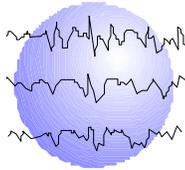


CORPUS CALLOSOTOMY AND RESECTIVE SURGERY FOR SEIZURE CONTROL

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REVISED ABSTRACT

RATIONALE: Corpus callosotomy (CC) is a procedure that has been shown to be effective in improving seizure control for patients who do not have a clear localized or lateralized seizure onset (i.e., not clear resective surgical candidates). A CC historically has been most helpful in tonic seizures, particularly tonic drops in children. It has been our suspicion through the years that some patients who undergo a CC (anterior 2/3 and complete CC) may ultimately be focal resective candidates in that following the CC, a lateralized and/or localized seizure onset can be identified. Therefore, we reviewed our experience at the Minnesota Epilepsy Group in patients who underwent both a CC and a resective procedure.

METHODS: Since 1991, 75 anterior 2/3 and 30 complete CCs have been performed in children. Of these patients, 13 had resective surgery as well. The records of these patients were reviewed with particular attention to seizure type/epilepsy syndrome, timing of the surgical procedures, and seizure outcome.

RESULTS: Of the thirteen patients who underwent both a CC (anterior only with or without completion), five underwent a resection with a CC (Group I). The remaining nine patients had the procedures spread over 9 months to 7 years (Group II). Seizure types and EEG correlates included tonic, atypical absence, generalized tonic-clonic and complex partial without a clearly localized EEG onset. Of the Group I patients, all had mixed seizure types (combination of generalized tonic-clonic, tonic, myoclonic, and atypical absence). The outcome of these patients was: three had Engel class I or II, one had Engel class III, and one had Engel class IV outcomes. In Group II, six had Engel class I or II outcome, two had Engel class III, and one had Engel class IV outcome. All patients who underwent resection surgery had a frontal lobe (all or part) included in the resection. Eight had either multiple lobes (all or partial) resected as well. Three had a functional hemispherectomy. Details regarding specific seizure types, etiology (if known) will be discussed as to how they relate to the timing of the procedures in these two groups as well as how the EEG findings changed.

CONCLUSION: Corpus callosotomy is a palliative procedure for seizure control. Some patients may be suspected of having a focal seizure disorder, but only after or in association with a CC can the EEG lateralize or localize seizure onset. In some patients with multifocal pathology (such as tuberous sclerosis), a CC may ultimately reveal a dominant focus that may respond to a successful focal resection. Indicators for the resection include a lateralized EEG and/or a focal component to the seizure semiology.

Introduction:

Historically, corpus callosotomy was developed as a palliative epilepsy surgery for patients with medically intractable epilepsy and no identifiable resectable focus. It has been of particular value to patients who have tonic drops (as in Lennox Gastaut Syndrome) and patients with recurrent convulsive and/or nonconvulsive status epilepticus. There are some patients who have very rapid secondarily generalized seizures that appear to have a primarily generalized epilepsy. Although the mechanism by which a callosotomy improves seizure control is not well understood, it does interrupt interhemispheric pathways and slows interhemispheric communication. Thus, there may be a group of patients with rapid secondary generalization who, after callosotomy, may lateralize or localize their seizure onset. It is this group of patients that we evaluated retrospectively.

Methods:

Since 1991, 75 anterior 2/3 and 30 complete CCs have been performed in children. Of these patients, 13 had resective surgery as well. The records of these patients were reviewed with particular attention to seizure type/epilepsy syndrome, timing of the surgical procedures, and seizure outcome.

Results

Group 1 (N=5) consisted of patients who underwent an anterior 2/3 callosotomy and resective procedure during one operation (Table 1). There were five patients in this group. All had mixed seizure types with either multifocal and/or not lateralizable ictal and interictal EEG abnormalities. This was the case even with indwelling electrodes (depths and/or subdural electrodes). Patient 1-1 was referred as a primary generalized epilepsy although there was a suggestion on EEG of a right frontal onset and there were some seizures recorded that appeared to have an adverse component clinically. His EEG lateralized during the anterior 2/3 callosotomy. Patient 4-1 had a left frontal porencephalic cyst that was resected with the anterior 2/3 corpus callosotomy. All patients had frontal resections. The two patients who had poor outcomes (2-1 and 5-1) had either incomplete resections of the epileptogenic zone (5-1) or a recurrence of seizures following a new insult (2-1) and ultimately underwent a functional hemispherectomy.

Group 2 (N=8) consisted of patients who underwent a callosotomy followed by a resective surgery from 9 months to 7 years following the initial procedure. This group consisted of 6 patients with Lennox Gastaut Syndrome (LGS), two of whom had tuberous sclerosis complex (TSC) and one who had a porencephalic cyst. The other two patients had a history of severe head trauma (4-2) or porphyria, mental retardation without another etiology (6-2). The overall outcomes in this group were Engel Class I or II in six, Engel Class III in one and Class IV in one (6-2). The two patients with TSC had Class I or II outcomes overall but Class I when only considering the “target” (dominant and/or most troublesome) seizure prior to resection. The worst outcome was in patient 6-2 who ultimately died due to complications of status epilepticus.

Discussion

Overall, the best outcomes in both groups 1 and 2 were those patients who had structural lesions that could ultimately be shown to be responsible for the majority if not all of the seizures. For some patients in Group I they became apparent with the initial evaluation and /or at the time of the anterior callosotomy. For others, particularly those with multiple lesions (such as the TSC patients), only after the completion of the callosotomy did a dominant seizure focus time become apparent so that the focus responsible for that seizure could be identified and resected. The patients who did not have a specific identifiable lesion or a focus that could not be completely resected had the worst outcomes. This is similar to the outcome of resective surgery alone depending on identifiable lesion/focus removal and/or complete resectability of the epileptogenic zone when the frontal lobe is the area of onset.

Conclusion:

Although callosotomy is typically a palliative procedure for patients with medically intractable epilepsy who may appear not to be resective candidates, it may in fact be a lateralizing procedure for some patients. This seems to be particularly true in the case of frontal lobe onset. In patients with TSC and/or LGS, it may be of particular value.

Considering that this series dates back to 1991, newer technologies such as PET scan, 3-tesla MRI scan, SISCOM, and magnetoencephalography may assist in identifying the epileptogenic area before or after a callosotomy. Careful attention to these tests as well as the seizure semiology prior to or following a callosotomy may also give insight into a potential resectable focus.

References:

1. Gates, J., et. al., *Epilepsia*, 1984; 25:308-316
2. Gates, J., et. al., *Arch Neurol*. 1986;43:1188-1191
3. Spencer, D., et. al., *Clev Clin J Med*. 1989; 56:S69-S78
4. Cendes, F., et. al., *Epilepsia* 1993; 34: 910-917
5. Gates, J, *Epilepsy and the Corpus Callosum II* 1995; 137-144.
6. Madsen, J., et. al., *Neurosurg Clin North Am* 1996(3): 541-548

Table 1

Group 1

Patient	Sz Type by CC (EEG Pattern)	Procedure	Sz/EEG after CC / Outcome	Outcome/Engel Classification
1-1	<ul style="list-style-type: none"> Bifrontal and Generalized (R frontal lead) Absence GTC 	<ul style="list-style-type: none"> 5/19/97 Bilateral Depths and subdural strips. 5/30/97 Anterior 2/3 cc R frontal topectomy 	<ul style="list-style-type: none"> EEG lateralized intraoperatively (to R frontal lobe) 1 yr Now occasional GTC (no absences) 	I
2-1	<ul style="list-style-type: none"> CP w/ 2° generalization History of status epilepticus 	<ul style="list-style-type: none"> 5/18/95 R Frontal Resection w/ anterior 2/3 CC and MST through motor strip 	<ul style="list-style-type: none"> CP w/ 2° generalization Ongoing history of status epilepticus Seizure free for 2 yrs Recurrence after fall and closed head injury Subsequent VNS 11/05 R functional hemispherectomy 	I/IV
3-1	<ul style="list-style-type: none"> CP w/ rapid 2° generalization to TC (non-lateralized EEG – Bifrontal Onset) 	<ul style="list-style-type: none"> Ant 2/3 followed by L frontal topectomy (VNS 18 mos. prior) 	<ul style="list-style-type: none"> 8/02 EEG w/ bifrontal onset CPS and SPS involving R arm and leg or L arm and leg Occasional 2° generalization to tonic-clonic 2 seizures/week Nonepileptic events 	III
4-1	<ul style="list-style-type: none"> Bifrontal Onset L & R Interictal epileptiform Note: L frontal porencephaly, R hemiparesis 	<ul style="list-style-type: none"> L grid w/ R frontal depths Ant 2/3 cc L Frontal topectomy 	<ul style="list-style-type: none"> Seizure free Markedly improved cognition 	I
5-1	<ul style="list-style-type: none"> Mixed seizure type Multifocal EEG (interictal) Bifrontal SZ onset (unable to lateralize) 	<ul style="list-style-type: none"> R Depth/L Grid Ant 2/3 with L frontal resection (onset overlap with language) 11/20/01 VNS 	<ul style="list-style-type: none"> Sz free for 6 months (now 2-3/month) Mild R hemiparesis 	III

Table 2

Group 2

Patient	Sz Type by CC (EEG Pattern)	Procedure	Sz/EEG after CC	Outcome/Engel Classification
1-2	<ul style="list-style-type: none"> Tonic/atonic drops CPC with rapid 2° generalization LGS Perinatal stroke – R porencephaly 	<ul style="list-style-type: none"> 1/96 Ant 2/3 CC 8/96 Completion 10/96 R frontal hemispherectomy 	<ul style="list-style-type: none"> No change in function 1 “drop” in 2 years Occasional R hemitonic seizure 	II
2-2	<ul style="list-style-type: none"> LGS Atonic drops 	<ul style="list-style-type: none"> 11/88 Ant 2/3 1/95 Completion w/ L temporal and frontal lobectomy after L grid 	<ul style="list-style-type: none"> 1 seizure/year Some nonepileptic events 	II
3-2	<ul style="list-style-type: none"> Tuberous sclerosis LGS CPS and drops 	<ul style="list-style-type: none"> 3/93 Ant 2/3 CC 2/94 Post CC 1/96 L Frontal topectomy 2/99 VNS 	<ul style="list-style-type: none"> Multifocal EEG R onset > LCP w/ 2° generalization; 1 daily 	II
4-2	<ul style="list-style-type: none"> Head trauma at 6 wks of age R hemiparesis Myoclonic and tonic seizures, occasional CPS with 2° generalization 	<ul style="list-style-type: none"> 2/93 Ant 2/3 CC 4/94 R functional hemispherectomy 	<ul style="list-style-type: none"> Sz free Overall improved cognition/development 	III
5-2	<ul style="list-style-type: none"> Tuberous sclerosis LGS 	<ul style="list-style-type: none"> 4/02 Ant 2/3 CC 9/02 Completion 12/00 VNS 8/04 Grid w/ R frontal and temporal resection 	<ul style="list-style-type: none"> Major seizures controlled 	II for target seizure
6-2	<ul style="list-style-type: none"> Porphyria MR Etiology? CPC 2° generalization (Bifrontal EEG) 	<ul style="list-style-type: none"> 6/91 Ant 2/3 EEG lateralized to R frontal onset Grid – R frontal/temporal with R frontal and lateral topectomies 	<ul style="list-style-type: none"> No change or worsening of myoclonic and atypical absence seizures 9/96 Deceased 	IV
7-2	<ul style="list-style-type: none"> LGS Mild L hemiparesis 	<ul style="list-style-type: none"> 5/18/00 Ant 2/3 CC 9/7/00 Completion of CC 5/20/04 L depth/R grid 5/28/04 L frontal topectomy 	<ul style="list-style-type: none"> Seizure free since 7/04 	I
8-2	<ul style="list-style-type: none"> LGS 	<ul style="list-style-type: none"> 1/93 Ant 2/3 CC 9/93 Completion CC 10/27/95 R grid 11/7/95 R FL disconnection & MTS (sparing motor strip) 4/1/04 Further R frontal resection 	<ul style="list-style-type: none"> Initially dramatic decrease in seizures- 2° generalization 1 daily 	II