Analysis of EEG Activity: What does it look like?

- 1. Frequency/wavelength
- 2. Voltage
- 3. Waveform
- 4. Manner of occurrence (*random, periodic, continuous*)
- 5. Location
- 6. Interhemispheric coherence (symmetry, synchrony)
- 7. Reactivity

P. Kellaway in Ebersole & Pedley Current Practice of Clinical EEG

Analysis of EEG Activity: What does it mean?

- Cerebral Origin
  - Normal
  - Abnormal
- Non-Cerebral Origin (ARTIFACT)
  - What is the source?
  - What is the significance?
Interpretation + Reporting

- What is the ordering provider's question, and how may I best answer it with my EEG interpretation?
- Is this record normal or abnormal?
- If abnormal, is the abnormality focal or generalized?
- Is the abnormality suggestive of seizures or an alternative diagnosis (e.g., encephalopathy)?
- Is the abnormality persistent, intermittent or rhythmic?

Pitfalls in Interpreting Scalp EEG

- Misread/over read
- Technical factors + artifact
- Over reliance on EEG report – ignoring clinical context

Commonly Misread EEG Patterns

- Wicket waves
- Normal sharply contoured background activity
- Artifacts

EEG #1 shows...

- 1) Left temporal breach rhythm
- 2) Misplaced leads
- 3) Left temporal electrographic seizure
- 4) Normal background
EEG #2 shows...

- 1. Frontal intermittent rhythmic delta activity (FIRDA)
- 2. Frontal electrographic seizure
- 3. Nystagmus
- 4. Glossokinetic artifact
- 5. Frontal alpha variant

Artifacts: Pearls

- Common cause of EEG misinterpretation
- A good EEG tech will help identify and minimize artifact at the time of acquisition
- Be suspicious of:
  - Normal waveforms appearing in the wrong head region
  - Activity limited to a single electrode
  - Highly periodic activity (e.g. pulse, respiration)
EEG #5 shows...

- 1) Frontal intermittent delta activity (FIRDA)
- 2) Abnormal generalized delta slowing
- 3) Physiologic (normal) generalized slowing
- 4) Eye movement artifact
EEG #6
28 yo ♀ with recent syncope

EEG #6 shows...

- 1) Bi-temporal sharp waves
- 2) Wicket waves
- 3) Pathologic temporal slowing
- 3) Glossokinetic artifact

EEG #7
EEG #7 shows…

- 1) Left temporal sharp waves
- 2) Wicket waves
- 3) Pathologic temporal slowing
- 3) EKG artifact in left temporal leads

Epileptiform Discharges

- Should be discrete, not just an accentuation of one in a sinusoidal wave series
- Distinguished from the background by amplitude, morphology, and duration
- Often bi-or tri-phasic, asymmetric in phases
- Aftercoming slow wave
- Physiologic field (>1 electrode)

EEG #8

32 year old woman, frequent seizures, mental retardation
ACNS Guidelines for Writing EEG Reports

1. Basic patient identifiers
2. Introduction
3. Description of the Record
4. Interpretation
   - Normal vs. abnormal
   - Correlation of EEG findings with clinical picture

EEG Reports: Introduction

- Mention any medications taken by the patient that may affect the EEG (AEDs, chloral hydrate, benzodiazepines).
  - Identify the state of the patient (awake, asleep, comatose, agitated)
  - Mention if fasting or sleep deprived
  - Number of electrodes used, esp. if not standard 21 electrodes of 10-20 system.
  - Total recording time.

EEG Report: Description

- Include all characteristics of the record, normal AND abnormal, presented in an objective way, avoiding judgment about their significance.
  - Describe background, with dominant activity (PDR) if present, first.
  - Non-dominant activities: type (spikes, sharp waves, slow waves), frequency, quantity, amplitude, location, symmetry/asymmetry, synchrony, timing (continuous, intermittent, episodic or paroxysmal).
  - Activation procedures, including sleep, with response described.
- Hyperventilation, photic stimulation.
- Only mention artifacts if they are questionable, unusual or excessive, or if they may provide valuable diagnostic information
EEG Report: Interpretation

– Impression

• Your subjective statement about the normality or abnormality of the record, with reasons for the impression (brief).

– Clinical correlation

• An attempt to explain how the EEG findings fit (or do not fit) the total clinical picture. Vary wording depending on to whom it is addressed (the ordering clinician – what degree of expertise?)

What is your report?

Interpretation #1: This is an abnormal EEG due to the presence of epileptogenic activity over the right temporal head region, indicating the potential for focal seizures to arise in this area. No electrographic seizures were recorded.

Interpretation #2: This is an abnormal EEG due to the presence of epileptogenic activity over the right temporal head region, consistent with the known diagnosis of intractable focal epilepsy.
Audience Response

- A = Normal
- B = Abnormal

Frontal Intermittent Rhythmic Delta Activity (FIRDA)

DESCRIPTION OF RECORD: “...There are intermittent bursts of moderate amplitude, rhythmic 2Hz delta activity in a generalized distribution with frontal predominance (FIRDA)...”

INTERPRETATION: “This is an abnormal EEG due to moderate generalized slowing of background activity with intermittent, frontal-predominant rhythmic delta activity (FIRDA). These findings are consistent with a diffuse encephalopathy which could be toxic, metabolic, infectious, anoxic, or degenerative in etiology. Clinical correlation is advised.”
Audience Response

• A = Normal
• B = Abnormal

Breach at F4; focal delta

DESCRIPTION OF RECORD: "There is focal slowing with mixed 4-5 Hz theta and 2-3 Hz delta activity over the right frontotemporal region. Higher amplitudes and faster frequencies are also seen in this region compared to the contralateral side (breach rhythm)."

INTERPRETATION: "Moderate focal slowing of the background and a breach rhythm are seen over the right frontotemporal region, consistent with the patient's history of surgical resection of tumor in this area."
DESCRIPTION OF RECORD: "...During light stages of sleep, bitemporal wicket waves (normal variant) are seen in trains lasting up to 4 seconds at times.** Include this only if there is concern for misinterpretation of this benign variant."
How to report THAT?

• DESCRIPTION OF RECORD
  - “...At 14:23, 15 minutes into the recording, the patient is noted to lean forward briefly and then throw herself back into her chair with generalized stiffening and shaking of her torso and all 4 limbs for about 14 seconds. The EEG background is obscured with motion and muscle artifact during this clinical event, but it is normal both before and immediately afterwards.”

• INTERPRETATION
  - Normal EEG
  - “This is a normal EEG during wakefulness, including during a typical clinical event, as described above. This suggests a non-epileptic etiology for the events. Clinical correlation is advised.”
DESCRIPTION OF RECORD: The EEG during wakefulness demonstrates 10 Hz occipital dominant rhythm that is symmetrically distributed and reactive to eye opening. At times, there is a subharmonic posterior dominant pattern with notched waveforms at 5 Hz (1/2 the alpha rhythm).

Summary: EEG Basics

• Watch for common sources of error:
  – Wickets
  – Artifacts
    – Sharply contoured normal background
• If in doubt, it is usually better to under read than to over read
• In your reporting: accuracy!; consider how to explain the results to the ordering provider in light of the clinical history