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Individually tailored extratemporal epilepsy surgery in children: Anatomo-electro-clinical features and outcome predictors in a population of 53 cases

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ABSTRACT

Surgery for refractory extratemporal lobe epilepsy (ETLE) in the pediatric age group has been reported to be associated with a high percentage of failure and relapse. We performed a retrospective study of 53 consecutive patients with epilepsy onset before 12 years of age, who underwent, mostly at a pediatric age, an individually tailored ETLE surgery (32 in frontal and 21 in posterior cerebral areas) for pharmacoresistant seizures; these patients were selected and followed by a single national tertiary care pediatric center. Mean age at seizure onset was 3.14 years, and mean age at surgery was 11.23 years. Complete seizure freedom was achieved in 75% of the subjects. Short duration of illness before surgery, MRI features, no invasive pre-surgical evaluation, a localized interictal and ictal pattern as well as the presence of ictal fast activity on scalp EEG, localized interictal fast rhythms and absence of a diffuse initial ictal modification during SEEG, a complete resection of the epileptogenic zone, a type II FCD, and the absence of acute postoperative seizures correlated in a statistically significant way with a seizure-free outcome.
We conclude that the seizure outcome of ETLE surgery in a carefully selected pediatric population can be excellent.

1. Introduction

Surgical treatment of extratemporal lobe epilepsy (ETLE) concerns about 40% of resections among large pediatric series [1,2].

Despite the progressive development of neuroimaging, electrophysiological, and operative techniques, incidence of ETLE surgical failure in children is reported to be relatively high [3–11], and could be attributed, not only to the major complexity in localizing the epileptogenic zone (EZ) and to the presence of eloquent areas, but also to the fact that selection criteria for children who could benefit from ETLE surgery are still not completely defined.

Furthermore, despite the fact that focal non-idiopathic ETLE is more frequent in childhood than in adults, there have been relatively few studies characterizing the features and exploring the prognostic factors influencing the outcome of ETLE surgery within a pediatric population, an essential element for counseling families for epilepsy surgery.

In this regard, the aim of this study was to characterize a population of patients with pharmacoresistant ETLE, whose diagnosis and indication for individually tailored resective epilepsy surgery were achieved at a single national tertiary care pediatric center, and to identify the prognostic factors associated with a favorable postoperative seizure outcome.

2. Patients and methods

We retrospectively studied the medical records of 53 consecutive patients suffering from pharmacoresistant ETLE with onset before 12 years of age, all recruited and followed by the Infantile Neuro-Psychiatry Service of the University Hospital of Verona; these patients received individually tailored resective surgery for resistant seizures at the "Claudio Munari" Epilepsy Surgery Centre of the Niguarda Hospital, Milano, between 1996 and 2010.

In order to obtain a semiologically homogeneous population, the age limit of 12 years at seizure onset was chosen, since adolescents tend to show clinical ictal patterns superimposable to adults [12].

Pre-surgical evaluation protocol included a detailed neurologic and neuropsychological (IQ: intelligence quotient or DQ: developmental quotient, attention, problem solving, linguistic, amnestic, visuo-constructive function assessment, behavioral profile) examination, prolonged scalp video-EEG monitoring with scalp electrodes placed according to the International 10–20 system, a neuroradiological investigation by a 1.5 T MRI using a dedicated epilepsy protocol [13] and, when necessary, functional imaging.

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In cases where the data obtained by non-invasive pre-surgical evaluation were discordant, or MRI was unremarkable, or highly functional regions were located immediately close to the presumed EZ, stereo-electroencephalography (SEEG) monitoring was performed; implantation strategy, aiming to explore the areas putatively involved in the seizure onset and early propagation, was based on an individual electro-clinical hypothesis (the technique for placement of intracerebral electrodes employed in SEEG has been previously reported [14]).

Six months after surgery, all subjects had a first follow-up visit with EEG, MRI, and neuropsychological evaluation; further follow-ups were obtained annually until at least 5 years from surgery. Postoperative outcome was classified according to Engel's classification [15].

In all cases, at least one seizure was recorded, and semiological features were analyzed for each patient. For the purpose of the study, subjective manifestations and the initial objective ictal clinical sign were taken into account.

Table 1
Patients' features.
Age onset: age at seizure onset (months), age surgery: age at surgery (months), exam (neurologic/neuropsychologic/psychiatric): n: normal/m: moderate/s: severe, MRI+: positive, MRI −: negative, freq: frequency, CPS: complex partial seizures, SPS: simple partial seizures, S: spasms, D: daily, W: weekly, M: monthly, A: annual, pf: partial functional resection, t: total resection, def postop: de novo permanent postoperative deficits, R: right, L: left, F: frontal, P: parietal, O: occipital, T: temporal, C: central, Operc: opercular, Ins: insular, OpercIns: opercular-insular, cing: cingular, FU: follow-up (years), AED: antiepileptic drugs, *t*: AEDs tapered, *m*: monotherapy, p: polytherapy, d: deceased, crypto: cryptogenic, TSC: tuberous sclerosis complex, FCD: focal cortical dysplasia, FCDI: FCD type I, FCDII: FCD type II, DNET: dysembryoplastic neuroepithelial tumour, PMG: polymicrogyria, astrocyt: astrocytoma, ganglio: ganglioglioma, oligod: oligodendroglioma, heterot: heterotopia, HH: homonymous hemianopsia, HQ: homonymous quadrantanopsia, hp: hemiparesis, mp: monoparesis, contr: contralateral, ipsil: ipsilateral.

Pt	Age onset	Age surgery	Exam	Seizures type/freq	Status	MRI	SEEG	Excision	Etiology	FU (years) /AED	Engel class	Def postop
1	0.6	76	m/m/n	CPS/W	Yes	+	Yes	L F dorsolateral	FCDIIB	10/*t*	Ia	No
2	41	151	n/n/n	SPS, CPS/D	No	−	Yes	R F mesial	FCDIIA	6/*t*	Ia	No
3	60	156	n/n/n	SPS, CPS/A	No	+	No	L F2	TSC	6/*t*	Ia	No
4	48	96	n/n/n	CPS/D	No	+	Yes	R F mesial + dorsal	FCDI	7.5/*t*	Ia	No
5	55	133	n/n/n	SPS, CPS/W	No	−	Yes	L F mesial + dorsal (pf → t)[a]	FCDIIB	6.5/*t*	Ia	No
6	9	75	n/n/n	SPS, CPS/D	Yes	−	Yes	R F orbito-frontal	FCDI	13.5/*t*	Ia	No
7	4	144	n/m/n	SPS, CPS/D	No	+	Yes	R F1 + F2 + cingular	PMG	1.5/*m*	Ic	No
8	42	114	n/m/n	SPS, CPS/W	No	−	Yes	R F1	FCDIIB	5/*t*	Ia	No
9	68	132	n/n/n	CPS/W	No	+	Yes	L F3	Gliosis	6.5/*t*	Ia	No
10	12	156	n/m/n	CPS/A	No	+	No	R F1, F2, F3	FCDIIB	5/*t*	Ia	No
11	11	85	n/m/m	SPS, CPS/D	Yes	+	No	L F1 + mesial	TSC	8/*t*	Ia	No
12	1	13	n/n/n	S, CPS/W	No	+	No	R F polar + cing + operc	FCDIIA	4/*t*	Ia	No
13	72	273	n/n/n	SPS, CPS/D	No	+	Yes	R F OpercIns	FCDIIA	6.5/*t*	Ia	No
14	26	162	m/m/n	SPS/M	No	+	No	L F Operc	DNET	4/*m*	Ia	No
15	6	203	n/n/n	SPS, CPS/M	No	−	Yes	R F OpercIns	FCDI	2/*m*	Ia	No
16	11	41	n/n/n	SPS, CPS/D	No	+	Yes	L F OpercIns	FCDIIB	11.5/*t*	Ia	No
17	60	215	n/n/n	SPS, CPS/W	No	+	No	R F Ins	FCDI	2.5/*m*	Ia	No
18	12	211	n/s/m	CPS/W	No	−	Yes	R F mesial[a]	FCDI	9/p	II	No
19	9	114	m/m/m	S, CPS/W	No	+	Yes	R F dorsolateral (pf)	FCDI	10/p	II	No
20	25	60	m/m/m	SPS, CPS/M	No	+	Yes	R F (SMA + operc + cingular + orbital) (pf)[a]	FCDI	7/p	II	No
21	32	122	n/n/n	CPS/W	No	−	Yes	R F mesial	Gliosis	2/p	II	No
22	108	288	n/n/n	SPS, CPS/W	Yes	+	Yes	L F mesial C (pf)	DNET	11/p	II	No
23	90	180	n/n/n	SPS, CPS/W	No	+	No	L F mesial	Astrocyt	11.5/p	IV	No
24	96	219	n/m/m	CPS/D	No	−	Yes	L fronto-orbital	FCDIIA	d	d	
25	16	48	n/n/n	SPS, CPS/W	No	+	Yes	R FC	FCDIIB	2.5/*m*	Ia	No
26	0.1	312	m/n/n	SPS, CPS/M	No	+	No	L FCT	Gliosis	4/p	III	No
27	22	84	m/n/m	SPS, CPS, reflex/D	Yes	+	Yes	R FCT	Gliosis	12/*t*	Ic	No
28	60	117	n/m/n	SPS, CPS/D	No	+	Yes	L FCT (pf → t)[a]	FCDIIIA	3.5/p	III	No
29	13	103	m/m/n	SPS,CPS/W	Yes	+	Yes	R FCP	FCDIIA	5/*t*	Ia	Hp
30	1	41	m/m/m	SPS, CPS/D	Yes	+	Yes	R FCP [a]	FCDIIA	6/*t*	Ia	No
31	0.3	26	m/m/m	SPS, CPS/W	No	+	Yes	R FCP (pf → hemisph)[a]	FCDIIB	7.5/*t*	Ia	Hp
32	48	87	n/n/n	SPS, CPS/W	Yes	+	No	R FCP (pf → t)[a]	Astrocyt	6.5/*t*	Ic	Mp
33	48	120	n/n/n	SPS, CPS/D	No	+	Yes	R P (pf → t)[a]	DNET	11.5/*m*	Ic	No
34	144	276	n/n/n	SPS, CPS/M	No	+	Yes	R P	DNET	11/*t*	Ia	No
35	24	87	n/n/n	SPS, CPS/D	No	+	Yes	R PC	FCDI	2/*m*	Ia	No
36	89	288	n/m/m	SPS, CPS/W	No	+	Yes	R P	Ganglio	7/*t*	Ia	No
37	72	78	n/n/n	SPS, CPS/W	No	+	No	L P	Oligod	5/*t*	Ia	No
38	5	146	m/m/m	SPS, CPS/D	No	−	No	L P (pf)	FCDIIA	8.5/p	III	No
39	6	12	n/n/n	S, CPS/W	No	+	Yes	R PT	TSC	13/*t*	Ia	No
40	30	63	n/n/n	SPS, CPS/D	No	+	No	R PT	Ganglio	10.5/*t*	Ia	HQ
41	23	47	n/m/n	S, CPS/D	No	+	Yes	L O	FCDIIA	3/*m*	Ia	HH
42	36	95	n/n/n	CPS/D	No	+	No	R OT	Gliosis	5/*t*	Ia	No
43	116	180	n/n/n	SPS, CPS/W	No	+	No	L OT	DNET	4.5/*t*	Ia	No
44	18	168	n/n/n	CPS/M	No	+	No	R OT	FCDIIB	3.5/*t*	Ia	HQ
45	51	188	n/n/n	SPS, CPS/D	No	+	No	R OT	Gliosis	10/*t*	Ia	HH
46	144	204	n/n/n	SPS, CPS/W	No	+	Yes	R OT (pf → t)[a]	Ganglio	5/*m*	Ia	HH
47	0.6	204	n/m/m	SPS, CPS/M	No	+	Yes	L OT	FCDI	9.5/p	IV	HH
48	1	61	m/m/m	CPS, S/W	No	+	No	L TPO	FCDIIA	4/*t*	Ia	No
49	0.16	51	m/m/m	S, CPS/D	No	+	No	R TPO	FCDIIB	6/*t*	Ia	No
50	58	240	n/n/n	SPS, CPS/W	No	+	No	R TO	FCDIIIB	9.5/*t*	Ia	HQ
51	2	80	n/m/n	CPS/D	No	+	Yes	R TPO	crypto	2/p	III	No
52	72	276	n/n/n	SPS, CPS/W	No	−	Yes	L TPO (pf)	Laminar Heterot	7.5/p	IV	HH
53	4	43	m/s/m	S, CPS/D	No	−	Yes	L TPO	Gliosis	5/p	IV	No

[a] Re-operation.