Normal EEG of wakeful resting adults of 20-60 years of age

Suthida Yenjun, M.D.

Normal EEG of the wakeful adult at rest

- Alpha rhythm
- Beta rhythm
- Mu rhythm
- Lambda waves
- Vertex sharp transients
- Intermittent posterior theta rhythms
- Low voltage activity

Alpha rhythm

- Regular (monomorphic) waveforms, sharp points at the top or bottom or sinusoidal
- Frequency $>8$ Hz to $\leq 13$ Hz, may decrease 1 Hz or more in drowsiness
- Variable frequency depending on behavioral state

Alpha rhythm

- Phase relation over different parts may vary
- Maximum over the posterior head region, during drowsiness may be more prominent over the frontocentral regions
- Amplitude often waxes and wanes, higher on the right side is common, $<50\%$ difference between the two hemispheres

Alpha rhythm

- Reactivity: blocked by eye opening or other alerting maneuvers, disappear in drowsiness and sleep
- Alpha variants
  - slow alpha variant: 3.5-6.5 Hz; half the frequency of alpha rhythm elsewhere in the same record
  - fast alpha variant (posterior beta rhythm): 16-20 Hz; twice the frequency of alpha rhythm
**Alpha rhythm**

- Unknown physiological significance
- Characters of posterior distribution, blocking with eye opening: integrated with visual function
- Modulated by thalamic and cortical interactions

**Alpha rhythm: sinusoidal shape**

**Alpha rhythm: reactivity to eye opening**

**Alpha rhythm: reactivity to stage change**

**Slow alpha variant**

**Beta rhythm**

- Frequency > 13 Hz
- Beta rhythm over 30 Hz, very low amplitude, difficult to record with routine EEG => gamma range
- Amplitude: usually lower than alpha in the same record, should be symmetrical or not differ > 35%
Beta rhythm

- Distribution
  - Frontal beta rhythm: most common, blocked by movement, intention to move and tactile stimulation
  - Widespread beta rhythm: not blocked by stimulus
  - Posterior beta rhythm (fast alpha variant): 16-20 Hz; twice the frequency of alpha rhythm

- Ratio of beta to alpha activity increases with age
- Excessive beta activity in wakefulness and drowsiness is almost always from medication effect (BDZ, barbiturates)
- Unknown physiological significance
- Highly dependent on normal cortical function

Mu rhythm

- Trains of medium amplitude, arc-shaped waves at 7-11 Hz lasting for a few seconds over the central or centroparietal regions at different times on the two hemispheres
- Seen prominently < 5% of EEG, most commonly in young adults
- No longer used names: wicket, comb or arceau rhythm

- Mu waves intermix or alternate with beta activity, often have half the frequency of beta activity
- Usually intermittent and asynchronous, may show only on one side
- If persist asymmetry of amplitude or frequency of mu rhythm, suggest abnormality on the side of lower amplitude or frequency
**Mu rhythm**

- Best recognized in bipolar montages, during eye opening when alpha rhythm is blocked
- Blocked by voluntary, reflex or passive movement, intention to move or tactile stimuli >> greatest effect over the hemisphere opposite the site of movement or stimulation

**Mu rhythm**

- Unknown physiological significance
- May be related to somatosensory processes associated with movement
- Like alpha rhythm, may represent the idling of a sensory system not processing specific input from thalamic nuclei

**Lambda waves**

- Broad sharp transients of sawtooth shape, 160-250 msec in duration
- Presence when the patient is looking at images containing visual detail
- Voltage: moderate amplitude 40-60 uV

**Lambda waves**

- Location: occipital region, resemble positive sharp transient of sleep (POSTs)
- May be asymmetric
- Occurred in children or young adult, rare in elderly
Lambda waves

- Neither presence nor absence of lambda waves is abnormal
- Marked asymmetry suggests abnormality on the side of lower amplitude
- Need to differentiated from occipital sharp waves

Vertex sharp transients (V waves)

- Bilaterally synchronous waves, negative polarity, maximum amplitude at vertex
- Often extend into frontal, temporal and parietal regions
- Single, often recur at regular interval = 2 times/s.

- Occur in sleep, but rarely in wakefulness following sudden loud noise or other unexpected stimuli
- May be more sharply contoured in young individuals or occur in bursts of rhythmic trains
- Need to differentiated from epileptiform activity
Normal posterior theta rhythms

- Rare
- Distribution and reactivity resemble that of alpha rhythms
- Two patterns
  - Slow alpha variant:
    - Half the frequency of alpha rhythm
    - Alternating with alpha rhythm
  - Rhythmic slow waves of about 4-5 Hz

Low voltage EEG

- No activity over 20 μV from any parts
- At high sensitivity, a wide range of frequency can be distinguished
- Waves of higher amplitude can be sometimes induced by hyperventilation, photic stimulation and sleep

Low voltage EEG

- Found in tense subjects who show normal amplitude when relaxed
- More common in advancing age
- Must be distinguished from electrocerebral inactivity when no activity > 2 μV