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Increasing volume and complexity of pediatric epilepsy surgery with stable seizure outcome between 2008 and 2014: A nationwide multicenter study

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ABSTRACT

Objective: The objective of the study was to assess common practice in pediatric epilepsy surgery in Italy between 2008 and 2014.
Methods: A survey was conducted among nine Italian epilepsy surgery centers to collect information on presurgical and postsurgical evaluation protocols, volumes and types of surgical interventions, and etiologies and seizure outcomes in pediatric epilepsy surgery between 2008 and 2014.
Results: Retrospective data on 527 surgical procedures were collected. The most frequent surgical approaches were temporal lobe resections and disconnections (133, 25.2%) and extratemporal lesionectomies (128, 24.3%); the most frequent etiologies were FCD II (107, 20.3%) and glioneuronal tumors (105, 19.9%). Volumes of surgeries increased over time independently from the age at surgery and the epilepsy surgery center. Engel class I was achieved in 73.6% of patients (range: 54.8 to 91.7%), with no significant changes between 2008 and 2014. Univariate analyses showed a decrease in the proportion of temporal resections and tumors and an increase in the proportion of FCDII, while multivariate analyses revealed an increase in the proportion of extratemporal surgeries over time. A higher proportion of temporal surgeries and tumors and a lower proportion of extratemporal and multilobar surgeries and of FCD were observed in low (<50 surgeries/year) versus high-volume centers.

Abbreviations: FCD, focal cortical dysplasia; fMRI, functional MRI; PET, positron emission tomography; SEEG, stereoelectroencephalography.

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There was a high variability across centers concerning pre- and postsurgical evaluation protocols, depending on local expertise and facilities.
Significance: This survey reveals an increase in volume and complexity of pediatric epilepsy surgery in Italy between 2008 and 2014, associated with a stable seizure outcome.

1. Introduction

Epilepsy surgery is underused in children [1–3] possibly because of the common practice to try all available antiepileptic drugs, the succession of seizure remissions and relapses, and the uncertainties concerning cognitive outcome. An international survey of pediatric epilepsy surgery centers [4] showed that only a third of children had proceeded to surgery within 2 years from epilepsy onset, despite the fact that 60% of these children were experiencing seizures since 2 years of age.

A US community based cohort study estimated the incidence of childhood-onset drug-resistant focal epilepsy as 11.3 per 100,000 per year and that of epilepsy surgery procedures as 1.3 per 100,000 per year [5]. This ninefold difference has been related to the availability of comprehensive presurgical assessment for only 45% of children with drug-resistant epilepsy [5]. Accordingly, a UK survey reported 1.0 per 100,000 epilepsy surgery procedures in children between April 2010 and March 2011 [6]. In contrast, more recent nationwide surveys have demonstrated an increasing utilization of pediatric epilepsy surgery in the US and Europe [3,7–9].

Based on previous nationwide reports [3,7–9] and the 2008 ILAE survey [4], the Commission on Epilepsy Surgery of the Italian League Against Epilepsy recognized the need to obtain information on common practice of pediatric epilepsy surgery in Italy between 2008 and 2014. This assessment period was determined because most Italian pediatric epilepsy surgery centers were established from 2008 onwards.

Subsequently, a survey was conducted among nine Italian pediatric epilepsy surgery centers that had been identified through a previous Italian League Against Epilepsy epidemiological survey. We aimed at collecting information on common presurgical and postsurgical evaluation protocols and, on volumes and types of surgical interventions, etiologies and seizure outcomes in children operated on between 2008 and 2014. Moreover, the survey aimed at investigating the geographic origin of patients in relation to the distribution of epilepsy surgery centers through the Italian territory and the specialty profile of the referring physicians.

In this study, we report the results of this nationwide multicenter survey.

2. Material and methods

Information on data collection and statistical analysis methodology are reported as supplementary material.

Each center sent aggregate data to C.B. with no indications to individual patients. Informed consent for all clinical procedures was obtained from all patients.

3. Results

Nine centers provided full information on surgical procedures performed between 2008 and 2014 (see Table 1 for the list of the participating centers). Eight of them also completed the questionnaire on presurgical evaluation and postsurgical follow-up protocols.

3.1. Questionnaire

3.1.1. Selection criteria

According to the international criteria for referral [1,10,11], children with seizures that were uncontrolled by medical treatment (i.e., failure of two appropriate drugs [10]) or disabling (including medication side effects) were considered as possible surgical candidates in all centers. However, drug resistance was not considered as a mandatory selection criterion for surgery in two conditions: a) developmental arrest or progressive cognitive decline and b) suspected tumoral etiology. Children with drug-responsive seizures were included in the analysis if they had been operated on according to "epilepsy surgery" criteria, i.e., identification of the area to be removed through the optimal presurgical assessment and consensus conferences.

3.1.2. Presurgical evaluation protocol

All participating centers performed at least 1-hour scalp video-EEG in all patients. Three centers (37.5%) performed long-term monitoring to capture seizures in all patients, and four (50%) in selected cases only, i.e., normal brain MRI or discordant anatomoclinical correlations. Five centers (62.5%) performed invasive recordings (subdural grids only in two centers, stereo-EEG only in two, both approaches in the remaining center). All centers carried out intraoperative functional mapping in case of close proximity of the epileptogenic lesion and/or zone to eloquent area, and three also intraoperative electrocorticography (EcoG; 37.5%).

All centers performed at least one brain MRI during the presurgical evaluation (three centers (37.5%) 1.5 T, three centers (37.5%) 3 T MRI, and two centers (25%) either 1.5 or 3 T MRI depending on clinical needs). There was no agreement on specific imaging protocols; however, an anatomic, thin-slice volumetric T1-weighted gradient-recalled-echo sequence, axial and coronal T2-weighted sequences, and fluid attenuated inversion recovery (FLAIR) sequences (axial, and coronal if possible), with maximal slice thickness not exceeding 4–5 mm were performed in all surgical candidates in all centers [12]. All centers performed functional brain MRI (fMRI) during language and motor tasks in case of close proximity of epileptogenic lesion and/or zone to eloquent areas, four (50%) also under sedation in uncooperative children. All centers performed FDG-PET in selected cases only, i.e., normal brain MRI and discordant EEG findings; four (50.0%) also under sedation.

Table 1
Volumes of epilepsy surgeries in Italy. Trends at the centers included in the survey (2008–2014).

	Niguarda, Milan n (row%)	Bellaria, Bologna n (row%)	Gemelli, Rome n (row%)	Gaslini, Genoa n (row%)	Meyer, Florence n (row%)	Salesi, Ancona n (row%)	Neuromed, Pozzilli n (row%)	Bambino Gesù, Rome n (row%)	Carlo Besta, Milan n (row%)	All centers
2008	26 (46.4)	4 (7.1)	8 (14.3)	2 (3.6)	6 (10.7)	4 (7.1)	3 (5.4)	0 (0.0)	3 (5.4)	56
2009–2010	70 (48.6)	4 (2.8)	9 (6.3)	5 (3.5)	26 (18.1)	9 (6.3)	7 (4.9)	8 (5.6)	6 (4.2)	144
2011–2012	57 (39.3)	1 (0.7)	7 (4.8)	9 (6.2)	35 (24.1)	4 (2.8)	1 (0.7)	23 (15.9)	8 (5.5)	145
2013–2014	72 (39.6)	1 (0.5)	7 (3.8)	12 (6.6)	40 (22.0)	7 (3.8)	0 (0.0)	34 (18.7)	9 (4.9)	182
All years	225 (42.7)	10 (1.9)	31 (5.9)	28 (5.3)	107 (20.3)	24 (4.6)	11 (2.1)	65 (12.3)	26 (4.9)	527