Interictal epileptic spikes and partial seizures

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Introduction

- **Spikes**
  - Definition
  - Types of spikes
  - Relationship with seizures
  - Usefulness
  - Limitations

- **Seizures**
  - Definition
  - Types
Disclosure

• I have nothing to disclose
Definitions

• Epilepsy
  – A condition characterized by clinical seizures

• Seizures
  – Acute behavioural alterations associated with simultaneous paroxysmal EEG changes with specific characteristics

• Interictal epileptiform activity
  – EEG changes predictive of epilepsy
More Definitions

• Epileptiform pattern:
  – Distinctive EEG waves or complexes distinguished from background activity and resembling those recorded in a proportion of human subjects suffering from epileptic disorders (Chatrian 1974)
WHAT IS A SPIKE?
Spikes in the world
What is a spike?

- A spike is a sharp transient
  - Easily distinguishable from the background activity
  - Having a duration of less than 70ms
- A sharp wave has a duration of >70ms and <200ms
Spikes and Sharp Waves

- Epileptiform activity
- Eye blinks
- Vertex sharp waves
- Electrode artifacts
- Movement artifacts
What is an interictal epileptiform discharge?

- **Criteria:**
  - Spikes must be:
    - Paroxysmal (set apart from background)
    - Abrupt change in polarity (sharp contour)
      - (Mainly surface negative)
    - Duration < 200ms
      - Spikes < 70 ms
      - Sharp waves < 200 ms
    - Must have a field
      - Distribution
      - Voltage gradient
    - (Most spikes are followed by a slow (2-4 Hz) wave)
Epileptogenesis

- Unstable (hyper excitable) dendritic post-synaptic membranes
  - Glutamate receptor over expression
- Dysfunctional GABA receptors
- Loss of inhibitory interneurons
- Recurrent excitatory connections
- Facilitating effect of glial gap junctions on seizure propagation
Seizure propagation

- Cortical layer 1
- U-fibers
- Uncinate fasciculus
- Corpus callosum
- Anterior and posterior commissures
- Papez circuit
- Interthalamic connexions?
Friendly spikes and sharp waves

- Vertex waves
- Wicket spikes
- Small Sharp Spikes
- Needle-like occipital spikes of the blind
- POSTS
- Lateral rectus spikes
- Electrode artifacts
Bad spikes

Spike and waves (epileptiform spikes)
Tricky spikes (good or bad?)

• Small Sharp Spikes !?
  – Yes, they are good but…
    sometimes I prefer to call them “of uncertain clinical significance” instead of “benign”
What to do with doubtful findings?

• Are they reproducible?
  – Play with the software
    • Filters
    • Montages
    • Use the referential montage
  – Get a repeat EEG
  – Get the context
    • Ask for more clinical information
  – In doubt, don’t overcall!
Bad spikes: how bad are they?

Can we rely on them to plan surgery?
Electroencephalographic Features of Temporal Lobe Epilepsy

Mohammed M. Jan, Mark Sadler, Susan R. Rahey

Volume 37, No. 4 – July 2010

http://www.cnsfederation.org/journal.html
If you have a first unprovoked seizure, what is the likelihood of finding interictal epileptiform discharges on your initial EEG?

**SENSITIVITY**

- 12-50%
- After 4 EEG recordings: 80-90%
- If prolonged video-EEG monitoring is used: 19% show seizures but NO interictal epileptiform discharges
Higher probability of finding IEDs:

- Children
- Untreated infantile spasms
- Landau-Kleffner syndrome
- Benign Rolandic Epilepsy
- Sleep recordings
- Use of special electrodes
Why no IEDs?

- Long distance between the generator and the surface electrodes
- Small cortical area involved in spike generation < 6-20 cm²
- Other reasons…
How many of us happily walk on the street with IEDs in our brains?

SPECIFICITY

- Children: 1.9-3.5%
- Adults: 0.5%
  - Some will develop epilepsy
  - Some have diagnosed or undiagnosed neurological conditions but no clinical manifestations of epilepsy
How are epileptiform abnormalities found in healthy subjects different from those found in epileptics?

• HEALTHY:
  – Central-midtemporal discharges
  – Generalized spike-wave discharges
  – Photoparoxysmal responses
  – (may represent genetic traits)

• EPILEPTICS:
  – Focal spikes
  – Multifocal IEDs
Focal seizures

• What is the essence of a seizure?
  – Onset
  – Progression
    • Frequencies
    • Dispersion
  – Post-ictal changes

• Clinical vs subclinical
• Anarchy in seizures
• Synchronization in seizures
Characteristics of a seizure

- Sudden change of frequency
- Sudden loss of voltage
  - *Electrodecremental seizures*
    - *Small amplitude flat or fast activity*
- Sudden increase of voltage
- Start-stop-start
Focal seizures

- Focal/Regional/Lateralized onset
- Rhythm
- Progression
  - Changes in frequency and amplitude
- Propagation
- Post-ictal slow activity
Seizure Onset

• Blume et al.
  – ⅔ of seizures began with rhythmic waves
  – Attenuation of amplitude in 10% of focal seizures (71% in infantile spasms – Kellaway)

• Geiger and Harner
  – (β) Rhythmic activity in 50%
  – (α) Rhythmic activity in only 8-16%
    (epileptic recruiting rhythm)
  – (θ) Rhythmic activity 46%
  – (δ) Rhythmic activity in 20%

• No change
  – Remote seizure onset area
  – Frequent with simple partial sz of temporal lobe origin

• Start-Stop-Start
Mimickers

- Rhythmic Midtemporal Discharges (aka Psychomotor Variant)
- Subclinical Rhythmic EEG Discharge of Adults (SREDA)
- Artifacts
New” Concept: fast ripples

- Ripples: 80-200Hz
- Fast Ripples: 250-500Hz
- Can be recorded with depth macroelectrodes
- Fast Ripples correlate with the ictal onset zone whereas Ripples don’t
Conclusions

• Our concepts and definitions are continuously challenged in the clinical world

• EEG interpreters need to correlate and confront their predictions (interpretations) with the clinical situation and improve/adjust on that basis
  – Get feedback on your EEG interpretations

• Words and theory have significant limitations in teaching/learning EEG interpretation
  – Get good training/multiple mentors
Thank You