patients (tonic, tonic-clonic, absence, and myoclonic seizures). One patient initially underwent a complete callosotomy (25-year-old woman, case 7, Table 1) only. Following this, the patient went into status on the third postoperative day. Bedside electroencephalogram showed continuous nonconvulsive status epilepticus with ictal discharges from bilateral centroparietal areas. She was taken up for surgery in emergency; an additional ACT, HCT, and PCT were performed. After this, the seizures stopped. One patient encountered increased duration of seizure with a change of seizure type from spasms to unilateral tonic seizures of long duration.

Neuropsychological Outcomes

Aggression in behavior of patients was noted in 8 (first 3 months); this was reduced in 6 to 9 months in 3 patients. The mean IQ preoperatively was 25.23 ± 10.71, which did not deteriorate following surgery (mean score after surgery: 26.43 ± 11.41 at 6 months and 26.87 ± 11.95 at 1 year). Behavioral parameters, in particular, social contacts, attention span, and learning, also did not show deterioration. Detailed social

TABLE 1. Table Showing Summary of the Cases (n = 16)[a,b]

Patient No.	Age/Sex	Seizure Onset (mo)	Frequency	Seizure Types	Perinatal Insult	Imaging	Intelligence Level
1	16/F	30	10/d	D, T, A	Present	Lissencephaly	Moderate
2	15/M	0.5	5-6/wk	D, T-C, A	Present	No substrate, brain shrunken because of epileptic encephalopathy	Severe
3	13/M	36	60/d	D, T, T-C, FDS	Present	HIE	Severe
4	6/M	0.5	50/d	D, T	Present	HIE	Profound
5	13/F	84	5/d	D, T	Present	HIE	Moderate
6	13/M	0.3	7/d	D, T-C	Absent	Pachygyria, microgyria	Profound
7	25/F	72	50/d	D, T-C, T	Absent	No substrate, brain shrunken because of epileptic encephalopathy	Severe
8	2/F	0.3	40/d	T, SS, M	Present	HIE	Profound
9	11/M	60	4/d	D, T, FDS	Present	HIE	Severe
10	12/M	72	50/d	D, T-C	Present	No substrate, brain shrunken because of epileptic encephalopathy	Profound
11	3/F	0.6	15/d	T, SS, M	Present	HIE	Profound
12	4/M	0.16	10/d	D, T-C	Absent	Pachygyria, microgyria	Profound
13	6/M	1	20/d	D, T-C	Present	BL band heterotropia	Severe
14	8/M	2	10/d	D, T, T-C	Absent	BL band heterotropia	Severe
15	7/M	At birth	30/d	D, T, T-C, FDS	Absent	Lissencephaly	Profound
16	6/M	0.3	30/d	D, T, T-C	Present	HIE	Severe

[a]D, head drops; T, tonic seizures; T-C, tonic clonic; A, absences; M, myoclonic seizures; ES, epileptic spasms; FDS, focal dyscognitive seizures; HIE, hypoxic ischemic encephalopathy.
[b]Intelligence level: profound: IQ < 20, severe: IQ 20-34, moderate: IQ 35-49.

quotients analysis (at 6 and 12 months) did not show any deterioration. CBCL scores are summarized in Table 2 and also revealed no significant deterioration (rather improved mildly after surgery). The mean preoperative CBCL was 69.25 ± 2.5 in comparison with the postoperative score of 61.81 ± 3.8 (Table 2) at 1-year follow-up. On the parental questionnaire, 11 parents were satisfied with the surgical results and agreed to recommend this surgery to others.

Control Cohort

The study group was compared with a similar cohort (n = 16, mean age 12 ± 4.7 years, range of 4-21 years) (Table 3), where a complete CC only was performed. The mean age of onset of seizures was 26.7 ± 29.1 months, and mean seizure frequency was 10.3 ± 4.8/day (much less than the study group). All had drop attacks with multiple other seizure types. Four patients had profoundly low IQ (<20), 3 had severely low IQ (20-34), 4 had moderately low IQ (35-49), and the remaining 5 had an IQ >49. Following a CC, drop attacks were relieved (>90%) in 10 of 16 (62%), and other seizure types were relieved >90% in 7 of 16 (43%) at a mean follow-up of 16.4 months (13.2-21 months). On applying the Fisher exact test there was a significant difference in study and control groups for drop attacks (P = .003), being better in the case group. However, there was no significant difference for other seizure types (P = .240).

Complications

Four patients had evidence of acute disconnection, characterized by confusion and limb apraxia of the nondominant side, and buccal apraxia (with pooling of saliva). This improved during the hospital stay to their preoperative functional levels. Two patients developed hyperammonemic encephalopathy, which required the discontinuation of valproate and the administration of lactulose. One patient developed bacterial meningitis and was treated appropriately. Mean hospital stay was 9.5 ± 5.1 days (5-20 days). No mortality or long-term procedural morbidity was recorded. Although it was not possible to examine the detailed extraocular movements because of the severe deranged cognitive status of the patients, none of the patients had contralateral light reflex. This did not affect them or their caregiving in any manner.

DISCUSSION

Complete callosal sectioning (first introduced by Van Wagenen in 1940[34]) is a very effective "palliative" procedure for breaking secondary bilateral synchrony and alleviating drop attacks, with more than 90% improvement in drops with reasonable long-term remission.[1,2,6,7,11,12] Various authors have tried different combinations: Watson (1968): complete CC + HCT; Wilson (1978)[35]: complete CC; Gloor (1980)[36]: complete CC + ACT; and Gates (1984)[37]: complete CC + HCT. Most of

TABLE 2. Seizure Outcomes and Neuropsychological Assessments in the Cases (n = 16)

	Seizure Outcomes		Intelligence/Social Quotient				CBSL Scores (Child Behavior Check List)	
Patient No.	% Decrease in Seizure Frequency	Drop Attacks After Surgery (Present or Absent)	Presurgery	Subjective Score: Moderate = 35-49, Severe = 20-34, Profound ≤ 20	Postsurgery (6 mo)	Postsurgery (12 mo)	Presurgery	Postsurgery (12 mo)
1	>50	Absent	44.81	Moderate	48.1	49.9	69	59
2	>90	Absent	29.4	Severe	30.2	24.8	70	62
3	>90	Absent	33.1	Severe	39.1	39.4	67	60
4	>90	Absent	19.1	Profound	19.2	19.4	70	64
5	>50	Absent	15.91	Moderate	19.53	23.4	68	65
6	>90	Absent	38.51	Profound	39.45	49.6	72	65
7	Status immediate post op followed by >90 improvement	Absent	25.3	Severe	23.8	19.1	75	72
8	>90	Absent	17.19	Profound	18.6	18.8	69	65
9	>50	Absent	32.6	Severe	33.2	35.6	68	61
10	>90	Absent	9.34	Profound	8.57	8.68	70	64
11	>90	Absent	6.01	Profound	7.05	8.1	65	58
12	>50	Absent	18.2	Profound	21	21	71	58
13	>50	Absent	32	Severe	32.4	34	67	59
14	>90	Absent	30	Severe	31.2	36	66	57
15	Worse	Absent	19.2	Profound	17.3	17	72	61
16	>90	Absent	33	Severe	34.2	35.2	69	59

these authors reported 10% to 20% of primary nonresponders and close to 30% of patients experienced further relapses in the next few years with outcomes mostly remaining stable thereafter.[12,13] The common reasons cited for callosal sections failing to alleviate drop attacks or their recurrence is the possibility of transmission of epileptiform activity through other interhemispheric pathways like anterior, posterior, and HC.[13,38-40] Using diffusion tensor imaging, Jang and Kwon (2013, 2014) have demonstrated a much wider connection of the fornix to include the cerebral cortex (precentral gyrus, postcentral gyrus, and posterior parietal cortex) and also the brainstem through the thalamus.[41-43] The AC connects temporal lobes,[39] whereas the HC, mostly considered as rudimentary in humans, connects both the hippocampi and joins both the bodies of the fornices just under the posterior part of the body of the corpus callosum.[14-18,38,44] Thus, division of anterior and HC may be expected to have a significant effect to reduce the seizure burden.

The PC is known to carry pupilloconstrictor fibers to mediate the bilateral light reflex. However, a detailed anatomical study using anterograde fiber degeneration and retrograde axon transport (using horse peroxidase) revealed a much larger distribution of PC to pars reticularis, periaqueductal gray matter connecting both cranial and caudal reticular system, ventral lateral geniculate nucleus, H field of Forel, and zona incerta.[45] Hence, it is possible that the PC may be responsible for subcortical spread and contralateral transmission of seizures.

The main complication of the earlier series combining a complete CC with either ACT or HCT commissurotomies was the morbidity associated with acute disconnection.[35-37,46-48] Similar complications and seizure outcome profiles were also reported in contemporary series.[19,35,49] Although we observed acute disconnection syndromes, they did not alter the functional status of our patients. Even though all our patients had moderate to severe mental retardation with severe epilepsy, there was no deterioration (rather mild improvement) after surgery. One of the reasons could be because the patients were already severely compromised in their cognitive status, so that an additional disconnection may not alter their quality of life or leave a permanent disability. On the contrary, relief of disabling seizures was perceived as the biggest factor of improvement by parents in the postoperative period.[50,51]

Recently, surgeries using smaller craniotomies have been performed more frequently for epilepsy surgeries like peri-insular hemispherotomies and even for anterior corpus callosotomies.[6,44] More recently, an endoscopic-assisted hemispherotomy through a transcallosal route has been described.[52] In the present series, we performed a complete callosal sectioning along with section of AC, hippocampal (HC), and PC using a small craniotomy in the first 11 cases. This was followed by the use of an endoscopic-assisted approach only in the last 5 cases. Our study is the first of its kind to demonstrate the utility and safety of this approach for CC, AC, HC, and PC division. We also believe that an endoscopic-assisted approach through a mini craniotomy

TABLE 3. Table Showing the Outcome in the Control Cohort[a,b,c]

Patient No.	Age/ Sex	Seizure Onset (mo)	Frequency	Seizure Types	Perinatal Insult	Imaging	Intelligence Level: Mild: IQ > 49, Moderate: IQ 35-49, Severe: IQ 20-35, Profound: IQ < 20	Outcome: Drop Attacks Relief >90%, Present or Absent (Mean Follow up 16.4 mo)	Drop attacks After Surgery (Present or Absent)	Outcome: Other Seizures Relief >90% Present or Absent (Mean Follow up 16.4 mo)
1	17/F	42	15/d	D, T-C, A	Present	No substrate, brain shrunken because of epileptic encephalopathy	Moderate	Present	Absent	Present
2	16/M	6	1/d	D, T-C, A	Present	No substrate, brain shrunken because of epileptic encephalopathy	Mild	Present	Absent	Absent
3	13/M	36	10/d	D, T, T-C, FDS	Present	HIE	Severe	Present	Absent	Present
4	14/M	3	8/d	D, T-C	Present	No substrate, brain shrunken because of epileptic encephalopathy	Mild	Present	Present	Absent
5	16/F	4	6/d	D, T-C	Present	HIE	Profound	Absent	Present	Absent
6	13/M	84	9/d	D, T-C	Absent	HIE	Moderate	Absent	Present	Absent
7	21/F	74	12/d	D, T, T-C, FDS	Absent	No substrate, brain shrunken because of epileptic encephalopathy	Severe	Present	Absent	Present
8	7/F	4	11/d	T, SS, M	Present	HIE	Profound	Absent	Present	Absent
9	12/M	67	4/d	D, T, T-C, FDS	Present	HIE	Severe	Present	Absent	Present
10	16/M	68	16/d	D, T-C	Present	No substrate, brain shrunken because of epileptic encephalopathy	Moderate	Absent	Present	Absent
11	16/F	4	12/d	T, SS, M	Present	HIE	Profound	Present	Absent	Present
12	4/M	5	7/d	D, T-C	Absent	Pachygyria, microgyria	Mild	Absent	Present	Absent
13	6/M	7	6/d	T, SS, M	Present	HIE	Moderate	Present	Absent	Present
14	8/M	7	14/d	T, SS, M	Absent	HIE	Mild	Present	Absent	Present
15	7/M	9	15/d	D, T, T-C, FDS	Absent	Lissencephaly	Profound	Absent	Present	Absent
16	8/M	8	20/d	D, T, T-C, FDS	Present	HIE	Mild	Present	Absent	Absent

[a]D, head drops; T, tonic seizures; T-C, tonic clonic; A, absences; M, myoclonic seizures; ES, epileptic spasms; FDS, focal dyscognitive seizures; HIE, hypoxic ischemic encephalopathy.
[b]Intelligence level: profound: IQ < 20, severe: IQ 20-34, moderate: IQ 35-49.
[c]Explanation for the outcome: Column 9 shows the patients where a control of drop attacks >90% is present or absent. Column 10 shows patients with 100% control of drop attacks, Column 11 shows the relief of other types of seizures.

helps minimize unnecessary brain exposure and reduces blood loss. However, in 1 case, we had to extend the craniotomy because of the presence of large veins at the site of the craniotomy. It does become important to localize the venous anatomy preoperatively (MRI with gadolinium along with susceptibility-weighted imaging) to plan the optimal location for performing the craniotomy. Overall, we believe that, with some experience, the endoscopic-assisted approach through a "mini craniotomy" is feasible and is of advantage in performing this procedure (see **Video**, **Supplemental Digital Content**, http://links.lww.com/NEU/A786).

Neurological complications are reported in all major series in the magnitude of 2% to 5% with permanent sequelae in 5% of patients.[2,6,8] We did not encounter any motor deficits or permanent deficits. However, postoperative akinetic state, buccal apraxia manifested as drooling of saliva, and limb apraxia were common. We believe that all these changes are due to acute disconnection syndromes, which were seen in 4 patients and persisted from weeks to months in a few patients. However, it improved in all patients within 3 to 6 months. In addition, improvement in seizure outcome and cognitive status compensated adequately this short-term morbidity.

However, despite the limitations mentioned below, the study did succeed in the objective of establishing the safety, efficacy, and acceptable morbidity of CC combined with anterior, hippocampal, and posterior commissurotomies. It also demonstrated a similar efficacy, if not better, compared with complete CC alone. Long-term follow-up of larger cohorts and comparison studies are needed for better understanding. Also, for the first time, the authors demonstrated a key hole endoscopic-assisted CC with anterior, hippocampal, and posterior commissurotomy.

Limitations

The biggest limitation of this study is the fact that it is not randomized and has been performed in a relatively small cohort. We have tried to compensate this to some extent by comparing this with a retrospective cohort. The follow-up is also relatively short. It also remains to be seen how safe the procedure would be in a patients who have a much better preserved cognitive status.

CONCLUSION

Complete corpus callosotomy combined with anterior, hippocampal, and posterior commissurotomy performed in patients with severe drop attacks and nonlocalizing epilepsy has been demonstrated to be safe and efficacious in LGS. Drop attacks ceased completely in all patients, and there was a significant improvement in all other seizure types (>90% reduction in 66% of cases). This was also accompanied with a significant improvement in cognition. We would also be hesitant at this stage to subject this procedure in patients with well-preserved cognitive status. Larger future studies, especially those involving blinding this procedure with CC only, may be helpful in further establishing its role.

Disclosures

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COMMENT

The authors describe a series of 16 patients with Lennox-Gastaut Syndrome (LGS) undergoing an endoscopic-assisted corpus callosotomy with commissurotomies via a mini craniotomy, compared with a cohort undergoing callosotomy without commissurotomy. They report acceptable rates of complications and excellent seizure control for atonic seizures/drop attacks. As a retrospective, nonblinded cohort comparison study, this report mainly serves to demonstrate the safety and feasibility of their technique, and conclusions regarding the additional efficacy of commissurotomy beyond callosotomy remain to be validated. All patients had LGS and moderate to severe cognitive deficits with IQ <20 in half the patients, and less than 50 in the rest. As such, conclusions drawn from this study should be limited to this specific patient population in which cognitive and other morbidities may be masked by the severity of their neurocognitive deficits. From a technical standpoint, the challenges of minimal access to the interhemispheric fissure and third ventricle have been managed nicely with the addition of endoscopy to microsurgical dissection, and over time it seems to have resulted in shorter operative times across the learning curve. The authors should be commended for achieving a technical advancement in reducing the invasiveness of the traditional callosotomy approach and revisiting the utility of commissurotomy in these patients. I would encourage them to prospectively randomly assign similar patients to callosotomy with/without commissurotomy as a next step in validating the technique.

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