Subhairline EEG Part II - Encephalopathy

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Objectives

- To review the subhairline EEG changes seen with encephalopathy
- To discuss specific EEG findings in encephalopathy
- To outline basic EEG patterns associated with HIE

EEG and Encephalopathy

- Why use continuous EEG in encephalopathy and coma?
  - Evolution of coma pattern
  - Assess for non-convulsive status epilepticus
  - Assist with prognosis

EEG and Encephalopathy

- EEG is nonspecific in encephalopathy and coma
  - Some features may suggest etiology
    - e.g. generalised periodic epileptiform discharges
- Similar EEG changes are seen with increasing depth of sedation or anaesthesia

EEG recordings in Coma

- Quiet recording
  - To assess for spontaneous reactivity
- Should include external stimulus in order to assess reactivity
  - Auditory stimulus - clap, call name
  - Painful stimulus - only if no response to previous stimuli)

EEG and Encephalopathy

- Spontaneous variability
  - Variety of different frequencies observed during the resting state
  - Changes in EEG seen with changes of state
    - Awake vs asleep
  - Occurs due to normal oscillations in cerebral function

EEG and Encephalopathy

- Reactivity to graded stimulus
  - Auditory
  - Pain
- Look for changes in voltage (height of the waveforms) or frequency (number of waveforms per second)
  - May be brief or sustained

EEG in Coma

- Usually get increased slowing with decreased LOC

Mild Encephalopathy

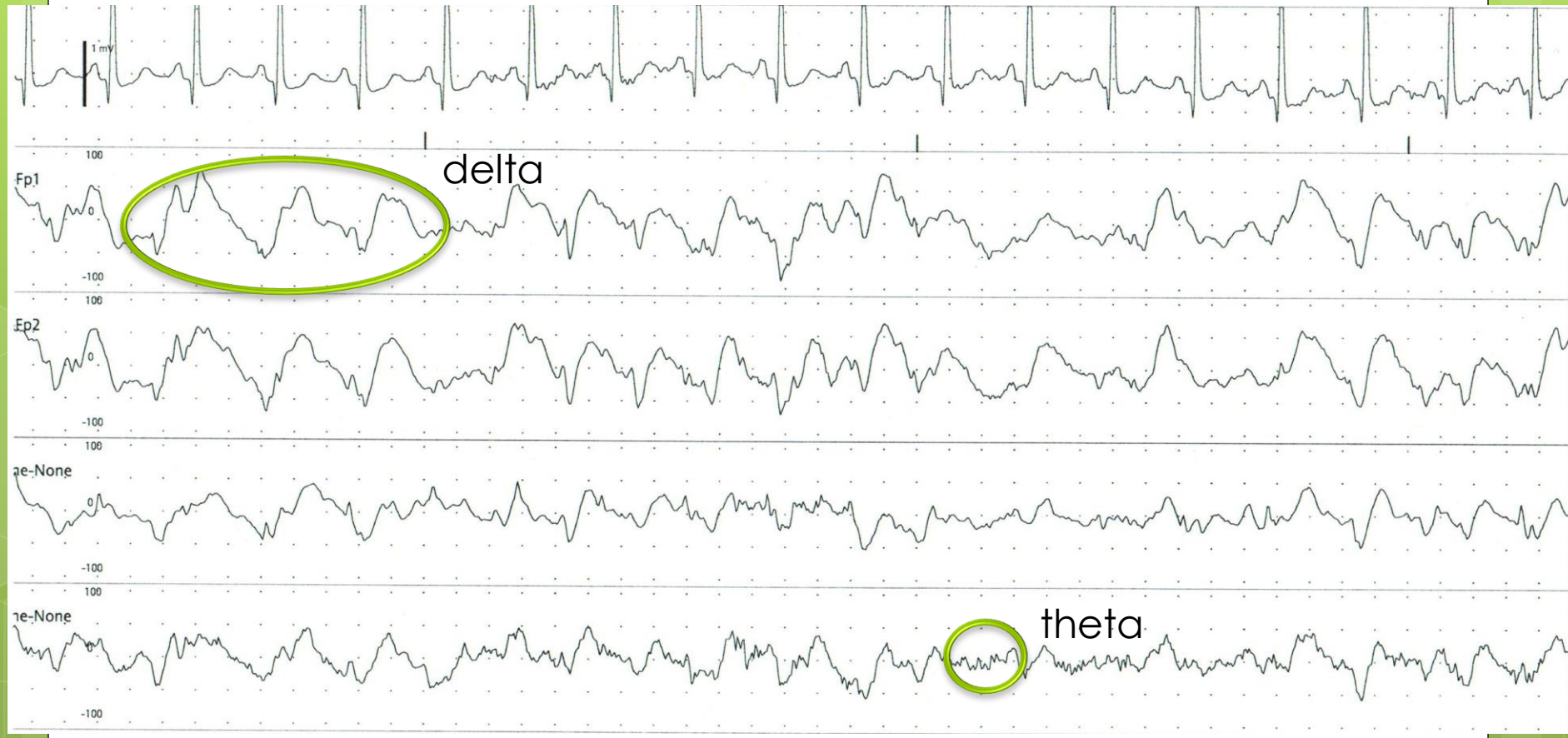
- Diffuse theta
- Occasionally delta
- Spontaneous variability present
- Reactivity present
- State changes present
  - e.g. clear difference in sleep and awake EEG

Mild Encephalopathy

Moderate Encephalopathy

- Some theta
- Diffuse delta
- Spontaneous variability present
- Reactivity present
- State changes present
  - e.g. clear difference in sleep and awake EEG

Moderate Encephalopathy



Severe Encephalopathy

- Predominantly delta
- May see periods of faster activity
- May alternate with periods of suppression
  - This is still spontaneous variability
- May no longer see reactivity
- No clear state changes

Severe Encephalopathy

Severe Encephalopathy

Severe Encephalopathy

suppression

Severe Encephalopathy

Electrocerebral Inactivity

- No EEG activity >2 uV
  - Cannot make this distinction using subhairline EEG
- Usually represents brain death
- May be seen in hypothermia, deep anaesthesia

Specific EEG Patterns

- When seen, these patterns are suggestive of a particular etiology
  - Triphasic waves
  - Excess beta
  - Alpha coma
  - Burst-sppression

Triphasic Waves

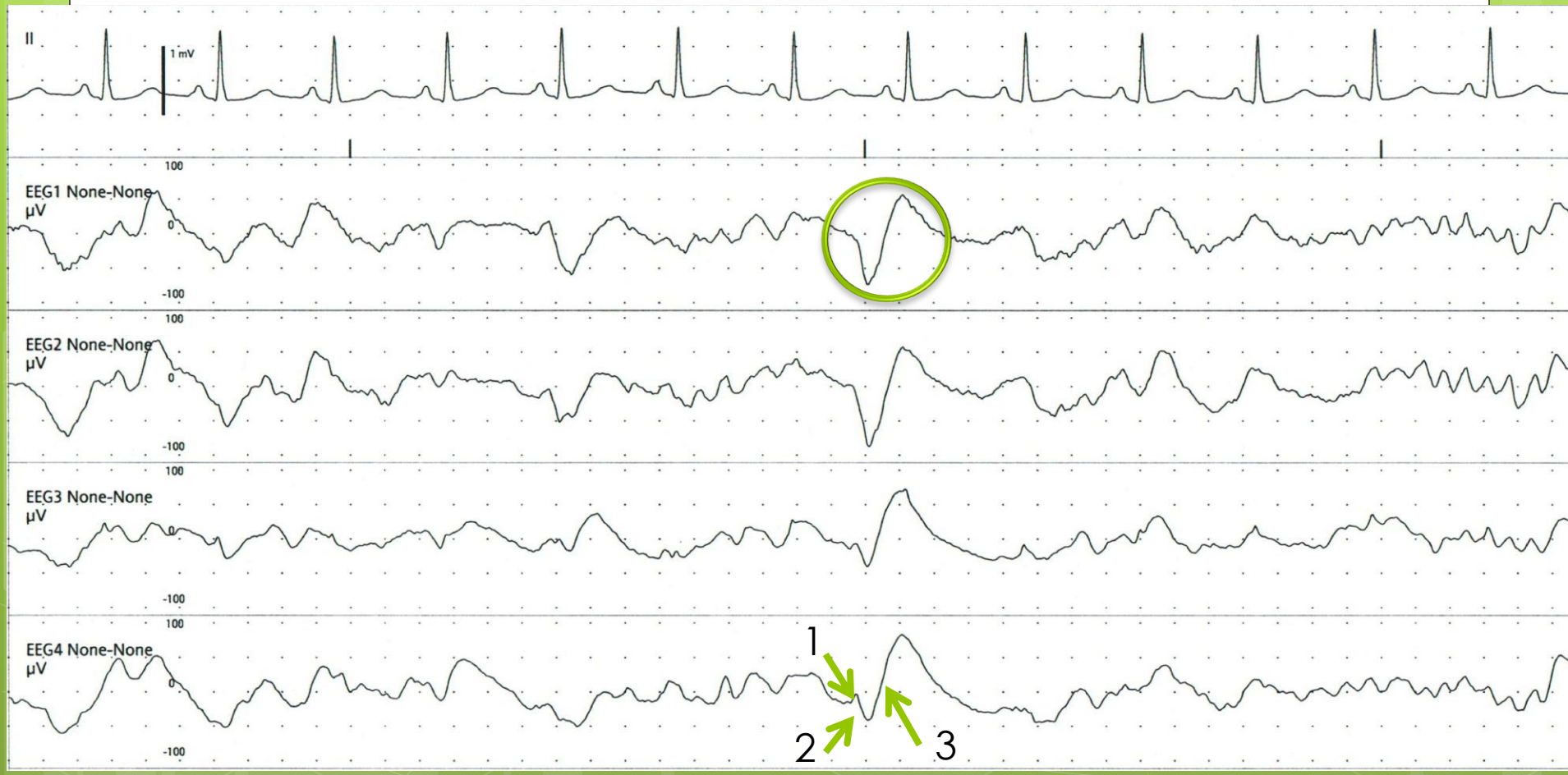
- Generalised, frontally predominant
- Brief negative phase (up)
- Larger positive phase (down)
  - Longer duration than 1st phase
- Followed by negative phase (up)
  - Longer duration than other 2 phases

- May occur alone, periodically or in runs

Triphasic Waves

- Seen in toxic, metabolic encephalopathy
  - Uremic, hepatic, septic
  - Hypercalcemia, hyperosmolarity
- Occasionally associated with seizures
  - In this case, may be very difficult to determine if seeing status epilepticus or periodic TWs

Triphasic Waves



Triphasic Waves

Excess Beta

- Barbiturate or benzodiazepine overdose
- Anaesthesia using propofol or midazolam

Alpha Coma

- Nonreactive alpha pattern
- No spontaneous variability
- No reactivity
- Seen in hypoxic-ischemic encephalopathy
  - In this case, usually associated with poor prognosis, but not always
- If posterior predominant think about "locked-in" syndrome

Burst Suppression

- High amplitude mixed frequencies alternating with periods of suppression
- Duration of bursts and suppression is variable
- Reversible if due to medication exposure

- Associated with poor outcome in hypoxic-ischemic encephalopathy

Burst Suppression

Hypoxic-Ischemic Encephalopathy (HIE)

- Associated with respiratory or cardiac arrest
- Prolonged recording is preferred because EEG patterns change over time
- NB: EEG patterns are influenced by medications used in the ICU

- Most reliable EEG finding in HIE
  - Myoclonic status epilepticus
  - However, NOT absolute with respect to prognosis after induced hypothermia

HIE Status Epilepticus

Hypoxic-Ischemic Encephalopathy (HIE)

- Other patterns that can be associated with poor prognosis
  - Complete suppression
    - But this may be due to medications
  - Burst-suppression
  - Generalised periodic epileptiform discharges on a suppressed background

Hypoxic-Ischemic Encephalopathy (HIE)

- Up to 35% of post-anoxic patients have seizures
  - often non-convulsive
- Seizures may be
  - focal
  - multifocal
  - Generalised
- Background may be continuous, suppressed, burst suppression

Hypoxic-Ischemic Encephalopathy (HIE)

- Subhairline EEG is inadequate for prognostication in the setting of HIE
- Formal EEG is required