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 The recording withdrawn may be computerized or recorded on paper.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.
- Epileptiform 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. Intercital 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 it occurs monorhythmic and does not evolve
frequencies. The subclinical rhythmic

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

REFERENCES
epilepsy : definitions proposed by International league against
Epilepsy and the International Bureau for Epilepsy. April
2005;46(4):470-2 (Medline)
[2] Battaglia A, Filipp T , South ST, Carey JC. Spectrum of epilepsy and
electroencephalogram patterns in Wolf-Hirschhorn syndrome :
experience with 7 patients . Dev Med Child Neurol.May
2005;51(5):373-80
[3] Epilepsy & seizures .David Y Ko,MD Associate professor of
Clinical neurology
[4] Epileptic seizures and Epilepsy : Definitions proposed by the
International League Against Epilepsy and the International Bureau
for Epilepsy
Phillip Lee, Jerome Engel Jr. 29 MAR 2005 . Epilepsia
Australia
[7] Epilepsy and the electroencephalogram , Webmed
[8] EEG in Common Epilepsy Syndromes , Author :Raj D sheth , Md;
Chief Editor : Selim R Benbadis, Medscape
[9] Zivin L, Ajmone Marsan C. Incidence and prognostic significance of
epileptiform activity in the EEG of non epileptic subjects. Brain ,
A Journal of Neurology , Volume 91 Issue 4 Pg 751-778
affecting interictal spike discharges in adults with epilepsy.
Electroencephalogram Clin Neurophysiol, April 1990 ;75:358-60
with EEG features of benign epilepsy of childhood with
Epilepsia , 1992 Nov-Dec ; 33 (6) : 1091-6
[15] Analysis of EEG records in an epileptic patients using wavelet
transformat. Hojat Adeli, Zlqin Zhou, Nahid Dadmer, Journal of
[16] Classification Of EEG using wavelet transform , Neep Hazarika,
jean Zhu Chett , Ah Chung Tsoi, Alex Sergejew , Signal Processing
May 1997 , Vol. 59 (1) 61-72
[17] Automatic detection of epileptic seizures in EEG using discrete
wavelet transform and approximate entropy, Hasan Ocake , March
2009 Vol .36(2) , Expert systems with Applications
[18] Seizure detection using EEG nad ECG signals for computer based
monitoring, analysis and management of epileptic patients, Josif
Mporas , Vasiliki Tisrkia, Evangelia I – Zacharaki, Michalis
Koutroumanidis, Mark Richardson, Vasileios Megalokonomou,
15 April 2015 , Vol 42(6) :3227-3233, Expert systems with
Applications
[19] Epileptic EEG classification based on extreme learning machine and
non linear features , QI Yuan , Weidong Zhou , Shufang LI,
Dongmei Cai. September 2011, Vol.96(1);29-38, Epilepsy Research
, Agustina Graces Correa , Lorena Orcozo , Pablo Diez, Eric Laciar.
Computers in Biology and Medicine 1 February 2015, Vol. 57 66-73
[21] Epileptiform normal Variants in EEG Author ; Selim R Benbadis,
MD ; Chief Editor, Helmi L Lutsep, Medscape
[22] EEG in the diagnosis , classification and management of patients
with epilepsy S J M SMITH , Journal of Neurology, Neurosurgery &
Psychiatry , Volume 76
[23] Halaz P, Filakovzhy J, Vargha A Effect of sleep deprivation on
spike wave discharges in idiopathic generalized epilepsy a long term
EEG monitoring study, Epilepsy Res 2002 ;51 123-32, Medline
[24] Yejun S , Harvey AS , Marini e EEG in adult onset idiopathic
generalized epilepsy .Epilepsia 2003 44; 252-6

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