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Interpretation of EEG in Epileptic Patients, A Review

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Abstract

Aim – To do a review on The Interpretation of EEG in epileptic patients.

Objective – Electroencephalography is the recording of electrical activity along the scalp. It measures the voltage fluctuations across the brain. It is an important test to diagnose epilepsy sleep disorders, coma and brain death. The recording of EEG is done by placing electrodes on the scalp, each one connected to the amplifier. The recording withdrawn may be computerized or recorded on paper. The interpretation of EEG mainly involves the inspection of waveforms and patterns, mentally reconstructing the spatial and anatomical origins of electrical sources and also determining the physiological basis.

Reason – The EEG shows patterns of normal or abnormal brain activity. Some abnormal patterns may occur with a number of different conditions. Certain patterns indicate tendency towards epilepsy. This review will help one to understand the variations in EEG of an epileptic patient compared to a normal pattern

INTRODUCTION

Epilepsy is defined as a brain disorder which is characterized by an enduring predisposition to generate epileptic seizures and by the neurobiological, cognitive, psychological and social consequences of this condition [1] .Epileptic seizures are the transient occurrence of signs or symptoms due to abnormal excessive or synchronous neuronal activity in the brain. The seizures depends on the location of the onset of the brain , patterns of propagation , maturity , confounding disease processes , sleep-wake cycle, medications and other factors[2] .Seizures can be a result of epileptic discharges which can disrupt the cerebral cortex which can affect the learning. Epileptic patients may also face a restriction of lifestyle, dependent behavior, poor academic achievement which in turn affect the quality of life [3]. Epilepsy can be diagnosed by blood test, positron emission scan(PET), spinal tap and EEG test [4] .

An EEG or a electroencephalogram , discovered by German psychiatrist Hans Berger, is a test that detects electrical activity in the brain using small , flat metal discs(electrodes)attached to the scalp. Brain cells communicate via electrical impulses and are active all the time, even one is asleep. This activity shows up as wavy lines on an EEG recording.

An EEG can determine changes in brain activity that is useful in diagnosing brain disorders, especially epilepsy. The EEG provides important information about epileptic discharges and is required for the diagnosis of specific electro clinical syndromes [5]. Such a diagnosis carries important prognostic information, guides selection of antiepileptic medication, and suggests when to discontinue medication. The EEG reading can show a difference in small sharp spikes, wicket spikes, phantom spikes and waves, psychomotor variant and midline theta rhythm [6,7 ,8] .

With this background in concern, a review was taken on the interpretation of EEG of several epileptic cases.

DISCUSSION

Analyses of electroencephalograph (EEG) records can provide valuable insight and improved understanding of the mechanism causing epileptic disorders.

Wavelet Transform is particularly effective for representing various aspects of non-stationary signals such as trends, discontinuities, and repeated patterns where other signals such as trends, discontinuities and repeated patterns where other signal processing approaches fail or are not as effective. The wavelet transform is used to analyze and characterize epileptic discharges form of 3-Hz spike and wave complex in patients [9]. Certain recordings also showed that during seizure activity EEG had lower ApEn(Approximate Entropy) values compared to normal EEG

Non-linear features extracted from EEG signals such as approximate entropy (ApEn), Hurst exponent and scaling exponent help to characterize interictal and ictal EEG (10, 11, 12) .

Abnormalities that may show detection of epilepsy in the epileptic discharges are

- Sharp waves.
- Spike wave complexes which tend to persist or become more prominent with deeper levels of sleep.
- Epilepetiform spikes are almost surface negative in polarity.
- Seizure discharges can evolve into other frequencies during seizures [13] .

EEG findings in epilepsy syndromes

- Idiopathic generalized epilepsies (IGE) ;
  EEG characteristics in IGE include generalized spike or polyspike and slow wave discharge at 3 – 5 Hz, normal background cerebral activity and high incidence of photosensitivity. The interictal EEG is normal or may show runs of occipital rhythmic delta in case of Childhood absence epilepsy. Patients with Juvenile absence epilepsy are more likely to show polyspike discharge with frequency above 3Hz and runs of occipital rhythmic delta.

- Benign Childhood epilepsy syndromes
  In benign childhood epilepsy with central – temporal spikes, the EEG hallmark is high amplitude focal sharp wave discharges in the central and temporal regions, either bilateral or unilateral. Background cerebral rhythms are normal. Interictal EEG often show striking amounts of discharge, occipital spike waves, multifocal discharges and rolandic spikes.
- Progressive myoclonic epilepsies
  Generalized spike wave discharge, photosensitivity, giant SEPs, abnormalities of background cerebral activity.

- Partial epilepsy syndromes
  Anterior/ mid temporal interictal spikes over the temporal lobe and a characteristic 5-7 ictal discharge accompanying seizures [14, 15, 16]

Epileptiform normal variants are electroencephalographic (EEG) patterns that resemble epileptogenic abnormalities. Most of these patterns initially were thought to be associated with epilepsy or other neurological conditions but however further studies have indicated that these readings had no significance, and they are now considered as normal variants with no clinical significance [17, 18, 19]

Certain variants like the small sharp spikes, wicket spikes, 14 and 6-Hz spikes, phantom spike and waves, psychomotor variant, subclinical rhythmic EEG discharges of adults and midline theta rhythm were often considered and misinterpreted as abnormalities of EEG. Small sharp spikes are distinguished from spikes because of their short duration and small amplitude [21, 22, 23, 24] . Wicket Spikes are misinterpreted as sharp waves. The 14 and 6 Hz spikes may be distinguished from temporal spikes (epileptic spikes are almost always surface negative in polarity). Psychomotor variant differs from the seizure discharge in that as it is monorhythmic and does not evolve frequencies. The subclinical rhythmic electroencephalographic discharges of adults are never associated with symptoms.

However their recognition is important to avoid over interpretation or misinterpretation of their significance.

CONCLUSION

EEG is an essential tool for correct diagnosis and management of epilepsy and helps to provide prognostic and classified information. It is useful for prediction of seizure relapse in children than adults or ones that carry high relapse like photosensitivity, juvenile epilepsy etc.
However, EEG has its own limitations which can cause certain diagnostic errors which can lead to poor yield of information that could be useful in the management of patients

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