

Continuous Electroencephalography in Acute Liver Failure: Findings and Prognostic Value

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BACKGROUND

- Neurologic complications contribute significantly to morbidity and mortality in acute liver failure (ALF), but the evaluation of neurologic function in ALF patients is often limited due to illness severity.
- Continuous video EEG (cEEG) monitoring is a noninvasive tool which can monitor real-time cerebral function.
- We aimed to evaluate cEEG findings and prognostic significance of specific EEG features in the ALF population.

METHODS

- Design:** retrospective study
- Participants:** 33 patients with ALF admitted to Emory University Hospital who underwent cEEG monitoring for at least 6 hours.
- Clinical variables:** ALF etiology, neuroimaging, laboratory data (ammonia, creatinine, ALT, AST, total bilirubin, INR, platelet count), treatments received (plasma exchange [PLEX], molecular adsorbent recirculating system [MARS] therapy)
- cvEEG analysis:** the entire cEEG recording for each patient was independently reviewed by DFC and ARR. EEG variables were classified using standardized critical care EEG terminology¹ and included:
 - Best and worst background continuity and frequency, per the categories depicted below
 - Presence or absence of background reactivity, rhythmic and periodic patterns, and seizures
- Primary outcome:** Cerebral Performance Category (CPC) scale
 - Good (CPC 1-2) vs. poor (CPC 3-5)
- Statistics:** comparisons of demographic, clinical, and cEEG variables between the two outcome groups were performed using Fisher's exact test for categorical variables and the Student t-test for continuous variables. Statistical analyses were performed in SAS.

ALF diagnostic criteria:

Development of encephalopathy, coagulopathy (INR \geq 1.5), and severe liver injury for <26 weeks without preexisting chronic liver disease

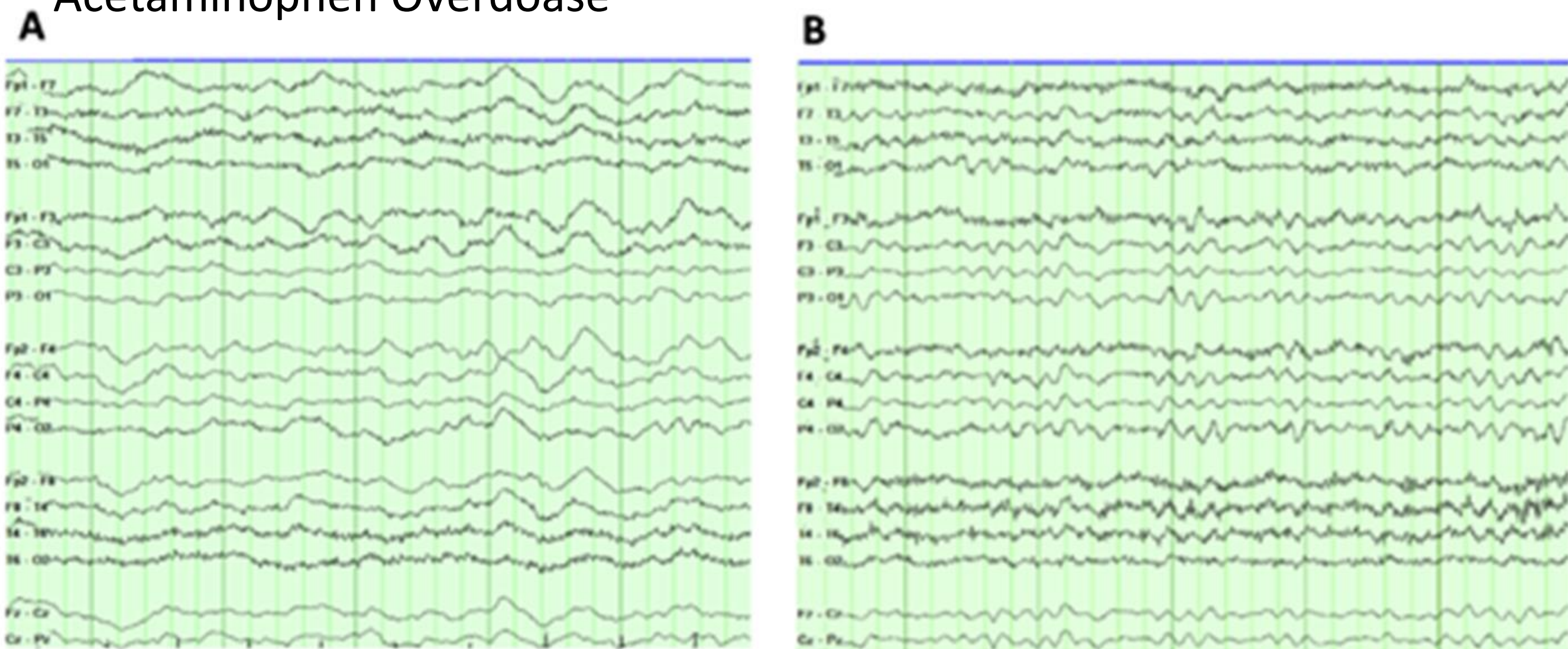
Background continuity:

0: suppression
1: attenuated
2: burst-suppressed
3: burst-attenuated
4: discontinuous
5: nearly continuous
6: continuous

Background frequency:

0: attenuated, suppressed, burst-suppressed, or burst-attenuated
1: delta
2: theta
3: alpha

Example Case - Continuous EEG in a patient with ALF secondary to Acetaminophen Overdose



(A) EEG with generalized slowing with predominant delta frequency (A) in patient with ALF rescued from peri-herniation event with hypertonic saline (B) EEG improved further on day 2 with the appearance of more theta frequencies

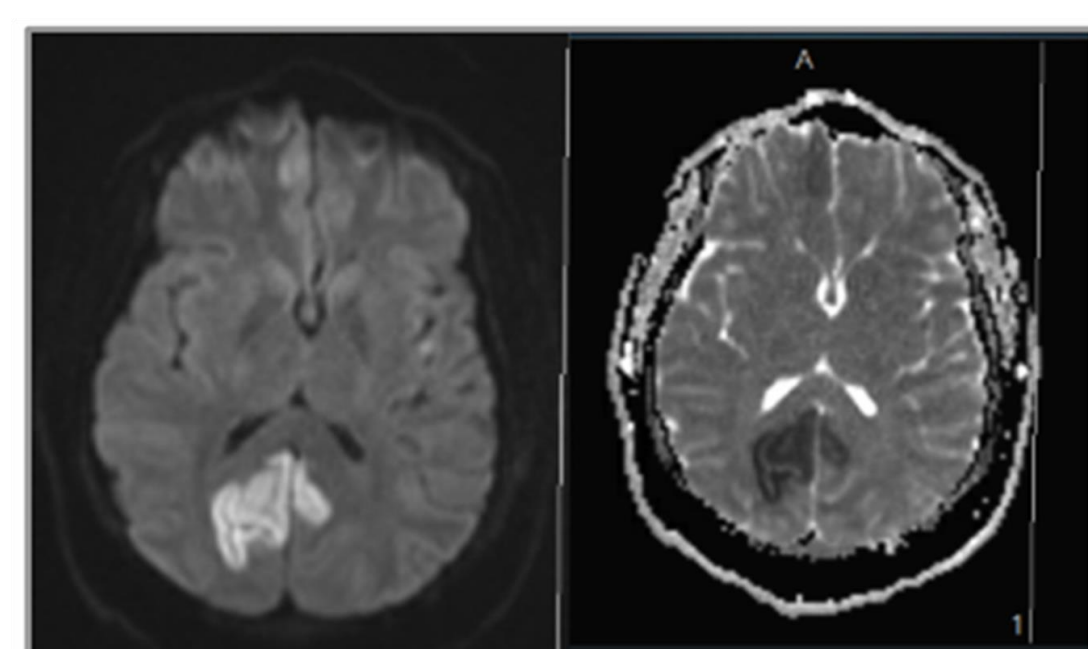


Image on Left
Brain MRI revealing bilateral posterior cerebral artery infarcts due to peri-herniation event. Patient managed without invasive intracranial monitoring. Discharged home with minimal deficits (CPC score 1)

RESULTS

Table 1: Patient demographics, clinical characteristics, and EEG features. *Other: autoimmune, infectious

Demographic/clinical variables	All patients (n=33)
Age at cEEG, years, median [IQR]	38[26-51]
Women (%)	23 (70)
Time to cEEG, days, median [IQR]	1 [0-2]
Length of stay, days, median [IQR]	12.7 [3.6-24.2]
ALF Etiology	
Acetaminophen/hepatotoxin (%)	21 (64)
Other* (%)	12 (36)
Therapies received	
PLEX (%)	8 (25)
MARS (%)	17 (52)
Neuroimaging (n=30)	
Abnormal imaging	12 (40)
Cerebral edema	8 (27)
cEEG variables	
All patients (n=33)	
Sporadic epileptiform activity	3 (9)
Rhythmic/periodic patterns (%)	19 (58)
GPD (%)	14 (42)
GRDA (%)	6 (18)
LPD (%)	1 (3)
LRDA (%)	0
Seizures (%)	2 (6)

- Thirty-three patients were included in our study cohort; demographic, clinical, and cEEG variables are depicted in Table 1.
- Twenty patients (61%) had a CPC score of 3-5 at the time of discharge.
- Two (6%) patients exhibits seizures, all of which were clinical and generalized in onset.
- Fifty-eight percent had rhythmic or periodic patterns; generalized periodic discharges and generalized rhythmic delta activity were the most common of these patterns.
- The presence of abnormal neuroimaging findings, laboratory values on admission, and treatments received were not significantly different between the 2 primary outcome groups. ($p>0.05$)
- Patients with worse background frequency and lack of EEG reactivity were more likely to have a poor outcome ($p=0.002$ and $p=0.014$, respectively).
- Patients with improvement in cEEG continuity ($p=0.006$) and improvement in predominant background frequency ($p=0.002$) were more likely to have a good outcome.

CONCLUSION

- We describe cEEG findings and the association of specific cEEG parameters with clinical outcome in a strictly defined group of ALF patients.
- The frequency of seizures in our population was low (6%), in contrast to previous work, which may reflect differences in methodology, EEG terminology and management.²
- Limitations include a single center design and small sample size.

References:

- Hirsch LJ, LaRoche SM, Gaspard N, Gerard E, Svoronos A, Herman ST, et al. American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology: 2012 version. J Clin Neurophysiol 2013;30:1-27.
- Ellis AJ, Wendon JA, Williams R. Subclinical Seizure Activity and Prophylactic Phenytoin Infusion in Acute Liver Failure: A Controlled Clinical Trial. Hepatology. 2000;32(3):536-541