INTERICTAL EPILEPTIFORM EEG PATTERNS

Vijayalakshmi Rajasekaran, MD
Emre Cakmak, DO
OBJECTIVES

1. Understand Generalized Epileptiform Discharges
2. Understand Focal Epileptiform Discharges
3. Epileptiform discharges in ICU EEG
SPECIFICITY OF EEG IN IDENTIFYING EPILEPTIFORM ABNORMALITIES

First EEG 29–55%

Second EEG would add in an additional 10%

Third routine EEGs around 67%–70% in those with new onset epilepsy.

Fourth EEG - Increased to 92%
Interictal Epileptiform Discharges (IEDS)

Pathological patterns generated in brain between seizures, that are clearly distinguished from the activity observed during the seizure itself.

Ligand-gated mechanisms activate and lead to hyperexcitability network.
ICTAL AND INTERICTAL DISCHARGES
CRITERIA FOR EPILEPTIFORM DISCHARGE

- Voltage: high

Morphology:
- Shorter, low amplitude upslope
- Longer, high amplitude downslope
- After going slow wave
- Different from background
- Polarity: Majority surface negative
SPIKE AND SHARP WAVE
EPILEPTIFORM DISCHARGES

- $F_{P1}-F_{7}$
- $F_{7}-T_{3}$
- $T_{3}-T_{5}$
- $T_{5}-O_{1}$
- $T_{3}-F_{P1}$
- $T_{4}-F_{P2}$
- $F_{P1}-F_{3}$
- $F_{P2}-F_{4}$
- $F_{P1}-A_{1}$
- $F_{P2}-A_{2}$
- $F_{3}-A_{1}$
- $F_{4}-A_{2}$

Sharp wave ($>70$ msec)  Spike ($<70$ msec)  Spike and wave

1 sec

100 μV
SEVERAL FACTORS DETERMINE THE MORPHOLOGY OF SCALP IEDS

- Dendritic location of synaptic structures
- Active and passive membrane properties of the discharging neurons.
- Frequency
- Phase
- Amplitude of the waveforms.
- Spatio-temporal averaging of electrical signals
- Synchrony of firing

(Janiti J Epi Research 2018)
TYPES OF EPILEPTIFORM DISCHARGES

Generalized

Focal
GENERALIZED PATTERN

- 3 Hz spike and wave
- Slow (2-2½ Hz) spike and wave
- Atypical spike and wave
- Paroxysmal fast
- Hypsarrhythmia
ATYPICAL SPIKE AND WAVE

- Differ from typical SW by either being less rhythmical or faster repetition rate
- Can be seen in JME
- Generalized seizures common
- Background normal or abnormal
POLYSPIKE AND SLOW WAVE COMPLEX
LENNOX-GASTAUT SYNDROME

• Slow spike and wave, rate less than 3 Hz

• Abnormal background

• Frequent seizures, multiple seizure types

• Intellectual disability
PAROXYSMAL FAST DISCHARGE

- Trains of repetitive spikes
- 8-20 Hz
- Tonic seizures
- Tonic stiffening
PAROXYSMAL FAST ACTIVITY WITH TONIC SEIZURE

7-year-old male

Tonic stiffening of the body
HYPSARRHYTHMIA

- Multifocal spikes and slow waves
- High-amplitude pattern
- Chaotic
- “Scrambled eggs pattern”
- Associated with Infantile spasms
FOCAL DISCHARGES
Temporal intermittent rhythmic delta activity (TIRDA)- has a strong association with epileptiform discharges

Temporal sharp waves/spikes- fairly specific for epilepsy
FRONTAL LOBE EPILEPSY EPILEPTIFORM DISCHARGES

Diagnosis rest largely on clinical features.

EEG often non diagnostic due to most of the frontal lobe inaccessible to scalp

Often poorly localized

EEG show multifocal, generalized (secondary bilateral synchrony) discharges
PARIETAL LOBE
IEDS:

Parietal lobe epilepsy much less common.

Non-localizing IEDs

Interictal discharges may be bitemporal, multifocal or generalized
OCCIPITAL LOBE IEDS

- Commonly seen in children
- Presence of spikes associated with seizures in 30-50%
- Can be seen in children with visual abnormalities
- In older children seen with benign occipital epilepsy, blocked by eye opening.
ROLANDIC EPILEPSY WITH CENTROTEMPORAL SPIKES

Typically seen in children aged 4-12 years of age.
80% will have seizures

Have a horizontal dipole, surface positive end of the dipole oriented towards the frontal lobe and negative end at the central or temporal areas

Have a characteristic morphology: they are

• Broad, blunt, followed by a slow wave
• Markedly activated in drowsiness and sleep
• May be bilateral independent or multifocal Horizontal dipole is common, with bifrontal positivity Generalized spike-and-wave discharges may co-exist
CRITICAL CARE EEG: EPILEPTIFORM ACTIVITY

LPDs: Lateralized Periodic Discharges
BiPDs: Bilateral Independent Periodic Discharges

GPDs: Generalized Periodic Discharges
Triphasic waves/GPDs with triphasic morphology

SIRPIDs: Stimulus Induced periodic, rhythmic or ictal discharges
SIGNIFICANCE

- Less than 1.5 Hz – Interictal
- 1.5-2.5 – Ictal inter-ictal continuum
- > 2.5 -3 Hz Ictal
**BIRDS**

- Brief Potentially Ictal Rhythmic Discharges
- Runs of focal or generalized rhythmic activity >4 Hz without evolution
- Duration: Very brief usually 0.5-4 seconds, All <10 seconds
- Associated with High risk of seizures and seizure focus
- Can be generalized even when focal source of epilepsy is known