Post-operative Infections Secondary to Invasive Electrode Monitoring and Epilepsy Surgery in Pediatric Population

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Introduction

Intracranial electroencephalography (iEEG) is a valuable tool in localizing the epileptogenic focus in patients with medically refractory epilepsy, when less invasive methods such as MRI and EEG are insufficient. iEEG electrodes are left in situ to record on average 7 days. Reported rates of surgical site infections (SSIs) in pediatric population range widely from 2.4 to 15%[1-2]. Furthermore, factors associated with SSIs is unclear. This retrospective study aims to describe the rate and nature of and identify risk factors for SSIs at our pediatric neurosurgery center.

Methods

We reviewed 199 consecutive patients who underwent iEEG monitoring between the 2001 and 2016. The study was approved by our institutional research ethics board. Data was extracted from electronic patient records containing also scanned documents. Variables including age, length of surgery, number of people present in the operating room, type and number of electrodes inserted, and length of hospital stay were collected. All patients received intravenous antibiotics while the electrodes were *in situ*.

Statistical analysis

Chi-squared test for categorical variables, Fisher exact test for small size, and Mann-Whitney U test for continuous variables were performed in SPSS. Variables with $p < 0.10$ were tested in a multivariate logistic regression where p value was taken at 0.05.

Characteristic	Value
Age (years)	10.9±4.8
Duration of implant (days)	4.5±1.7
Length of hospital stay (days)	12.0±5.6
Number of patient with	
Grid electrode	183 (92.0%)
Strip electrode	153 (76.9%)
Depth electrode	151 (75.9%)
Mean number of	
Strip electrodes	2.3±1.9
Depth electrodes	2.2±0.9
Number of people at	
Insertion of electrodes	15.9±4.2 people
Removal of electrodes	15.3±5.1 people
Duration of insertion operation (hours)	4.4±1.2 hours
Patients with prior operation at the same site	26 (13.0%)
Mean number of anticonvulsants	2.4±0.9
Patients with positive dural graft culture	2
Post-operative infection	17 (8.5%)
Pneumonia	6 (3.0%)
Gastroenteritis	1 (0.5%)
Urinary tract infection	1 (0.5%)
Parotitis	1 (0.5%)
Surgical site infection	8 (4.0%)
Number of days after surgery	33.7±14.8 days
Intracranial infection	3 (1.5%)
Meningitis only	0
Wound infection only	5 (2.5%)
Cases requiring surgical debridement	4 (2.0%)

Table 1 - Patient demographics

Age	Number of days from surgery	Type of infection	Organism	Treatment
15	21	Wound	*Candida albicans*	Antimicrobial
17	10	Wound	*Pseudomonas aeruginosa*	Antimicrobial
16	NA	Wound	NA	Antimicrobial
6	36	Wound	*Pseudomonas aeruginosa*	Antimicrobial
7	28	Wound	*Moraxella catarrhalis*	Antimicrobial plus surgical washout
9	46	Intracranial	Negative growth	Antimicrobial plus surgical washout
3	51	Intracranial	*Staphylococcus aureus*	Antimicrobial plus surgical washout
13	44	Intracranial	Negative growth	Antimicrobial plus surgical washout

Table 2 - Cases of surgical site infections

Factor	Value with SSI	Value without SSI	P value
Age	10.8±5.2 years	10.9±4.8 years	0.94
Duration of implant			
≤ 4 days	7	156	0.67
> 4 days	1	35	
Length of hospital stay (days)	13.1±5.9 days	11.9±5.6 days	0.84
No. of people at insertion			
≤ 15 people	1	102	**0.02**
> 15 people	7	89	
No. of people at removal			
≤ 15 people	4	105	0.78
> 15 people	4	86	
Length of insertion operation			
≤ 4 hours	1	96	**0.04**
> 4 hours	7	95	
Grid electrode	7	160	0.84
Number of strip electrodes	1.8±2.6	1.8±1.9	0.63
Number of depth electrodes	2.8±0.8	1.6±1.2	**0.01**
Prior operation at the same site	3	23	**0.04**
Number of anticonvulsants	2.3±0.9	2.4±0.8	0.85

Table 3 - Result of the univariate analysis

Factor	OR (95% CI)
≤15 people at insertion operation	0.08 (0.01 – 0.70)*
Insertion operation ≤ 4 hours	0.21 (0.02 – 1.95)
Number of depth electrodes	3.52 (1.44 – 8.59)*
First time operation	0.17 (0.03-1.04)

Table 4 - Result of the multivariate analysis

Results

All patients were followed up for at least 6 months. Table 1 outlines descriptive statistics of collected variables. Patients were monitored on average 4.5 days. 17 patients (8.5%) experienced operative infections of all types, of which 8 cases (4%) were surgical site infections. We noted a variety of microorganisms as the etiology of the infection (Table 2). Three patients experienced deep infections and four required surgical debridement of the infection.

While a handful of case series have documented the rate of SSI, our study is the first to look at a variety of patients and operative variables that might be associated with the SSI. We identified risk factors that are congruent with existing literature in other types of surgeries [3], as well as factors that have rarely been examined previously.

Univariate analysis revealed the number of people present in the implantation surgery, length of surgery, number of depth electrodes, and reoperation significantly correltaed with SSI (Table 3). The number of people present at an operation was dichotomized at 15 to estimate for surgical, anesthetic, electrophysiology, epilepsy and nursing team; the length of the operation at 4 hours which approximates a half-day operation. Results of the multivariate analysis are listed in Table 4, where we found the number of people and number of depth electrodes were independent risk factors.

Conclusions

We found a SSI rate of 4%, which reflects the experience with iEEG monitoring at our center. This is the largest case series in literature, yet the rarity of SSIs limits our analysis. In the future, meta-analysis of reported case series can provide insight on the durability of our observaitons. Identifying risk factors for SSI will help inform future prospective studies to reduce this morbidity in children undergoing invasive evaluation for epilepsy surgery.

References

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