



Electrocorticography in surgically managed brain trauma patients.

Part II: baseline patterns, seizures, and spreading depolarizations

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Introduction

- High-frequency (0.5-50Hz) brain electrical activity after injury exists on a continuum from normal to interictal to ictal, or seizure, patterns (Sz) (1).
- The prognostic importance of periodic discharge (PD) patterns and ECOG-recorded Sz, and their association with the presence of spreading depolarizations (SD) remains uncertain.
- Here we examined the relationship between electrocorticographic (ECoG) brain activity, SD, and outcome after severe brain trauma.

Methods

- We analyzed 138 patients with SD scoring as reported in an accompanying abstract (Part I).
- For each patient, we selected a single channel of ECoG, focusing on channels with SD and a range of pathology over the course of the recording period.
- We characterized background continuity (continuous, discontinuous, burst-suppression, or suppression), presence of sleep transients, PD and Sz every 4 hours using standardized terminology (2).
- The burden of PD and Sz were calculated as follows:
 - Daily Pattern Burden = Prevalence/Day (Hrs)
 - Daily Pattern Burden Index = Pattern Burden (Hrs) * Frequency (Hz)
- Functional outcome was assessed using the Glasgow Outcome Scale-Extended (GOSE) at 6-months; poor outcome was defined as GOSE 1-4.
- An ordinal regression was constructed to assess associations between PD, Sz, SD category, and outcome.

Table 1: EEG characteristics stratified by category of spreading depolarization

EEG Variable	No or Isolated SD, n (%)	Clustered or Isoelectric SD, n (%)	P-Value
Initially continuous background	62/87 (71.3%)	19/46 (41.3%)	<0.001
Initial burst-suppression or suppression	8/87 (9.2%)	18/46 (39.1%)	
Background theta/alpha predominant frequencies	16/91 (17.6%)	1/47 (2.1%)	0.028
Maintained continuous background throughout recording	28/91 (30.8%)	3/47 (6.4%)	<0.001
Sleep transients (spindles or K-complexes)	7/91 (7.7%)	0/47 (0%)	
Burst-suppression or suppression at any time during recording	34/91 (37.4%)	35/47 (74.5%)	<0.001
Presence of seizures	21/91 (23.1%)	20/47 (42.6%)	0.018
Periodic Discharge (PD) Index (Hz-Hr)	1.11 (0.06-4.04)	1.36 (0.54-5.07)	0.418
Daily Burden of PD and/or Seizures (Hr)	1.16 (0.08-5.59)	2.30 (0.88-5.52)	0.339
Daily Seizure Burden (Hr)	0 (0-0)	0 (0-0.10)	<0.01
Number of Seizures, n	0 (0-0)	0 (0-23.5)	<0.01

Figure 1: Relationship between periodic discharges, seizures and category of spreading depolarizations

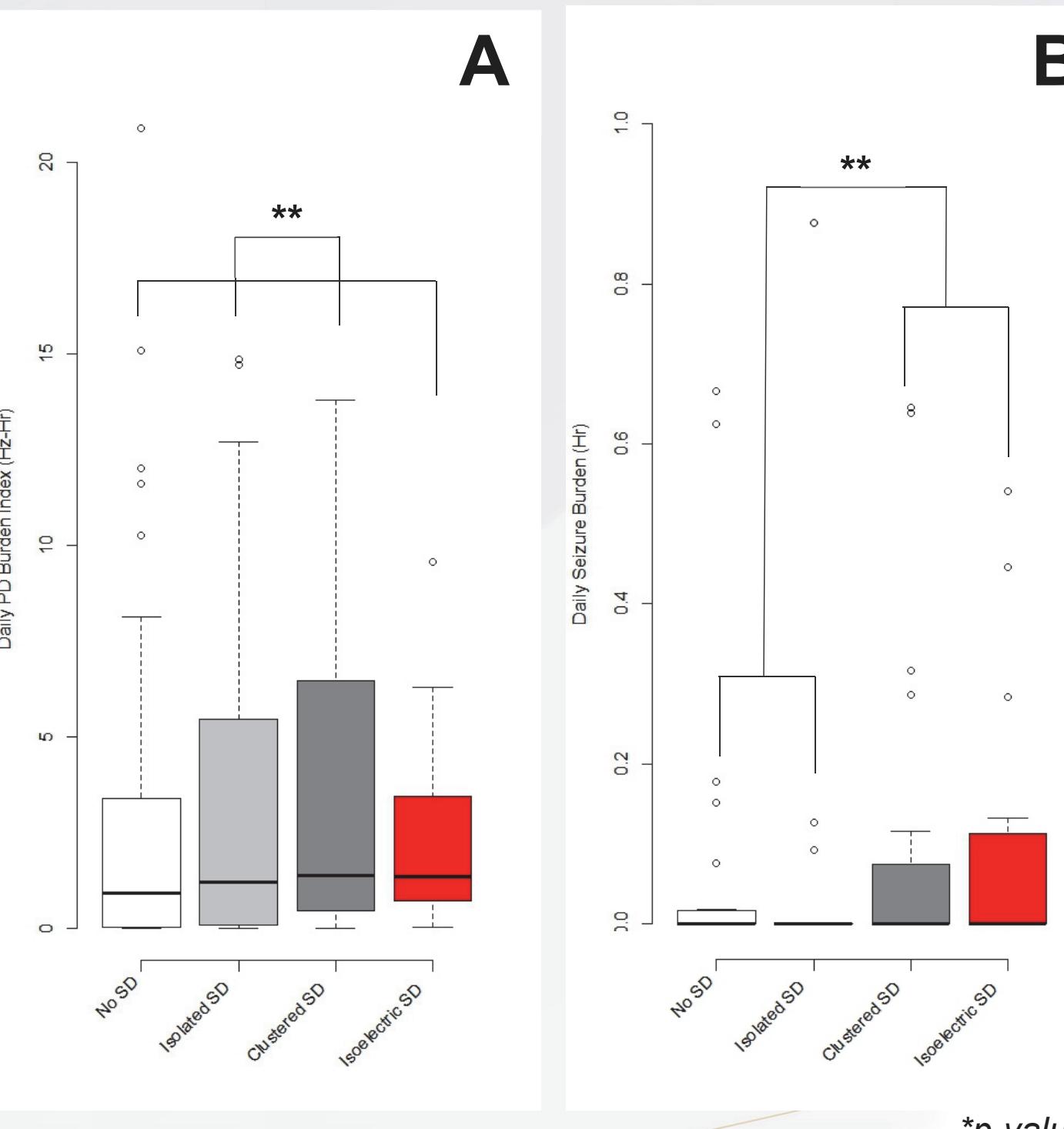
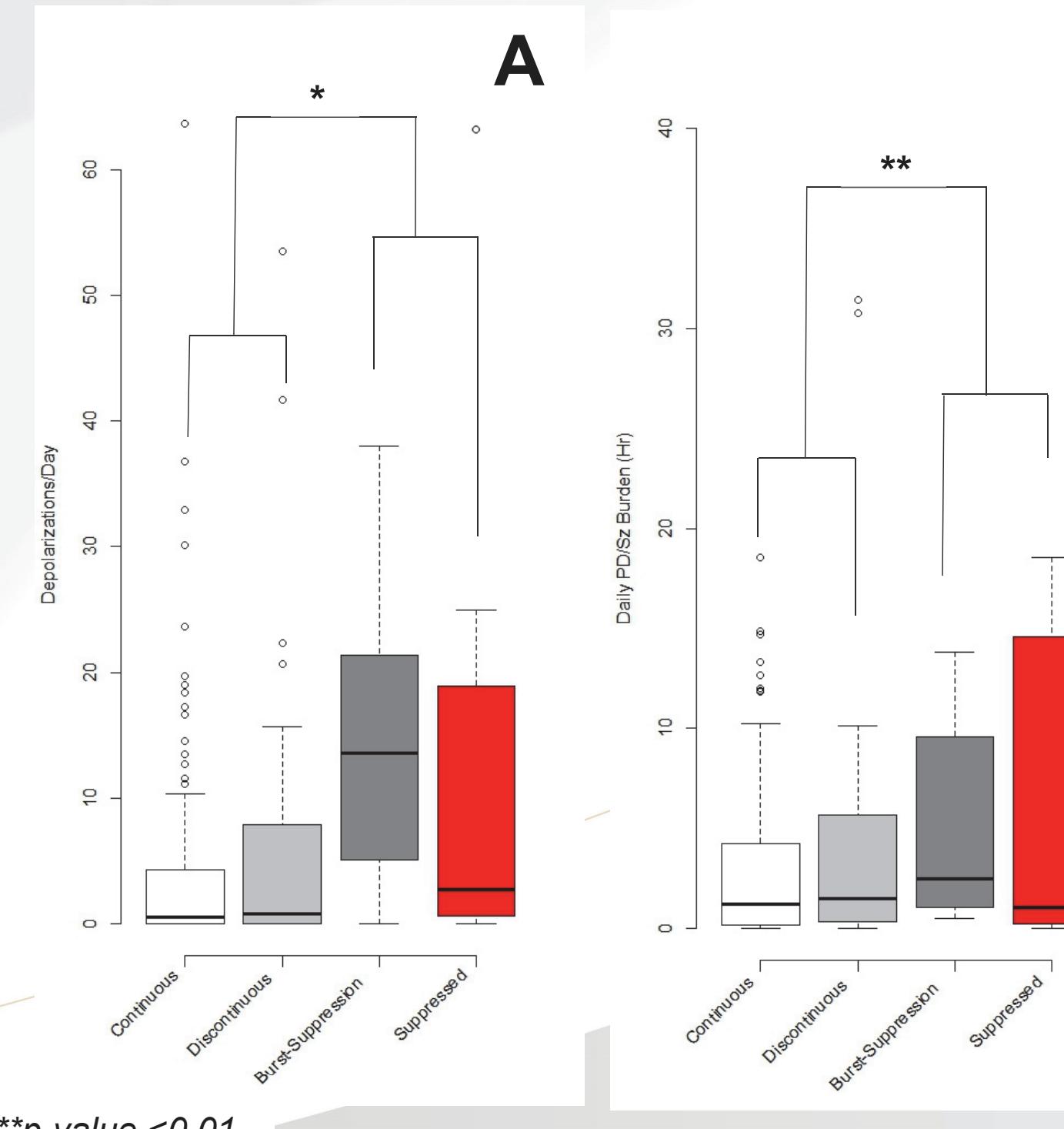


Figure 2: Relationship between depolarizations, seizures, and background suppression



Results

- Patient demographics were reported in accompanying abstract (Part I). EEG characteristics are shown in Table 1.
- 2841 Sz (median per patient [IQR]: 19 [5-50]) occurred in 41/138 patients (29.7%) while PD were observed in 122/138 (88%) patients.
- The daily PD index (Hz-Hr) was greater in those with isolated or clustered SDs (t test, p<0.01; Figure 1a) and Sz were more common in those with clustered or isolectric SDs (42.6% (20/47) vs. 23.1% (21/91) than those with no SDs or isolated SDs [χ^2 , p=0.018]) with higher daily Sz number and burden (t tests, p<0.01; Figure 1b).
- The degree of initial ECoG suppression was significantly associated with greater subsequent SD (ANOVA, p=0.02; Figure 2a) and PD/Sz (ANOVA, p<0.01; Figure 2b).
- Poor 6-month GOSE occurred in 32/41 (78.0%) patients with Sz vs. 67/97 (69.1%) without Sz (χ^2 , p=0.28).
- In unadjusted ordinal regression, the daily burden of PD/Sz was not associated with outcome (OR 1.01, 95% CI 0.98-1.05). However, the development of ECoG background burst-suppression or suppression had an odds ratio of 2.8 (95% CI 1.2-6.7) for poor outcome, which was independent of SD classification.

Conclusions

- PD/Sz are common after sTBI and the burden of PD/Sz patterns was related to the initial ECoG background and SD classification.
- ECoG patterns are distinct yet relate to each other and provide complementary information.
- Future efforts should focus on developing patient classification schemes based on these patterns to improve prognostication and patient selection for therapeutic intervention.

References

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