

EEG workshop

Epileptiform abnormalities

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Paroxysmal EEG activities (focal or generalized)
are often termed “epileptiform activities”

→ EEG hallmark of epilepsy

- Epileptiform abnormalities are usually divided into
 - * interictal discharges
 - * ictal discharges

Interictal activity
Epileptiform activity occurring between clinical seizures, signaling the presence of a focus

Ictal activity
Epileptiform activity occurring during clinical seizure, very different activity is seen and consisting usually of rhythmic wave forms

Epileptiform discharge ≠ Interictal discharge

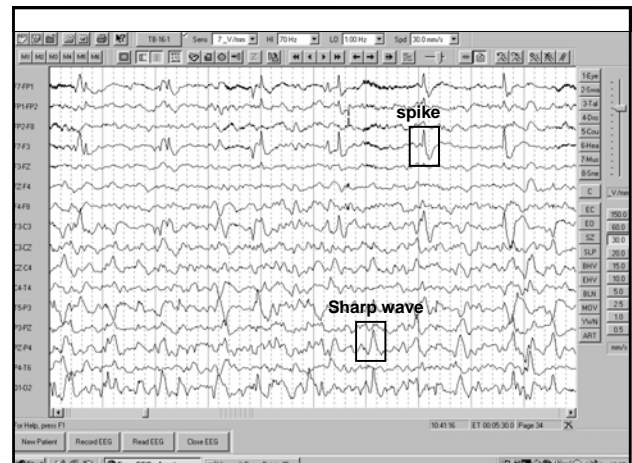
Definitions

Committee on Terminology of IFSECN (International Federation of Societies for Electroencephalography and Clinical Neurophysiology, 1974)

Epileptiform pattern:
“distinctive wave or complexes, distinguished from background activity, and resembling those recorded in a proportion of human subjects suffering from epileptic disorder...”

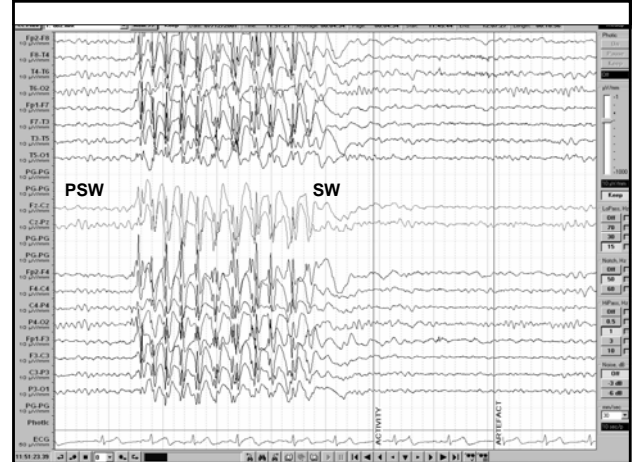
The following definition are in use (IFSECN 1974)

- Sharp wave - transient , clearly distinguishable from background activity, with pointed peak at conventional paper speeds and a duration of 70-200 millisecond (ms)
- Spike - same as sharp wave, but with duration of 20 to less than 70 ms



The following definitions are in use (IFSECN 1974)

- Spike-and-slow-wave complex (SW) – pattern consisting of a spike followed by a slow wave (classically the slow wave being of higher amplitude than the spike)
- Polyspikes-and-wave complex (PSW) – same as SW, but with 2 or more spikes associated with one or more slow waves



Ictal discharges

- Repetitive EEG discharges with relatively abrupt onset and termination
- Characteristic pattern of evolution lasting at least several seconds
- Vary in form, frequency and topography (distribution)

Epileptiform activity

Localized epileptiform activity

- focal irritative lesion of the cerebral cortex, acute or chronic

Generalized epileptiform activity

- no detectable abnormality : IGE
- diffuse cortical and subcortical disorders : structural change or toxic/metabolic disorders
- symptomatic generalized epileptic syndromes

Localized epileptiform activity

Interictal pattern

Wave shape : single or multiple focal spikes or sharp waves often in combination with slow waves, intermittent, may repeat briefly with little or no variation

Duration : brief duration (< 1 sec.)

Distribution : usually limited to one or a few electrodes

Localized epileptiform activity

Ictal pattern

Wave shape : consists of paroxysmal rhythmic waves with continue to change in shape

Duration : usually persists for several seconds

Distribution : wide distribution, may start at interictal focus and gradually extend to larger areas or rapidly involves both hemispheres in an asymmetric fashion

Periodic complexes

- **Rhythmic** : Repetition of a waveform with relatively uniform morphology and duration and *no interval* between consecutive waveforms
- **Periodic** : Repetition of a waveform with relatively uniform morphology and duration with *a definable and quantifiable interval* between consecutive waveforms and recurrences of the waveform at nearly regular intervals

Quasi-rhythmic or quasi-periodic = semi- or pseudo-

Periodic complexes

1. Periodic lateralizing epileptiform discharges (PLEDs)
2. Bilateral periodic lateralizing epileptiform discharges (BIPLEDs)
3. Generalized periodic epileptiform discharges (GPEDs)
4. Triphasic waves

Periodic lateralizing epileptiform discharges (PLEDs)

Interdischarge interval : typical 0.5 to 4 s, up to 8 s

Topography : lateralized (contralateral spread common)

Rate of focal or tonic-clonic seizures : high (≈80%)

Associated myoclonus : rare

Periodic lateralizing epileptiform discharges (PLEDs)

Mental status : altered

Outcome : variable

Morphology : variable, associated with EPC

Etiology : acute structural lesion e.g. infarction, ICH, tumor or infection; occasionally no lesion. *
Metabolic disturbance, HSE

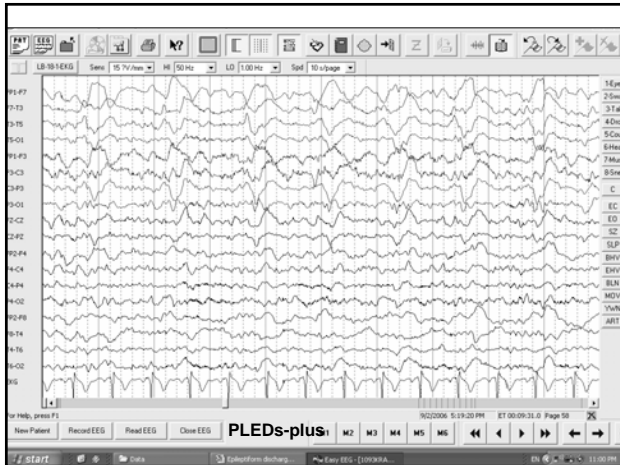
Periodic lateralizing epileptiform discharges (PLEDs)

PLEDs-proper
relatively stable periodicity and no associated rhythmic discharges

PLEDs-plus
variable periodicity and associated rhythmic activity with the discharges

Reiher et al., *Electroencephalogr Clin Neurophysiol*, 1991;78:12-7





Bilateral periodic lateralizing epileptiform discharges (BIPLEDs)

Interdischarge interval : typical 0.5 to 4 s, up to 8 s

Topography : independently lateralized

Rate of focal or tonic-clonic seizures : typically < in PLEDs but still high

Associated myoclonus : rare

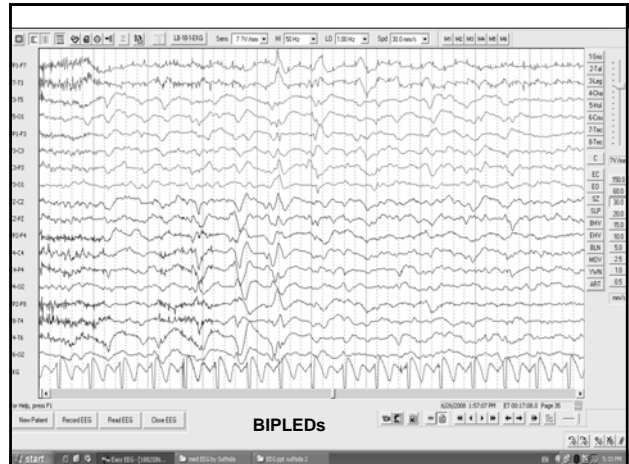
Bilateral periodic lateralizing epileptiform discharges (BIPLEDs)

Mental status : altered

Outcome : variable

Morphology : variable

Etiology : anoxia, bilateral acute lesions; occasionally unilateral or no lesion. *HSE



Generalized periodic epileptiform discharges (GPEDs)

- Periodic short-interval diffuse discharges (PSIDDs)*
- Periodic long-interval diffuse discharges (PLIDDs)*
- Burst-suppression pattern

*Brenner and Schaul., *J Clin Neurophysiol* 1990;7:249-67.

Periodic short-interval diffuse discharges (PSIDDs)

Interdischarge interval : 0.5 to 4 s

Topography : diffuse

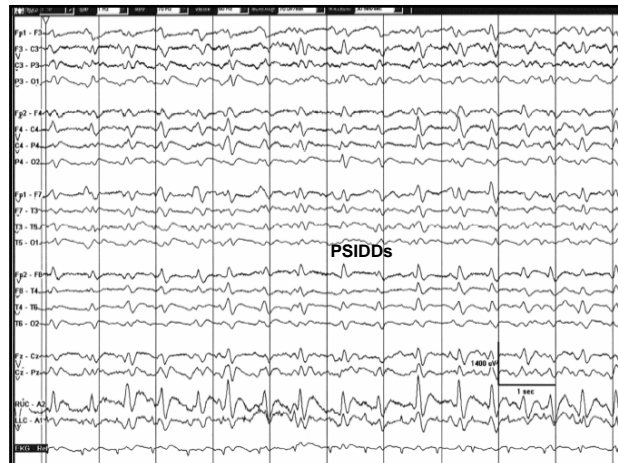
Rate of focal or tonic-clonic seizures : variable, but not rare

Associated myoclonus : common with CJD but often not time-locked

Periodic short-interval diffuse discharges
(PSIDDs)

Morphology : sharp waves, spikes, polyspikes, or sharply-contoured delta

Etiology : metabolic encephalopathy, anoxia, NCSE. After SE, lithium, baclofen, **CJD**



Periodic long-interval diffuse discharges
(PLIDDs)

Interdischarge interval : 4 -30 s

Topography : diffuse

Rate of focal or tonic-clonic seizures : rare

Associated myoclonus : common with SSPE, time-locked

Periodic long-interval diffuse discharges
(PLIDDs)

Morphology : variable; often complex, stereotyped, polyphasic bursts, lasting 0.5 - 3 s

Etiology : toxin (PSP, ketamine, barbiturates, anesthetics), anoxia, ***SSPE**



Burst-suppression pattern

Wave shape : high-voltage bursts of irregular or regular slow wave with or w/o sharp waves

Wave duration: 1-3 s

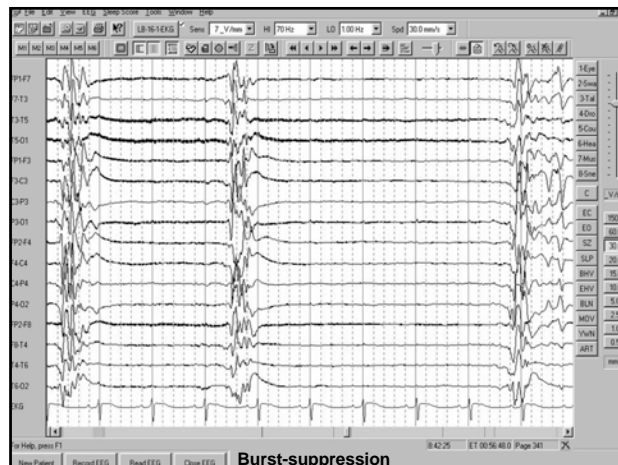
Interdischarge interval : depressed background or complete flatness lasting 2 s to many minutes

Burst-suppression pattern

Topography : bilateral

Rate of seizures : rare

Etiology : anesthesia, CNS depressant drugs, hypothermia, anoxia



Triphasic waves

Wave shape : sharp wave or sharply contoured delta waves with a triphasic morphology (negative / positive / negative polarity, with each phase lasting longer than the prior)

Wave duration: 0.2 - 0.5 s

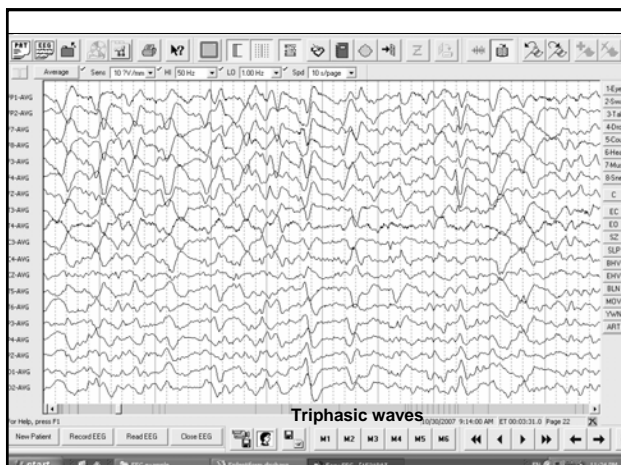
Interdischarge interval : 1-3 s

Triphasic waves

Topography : generalized, max. at frontal or occipital

Rate of seizures : none

Etiology : hepatic, uremic and other metabolic encephalopathies, anoxia



Stimulus-induced rhythmic, periodic, or ictal discharges (SIRPIDs)

- Periodic, rhythmic, or ictal appearing discharges that were consistently induced by alerting stimuli such as auditory stimuli, sternal rub, examination, suctioning, turning, and other patient-care activities

Hirsch et al., *Epilepsia* 2004;45:109-23

Stimulus-induced rhythmic, periodic, or ictal discharges (SIRPIDs)

- Subcategory
 - a. Periodic : GPEDs, PLEDs, Triphasics, Generalized polyspikes, Multiple periodic pattern
 - b. Ictal – appearing : Focal, Generalized, Focal and generalized
 - c. Frontal rhythmic delta activity (FRDA)
- Relation between SIRPIDs and seizures remains unclear

Hirsch et al., *Epilepsia* 2004;45:109-23

