ELECTRO ENCEPHALO GRAPHY (EEG)

EEG deals with the recording and study of electrical activity of brain. The brain waves can be picked up and recorded by means of electrode attached to the skill of a patient. Brain waves are the summation of neural depolarization in the brain due to stimuli from five sense and thought process.

1) Anatomy of brain

The brain consists of three major parts such as cerebrum, cerebellum and the brain stem.

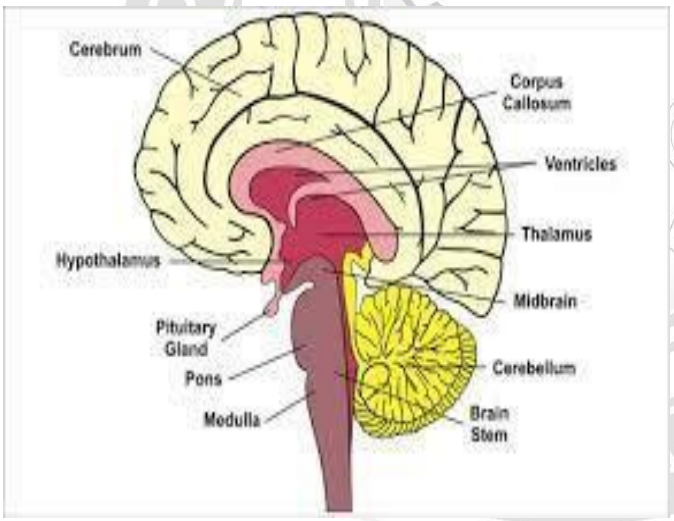

Fig 1.6.1: Internal structure of Human brain

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

Cerebrum consists of two hemispheres and the hemispheres are divided into frontal lobe, parietal lobe, occipital lobe and temporal lobe.

2) Action Potentials of Brain:

When the propagated action potential reaches the cell, the cell fires and thus a spike wave is produced. This firing spreads throughout the dendritic branches and causes the release of transmitter substances.

Inhibitory Post Synaptic Potential (IPSP)

If the transmitter substance is inhibitory, membrane potential of receptor neuron increases in a negative direction. It is less likely to discharge; this induced potential charge is called an IPSP.

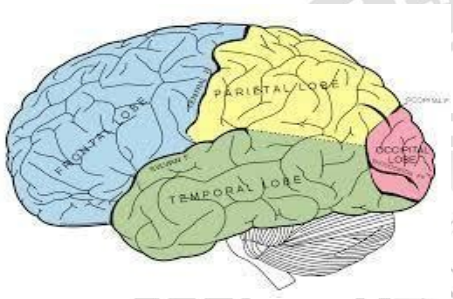

Fig 1.6.2: Human Brain

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

Excitatory Post Synaptic Potential (EPSP)

If the transmitter substance is excitatory, receptor membrane potential increases in a positive direction.

Evoked potentials

Evoked potential are the potentials developed in the brain as the responses to external stimuli like sound, light etc.

3) Brain waves

Brain waves are the recorded electrical potentials on the surface of brain. The intensity and patterns of electrical activity are determined by the overall level of excitation of brain.

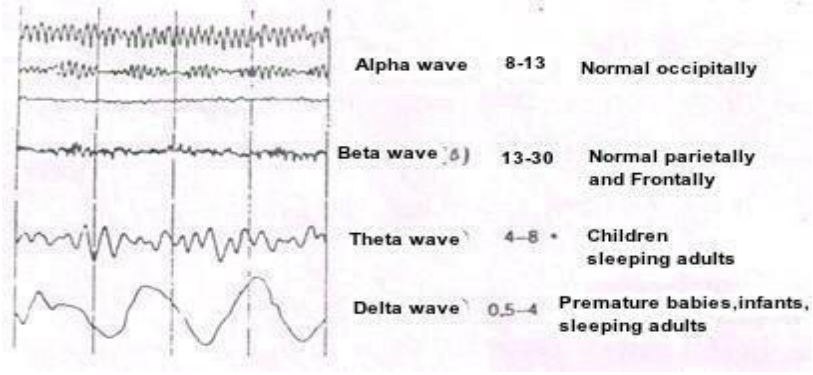

Fig 1.6.3: Brain Waves

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

Alpha waves

Frequency: 8 – 13 Hz

Occurrence: They found in normal persons when they are awake in a quiet, state. They occur normally in occipital region. During step, these disappear

Beta waves

Frequency: 13 – 30 Hz

Occurrence: These are recorded from parietal and frontal regions of scalp two types: - Beta I – Inhibited by cerebral activity

Beta II – Excited by mental activity (tension)

Theta waves

Frequency: 4 – 8 Hz

Occurrence: These are recorded from parietal and temporal regions of scalp of children.

Delta waves

Frequency: 0.5-4Hz

Occurrence: These occur only in every 2 or 3 sec. These occur in deep sleep in premature babies and in very serious brain disease.

4) Placement of electrode

In EEG, electrodes are placed in standard positions on skill in an arrangement called 10 – 20 system. The electrodes are arranged as follows.

Draw a line on the skull from the nasion, the root of nose, to the inion, ossification center on occipital lobe.

1) Draw a similar line from the left preauricular (ear) point to the right preauricular point.
2) Mark the intersection of two lines as Cz which is the midpoint of distance

nasion and inion.

3) Mark points Fpz, Fz, Cz, Pz and Oz at 10, 20, 20, 20, and 10% of total nasion – inion distance. Mark points T3, C3, Cz, C4, and T4 at 10, 20, 20, 20 and 10% of total distance between preauricular points.Measure the distance between Fpz and Oz along the circle passing through T3, and mark points as Fp1, F7, T3, T5, and O1 at 10, 20, 20, 20 and 10% of this distance.

4) Repeat this procedure on right side and mark the positions as Fp2, F8, T4, T6, and O2.

   Measure the distance between Fp1, and O1 along the circle passing through C3 and mark point as F3, C3, and P3 at 25% intervals.

5) Repeat this procedure on right side and mark as F4, C4 and P4.

   Check that F7, F3, Fz,F4 and F8 are equidistant along transverse circle passing through F7, Fz, and F8 check that T5, P3, Pz,P4, and T6, are equidistant along transverse circle passing through T5, Pz, & T6

   Pg1 AND Pg2 are nasopharyngeal electrodes and A1 and A2 are ear electrodes.

   Pg1 and Pg2 are nasopharyngeal electrodes and A1 and A2 are ear electrodes. The electrode systems are used to facilitate the location of foci, (ie) cortical areas from which abnormal waves spread.

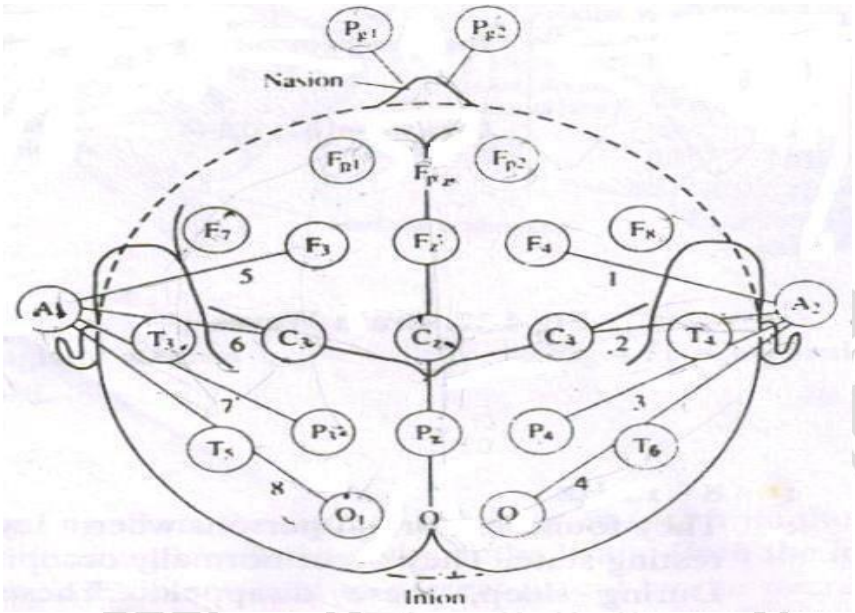

Fig 1.6.4: Placement of Electrodes on the Scalp for the EEG Recording

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

5) Recording Setup

In EEG recording setup, there are and drive amplifier whose gain can be increased by cascading several stages. The patient cable consists of 21 electrodes and is connected to the eight channel selector. The electrodes are attached to the channel selector in groups of eight called a montage of electrodes. The interference is reduced by employing differential amplifiers as preamplifiers.

EEG unit is covered with ferrous metal screen to reduce a,c interference.

The filter bank consists of appropriate filters to select different types of brain waves. Visual stimulus, Audio stimulus and tactile (touch) stimulus are used to record evoked potentials from sensory parts of brain. The time delay between stimulus and response can be measured in the signal processing unit.

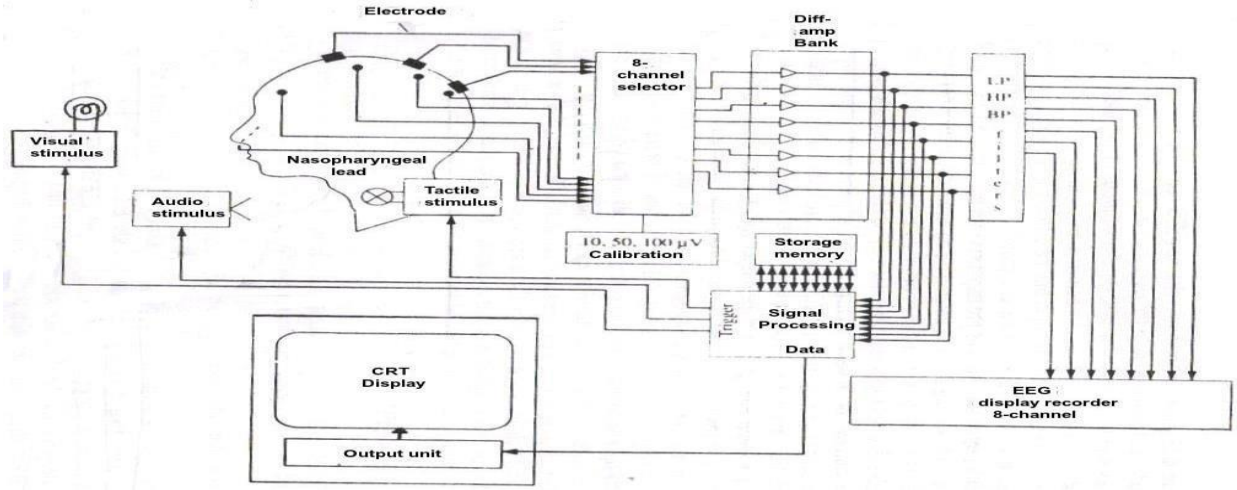

Fig 1.6.5: Fig: Modern EEG Unit

[Source: Khandpur, R.S., ―Handbook of Biomedical Instrumentation]

6) Analysis of EEG

EEG helps physicians to diagnose the level of consciousness, sleep disorders, brain death, brain tumors,

epilepsy etc.

i) Level of consciousness

EEG changes with the level of consciousness. Diminished mental activity results in a lower frequency and large amplitude EEG wave. REM means Rapid Eye Movement. REM sleep coincides with the periods of dreaming. EEG displays the characteristic features during the application of anaesthesia.

If the tumor displays the cortex and if it is large enough, the electrical activity will be absent since no electric potentials originate in the tumor. Thus a damped EEG over the cortex can be a sign of a tumor.

ii) Epilepsy

Epilepsy is a symptom for brain damage. It may due to defects in birth delivery or head injury during

accident or boxing. It may also be due to brain tumor. Epilepsy is divided into

two types.

1) Grandmal

2) Peritmal

1) Grandmal

Before grandmal attack, the patient recognizes a set of symptoms such that he sees a flash of light if grandmal arises from visual center .He hears a noise if it arises from acoustic center. It extends from few sec to several min

2) Peritmal

In peritmal attack, spike type waves are produced with a frequency 3 Hz. It lasts for 1– 20 sec.

Application

Epilepsy – EEG is very helpful to find acuteness of epilepsy.

Anesthetic level – It is helpful to find the depth of intensity of anesthesia

Brain injury – If there is a scar on the cerebral cortex, it creates irrigative effect on the nearby healthy

cortex. It is identified by EEG waveform.

(i) Monitor during surgery – Doctor to find patient‘s conditions.

(ii) Effect of Yoga – Identified by EEG for a normal person initially EEG in recorded.

The person has to do yoga for some time. After some period, once again EEG recorded for same person.

Then it is compared with previous wave form different gives the effect of yoga

During EMG test

- Small flat metal discs called electrodes are attached to the scalp with wires. The electrodes analyze the electrical impulses in the brain and send signals to a computer that records the results.
- The electrical impulses in an EEG recording look like wavy lines with peaks

and valleys. These lines allow doctors to quickly assess whether there are abnormal patterns.

- EEGs are safe and painless.
- During EEG test avoid anything with caffeine on the day of the test because it can affect the test results.
- During test, patient should wash the hair in night before or the day of the test, but patient should not use conditioners, hair creams, sprays or styling gels. Hair products can make it harder for the sticky patches that hold the electrodes to adhere to the scalp.