EEG SIGNALS HELP IN DIAGNOSIS OF INSOMNIA

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ABSTRACT

The human brain is one of the most complex systems in the universe. Nowadays various technologies exist to record brain waves and electroencephalography (EEG) is one of them. This is one of the brain signal processing technique that allows gaining the understanding of the complex inner mechanisms of the brain and abnormal brain waves have shown to be associated with particular brain disorders.

Keywords: Electroencephalogram, Sleep Disorder, Rapid Eye Movement sleep, CAP

I. INTRODUCTION

An electroencephalogram is used to measure and record the electrical activity of human brain. Brain cells continually send messages to each other that can be picked up as small electrical impulses on scalp. The process of picking up and recording the impulses is known as an EEG.

EEG can be used to help diagnose and manage a number of different medical conditions including:

- In diagnosis of Epilepsy
- Dementia- symptoms that are responsible for the decline of brain function.
- Coma
- Brain tumour- an abnormal and uncontrollable growth of cells in the brain.
- Brain abscess- a pus filled swelling in the brain that is caused by infection
- In sleep disorder like insomnia and narcolepsy.

II. TYPES OF EEG

- Routine EEG: Routine EEG is used to record the brain wave for about 20-40 minutes routinely. During the diagnosis from time to time eyes are closed or open.
- Sleep EEG: Sleep EEG is carried out during asleep for testing sleep disorder.
- Ambulatory EEG: Ambulatory EEG is used for recording brain activity throughout the day and night, over a period of one or more days.
- Video telemetry: Video telemetry is also known as Video EEG that records the video of brain wave activity.

III. EEG RHYTHMS

Specific harmonic oscillations commonly called rhythms may be observed in human EEG. Rhythms are classified into five major categories depending on their frequency ranges. These are alpha (α), beta (β), gamma (γ), theta (θ), and delta (δ).

EEG signals are divided into the following frequency bands-

- Delta (δ) Frequency: 0.5 to 4 Hz ,this occur only once in every 2 or 3 seconds. These occur in deep sleep, in premature babies and in very serious organic brain diseases. These can occur strictly in the cortex independently by the activities in the lower regions of brain.
- Theta (θ) Frequency: 4 to 8 Hz , these are recorded from the parietal and temporal regions of the scalp of children. These also occur during emotional stress in some adults particularly during disappointment and frustration.
- Alpha (α) Frequency: 8 to 13 Hz ,they found in normal persons when they are awake in quite, resting state.
- Beta (β) Frequency: 13 to 30 Hz, these are recorded from the parietal and frontal regions of the scalp. These are divided into two types as: beta I which is inhibited by the cerebral activity and beta II which is excited by the mental activity, like tension.
- Gamma(γ) Frequency: The waves with frequency above 30 Hz are known as gamma waves. Amplitudes of gamma waves are low.

III. DIAGNOSIS OF INSOMNIA USING EEG

Insomnia ia a sleep disorder that millions of people worldwide have to live with. The person who is suffering from insomnia find difficulties to either fall asleep or stay asleep. The Electroencephalogram is one of the useful biosignals to detect the sleep disorders.

Normal sleep progresses through a series of stages. Each stage has a typical EEG profile, easy recognizable to neurologists and sleep specialists. In patients with sleep apnea, insomnia , REM behavior disorder or other sleep disorder abnormalities in the EEG can help physicians for appropriate therapies to help correct EEG abnormalities and that can help improve insomnia symptoms.

In humans, normal sleep progresses through four stages: one of them is REM (rapid eye movement) sleep, which is associated with dream experiences. The portion of REM sleep during night alters with age- in new born babies REM sleep lashs for 50% and in adults for 20%. The other three stages are called NREM sleep, since they lack the eye movement. NREM sleep is also known as “Slow Wave Sleep” because of EEG patterns associated with these stages, which are dominated by delta waves.

Electroencephalogram (EEG) reflects the electrical activity occurring at the surface of a functioning brain. Special electrodes are attached to head and hooked by wires to a computer. The computer records the brain’s electrical activity on the screen. The skin on the scalp is cleansed and about 20 electrodes are attached to specific area measured out in the correct locations. Electrodes will be connected to an EEG machine by thin leads. The machine records the brain wave activity for analysis. Then, the electrodes will be removed and scalp will be cleaned. Then, the recording will be analysed and used for the purpose of diagnosis and treatment.

IV. CYCLIC ALTERNATING PATTERN

Cyclic alternating pattern (CAP) is a periodic EEG activity of NREM sleep for recording the data up to 1 min interval. In normal REM sleep CAP does not occur. The rate time (CAP)/time (NREM) in young adults is about 23% and increase with age. CAP is composed of two phases- Phase A and Phase B where Phase A represents apparent changes in frequency or amplitude compared with the rhythm. The interval between two Phases A is the phase B.

V. CONCLUSION

The purpose of the research is to detect the different human sleep disorders through EEG signal with time frequency analysis by receiving information from the internal changes of brain state. Researchers used EEGs first to distinguish the four separate stages of NREM sleep. A modern EEG signal is the digitized version of these potentials for computer storage and analysis. EEG was primarily used by the clinicians in understanding and treatment of neuro-physiological disorders. Presently, beside clinical purposes, EEG application has extended to neuroscience, cognition, and in other research fields. EEG is a blurred and highly attenuated electric potential that results from the activities of multiple groups of neurons from multiple cerebral regions.

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