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A follow-up study of cognitive function in young adults who had resective epilepsy surgery in childhood

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ABSTRACT

This study examined cognitive function in young adults who had epilepsy surgery in childhood. Thirty-seven individuals with medically intractable epilepsy with onset at 16 years or younger who had resective epilepsy surgery at least two years in the past (mean follow-up duration of 8.5 years) were assessed; of these, 13 had seizures within the year prior to the study, and the remainder had none. A comparison group of 16 individuals with childhood-onset intractable epilepsy who had not had surgery, all of whom had experienced at least one seizure in the past 12 months, was also included. The cognitive tests included measures of vocabulary, visuoconstructive ability, memory, and concept formation. Group differences were found only for the vocabulary and verbal memory tests, with the surgical group with seizures having the lowest performance. A subset of the surgical patients had preoperative data available on comparable tests, allowing for an examination of performance over time. Vocabulary scores were higher at follow-up, a finding which was present irrespective of seizure status. The results suggest that after epilepsy surgery in childhood or adolescence, few improvements in cognitive skills related to surgery or seizure outcome are to be expected.

1. Introduction

The major goal of epilepsy surgery in children is to stop or decrease the frequency of seizures. By so doing, it is hoped that surgery may have secondary benefits on children's cognitive and psychosocial development. The present study was conducted to determine whether any such advantages could be documented in cognitive functioning in a group of young adults who had surgery in childhood. To date, the majority of studies of cognition after pediatric epilepsy surgery have examined relatively short-term outcomes, ranging from 6 months to one year after surgery (for review, see [1]). These studies provide little evidence for changes over this time period; however, it may be that a longer period of time is required for such change to declare itself. Two studies examining IQ in patients who had undergone temporal lobectomy have investigated longer-term outcomes. Adams et al. [2] found no evidence for change in IQ five years after surgery, whereas Skirrow et al. [3] found that IQ improved but that this improvement was seen only in patients assessed six years or more after surgery. A third study examined a wider range of cognitive abilities 10 years after surgery in 17 patients with a variety of surgical procedures (cortical resection, hemispherectomy, multiple subpial transection, corpus callosotomy); changes in IQ and executive function were not found, although learning improved and memory and visual attention declined [4]. Given the small number of longer-term outcome studies and the inconsistency in findings, further investigation is warranted.

The main purpose of the present study was twofold: to examine the cognitive status of young adults who, as children or adolescents, had epilepsy surgery and to compare it to a group of individuals with epilepsy who had not had epilepsy surgery. The inclusion of such a comparison group is one way to ascertain whether changes over time are related to surgery and seizure outcomes. A second purpose was to relate the cognitive status of the surgical patients in adulthood to that demonstrated in childhood and adolescence prior to surgery.

2. Material and methods

2.1. Participants

Fifty-three participants, between the ages of 18 and 30 years, fell within one of three groups, defined by whether or not the individuals had surgery as well as their seizure status in the past year. Individuals

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with childhood-onset epilepsy (i.e., seizure onset at 16 years or younger) who had resective epilepsy surgery (n = 37) at least two years in the past at the Hospital for Sick Children (Toronto) or the Children's Hospital of Eastern Ontario (Ottawa) were subdivided into those who had experienced at least one seizure in the past year (n = 13) and those without any seizures in the past year (n = 24). The comparison group (n = 16) consisted of young adults with childhood-onset intractable epilepsy who had not had surgery, all of whom had experienced at least one seizure in the past 12 months. The comparison group was recruited from patients followed at the University Health Network — Toronto Western Division or the University of Alberta Hospital (Edmonton) or from former patients at the Children's Hospital of Eastern Ontario. Individuals who had undergone corpus callosotomy or hemispherectomy were excluded from the study. Exclusion criteria for the comparison group were the following types of epilepsy which are not treated with surgery: Lennox–Gastaut syndrome, benign occipital epilepsy, absence epilepsy, Janz syndrome, benign rolandic seizures, severe childhood myoclonic epilepsy, and epilepsy associated with neurodegenerative disorders such as progressive myoclonic epilepsy.

Table 1 presents the demographic and seizure-related data of the three groups. There were no differences between groups in age ($F < 1.0$), age at seizure onset ($F < 1.0$), proportion of life with epilepsy ($F(2,51) = 1.31$, $p > .05$), sex distribution ($\chi^2(2) = 1.21$, $p > .05$), or type of seizures ($\chi^2(8) = 11.72$, $p > .05$), but there was a significant group difference in the number of antiepileptic drugs (AEDs) taken ($F(50) = 24.86$, $p \leq 0.001$); post hoc Tukey's tests showed that the seizure-free surgical group was taking significantly fewer AEDs than either of the two other groups (surgical group with seizures, $p < .001$; comparison group, $p < .001$; these two latter groups did not differ, $p > .05$). Sixteen of the participants in the seizure-free surgical group were not taking any AEDs, whereas all participants in the surgical group with seizures and 15 of the 16 participants in the comparison group were on AEDs. The mean length of follow-up in the surgical group was 8.46 years (SD = 5.67; range = 2–22 years). The two surgical groups did not differ on years since surgery ($F(1,35) = 1.15$; $p > .05$), age at surgery ($F(1,35) = 2.31$; $p > .05$), laterality of excision ($\chi^2(1) = 0.00$, $p > .05$), or site of excision (temporal vs. extratemporal vs. multilobar; $\chi^2(3) = 3.38$, $p > .05$).

2.2. Tasks

Brief neuropsychological assessments were administered to provide estimates of vocabulary, visuoconstruction ability, verbal and visual memory, and problem solving. These abilities were measured with the vocabulary and block design subtests of the Wechsler Adult Intelligence Scale — Third Edition [5], the Logical Memory (stories) and Faces subtests of the Wechsler Memory Scale — Third Edition [6], and the Wisconsin Card Sorting Test [7,8], respectively. Data on neuropsychological functioning prior to surgery were obtained from the patients' clinical records of assessments conducted as part of clinical care.

2.3. Procedure

The data were collected as part of a larger study examining multiple outcomes in young adulthood after pediatric epilepsy surgery, including social function [9], psychological well-being [10], and quality of life [11]. Potential participants were mailed an introductory letter to explain the study. For the larger study, the overall response rate for those who we were able to contact was 69% (n = 69) of the surgical patients and 52% (n = 29) of the controls [11]. Those who indicated interest and who lived within a two-hour commuting distance from one of the participating institutions underwent the cognitive assessment. The study was approved by the Research Ethics Boards of the institutions partaking in the study, and all participants provided informed consent.

3. Results

Because of the relatively small n's in some of the comparisons, we reduced the number of variables analyzed. The story recall and face recognition tests contained scores for both immediate and delayed recall and recognition, respectively; for both these tasks, the scores for immediate and delayed tests did not differ significantly ($p > .05$). We chose the immediate memory scores only because at baseline, there were fewer participants with scores on delayed face recognition than on immediate recognition. For the Wisconsin Card Sorting test, the number of categories correctly sorted and the number of perseverative errors were the dependent variables.

Table 1
Patient characteristics.

	Surgical group		Comparison group (n = 16)
	With seizures (n = 13)	Seizure-free (n = 24)	
Age at follow-up (mean (SD))	22.19 (3.69)	22.13 (3.13)	22.62 (3.29)
Age at seizure onset (mean (SD))	5.45 (2.79)	6.21 (4.84)	7.69 (5.24)
Age at surgery (mean (SD))	15.09 (1.99)	12.93 (4.86)	N/A
Years since surgery (mean (SD))	7.10 (4.54)	9.19 (6.16)	N/A
Number of AEDs (mean (SD))	2.54 (1.26)	0.42 (0.65)	1.75 (0.93)
Type of seizures (n)			
Partial	6	11	6
Partial + secondarily generalized	5	4	2
Secondarily generalized	1	1	5
Other	0	1	0
Unknown	1	7	3
Site of resection[a] (n)			
Left Temp/ExTemp/Multi	5/2/0	11/3/1	
Right Temp/ExTemp/Multi	3/3/0	6/1/2	N/A
Pathology			
Tumor	2	9	
Mesial temporal sclerosis	0	2	
Cortical dysplasia	5	3	
Vascular anomaly	0	2	N/A
Gliosis	4	4	
Cyst	0	2	
Encephalitis	1	0	
Unknown	1	2	

AEDs: antiepileptic drugs; N/A: not applicable.
[a] Temp: temporal; ExtTemp: extratemporal; Multi: multilobar.