Epilepsy & Behavior 36 (2014) 47–52

Contents lists available at ScienceDirect

Epilepsy & Behavior

journal homepage: www.elsevier.com/locate/yebeh

Outcome after anterior callosal section that spares the splenium in pediatric patients with drop attacks

Peng-Fan Yang [a,*], Qiao Lin [b], Zhen Mei [b], Zi-Qian Chen [c], Hui-Jian Zhang [a], Jia-Sheng Pei [a], Jun Tian [a], Yan-Zeng Jia [b], Zhong-Hui Zhong [b]

[a] Department of Neurosurgery, Fuzhou General Hospital of Nanjing Command, PLA, Fuzhou 350025, China
[b] Department of Epileptology, Fuzhou General Hospital of Nanjing Command, PLA, Fuzhou 350025, China
[c] Department of Medical Imaging, Fuzhou General Hospital of Nanjing Command, PLA, Fuzhou 350025, China

ARTICLE INFO

Article history:
Received 11 March 2014
Revised 17 April 2014
Accepted 21 April 2014
Available online xxxx

Keywords:
Neurosurgery
Pediatric epilepsy
Extended callosotomy
Drop attacks
Outcome

ABSTRACT

We report on the efficacy and safety of extended, one-stage anterior callosal section that spares the splenium, which is performed in a large series of pediatric patients with drop attacks. Twenty-nine pediatric patients with drop attacks were studied (19 males and 10 females; mean age: 9.9 years). As presurgical factors, the age at surgery, age at seizure onset, age at drop attack onset, sex, hemiparesis, severe mental retardation, electroencephalograph abnormalities, magnetic resonance imaging abnormalities, and ^{18}fluorodeoxyglucose positron emission tomography abnormalities were analyzed. All patients had multiple seizure types, including drop attacks, atypical absence seizures, complex partial seizures, tonic seizures, and generalized tonic–clonic seizures. All patients were developmentally impaired and had electroencephalograph results showing marked secondary bilateral synchrony. All patients received an extended, one-stage callosal section, leaving only the splenium intact. The mean follow-up time was 5.2 years. Seizure outcome (cessation of seizures or ≥90% seizure reduction) was achieved in 79.3% of patients with drop attacks. The families assessed the overall daily function as improved in 62.1% of the patients, unchanged in 24.1%, and worse in 13.8%. Family satisfaction with callosotomy was achieved in 82.8% of the patients. The majority of the patients had some degree of a transient acute postoperative disconnection syndrome that disappeared within 3 weeks. Postoperatively, patients showed a consistent increase in attention levels. We conclude that extended callosal sectioning that leaves the splenium intact should be considered a good palliative surgical option for pediatric patients with drop attacks and that diminishment of epileptic discharge synchrony is a good prognostic sign following callosotomy. We also found that the postoperative increase in attention levels was as useful as seizure control in improving the quality of life of these patients.

1. Introduction

The use of surgical division of the corpus callosum to prevent the spread of epileptic discharges from one hemisphere to the other was first reported in 1940 by van Wagenen and Herren [1]. Since then, various reports have determined that drop attacks (seizures where the patient suddenly falls forward or backward without being able to protect himself or herself) are the most responsive seizure type to callosotomy [2–4]. In addition to reducing seizure frequency, this technique generally results in both improved behavior and high parental satisfaction [3].

The primary deficit associated with callosotomy is disconnection syndrome, a condition characterized by a complex variety of deficits including self-recognition failure, hemispatial neglect, and alien hand syndrome that vary depending on the extent and location of the callosal section [5]. Although disconnection syndrome generally improves somewhat over several months, there are reports of permanent mild to moderate residual symptoms that are more common with total compared with anterior callosotomy [3,6–9]. As both doctors and patients may be unaware of other deficits that can be avoided by performing the appropriate section, they should exercise prudence in balancing the risk of adverse effects against the benefits of seizure outcome.

However, the extent of callosal section in the treatment of drop attacks has been a subject of considerable controversy. There are reports that division of the entire section is effective [10–15], while others only recommend complete callosotomy in patients whose condition does not improve substantially following anterior callosal section [16,17]. However, a recent study has found that this strategy has lower efficacy compared with a single-stage, complete callosotomy [18]. A less aggressive approach is to only perform an anterior callosotomy [19,20] sparing the splenium to preserve sufficient fibers for interhemispheric transfer of some perceptual information and diminish the risk of disconnection

* Corresponding author at: Department of Neurosurgery, Fuzhou General Hospital of Nanjing Command, PLA, North Road 156, West Second Ring, Fuzhou 350025, China. Tel.: +86 591 22859387; fax: +86 591 87640785.
E-mail address: yangpengfan@outlook.com (P.-F. Yang).

http://dx.doi.org/10.1016/j.yebeh.2014.04.019
1525-5050/

syndrome, which is usually associated with complete callosotomy [21]. Other reports have supported sectioning of the anterior two-thirds of the corpus callosum and have demonstrated a postoperative improvement rate of about 75% [12,22–27]. Total callosotomy has been shown to be more effective than partial callosotomy in children with drop attacks [3,13,15], with no obvious disconnection syndrome in children less than 10 years old [15,28].

There is controversy over which patients are appropriate candidates for callosotomy as well as the extent of callosal sectioning necessary, with different studies showing different results [3,4,26,29]. These discrepancies are mainly the result of differences in outcome measures, the definition of a successful outcome, and target seizure types between the studies. Furthermore, there have been very few reports of callosal sectioning in pediatric Chinese patients. In this study, in order to help determine the optimal candidates for callosotomy and the proper extent of callosal section, we report on the results of extended callosal section (sparing the splenium) in 29 pediatric Chinese patients with drop attacks.

2. Methods

2.1. Patients

Twenty-nine pediatric patients with a history of drop attacks (atonic or tonic seizures resulting in falls) who received extended callosal section between May 2004 and July 2011 were studied at the Epilepsy Center at Fuzhou General Hospital of Nanjing Command, PLA. All patients in the present series were referred to our center after at least 2 years of medical treatment.

The study was approved by the Institute Review Board of Fuzhou General Hospital of Nanjing Command, PLA. Oral informed consents were obtained from the patients.

2.2. Preoperative evaluation

Callosotomy was considered when the preoperative evaluation revealed that resective surgery was not appropriate. The preoperative evaluation included history and neurologic examination, interictal and ictal video-electroencephalograph (EEG) recording, computed tomography (CT), high-resolution 1.5-T (prior to 2007) or 3.0-T (2007 and later) magnetic resonance imaging (MRI), and ^{18}fluorodeoxyglucose positron emission tomography (FDG-PET). Scalp EEG recordings were obtained with 27 electrodes (modified 10–20 montage with subtemporal electrodes). The distribution of interictal epileptiform discharges (IEDs) during prolonged video-EEG monitoring (including sleep) was assessed by visual analysis. Scalp video-EEG included 3 or more seizures for each patient. The MRI included coronal T_1-spoiled gradient (SPGR), coronal fluid-attenuated inversion recovery (FLAIR), sagittal T_1, and axial T_2 spin echo sequences. Thin slices through the temporal lobes were obtained, with 4-mm slice thickness for the coronal T_1 and 2-mm slices for the coronal FLAIR. The results of these tests are shown in Table 2. Also, IQ testing with the Wechsler Child Intelligence Scale (Chinese version) for 6- to 18-year-old children, testing general, verbal, and executive IQ, was performed. Patients were divided into 4 groups according to the preoperative general IQ (also called full IQ or FIQ): severe mental retardation (IQ ≤ 34), moderate mental retardation (IQ = 49–35), mild mental retardation (IQ = 70–50), and no mental retardation (IQ > 70). Seizure frequency and type were recorded preoperatively and postoperatively by the families or caregivers in a diary. Intelligence quotient testing was repeated one year after surgery. No patient was submitted to any invasive recording. The typical criteria for consideration of extended corpus callosotomy were as follows: (1) semiology of drop attacks (e.g., generalized atonic, tonic seizures that were often expressed as drop attacks), (2) no responsible focal abnormality revealed on MRI and FDG-PET, (3) bilaterally synchronous or multiple interictal epileptiform discharges, and (4) bilaterally diffuse onset of ictal discharges (e.g., electrodecremental patterns and fast activities on EEGs).

2.3. Surgical technique

All patients were submitted to extended microsurgical callosal section through a parasagittal craniotomy, leaving only the splenium of the corpus callosum in place. Dr. Yang Peng-fan, an experienced neurosurgeon at Fuzhou General Hospital of Nanjing Command PLA, performed all callosotomies. Briefly, after induction of general endotracheal anesthesia, the patient was placed in a supine position. The head was then positioned neutrally so as to allow visualization of both the genu and splenium of the corpus callosum during surgery. Positioning of the head was also guided by the preoperative MRIs, which were reviewed to determine if the pericallosal arteries were directly over the septum.

Surgery was performed using a curvilinear scalp incision with the superior limb on the midline combined with a vertical one extending down toward the zygoma anterior to the coronal suture. The craniotomy was usually performed anterior to the coronal suture on the nondominant side and did not cross the midline. The craniotomy was with an anterior–posterior dimension of approximately 5–6 cm and a mediolateral dimension of approximately 3–4 cm. Care was taken to preserve all veins when opening the dura mater. Using sharp microdissection, the two cerebral hemispheres were carefully separated and the pericallosal and callosomarginal arteries were identified. The corpus callosum was then exposed and, in keeping with standard practice, was visualized from the genu to the presplenium area before beginning the callosotomy.

As the location of the pericallosal arteries is not a reliable landmark, neuronavigation was used to identify the precise midline as well as confirm the anterior and posterior extent of the callosotomy. Division of the corpus callosum, using microsuction, sharp dissection and bipolar cautery, was performed precisely at the midline until the cleft between the two laminae of the septum pellucidum became apparent. Either a microhook or microdissector was then placed between the laminae of the septum pellucidum and gently traced anteriorly to the genu and posteriorly to the isthmus, so as to divide the corpus callosum without entering the ventricular system.

2.4. Postoperative analysis

After the patients had recovered from surgery, they underwent MRI and prolonged video-EEG monitoring (including sleep) along with a battery of neuropsychological tests. The same EEG analysis interpreted video-EEGs before and after surgery. Patients were followed up and examined at 6- to 12-month intervals. The mean follow-up time was 5.2 years (range: 2–9), with the latest follow-up data used for this study. Neuropsychological tests, as well as those used for measuring daily function and parental satisfaction, were performed as described above. Intraoperative anatomical landmarks and neuronavigation determined the extent of callosal section, which was later confirmed, based on postoperative midsagittal MRI. The seizure protocol MRIs were the same as those used for the preoperative MRI evaluation. The neuroradiologist attached to the epilepsy program (Dr. Chen Ziqian) initially interpreted all MRIs and reviewed the findings for this study.

Assessments of seizure severity and frequency (per month) were obtained from the families, caregivers, and patients. Seizure types were classified according to the international classification of seizures based on a review of videotaped attacks and descriptions in nurses' notes or by family members. Surgical outcomes of each seizure type were categorized as follows on the basis of postoperative seizure frequency: seizure freedom, >90% reduction, 50–90% reduction, and <50% reduction. We considered seizure freedom and >90% reduction to be satisfactory outcomes. Changes in daily function and parental satisfaction with surgical outcome were determined during follow-up