

Electroencephalography - EEG

- 1929 Johannes Berger performed the first examination, the first experiments in dogs
- Simple, repeatable, non-invasive
- The patient must cooperate
- External influences (medications, skull trauma, movements)
- Internal influences (sleep, metabolic effects, alertness)
- mainly in epileptology
- Sensitivity 25–56%, specificity 78–98% (J Neurol Neurosurg Psychiatry 2005; 76: ii2-ii7)
- Sleep medicine – polysomnography
- Functions of individual brain areas (short term records x long term monitoring)

EEG

- Graphical recording of brain biopotential field differences between two registering electrodes as a function of time
- Eeg depth – electrocorticogram
- Eeg scalp x semiinvasive x invasive
- Electrode placement in the “10-20” system
- Left-odd number, right-even number
- F-frontal, T-temporal, P-parietal, C-central, O-occipital
- Special caps with built-in electrodes
- Reference x bipolar x power supply

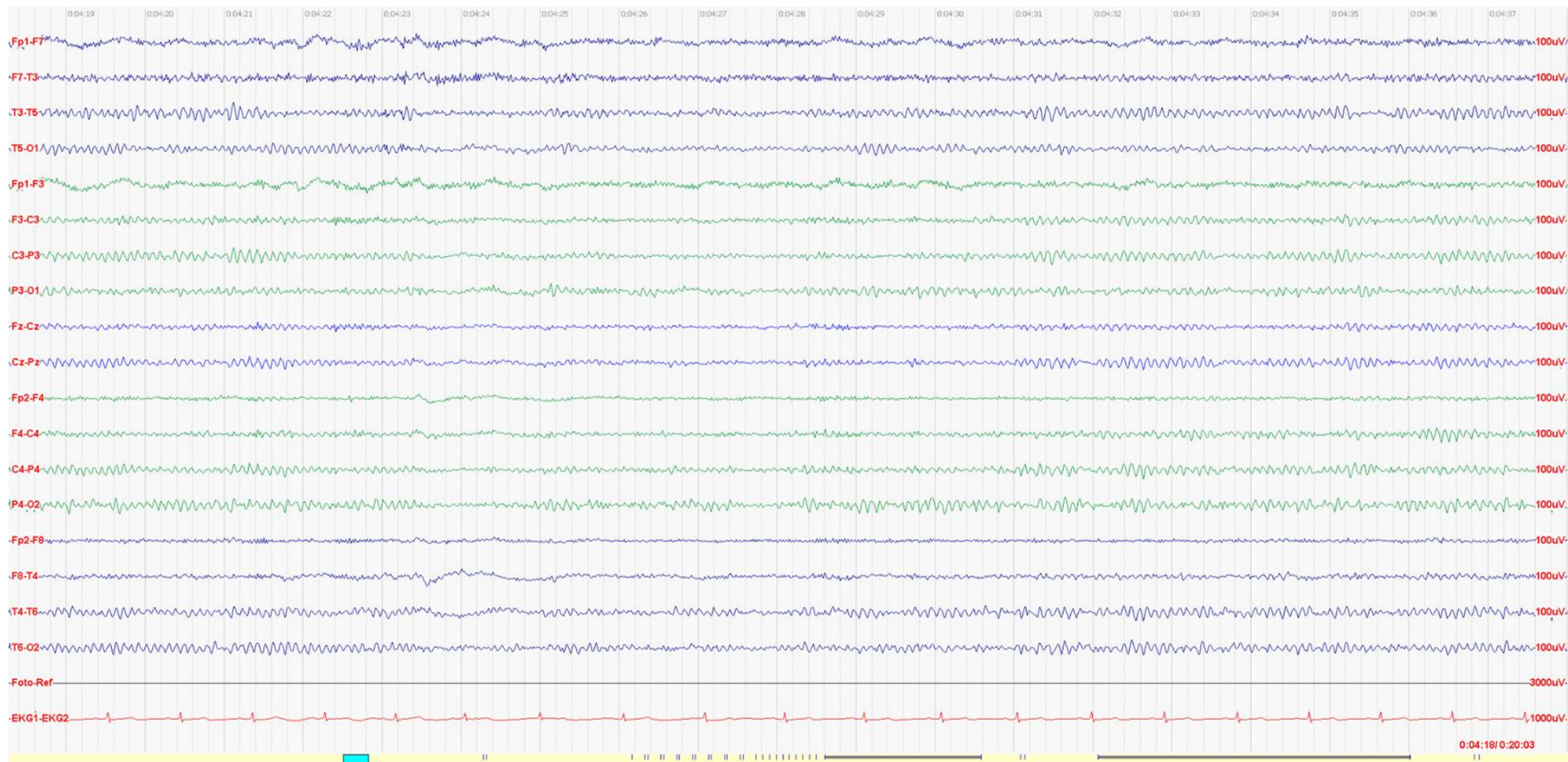
EEG (examination in our laboratory / in our workplace)

- "Normal eeg is one that occurs in most healthy populations of a given age and condition."
- Recording takes 20 minutes, can be completed with activation methods
- Hyperventilation (HV) through the nose and mouth - activation method (deep, regular breathing with f 20/min, duration 2-4 minutes, 2min. nose and 2 min. mouth)
- Eye opening and closing reactions (AAR, RF)
- Photostimulation - activation method (10 seconds stimulation and 10 seconds pause, stimulation rate ascending and descending 1-60 Hz)
- SD- eeg after sleep deprivation - activation method (provocation epiGE !!)
- EEG curve can be broken down into the simplest components (graphoelements - GE)

„normal EEG“

- Occipital quadrant: O1, O2
The most common alpha frequency 9.5-10.5Hz, amplitude 20-50 μ V.
Alpha activity is attenuated by eye opening and mental activity.
- Central area: C3, Cz, C4
Beta activity up to rhythm 18 to 25 Hz, amplitude 20 μ V
- Temporal region: T3, T4, T5, T6
Rear-intermittent alpha, dispersed theta, superimposed beta
Anterior-intermittent irregular beta, dispersed theta, rare flat delta
- Frontal area: F3, F4, F7, F8
Beta activity, which is faster and lower than in the C region, may also occur in rare flat delta waves. Common artifacts from eye blinks.

„normal eeg“



EEG curve, individual GE (graphoelements), GE properties

- **Frequency** (number of repetitions in 1 sec.)
 - Alfa 7,5-13 Hz (in the back quadrants with eyes closed)
 - Beta 13,5 a více Hz (F,C adult)
 - Theta 4-7 Hz (child, T – adult)
 - Delta 0,5-3,5 Hz (HV dospívající, N3 spánek, newborn)
- **Amplitude** (uV)
- **Shape, form** (monomorphic, polymorphic)
- **Occurrence in space** (generalized x localized x focal x regional)
- **Occurrence over** (continuous x intermittent x periodic x paroxysmal)
- **Reactivity**

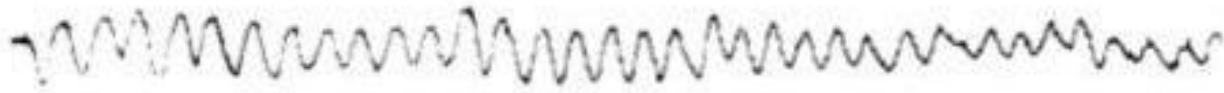
Beta



Alpha



Theta



Delta



three types of abnormalities

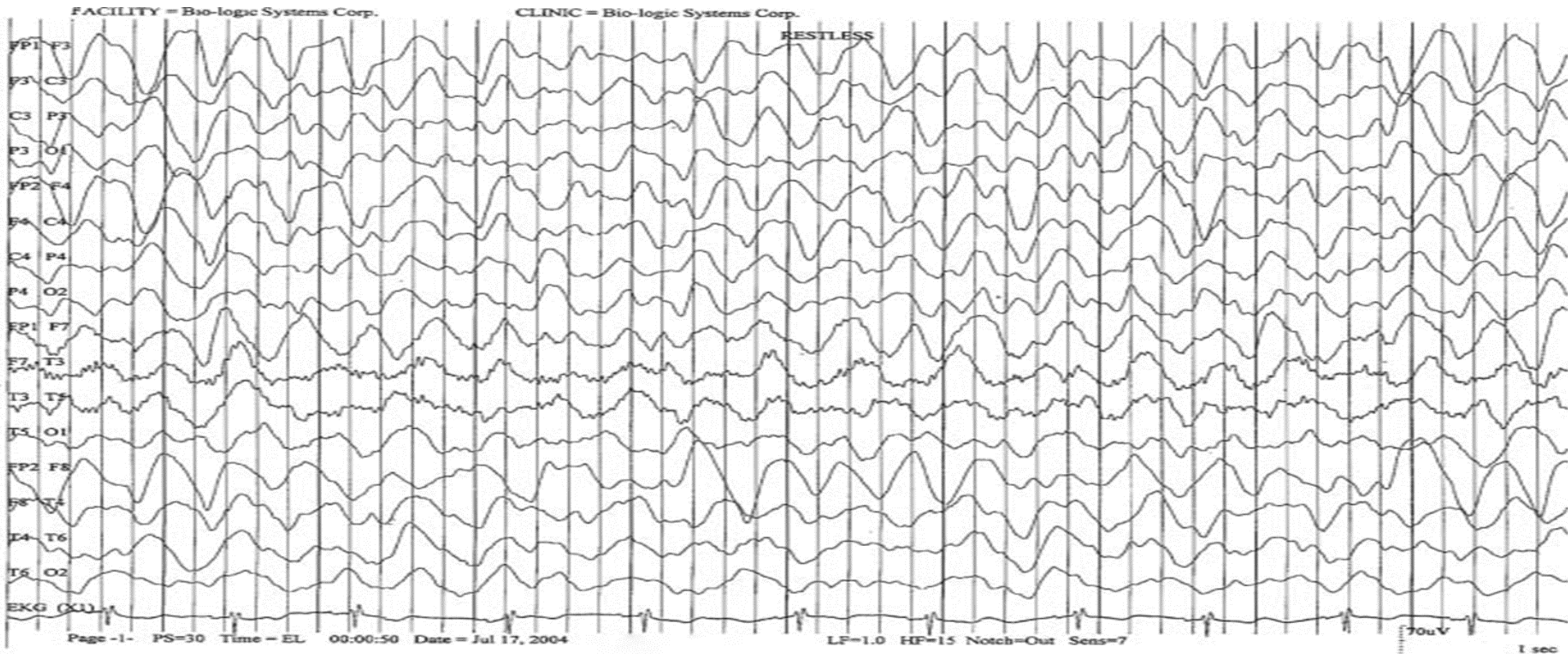
- **Background abnormality** (deceleration, suppression * flattening, disappearance of EEG background)
- **Slow abnormality** (theta, delta) localized or generalized, rhythmic x arrhythmic
- **Epileptiform abnormality**

Spikes under 80ms

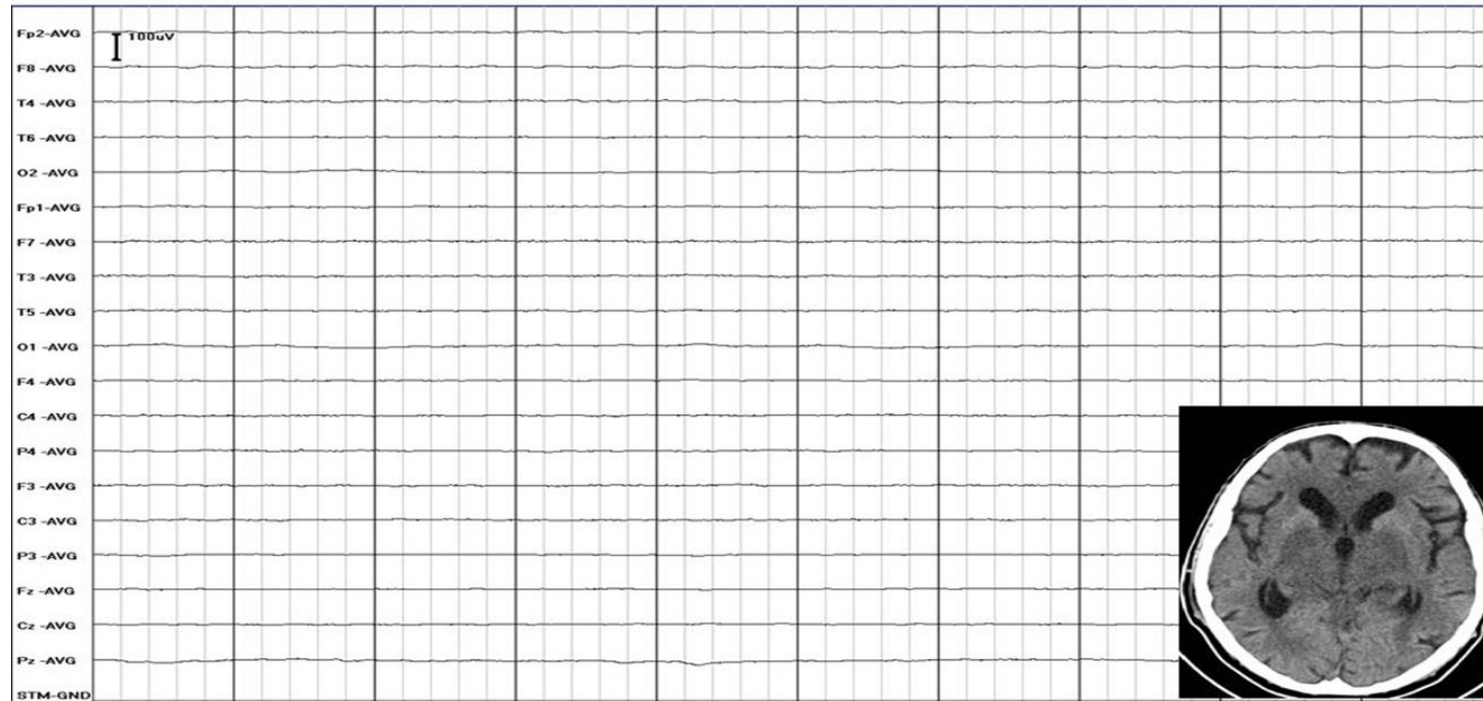
Sharp waves 80-200ms

Complexes - SWC, SSWC, PSWC, localized x generalized

DELTA COMA, background EEG disorder, slow abnormality



Elektrocerebral inactivity, „ EEG silence“ „silence in EEG“

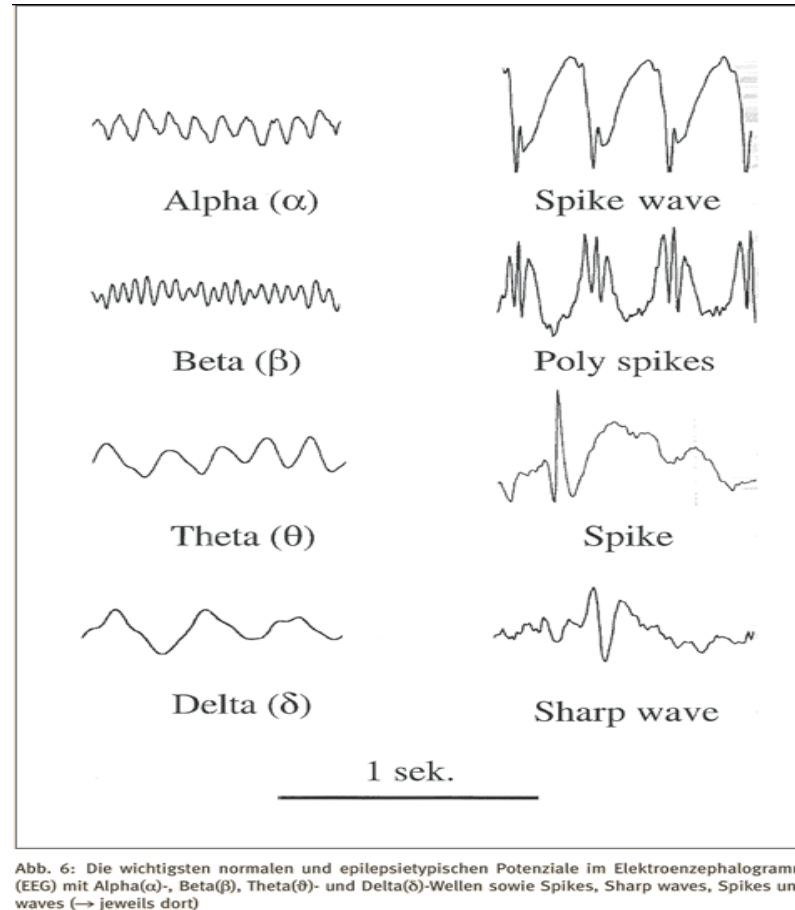


The amplitude does not exceed 2µV
Filters 0,3-30Hz
ECG
Breath curve
Somatosensory, auditory, visual stimulation
Normotenze
Not affected by medication

Epileptiform abnormality — spikes (70ms), sharp waves (70-200ms)

- **Non-epileptic epileptiform abnormality** - not significantly associated with epilepsy (physiological MU rhythm, sleep graphoelements-POSTs, vertex sharp waves, hypnagogic hypersynchronia, driving), formulas of uncertain significance: SSS 14a 6 posit spikes, 6Hz spike wave complexes, wicket spikes
- **Epileptic epileptiform abnormality** — morphologically meet epileptiform criteria associated with epileptic disease (SW, SWC, PSWC, temporal spikes, sharp waves)

Schematic.....



- **Spikes, sharp waves (regional occurrence supports diagnosis of focal epilepsy)**

Centro-temporal spikes, occipital spikes in benign focal pediatric epilepsy with good prognosis

SWC 3-6Hz in generalized epilepsy

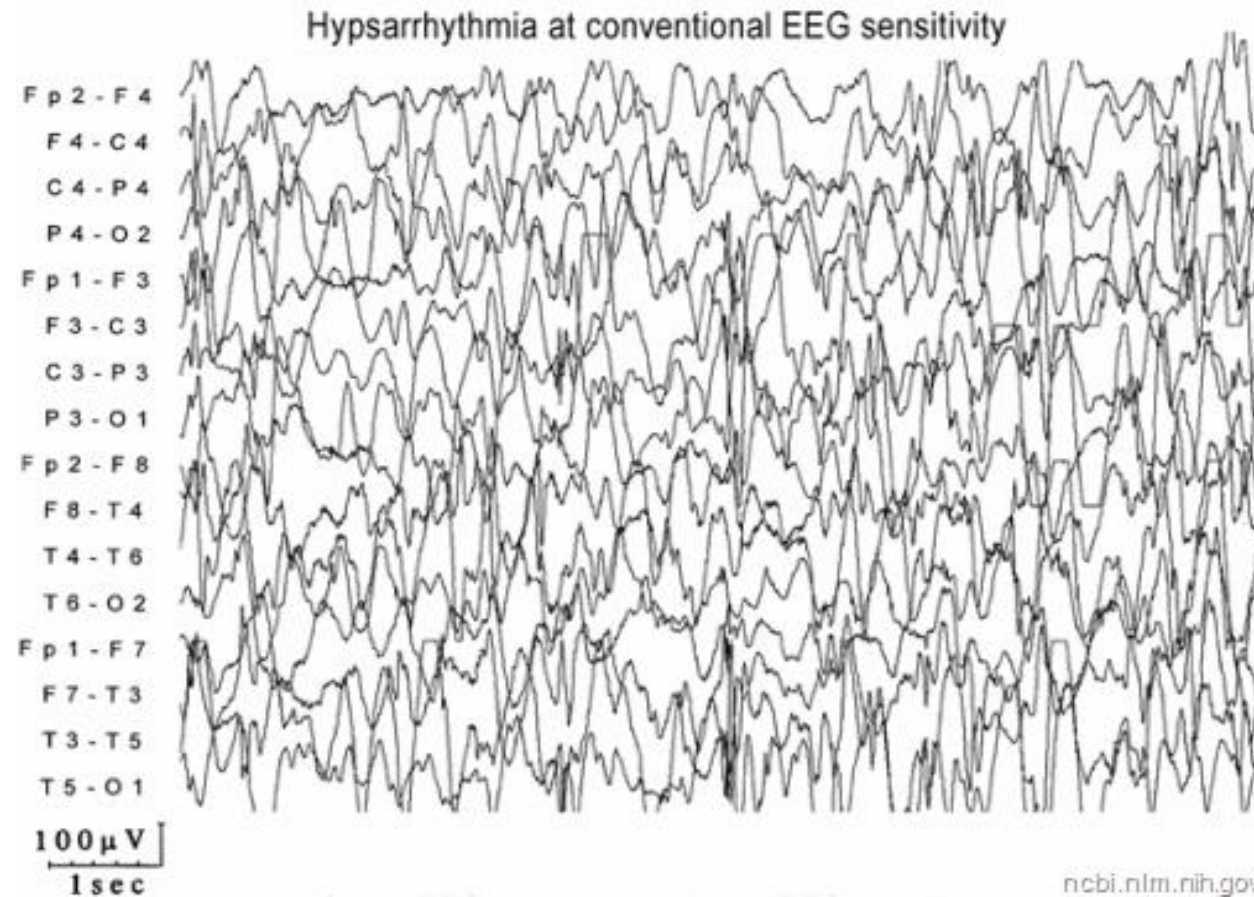
- **3SWC child absence syndrome**

Slow spike and wave complexes SSWC below 2.5Hz- symptomatic epilepsy, some pharmacoresistance with multiple seizures

Multiple spikes, PSWC - generalized epilepsy

- **Hypsarythmia** - prognostically unfavorable forms of childhood epilepsy, early age, encephalopathy
- The **photoparoxysmal response** when activated by photostimulation may indicate a higher degree of photosensitivity

Hypsarythmia



Abnormal eeg

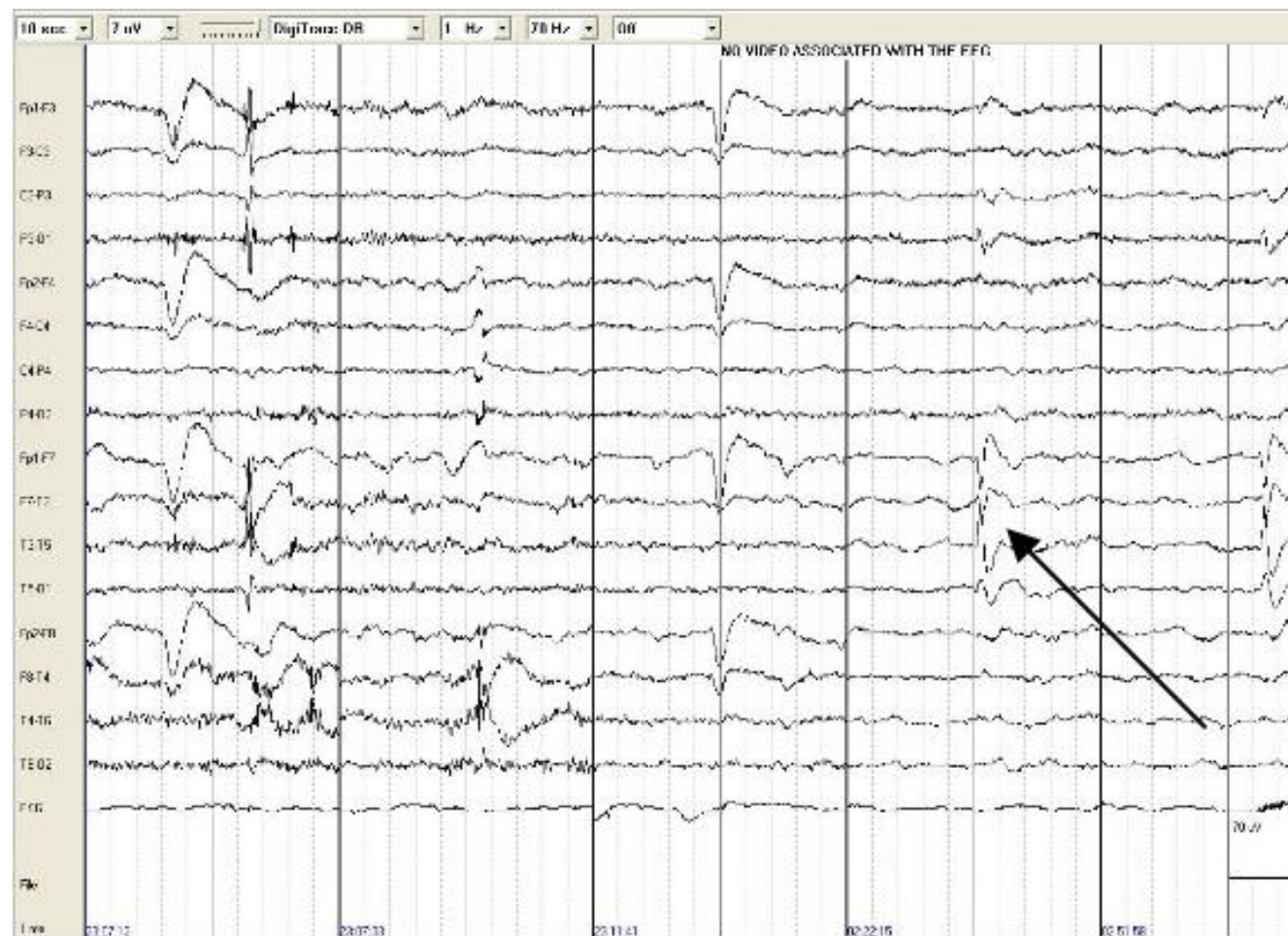
- **Interictal** epileptiform abnormality occurs between seizures
- **Ictal** abnormality during epileptic seizure

Frontal epilepsy

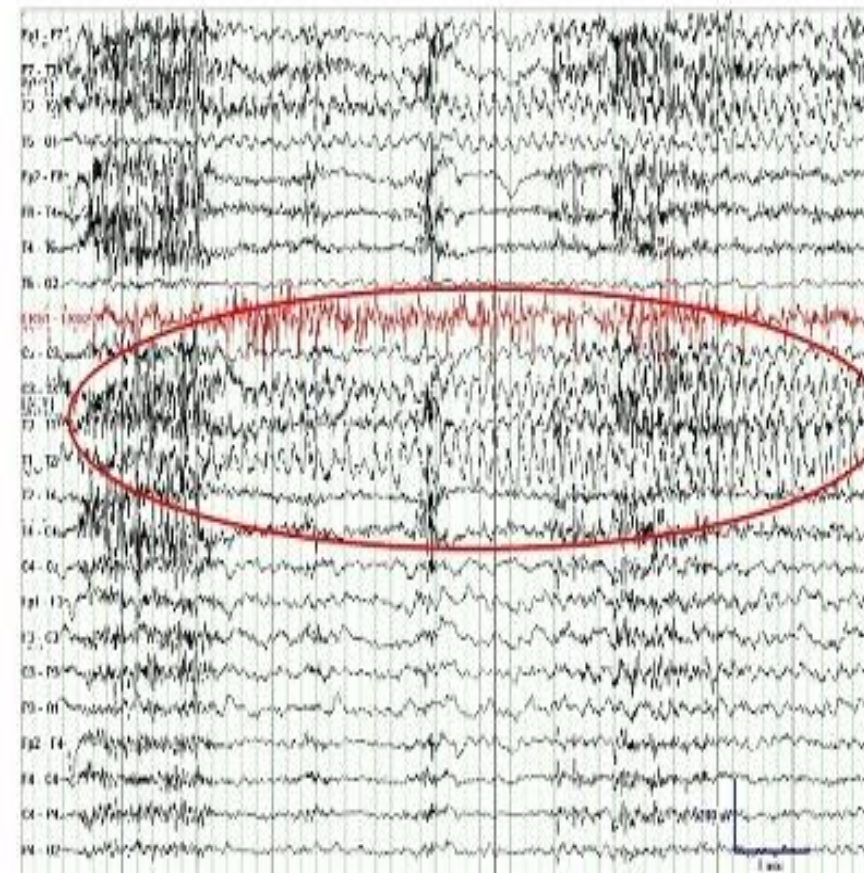
BRE with left temporal spikes



Frontal epilepsy



Temporal epilepsy



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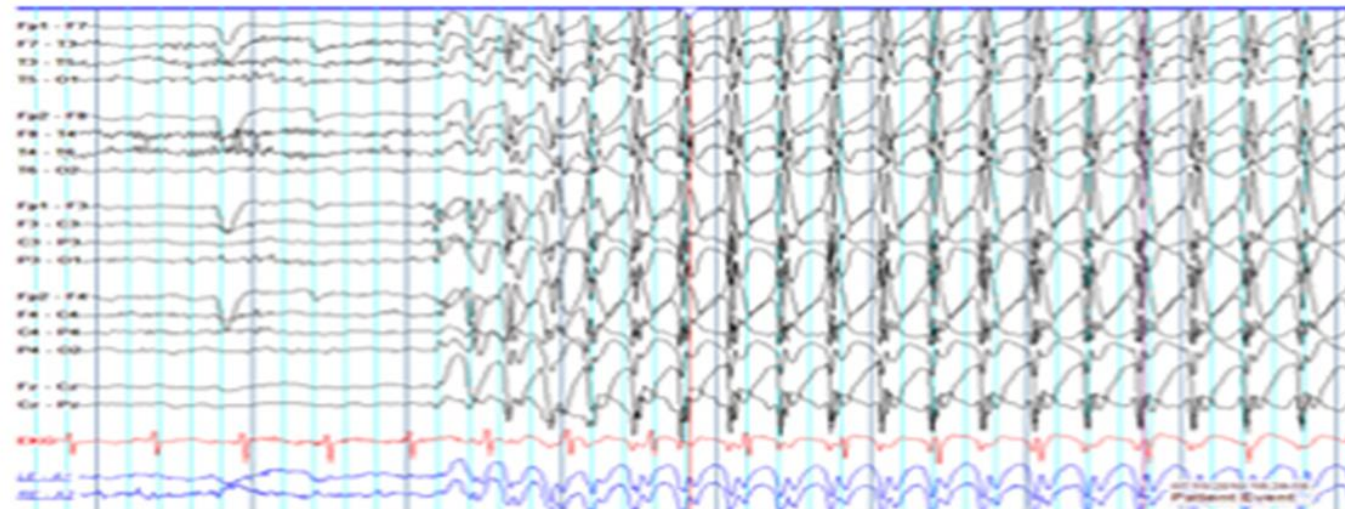
Centro-temporal epilepsy, with centro-temporal spikes



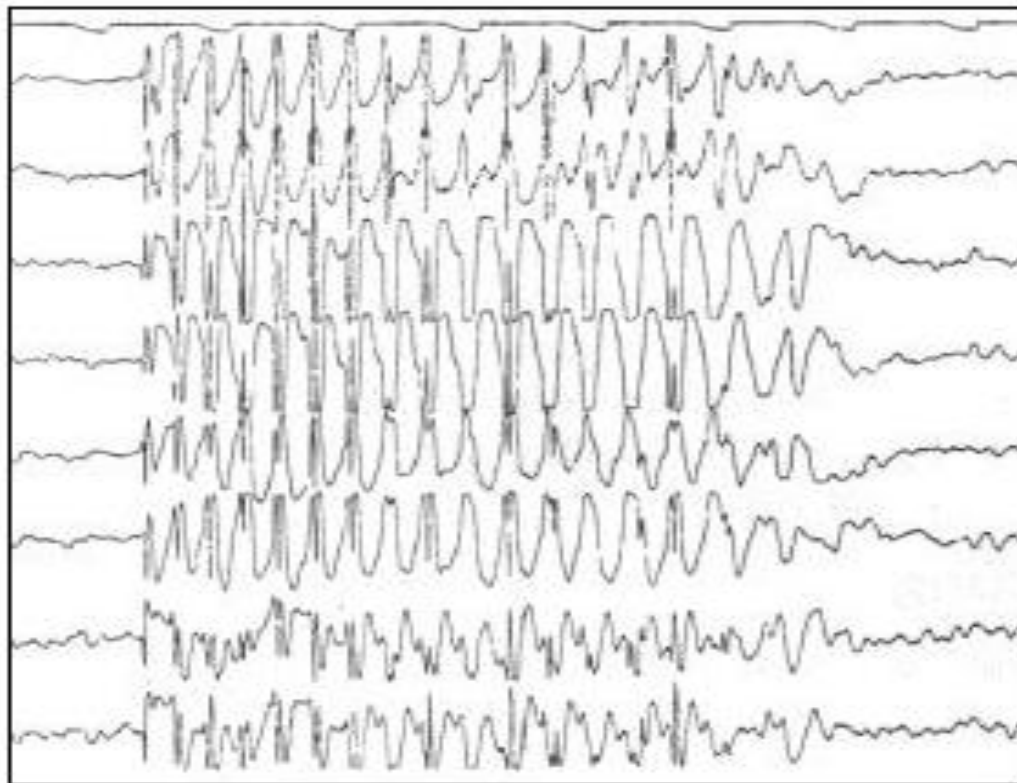
Normal EEG Awake



Absence Seizure



Absence



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Absence



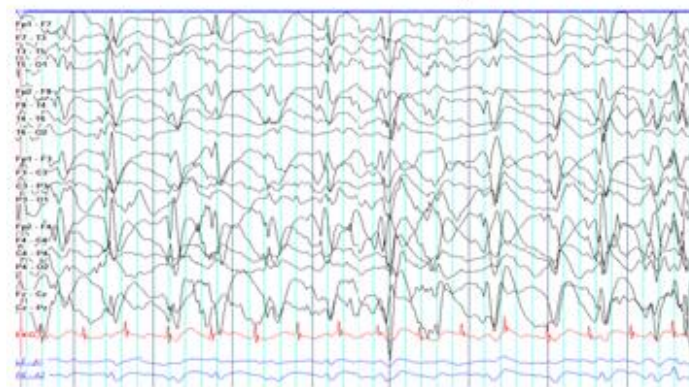
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Lennox-Gastaut syndrome

Normal EEG Awake



Lennox-Gastaut Syndrome

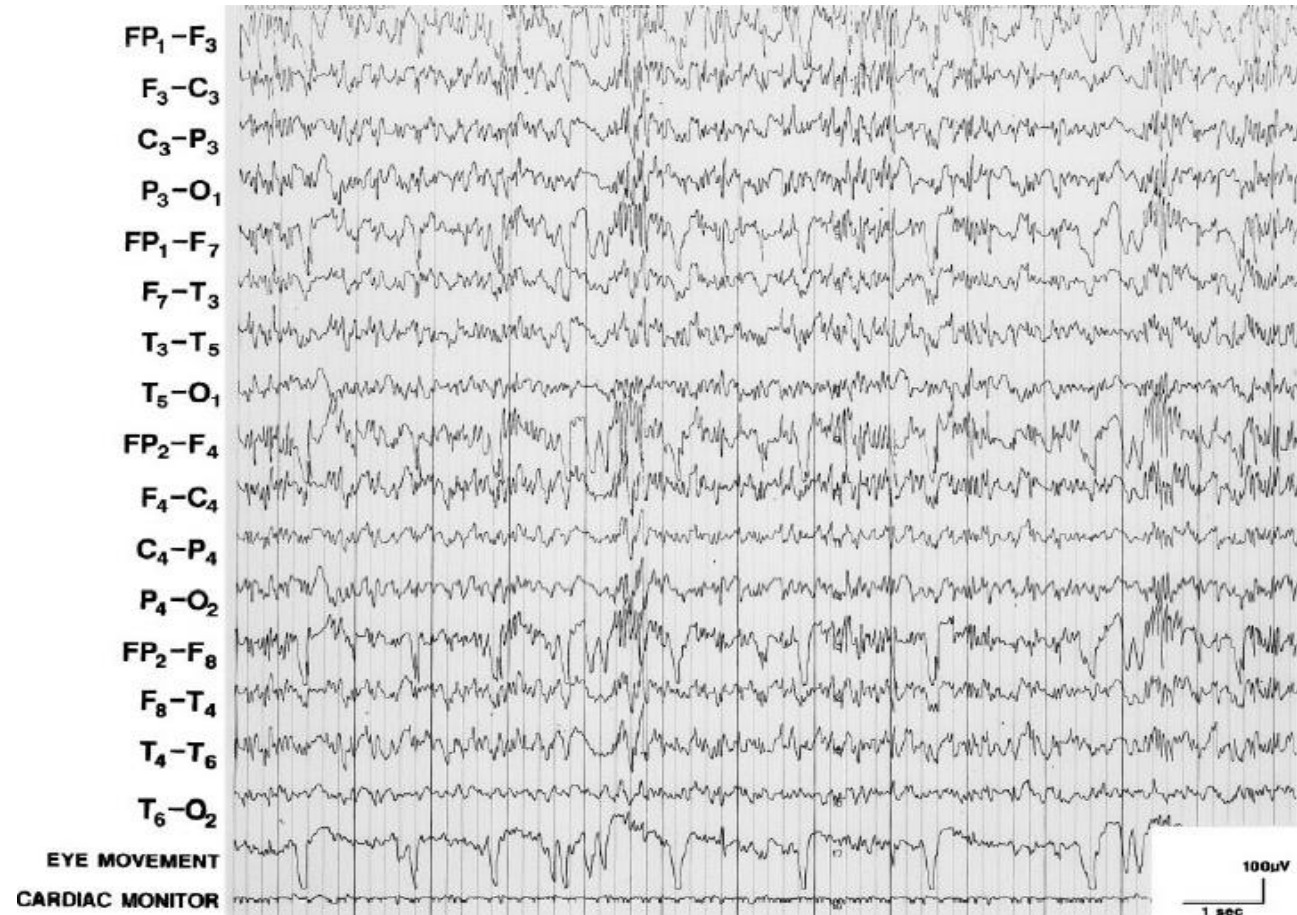


Lennox-Gastaut syndrome

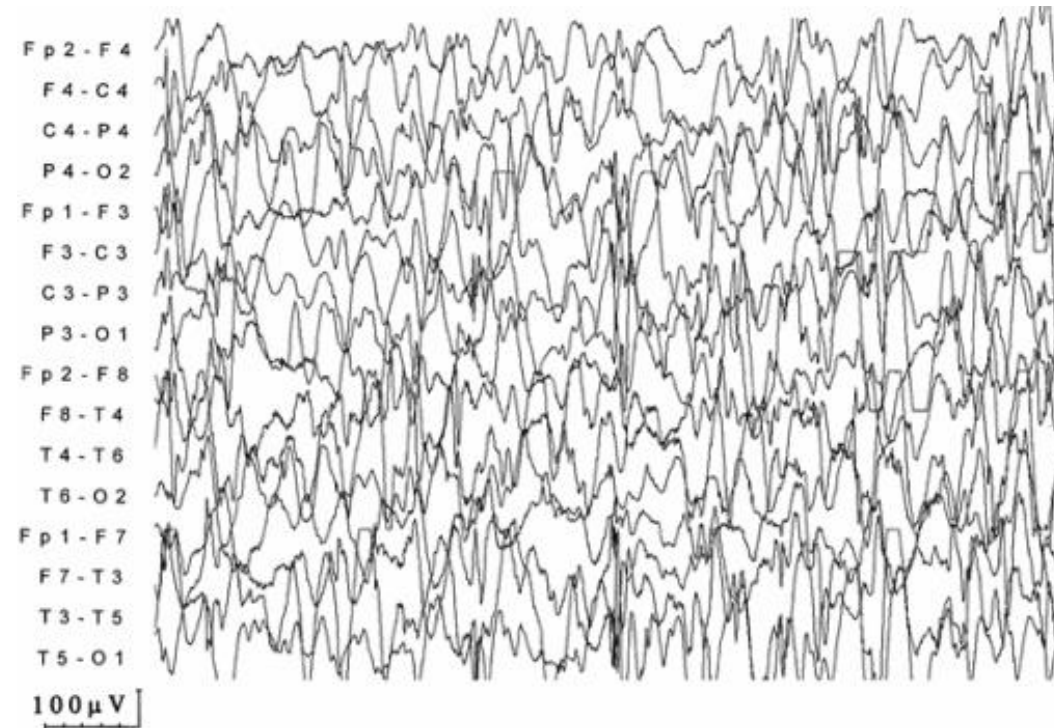


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PSWC

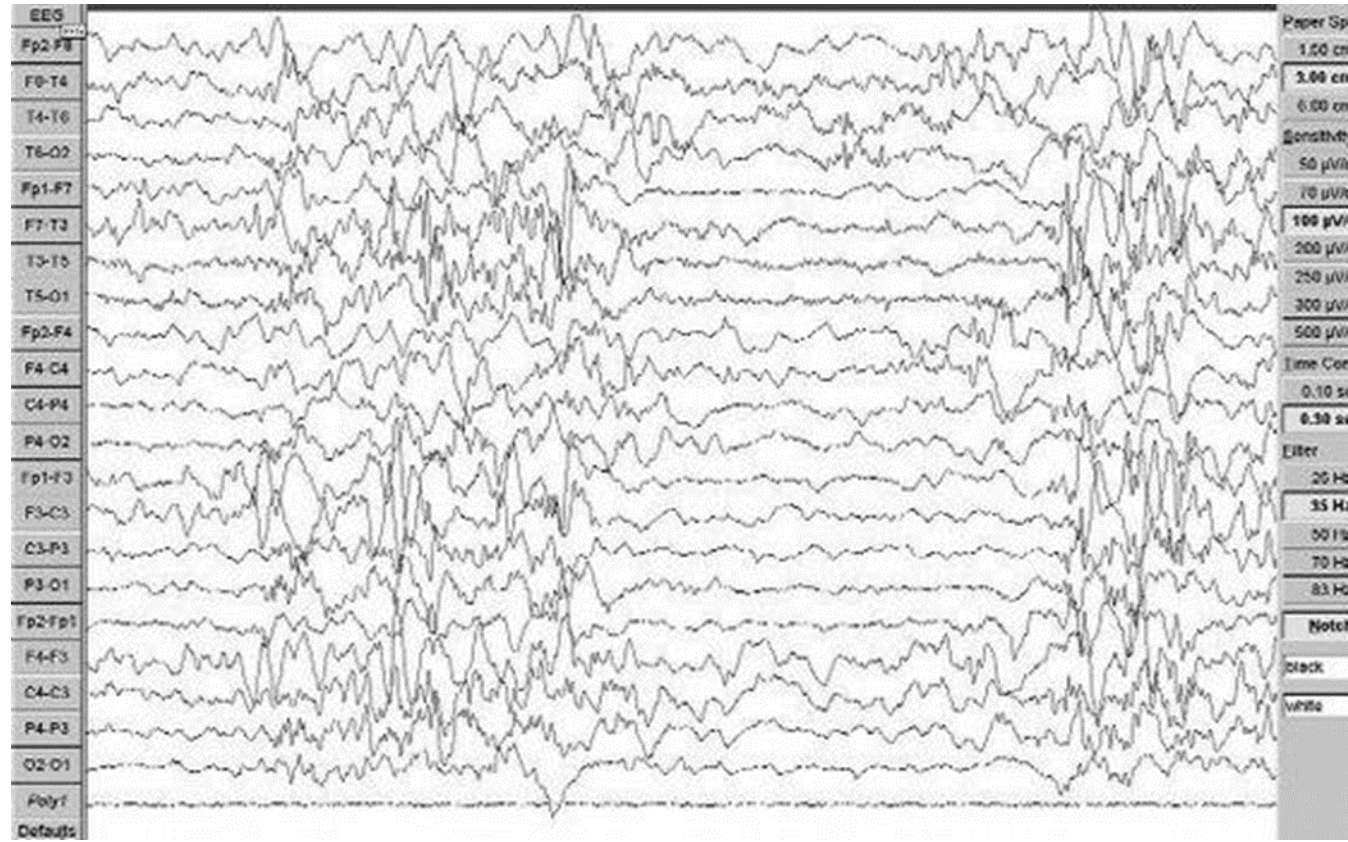


Hypsarytmia



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Hypsarythmia-West syndrome

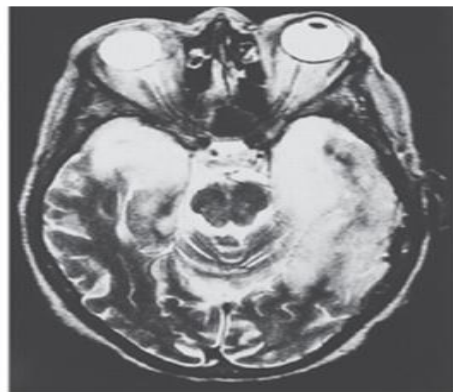


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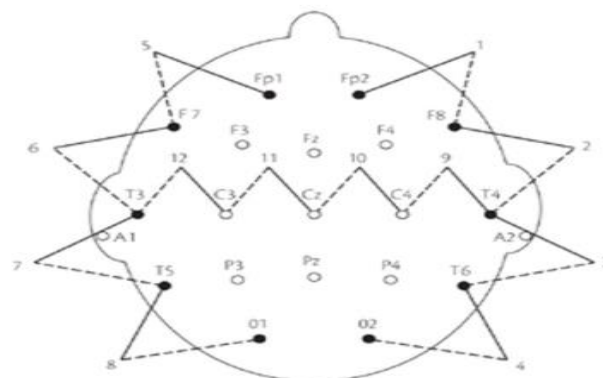
Complex in Jacob-Creutzfeldt disease



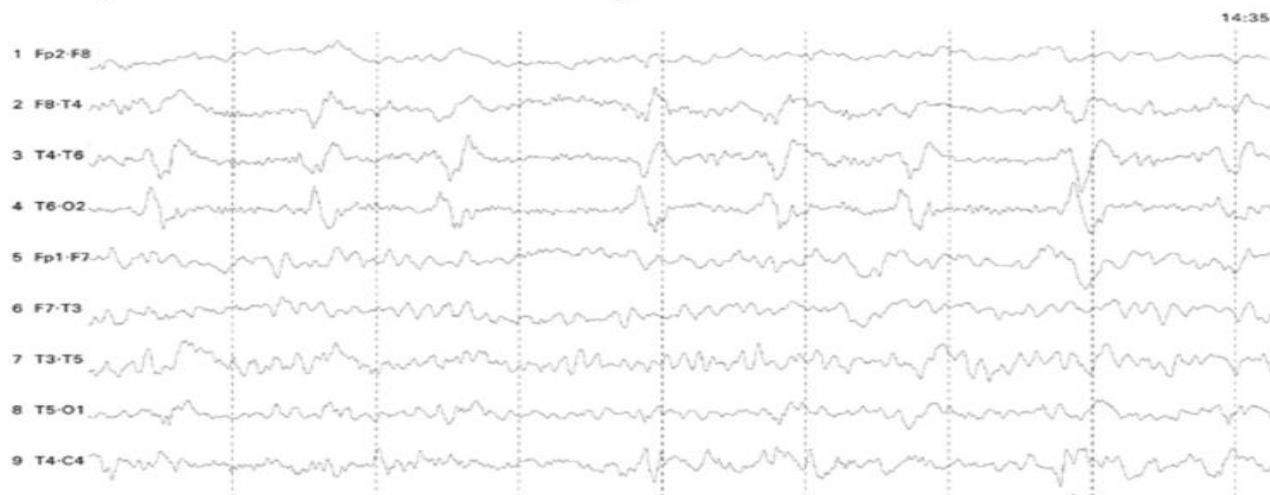
Herpetic encephalitis complex (HSV)



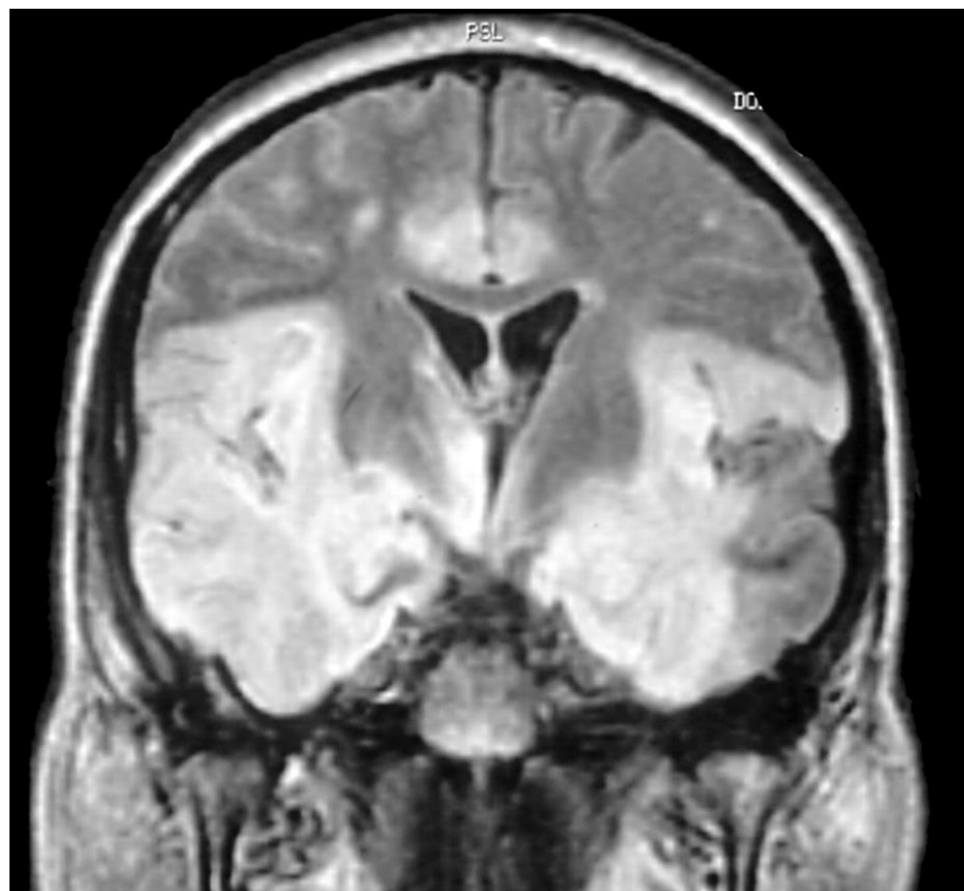
A



C

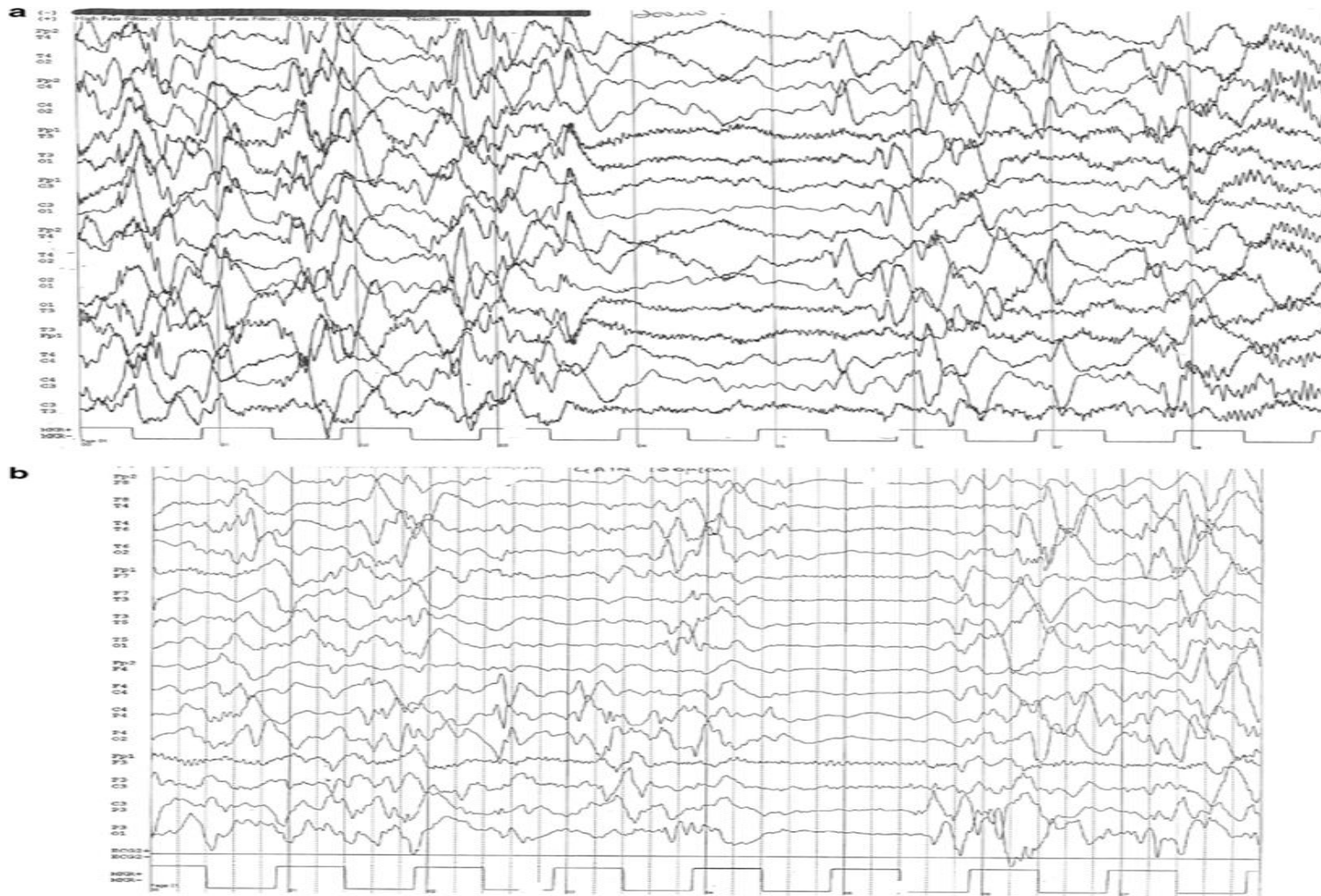


HSV – MRI sagit.

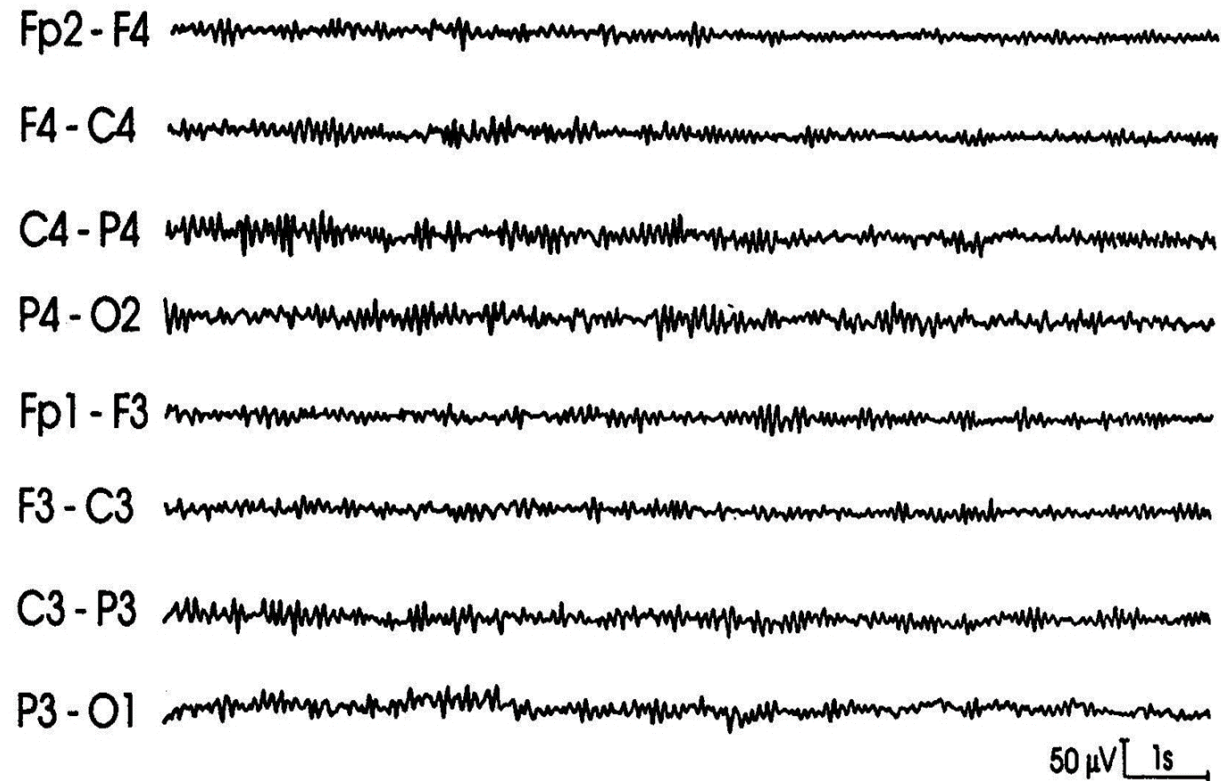


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Burst-suppression



COMA AND BRAIN DEATH



hyperventilation

- assumption
 - 1) systemic hypocapnia, vasoconstriction of brain vessels, brain hypoxia
 - 2) hypocapnia causes a decrease in mesencephalic reticular formation
 - 3) respiratory alkalosis leads to hyperexcitability of neurons and development of EPI GE

- EEG video - EEG and patient video are recorded synchronously. It is possible to correlate EEG curve abnormalities with the current clinical manifestations of the patient.

Analysis of ictal semiology, differential diagnosis. PNES x parasomnias x syncopes, seizure type specification, seizure monitoring

Very time consuming

- Semi-invasive EEG - sphenoid electrodes (closer amygdalo-hiocampal complex)
Lateralization of epilepsy of the temporal lobe, localization of the epileptogenic zone
- Depth EEG- able to detect pathological manifestations in the depth of the brain, especially in the temporal and temporal lobes of the brain and the medial part of the hemispheres

Before epilepsy surgery.

Less to distinguish epileptic and non-epileptic seizures.

Epileptiform graphoelements

- importance for diagnosis of epilepsy (whether paroxysmal condition is epileptic)
- epileptic syndrome, generalized epilepsy, focal
- it helps in the selection and implementation of antiepileptic therapy
- determine the likelihood of another seizure (EPI GE finding after the first seizure predicts the possibility of another seizure)

EEG indication

- Epilepsy
- Unconsciousness and Disorders of Consciousness (NCSE)
- Sleep Disorders (Polysomnography)
- Jakob-Creutzfeldt's disease
- Herpetic encephalitis (HSV)
- EEG barbiturate conduction, status epilepticus (burst-suppression formula)