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Hemispheric surgery for refractory epilepsy in children and adolescents: Outcome regarding seizures, motor skills and adaptive function

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ABSTRACT

Purpose: The aim of the study was to report the seizure outcome, motor skills and adaptive motor functions in a series of children and adolescents who underwent hemispheric surgery, analysing the risk-benefits of surgery.
Methods: The clinical course, seizure and motor function outcomes of 15 patients who underwent hemispheric surgery were reviewed.
Results: The mean age at surgery was 9.5, with 1–9 years follow-up. The underlying pathologies were Rasmussen encephalitis, vascular disorders, and hemimegalencephaly. All the patients presented with severe epilepsy and different degrees of hemiparesis, although motor functionality was preserved in 80% of the patients. At last follow-up, 67% were seizure free, and 20% rarely experienced seizures. Antiepileptic drugs were reduced in 60%, and complete withdrawal from such drugs was successful in 20% of the patients. The motor outcome following the surgery varied between the patients.

Despite the motor deficit after surgery, the post-operative motor function showed unchanged for gross motor function in most (60%), while 27% improved. Similar results were obtained for the ability to handle objects in daily life activities. Sixty percent of the children were capable of handling objects, with somewhat reduced coordination and/or motor speed.
Conclusion: Pre-surgical motor function continues to play a role in the pre-surgical evaluation process in order to provide a baseline for outcome. Hemispheric surgery, once regarded as a radical intervention and last treatment resource, may become routinely indicated for refractory hemispheric epilepsy in children and adolescents, with oftentime favourable motor outcomes.

1. Introduction

Hemispheric surgery (HS) is an established treatment for medically refractory epilepsy resulting from diffuse hemispheric disease, and it provides remarkable results in seizure outcome and quality of life.[1–3]

HS can be considered for patients with seizures arising from one hemisphere, with pre-existing structural and functional abnormalities; the other hemisphere is usually normal. This approach is particularly suitable for those with pre-existing hemiplegia and visual field deficit, in whom coexisting cognitive and behavioural impairments are common.[4] HS may be offered to patients without such disabilities, especially in circumstances in which intractable seizures are accompanied by the deterioration of motor and intellectual skills and in cases in which more conservative resections are unsuccessful.[4,5]

The decision making process and consideration of baseline motor function during the presurgical evaluation of patients considered for HS differs among epilepsy surgery centres. Certain centres are more conservative, limiting surgery to patients with preoperative hemiparesis.[2,6] On the other hand, surgery may be indicated in patients with or without minor motor deficits.[1,4,5,7,8]

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Despite good seizure outcome, the anticipated loss of motor function may prevent a decision to perform the surgery.[9]

The objective of this study is to report the seizure outcome, motor skills and adaptive motor functions in a series of children and adolescents who underwent HS at our centre, analysing the risks (residual motor deficit) and benefits (seizure reduction) of surgery.

2. Methods

We conducted a retrospective review of medical records in 15 children and adolescents (9 males) who underwent HS at Hospital São Paulo, Universidade Federal de São Paulo, between 2003 and 2011. The patients were assessed using a standard presurgical protocol, including clinical, neuroimaging and neurophysiological evaluations. Detailed clinical data were obtained from the patients and their families. All patients were examined by high-resolution magnetic resonance imaging and prolonged video-EEG recording. In the cases in which surgical treatment was indicated, the data were discussed during an interdisciplinary meeting. The records of the motor evaluation of muscle strength and motor function abilities, including the ability to sit, walk, and use both hands were reviewed, and these data were collected. The pre- and post-operative motor functions were assessed for presence and severity of hemiparesis. The muscle strength of the extremities was scored by manual muscle testing, with grades from 0 to 5. The functional level of each patient was evaluated through the Gross Motor Function Classification System (GMFCS) and the Manual Ability Classification System (MACS), which classify patients' movement and manual abilities, respectively. These scores were recorded in the charts or inferred by the available data.[10,11]

The GMFCS determines which of the five levels best corresponds to abilities and limitations in gross motor function, with particular emphasis on sitting (truncal control) and walking: level I denotes patients who walk without limitations, and level V indicates those with severe limitations of head and trunk control who require extensive assisted technology and physical assistance.[10]

The MACS scale is used to assess a patient for coordination in both hands working together; it is not an assessment of each hand taken separately. The five levels are based on a patient's self-initiated ability to handle objects and need for assistance or adaptation to perform manual activities in daily life. The patients classified at level I handle objects easily and successfully, whereas the patients classified at level V do not handle objects, have a severely limited ability to perform simple actions and require complete assistance.[11]

The Fisher exact test was used to compare the results of the pre- and post-operative GMFCS and MAC's scores, grouped according to motor adaptive functions (Group A: satisfactory scores – levels I, II or III; Group B: unsatisfactory scores – levels IV or V).

Seizure outcome was assessed using the Engel scale of seizure outcome after epilepsy surgery.[12]

During the postsurgical appointments, each parent was asked which grade of satisfaction he/she would attribute to the surgical intervention (from zero, minimum satisfaction, to 10, maximum satisfaction) regarding the seizure outcome and cognitive/motor functions in his or her child.

3. Results

3.1. Patients and pre-operative data

The age at seizure onset ranged from 18 days to 7 years (mean 3.1/median 3 years). The age at surgery varied between 1.3 and 16 years (mean 9.5/median 5.8), and the epilepsy duration was 0.2–14 years (mean 5.9/median 2). The post-operative follow-up period ranged from 1 to 9 years (mean 4/median 3) and the follow-up was longer than 2 years in two-thirds of the patients (Table 1).

The underlying pathology was Rasmussen encephalitis in nine patients (60%), vascular disorders in five patients (33%) and hemimegalencephaly in one patient (7%). The left hemisphere was involved in ten cases (67%) (Table 1).

Fifteen patients had daily seizures, and nine had *epilepsia partialis continua*. Fourteen patients were treated with antiepileptic drug (AED) polytherapy, and six had received previous immunomodulatory treatment.

All the patients presented with at least a mild level of hemiparesis, although it was not pronounced in one-half of the patients. Eight patients (53%) had a score of 3 or higher for muscle strength (Table 1). In six patients (40%), fine finger movements were preserved. The GMFCS and MACS scores are shown in Graphics 1 and 2.

3.2. Operative and complications – potential risks

In 14 patients (93%), a hemispherotomy was performed. One patient had undergone a previous surgery, and hence hemispherectomy was indicated. Mild intra- and/or post-operative complications were reported in all the patients, including minor bleeding and fever. Moderate reversible complications were observed as follows: infections (3 patients), ipsilateral vascular ischaemia (1), diabetes insipidus (1), lung atelectasis (1), and trigeminal neuralgia (1).

Table 1
Clinical data and pre- and post-operative muscle strength in upper and lower limbs.

	Age at surgery[a]	Pathology	Follow-up[a]	Engel Class	MS-UL Pre-HS	MS-UL Post-HS	MS-LL Pre-HS	MS-LL Post-HS
1	2.3	RE	9	I	4	5	3	4
2	1.3	Vascular	9	I	1	2	2	2
3	5.8	Vascular	9	II	3	4	3	4
4	10.8	RE	4.4	I	4	4	3	4
5	3.3	HME	1	II	2	2	2	3
6	13.6	Vascular	4	III	2	3	2	3
7	9.4	RE	3.6	I	4	4	3	4
8	4.9	RE	3.6	I	4	3	3	4
9	11.3	Vascular	3	III	3	4	3	3
10	6.3	Vascular	3	I	4	4	3	4
11	6.2	RE	2	I	2	3	3	4
12	5.6	RE	2	I	2	3	2	3
13	3.5	RE	2	II	2	2	3	3
14	3	RE	2	I	2	4	3	4
15	16	RE	1	I	4	3	2	4

[a] In years; MS-UL: muscle strength upper limb; MS-LL: muscle strength lower limb; HS: hemispheric surgery; RE: Rasmussen encephalitis; HME: hemimegalencephaly.