ELECTROENCEPHALOGRAPHY (EEG)

EEG

The electroencephalogram (EEG) is a recording of the electrical activity of the brain from the scalp.

The first recordings were made by Hans Berger in 1929

Origin of EEG waves



Electroencephalogram

EEG is the record of electrical activity of brain(superficial layer i.e. the dendrites of pyramidal cells) by placing the electrodes on the scalp.



Intracranial EEG (ECoG)



Intracranial EEG (ECoG)



Objectives of EEG practical

- Familiarize with the principles of techniques involved
- Count frequencies and measure the amplitudes of the record obtained.
- Categories the records into appropriate rhythms α , β, θ, and δ.



Objectives of EEG practical

- Identify and describe changes produced by provocation tests.
- e.g. eye opening & closing, intermittent photic stimulation (IPS) clapping sound, induce thinking & hyperventilation.
- Appreciate clinical uses of EEG

EEG Waves

- Alpha wave -- 8 13 Hz.
- □ Beta wave -- >13 Hz. (14 30 Hz.)
- □ Theta wave -- 4 7.5 Hz.
- □ Delta waves 1 3.5 Hz.
 - D T A B

Different types of brain waves in normal EEG

Alpha WMW MMMMMMMM Bets MANNAMMANA MANNA Theta momental www. 1 sec

EEG Recording From Normal Adult Male

F22F8 Marin manus ma EQTAMONTANIA Facanny Minimum Minimum Minimum Minimum Minimum exemption in the man with the second EVER Min Marin Ma F&Canning mining the second south the second southet the second south the second south the the hard hard hard hard hard

Alpha wave

- □ rhythmic, 8-13 Hz
- mostly on occipital lobe
- 🗖 20-200 μ V
- normal,
- relaxed awake rhythm with eyes closed

MMMMMMM

Beta wave

- □ irregular, 14-30 Hz
- mostly on temporal and frontal lobe
- mental activity
- excitement

an and the second of the second of the second s

Theta wave

rhythmic, 4-7 HzDrowsy, sleep



Delta wave

- □ slow, < 3.5 Hz
- □ in adults
- normal sleep rhythm



MMMMMMMMM [THETA: Drowsy/Ideating MANN T Steep/Dreaming ∼ I DEUTA: Deep, Dreamless Sleep

Different types of brain waves in normal EEG

Rhythm	Frequency (Hz)	Amplitude (uV)	Recording & Location
Alpha(a)	8 - 13	50 - 100	Adults, rest, eyes closed. Occipital region
Beta(β)	14 - 30	20	Adult, mental activity Frontal region
Theta(θ)	5 – 7	Above 50	Children, drowsy adult, emotional distress Occipital
Delta(δ)	2 – 4	Above 50	Children in sleep



Requirements

- □ EEG machine (8/16 channels).
- Silver cup electrodes/metallic bridge electrodes.
- Electrode jelly.
- Rubber cap.
- Quiet dark comfortable room.
- Skin pencil & measuring tape.

Computerized EEG Machine



EEG Electrodes



Sliver Electrodes

Electrodes Cap

Procedure of EEG recording

- A standard EEG makes use of 21 electrodes linked in various ways (Montage).
- Apply electrode according to 10/20% system.
- Check the impedance of the electrodes.

10 /20 % system of EEG electrode placement



EEG Electrodes

- Each electrode site is labeled with a letter and a number.
- The letter refers to the area of brain underlying the electrode
- e.g. F Frontal lobe and T Temporal lobe.
- Even numbers denote the right side of the head and
- Odd numbers the left side of the head.

Two types of recording

- Bipolar both the electrodes are at active site
 - Bipolar montage are parasagital montage.
- Unipolar one electrode is active and the other is indifferent kept at ear lobe.
 - Always watch for any abnormal muscle activity.
 - Ask the subject to open eyes for 10 sec. then ask them to close the eyes.





Montage

Different sets of electrode arrangement on the scalp by 10 – 20 system is known as montage.

21 electrodes are attached to give 8 or 16 channels recording.

Analysis

- Electrical activity from the brain consist of primarily of rhythms.
- □ They are named according to their frequencies (Hz) and amplitude in micro volt (µv).
- Different rhythms at different ages and different conditions (level of consciousness)
- Usually one dominant frequency (background rhythm)

Factor influencing EEG

🗖 Age

- Infant theta, delta wave
- Child alpha formation.
- Adult all four waves.
- Level of consciousness (sleep)
- Hypocapnia(hyperventilation) slow & high amplitude waves.

Slow waves

- Hypoglycemia
- Hypothermia
- Low glucocorticoids

NORMAL EEG CHANGES

Desynchronization or Alpha block



□ Cause:

Eyes opening (after closure)

Thinking by the subject (mathematical calculation)

Sound (clapping)

Eye opening

Alpha rhythm changes to beta on eye opening (desynchronization / α- block)



Thinking

Beta waves are observed



Provocation test

Intermittent photic stimulation

Increase rate & decrease amplitude

Hyperventilation

Decrease rate & increase in amplitude



Use of EEG

- Epilepsy
 - Generalized (grandmal) seizures.
 - Absence (petitmal) seizures.
- Localize brain tumors.
- Sleep disorders (Polysomnography)
 - Narcolepsy
 - Sleep apnea syndrome
 - Insomnia and parasomnia
- Helpful in knowing the cortical activity, toxicity, hypoxia and encephalopathy &
- Determination of brain death.
 - Flat EEG(absence of electrical activity) on two records run 24 hrs apart.

Sleep studies

- The EEG is frequently used in the investigation of sleep disorders especially sleep apnoea.
- Polysomnography : EEG activity together with
 - heart rate,
 - airflow,
 - respiration,
 - oxygen saturation and
 - limb movement

Sleep patterns of EEG

- □ There are two different kinds of sleep:
 - □ Rapid eye movement sleep (REM-Sleep)
 - Non-REM sleep (NREM sleep)/ slow wave sleep
- NREM sleep is again divided into 4 stages (I to IV). The EEG pattern in sleep is given in the following table:

Stages of sleep	EEG pattern	Somatic or Behavioral changes
Alert	Alpha activity on eye closed Desynchronization on eye opening	Respond to verbal commands
I (Drowsiness)	Alpha dropout & appearance of vertex waves & theta.	Reduced HR & RR
II (Light sleep)	Sleep spindles, vertex sharp waves & K- complexes	Reduced HR & RR
III (Deep Sleep)	Much slow background K- complexes	Reduced HR & RR

IV (very deep sleep)	Synchronous delta waves, some K- complexes	Reduced HR & RR
REM sleep (paradoxical sleep)	Desynchronization with faster frequencies	HR, BP & RR irregular Marked hypotonia Rapid eye movement 50 – 60 /min. Dreaming threshold of arousal