

EEG in Status Epilepticus

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Disclosures

- None



Overview

- Status epilepticus classification
- EEG in convulsive status epilepticus
- EEG in non-convulsive status epilepticus
- Periodic and uncertain EEG patterns



Status Epilepticus Definition

Research definition

“A single clinical seizure lasting more than 30 minutes or repeated seizures over a period of more than 30 minutes without intervening recovery of consciousness”

Clinical definition

A generalized tonic-clonic seizure lasting for more than 5 minutes



Status Epilepticus Classification

- **Generalized Convulsive Status Epilepticus**
 - Tonic-clonic SE with generalized onset
 - Tonic-clonic SE with partial onset
 - “Subtle convulsive status epilepticus”
 - Generalized myoclonic SE
- **Non-convulsive Status Epilepticus (NCSE)**
 - Absence SE
 - Simple partial SE – aura continua
 - Complex partial SE
 - NCSE in coma

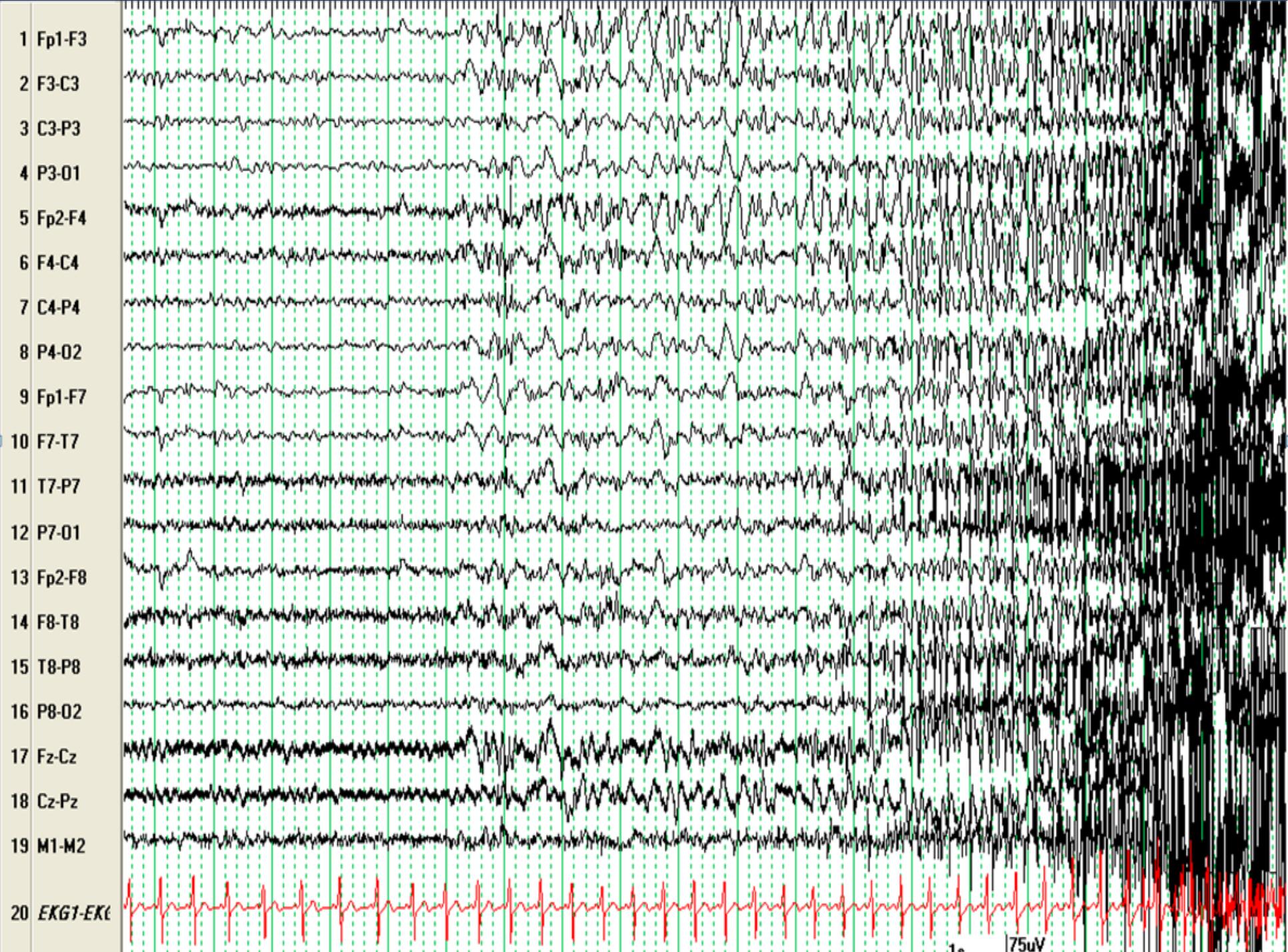


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Convulsive status epilepticus with generalized onset

- Seen in patients with idiopathic generalized epilepsy
- Often related to antiepileptic medication non-compliance or medication transitions
- Seizure onset is usually generalized low voltage fast activity or polyspikes that increase in amplitude and decrease in frequency



Generalized myoclonic status epilepticus

- Seen in IGE, particularly JME
- Symptomatic generalize epilepsy syndromes
 - SMEI, myoclonic-astatic epilepsy, LGS
- Progressive myoclonic epilepsy syndromes
- Acute anoxic brain injury

Case example: D.G.

Case example: 72 y/o woman presented after cardiac arrest. After completion of a hypothermia protocol and rewarming, she began to have whole body jerking movements and an EEG was ordered.

- Fp1-A1
- Fp2-A2
- F3-A1
- F4-A2
- C3-A1
- C4-A2
- P3-A1
- P4-A2
- O1-A1
- O2-A2
- F7-A1
- F8-A2
- T7-A1
- T8-A2
- P7-A1
- P8-A2
- Fz-A1
- Cz-A1
- Pz-A1



Space

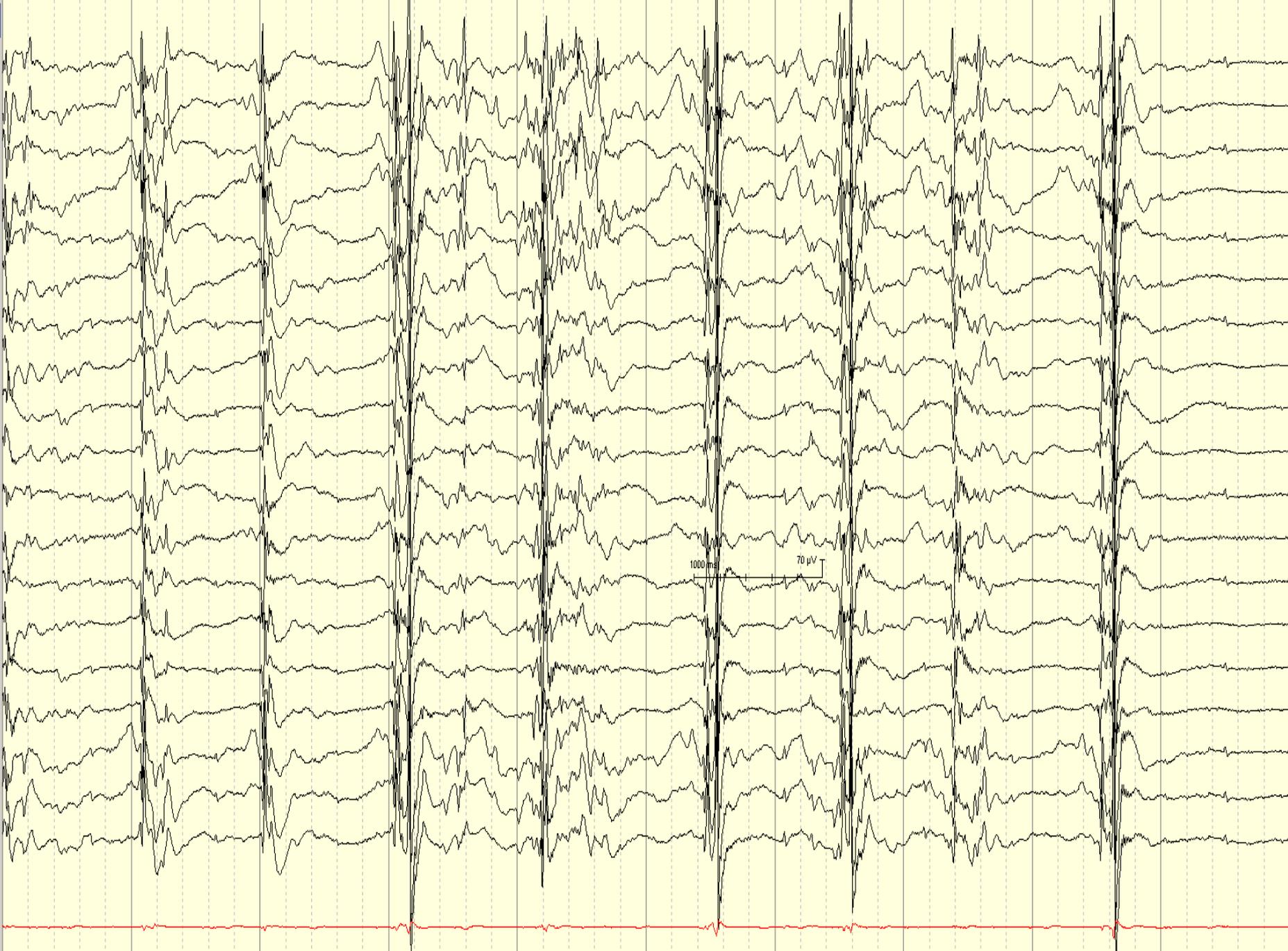
EKG

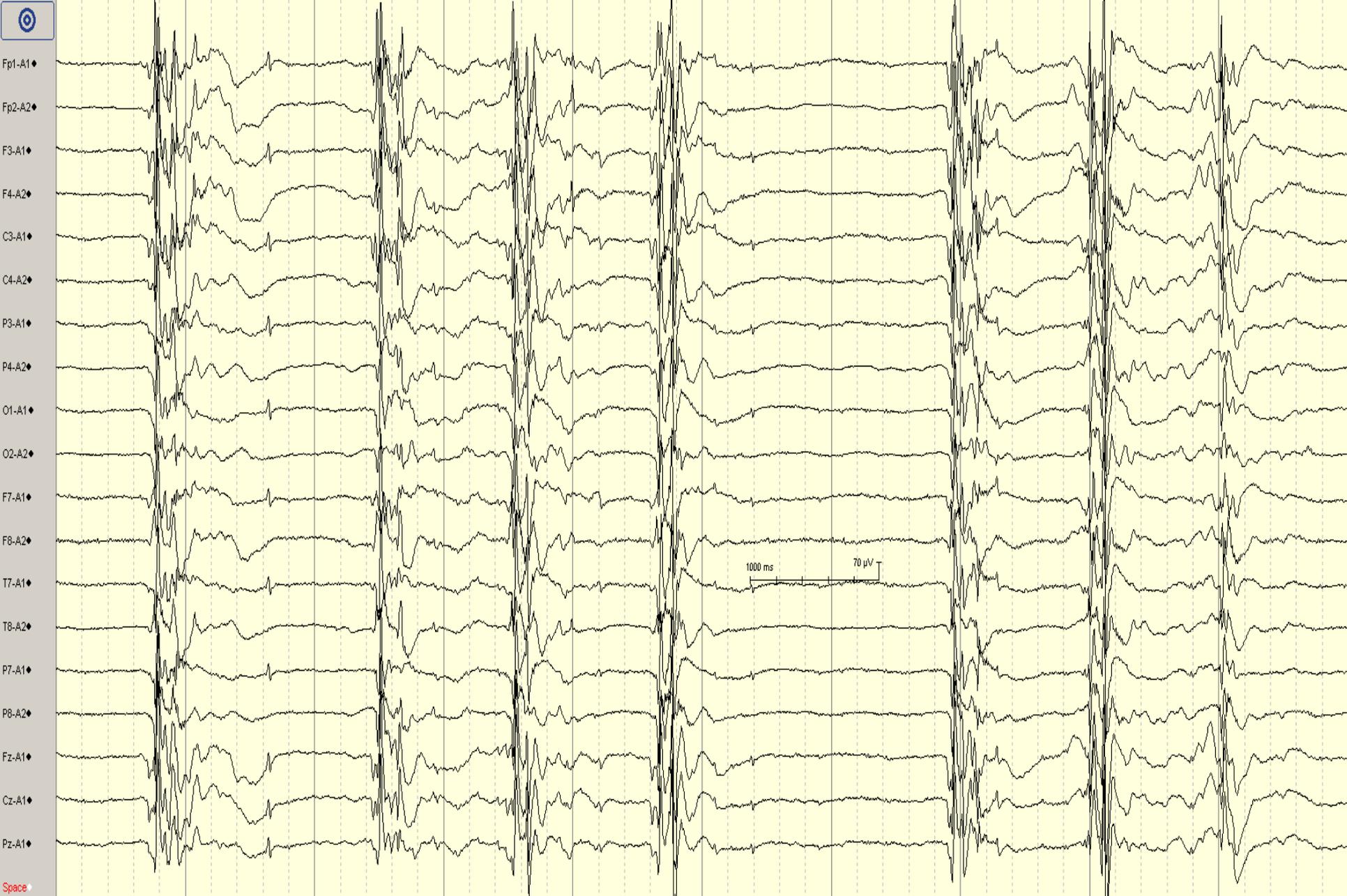


Fp1-A1
Fp2-A2
F3-A1
F4-A2
C3-A1
C4-A2
P3-A1
P4-A2
O1-A1
O2-A2
F7-A1
F8-A2
T7-A1
T8-A2
P7-A1
P8-A2
Fz-A1
Cz-A1
Pz-A1

Space

EKG





Space

EKG

Generalized convulsive status epilepticus with partial onset

- More common than GCSE with generalized onset
- DeLorenzo et al. 1998: Prospective study of 164 patients presenting with SE where cEEG monitoring was performed for a minimum of 24 hours after control of overt seizure activity
 - 52% had no ictal activity on EEG
 - 34% had additional discrete seizures recorded
 - 14% had continued status epilepticus on EEG
- Mortality was much higher in group with continued seizure activity

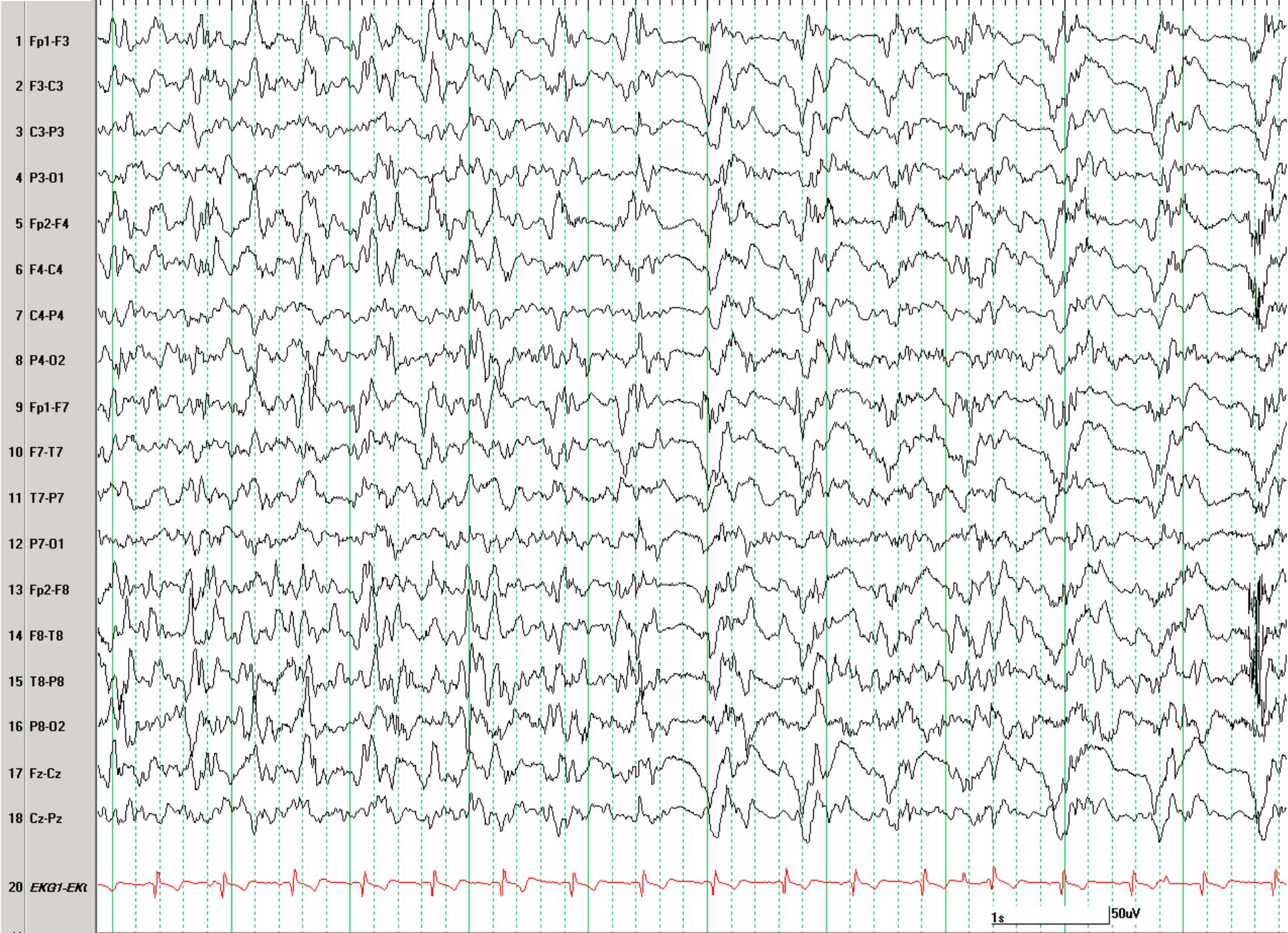
Subtle convulsive status epilepticus

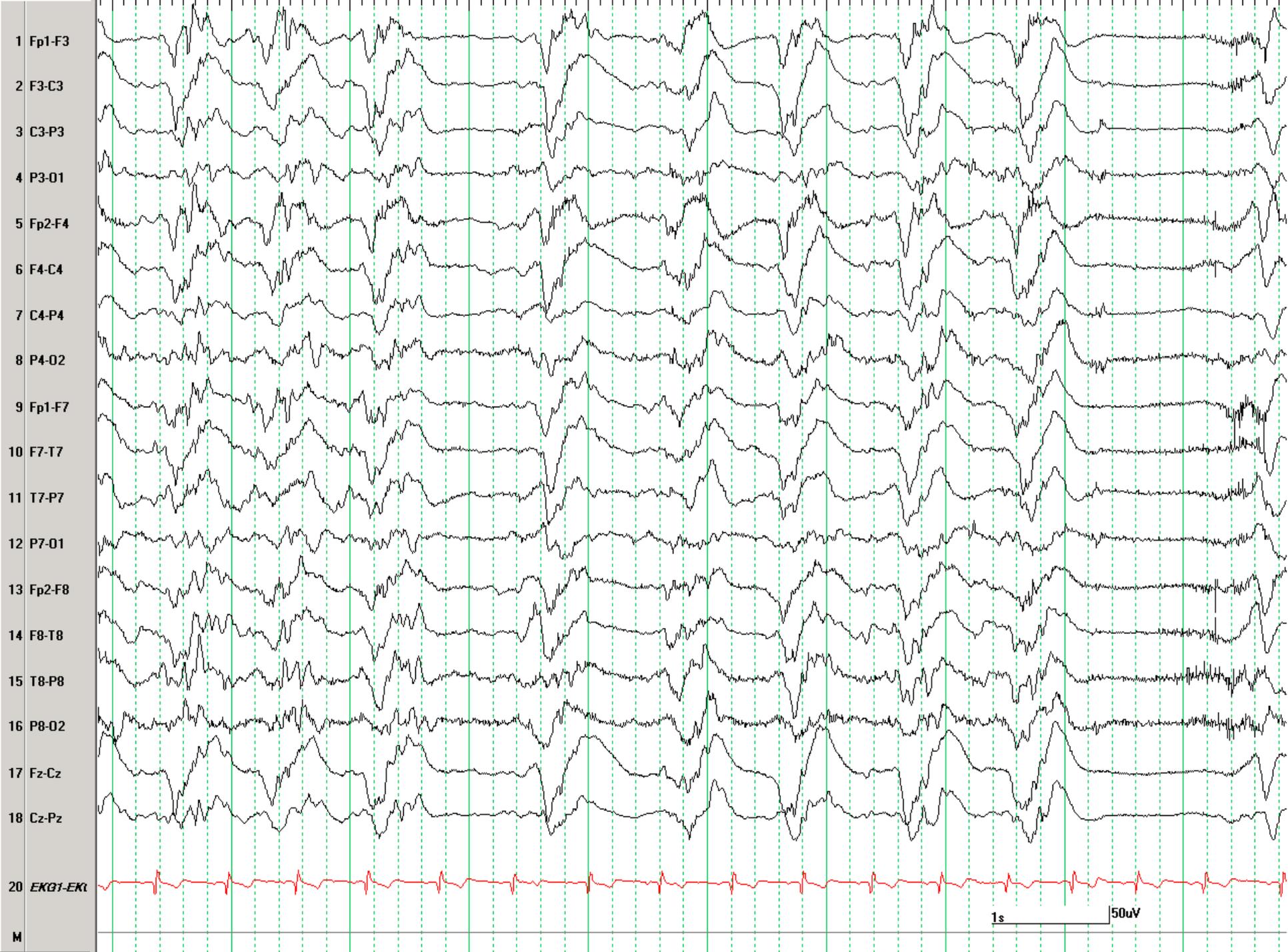
- A condition after overt convulsive seizure activity in which the patient remains unresponsive for at least 30 minutes, has generalized ictal activity EEG, and has subtle or no clinical correlate other than coma
- Observational studies of convulsive status epilepticus in patients and in animal models suggest that this may represent a common evolution from untreated or refractory convulsive status epilepticus

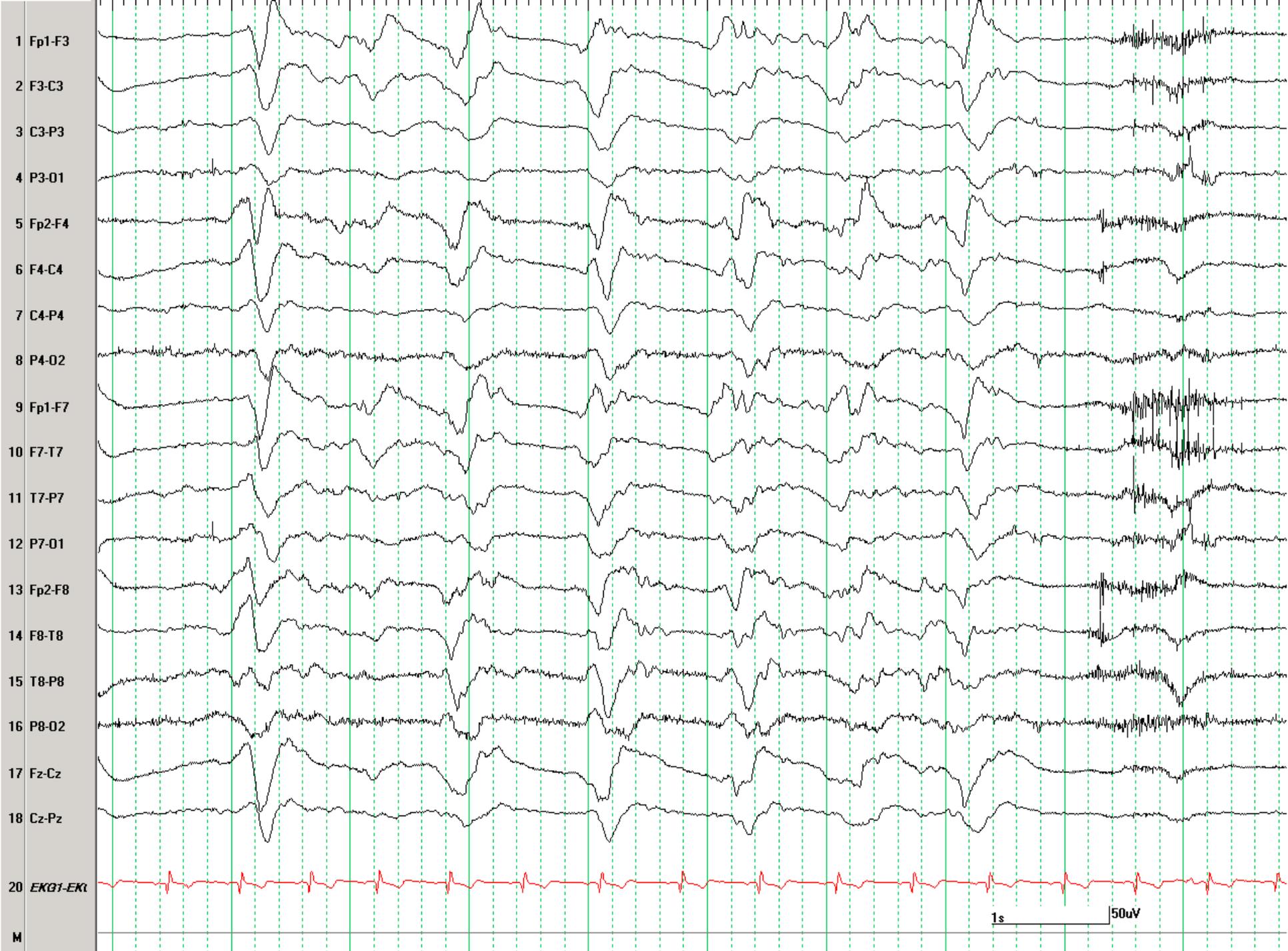
Treiman et al., Epil Res 1990; 5:49-60

Engel J, Epilepsia; 47(9):1558-68











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Simple Partial Status Epilepticus

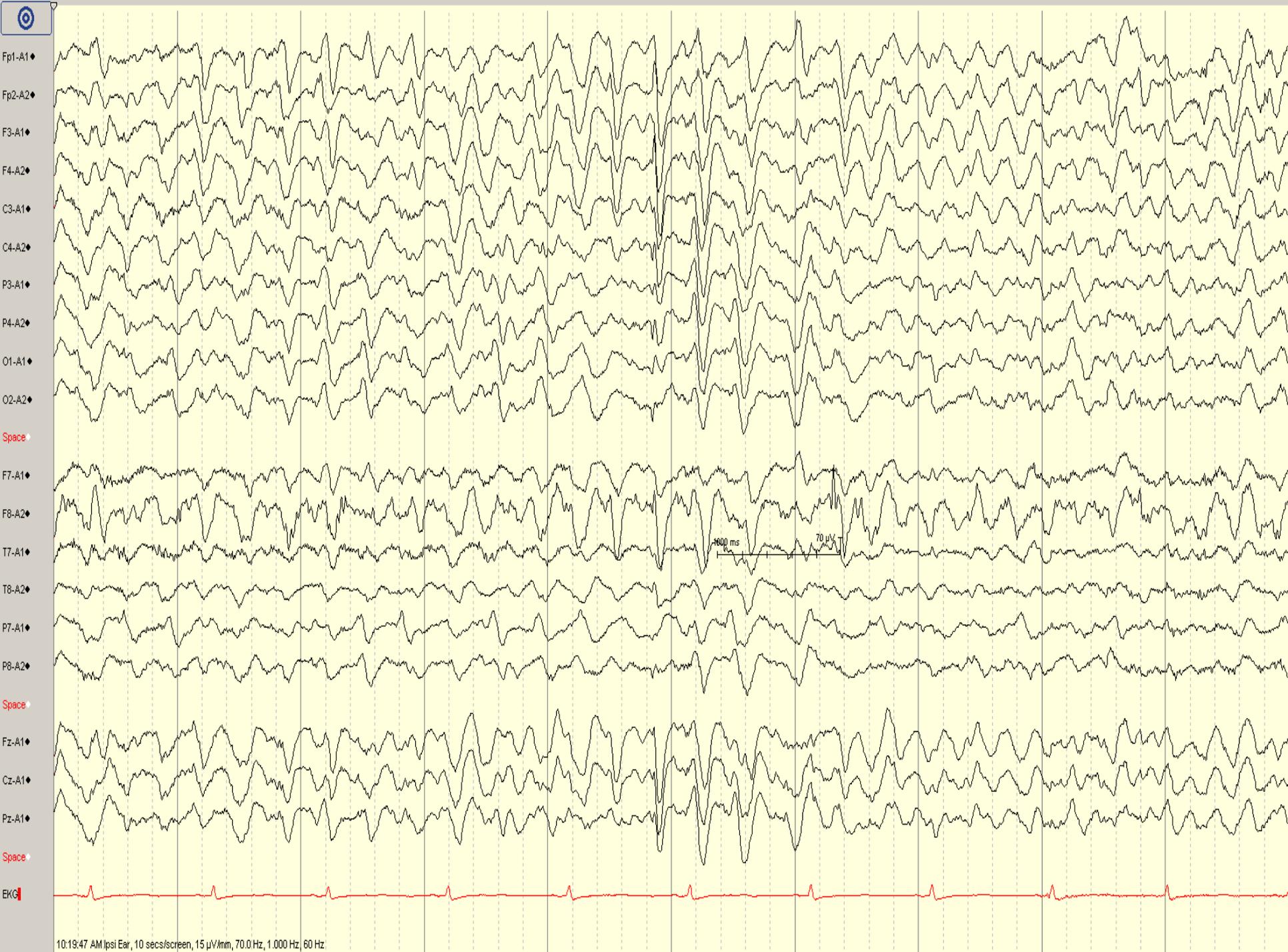
- Epilepsy partialis continua – continuous focal motor seizures
- Aura continua
 - Aphasic, dysasthetic, epigastric, visual, olfactory, gustatory, auditory, fearful, déjà vu, etc.
- EEG may show continuous focal epileptiform discharges or rhythmic delta activity
- May be undetectable with scalp EEG

Absence Status Epilepticus

- Prolonged confusional state with slowing of mental functions associated with generalized ≥ 3 Hz epileptiform discharges on EEG
- Frequently has associated perioral or eyelid myoclonus
- May occur in patients without a clear history of generalized epilepsy (particularly in the elderly)
- Responds rapidly to IV benzodiazepines or IV valproate, levetiracetam
- Risk of neuronal injury is very low

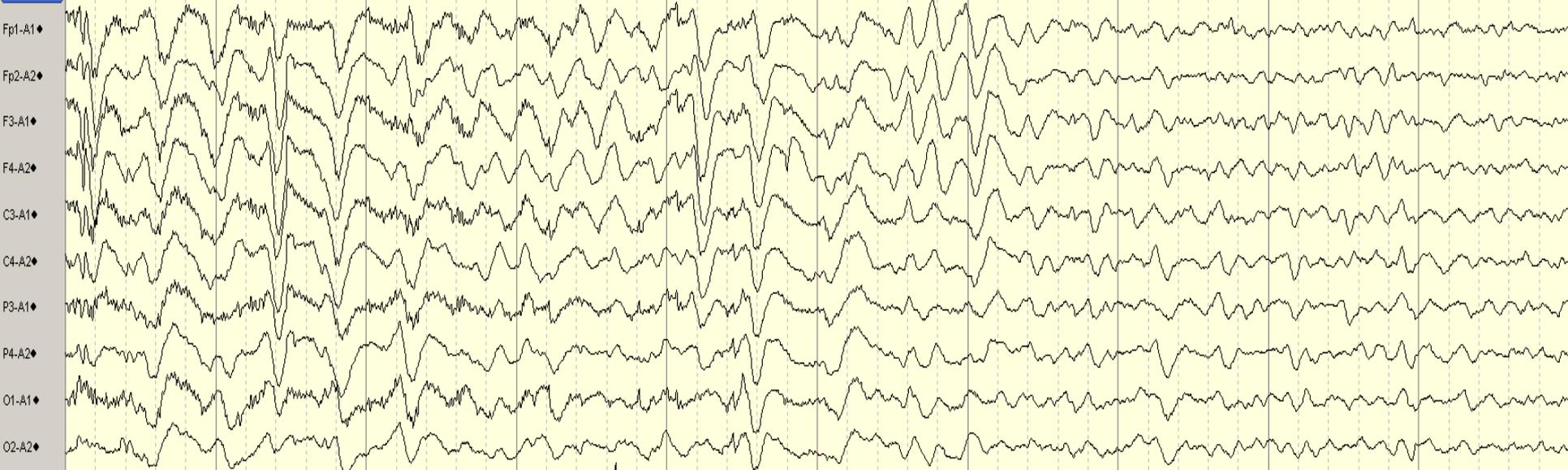
Case study S.M.

56 y/o woman with a history of epilepsy since her early 20's. Typical seizures were described as periods of behavioral arrest for 10-15 minutes that were preceded by blurred vision and fatigue. She had been treated with phenytoin for many years and averaged 1-2 seizures per year. She had seen a neurologist many years ago and was told that her seizures were likely "stress induced." She presented with a two generalized tonic clonic seizures and remained persistently confused and sleepy afterwards. PHT level was undetectable.

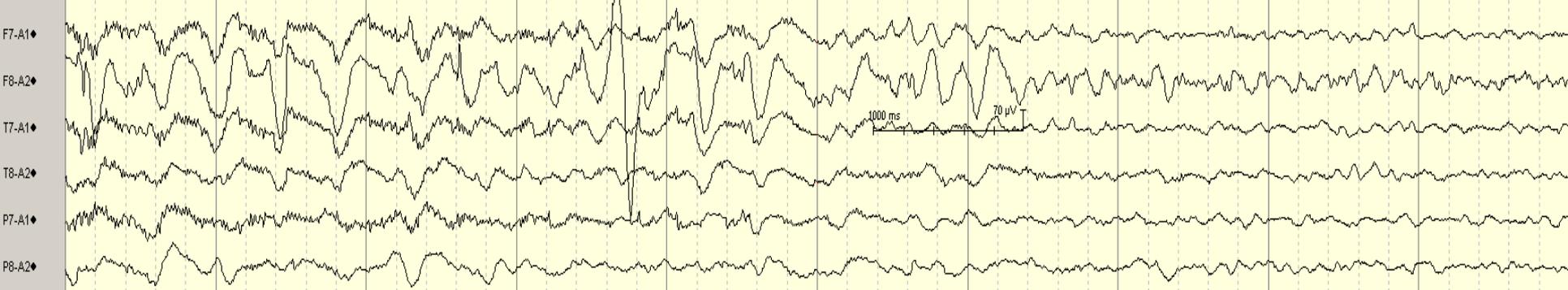


Case study S.M. (Continued)

She was treated with 2 mg lorazepam IV with clinical and EEG improvement. After IV valproic acid was loaded, her EEG normalized and she returned to her baseline cognitive function.



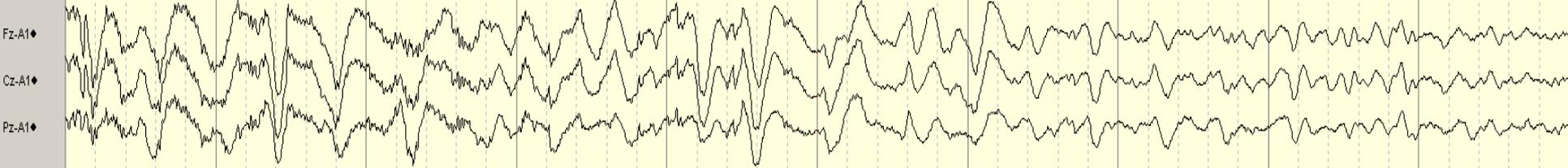
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1000 ms

70 μ V

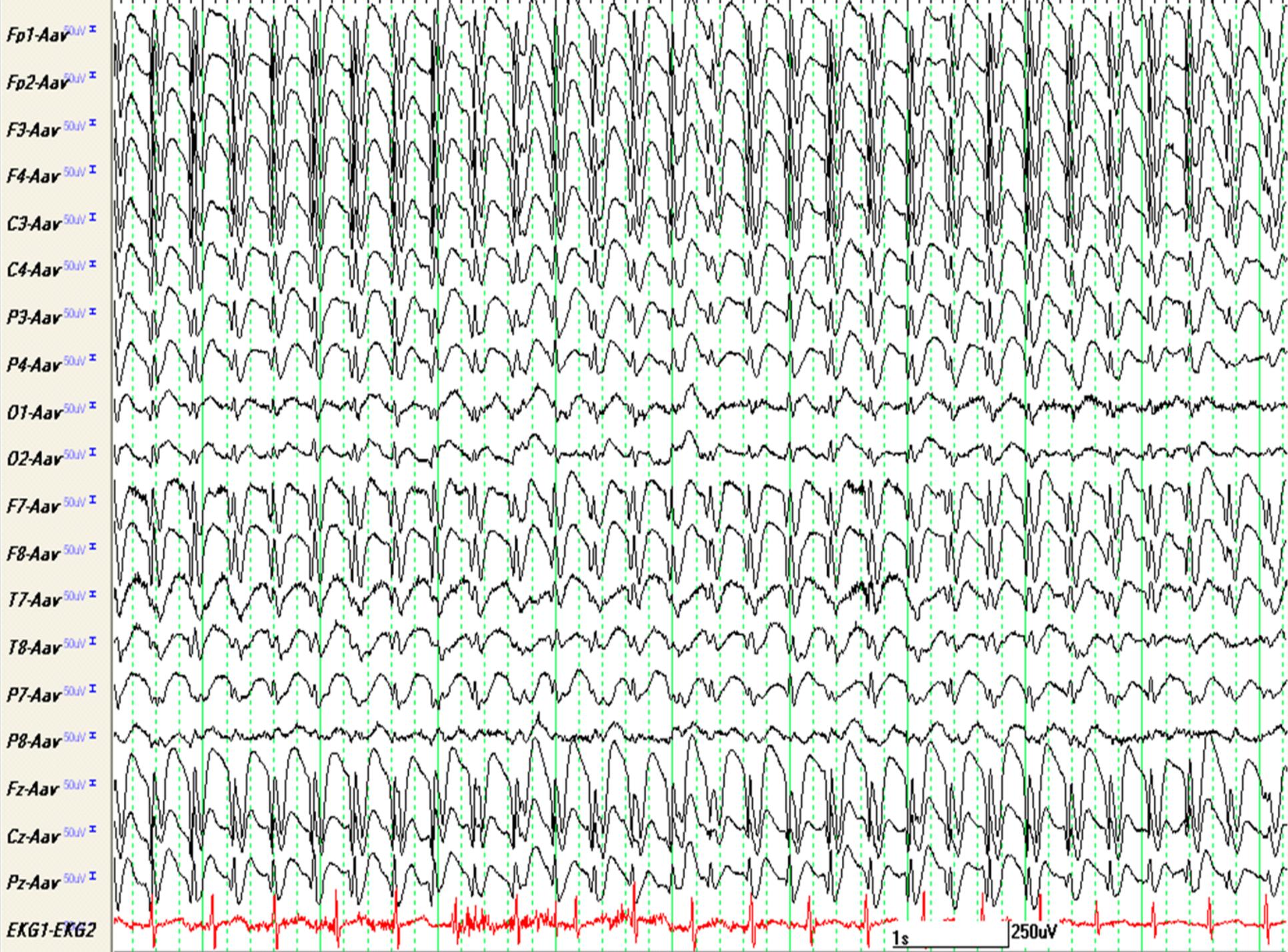
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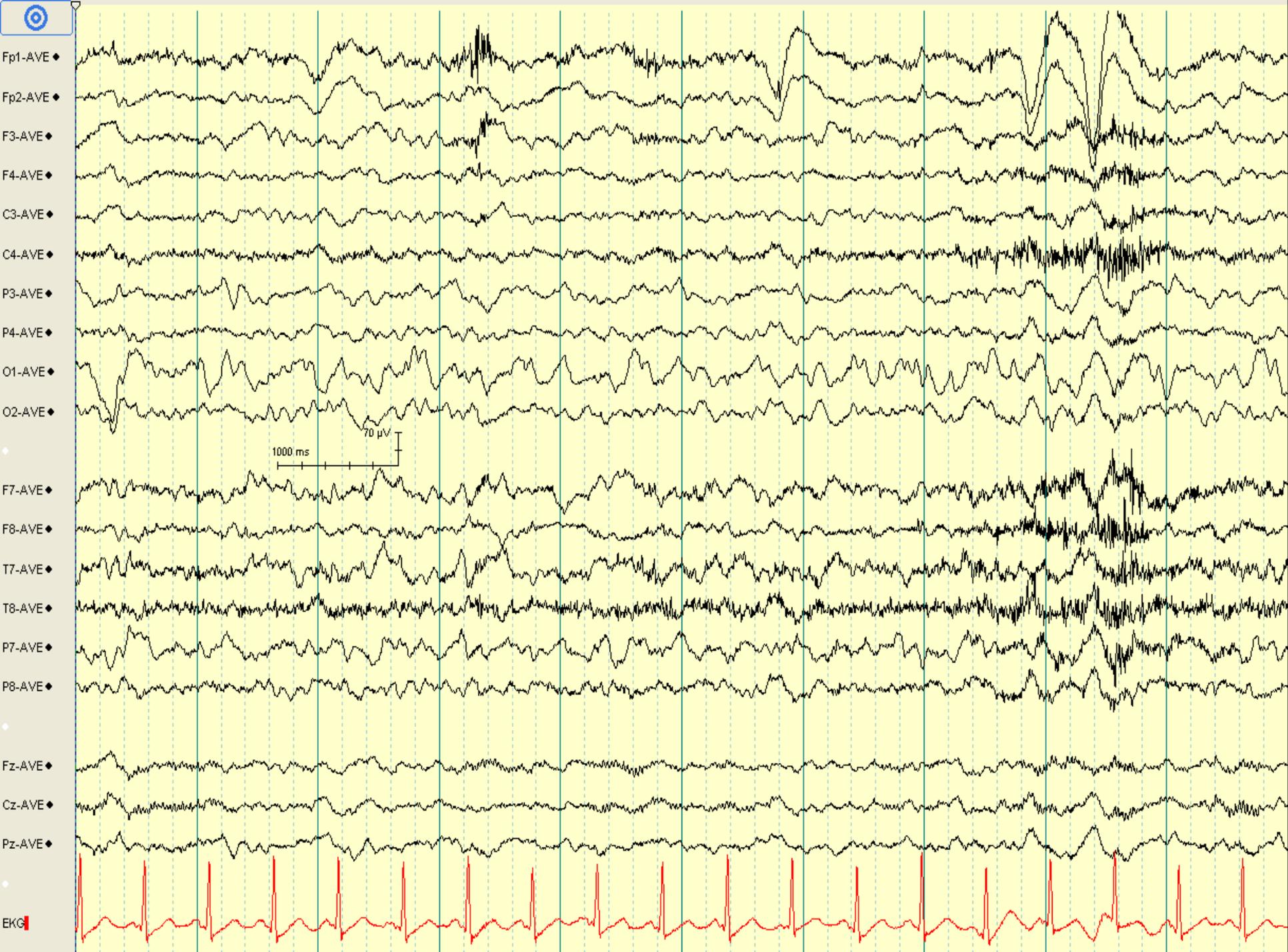


Complex partial status epilepticus

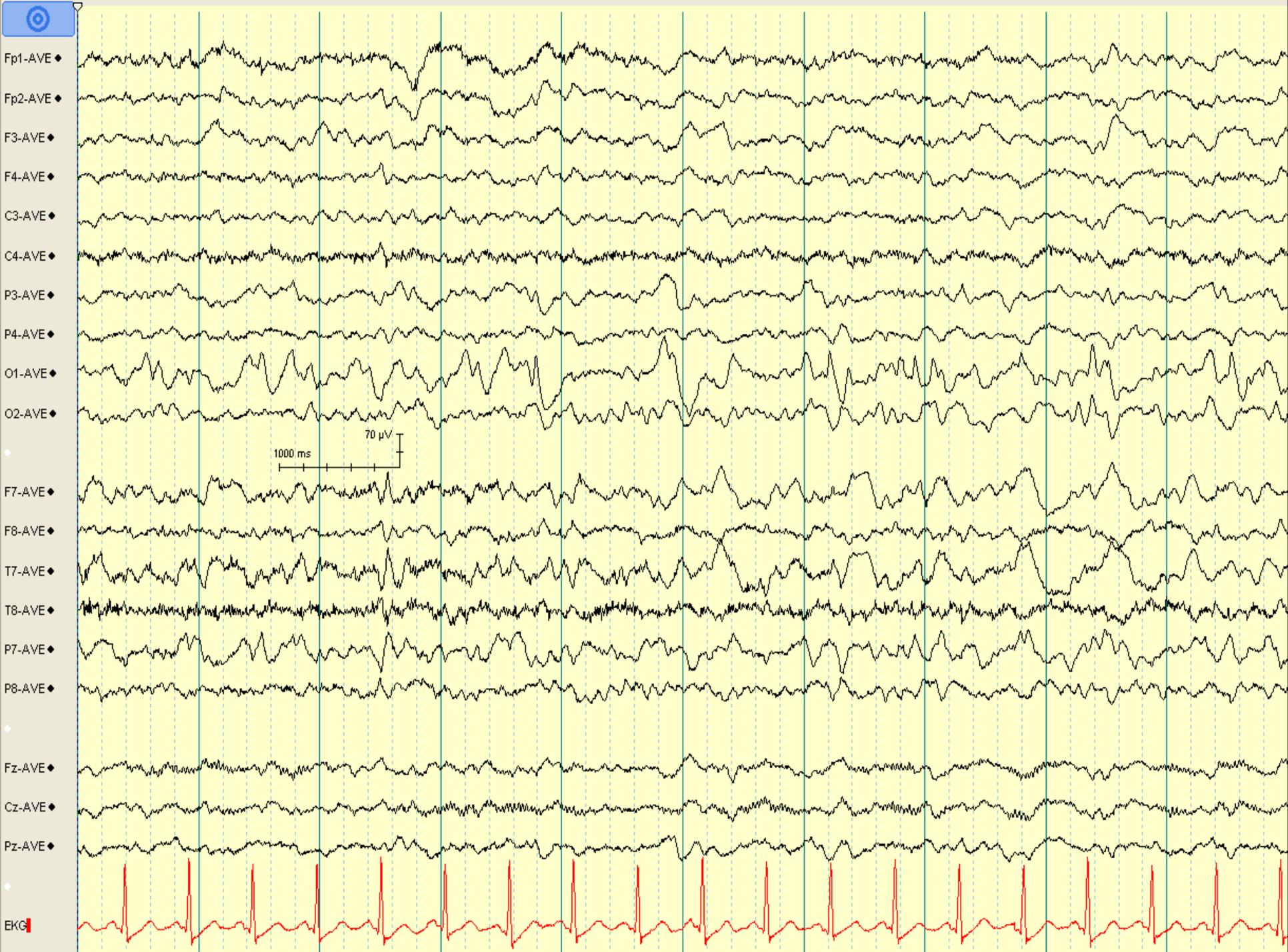
- Common clinical features
 - Impairment of cognition with fluctuating ability to respond
 - Subtle twitching of face or limb(s)
 - Unresponsiveness with eyes open
 - Head or eye deviation
 - Automatisms
 - Altered behavior
- Frequently responds to treatment, but depends on etiology
- Moderate risk of neuronal injury with prolonged seizure activity

Case example: L.R.

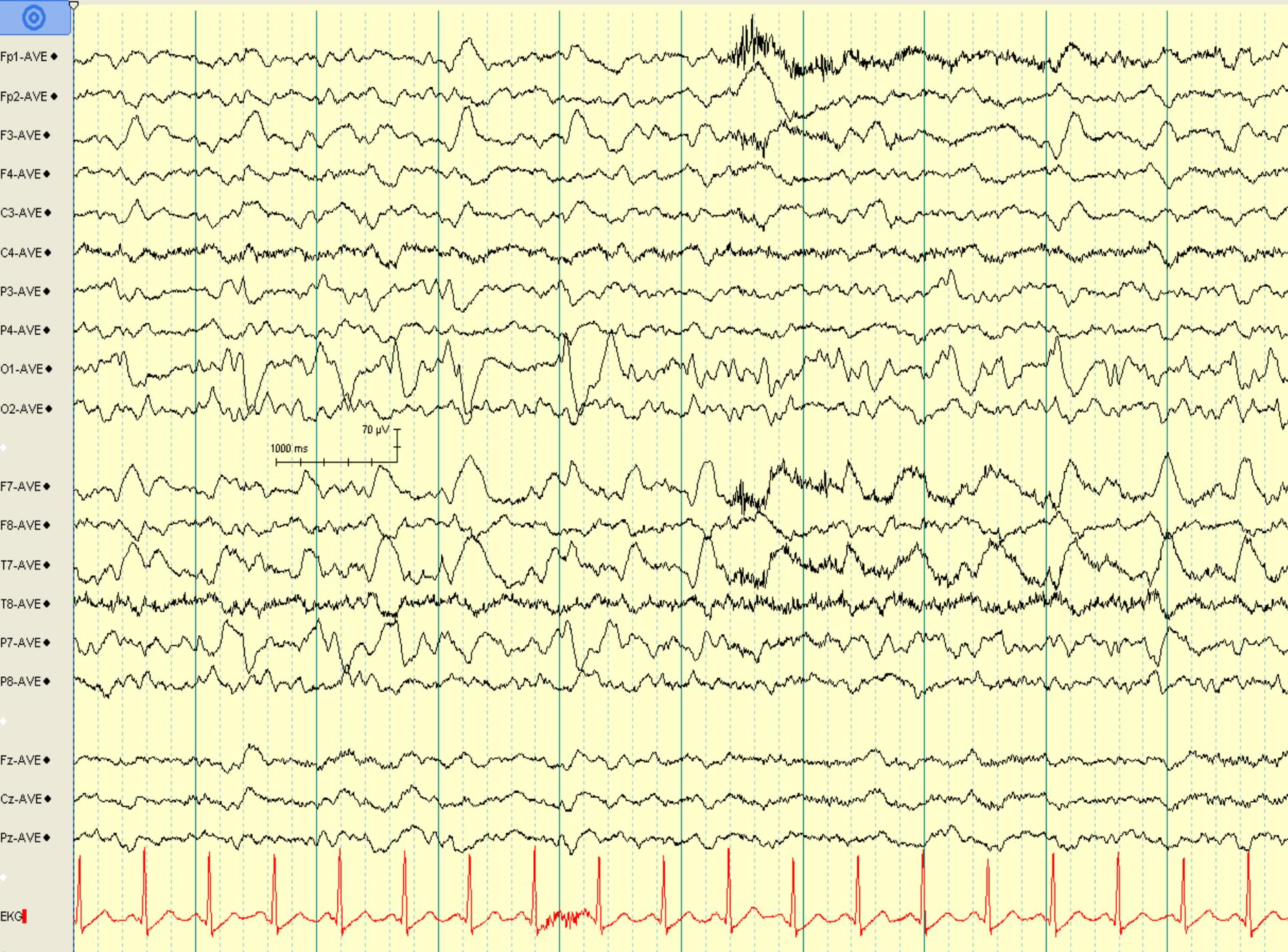
62 y/o woman who presented with acute onset of severe HA, blurred vision, vomiting who was found to have a left occipital intracerebral hemorrhage . On day 3 after admission, she became less responsive with waxing and waning level of alertness. EEG was performed the following day.

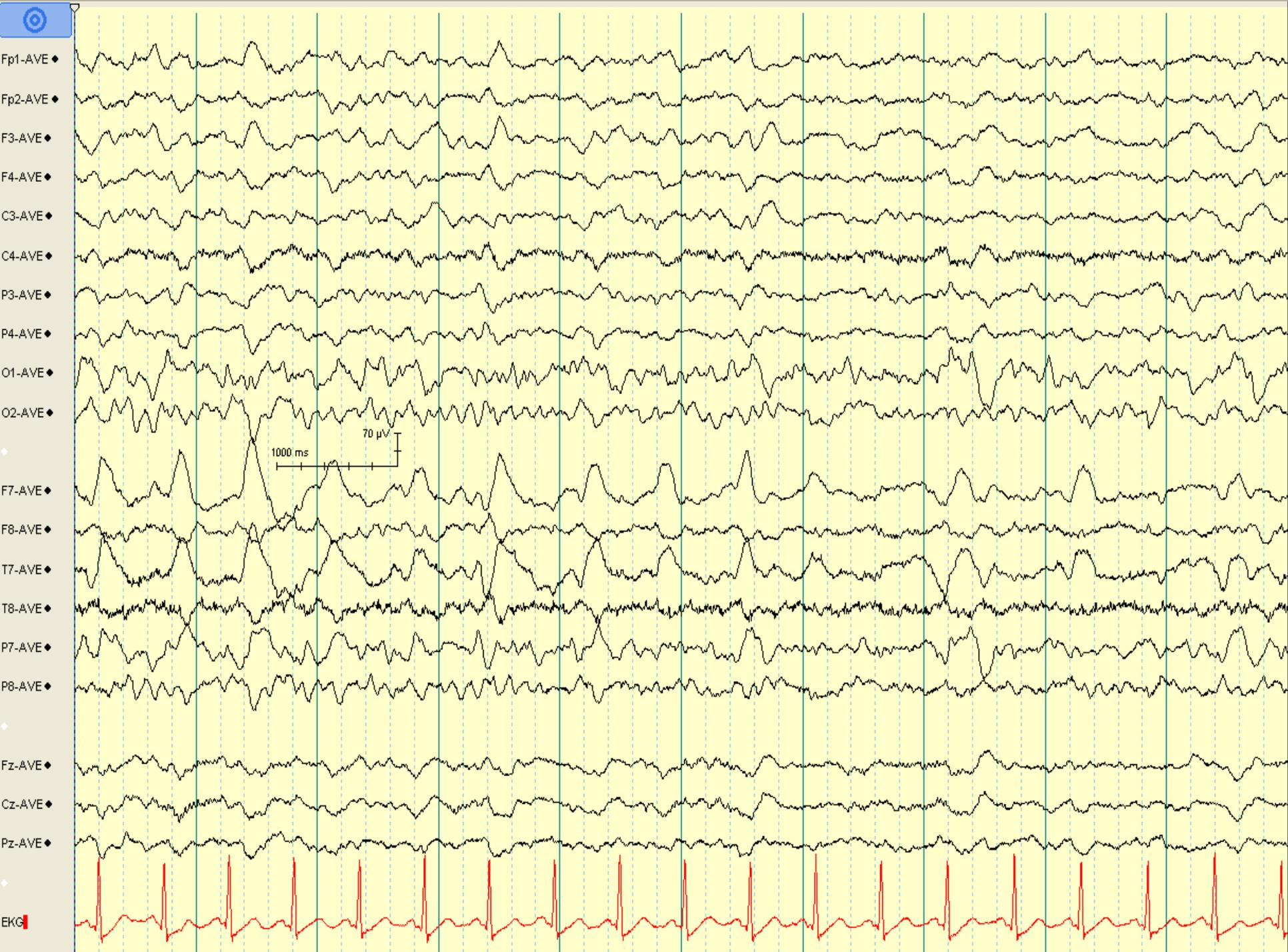


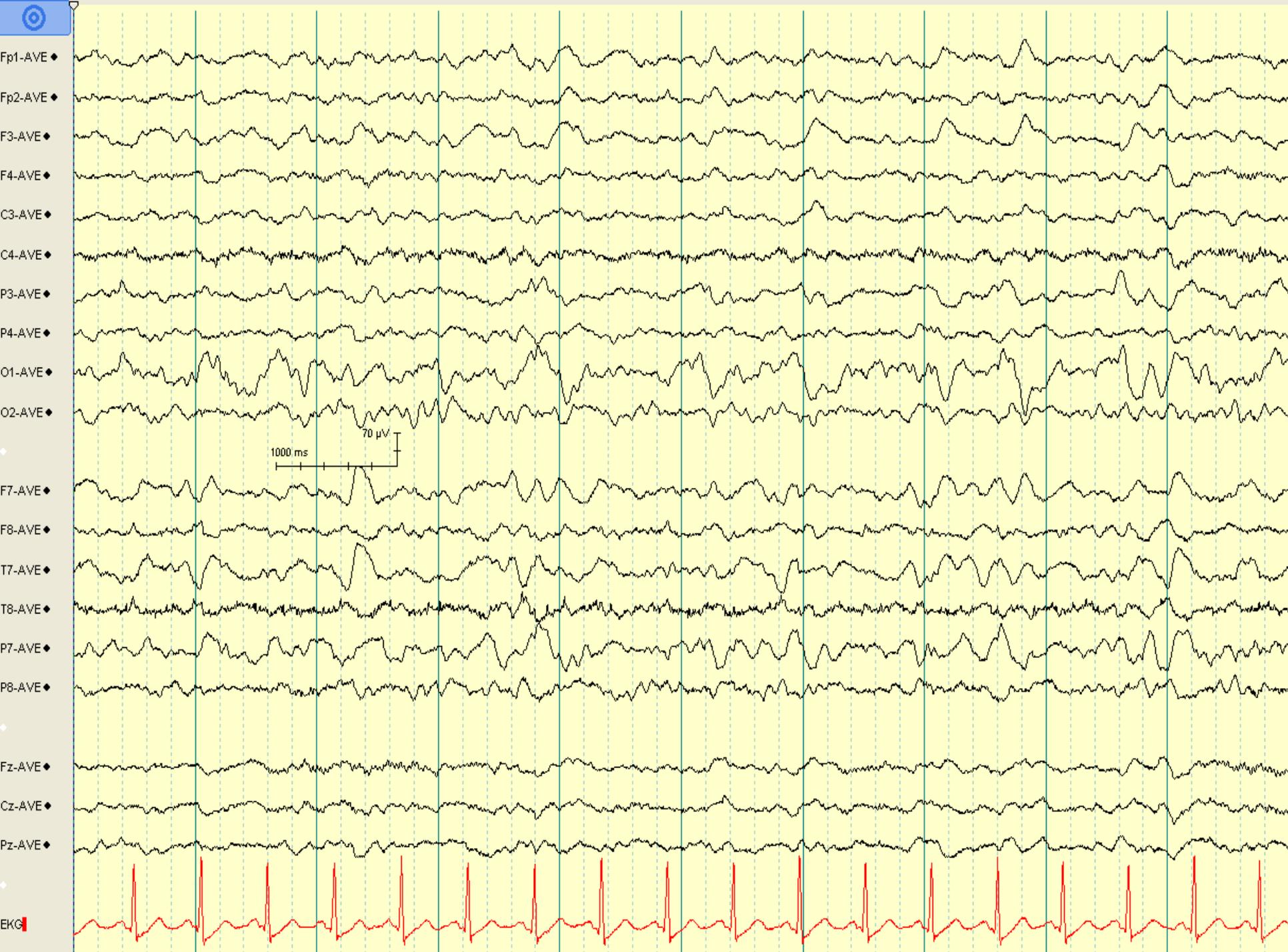












Case example: L.R. (continued)

She was treated with IV levetiracetam and fosphenytoin with resolution of ictal activity on EEG and return to her baseline mental status.

She continued to do well and was discharged home several days later on oral antiepileptic medication.



Which patients are most likely to have complex partial NCSE?

- Prolonged postictal state after a GTC seizure
- Brain neoplasms
- CNS infections
- Post neurosurgical procedures
- Stroke patients who are clinically worse than expected
- Altered mental status
 - History of seizures earlier in admission
 - Fluctuating level of responsiveness
 - Subtle twitching, eye deviation



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- Periodic and uncertain EEG patterns

Criteria for diagnosis of NCSE

In patients without a known epileptic encephalopathy

- Repetitive generalized or focal spikes, polyspike, sharp waves, spike-and-wave or sharp and slow wave complexes at >2.5 Hz
- Discharges <2.5 Hz but with EEG and **clinical improvement after benzodiazepines (BZDs)**
- Discharges <2.5 Hz with **focal ictal phenomena (facial twitching, gaze deviation, nystagmus, limb myoclonus)**
- Rhythmic waves (theta-delta) at > 0.5 Hz with incrementing onset, evolution in pattern or location, or decrementing termination and post PEDs background slowing and attenuation **that respond to treatment with IV BZDs**



Criteria for diagnosis of NCSE

In patients with a known epileptic encephalopathy

- Frequent or continuous generalized spike-wave discharges, which show an increase in profusion or frequency when compared to baseline EEG **with observable change in clinical state**
- **Improvement of clinical or EEG features with IV BZPs**

Chong and Hirsch, J Clin Neurophys 2005: 22(2): 79-91
Kaplan, Epilepsia 2007: Suppl 8:39-41, 2007



NCSE diagnosis

- Difficult – expert EEG readers may disagree
- EEG pattern is often indeterminate. There is a large large grey zone: **ictal-interictal continuum**
- Significance of an EEG pattern can vary depending on the clinical situation
- Clinical information and clinical response to treatment is critical

Indeterminate EEG patterns

- Periodic patterns
 - PLEDs/LPDs,
 - BiPEDs/BIPDs,
 - GPEDs/GPDs
- Stimulus induced rhythmic, periodic, or ictal discharges (SIRPIDs)
- Rhythmic high amplitude delta activity
- Alternating patterns of rhythmic activity without clear evolution in the context of acute cerebral damage

PLDs / PLEDS



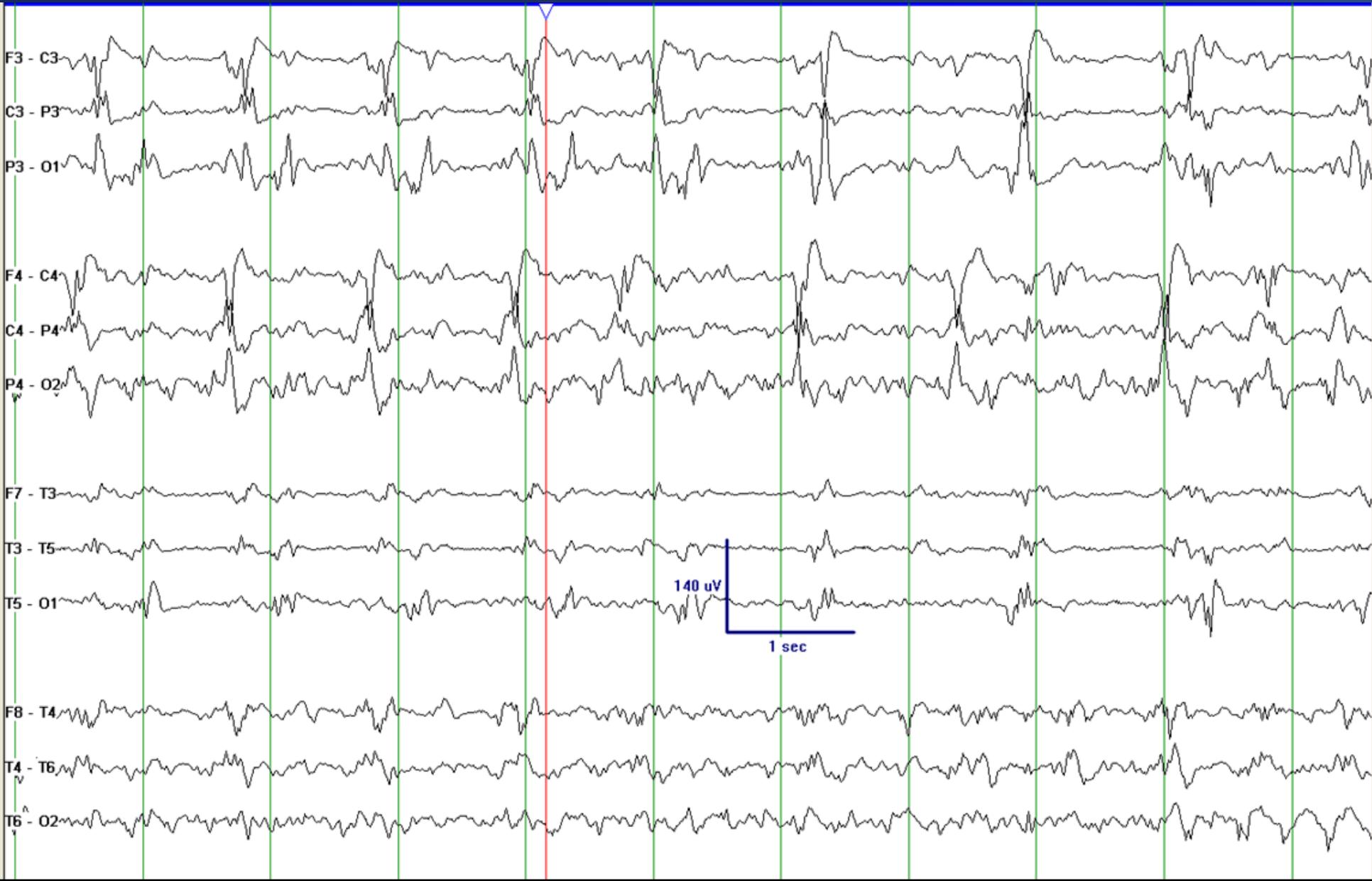
PLDs+ FA / PLEDS+



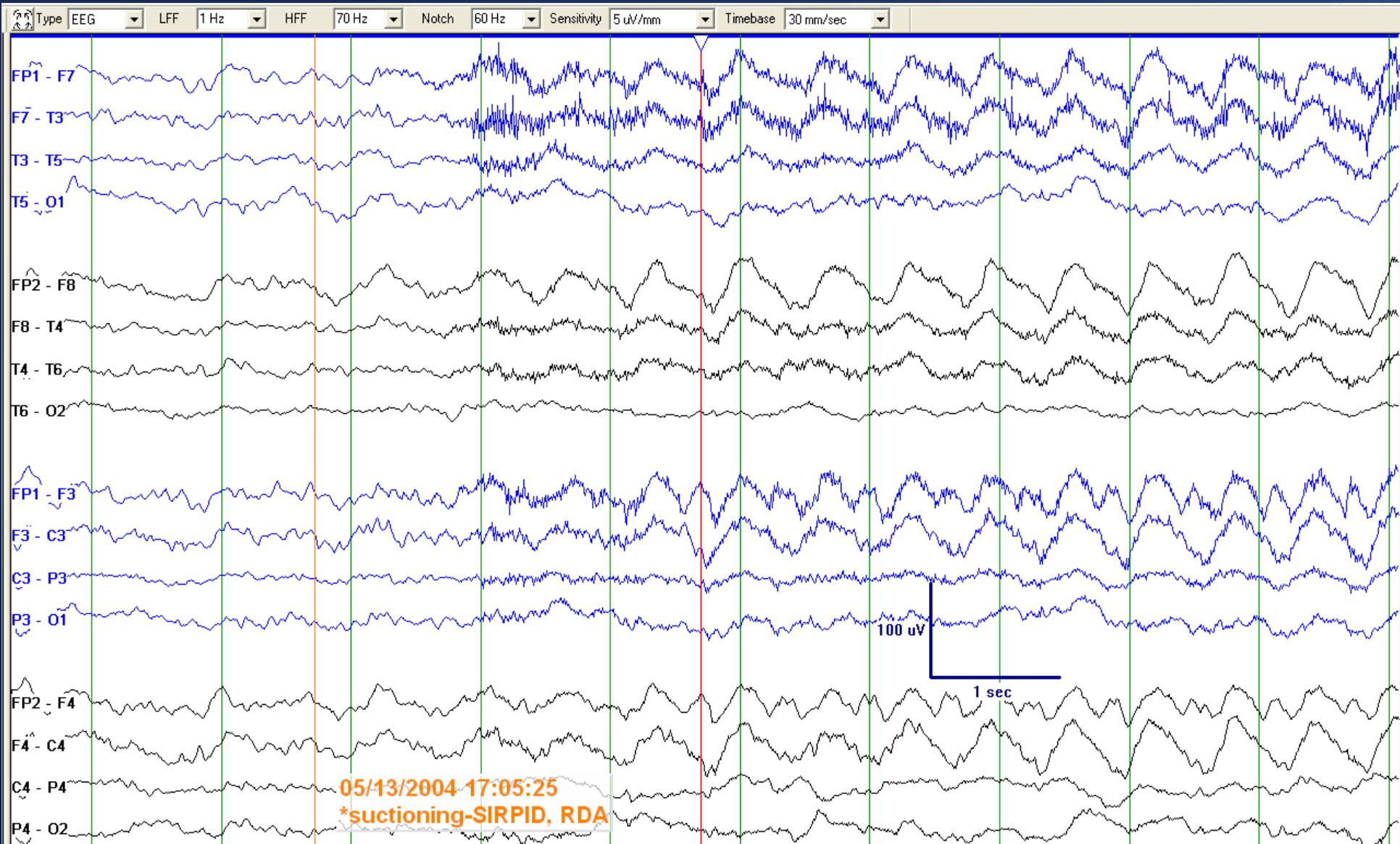
GPDs / GPEDs



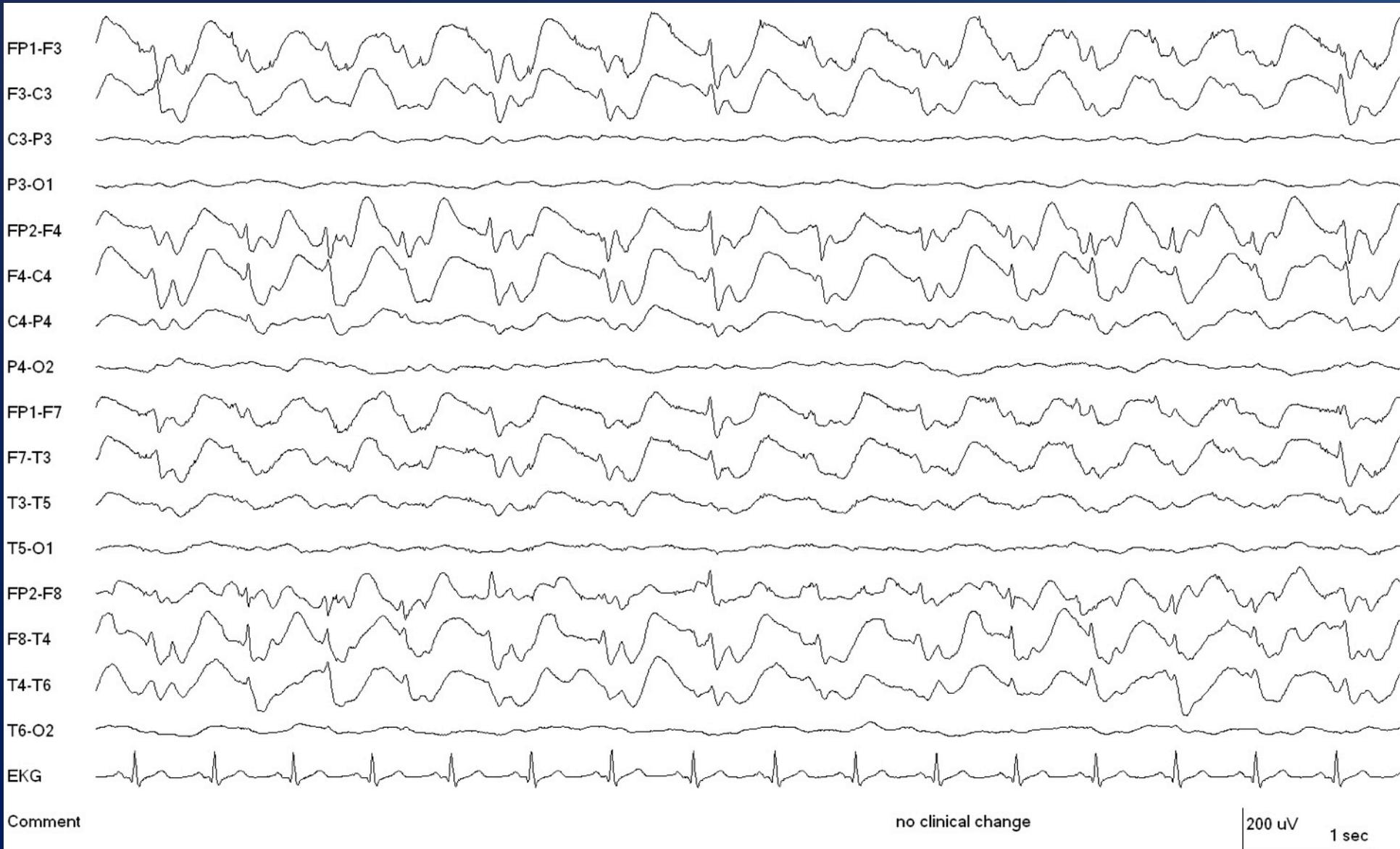
BIPDs/BiPEDs



Generalized rhythmic delta activity



Generalized spike and wave



The Ictal-Interictal-Injury Continuum

