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Significance of Inter-Ictal Period in Detection of Epilepsy by EEG

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ABSTRACT
Objectives: *To evaluate the sensitivity of EEG in diagnosing Epilepsy in different inter-ictal periods.*
Materials and Methods: *The study was done from June 2014 to May 2015.One hundred and thirteen clinically diagnosed cases of epilepsy were studied and analyzed through electro-encephalogram using the internationally accepted 10-20 electrode placement method.*
Results: *EEG was successful in detecting all 22 clinically diagnosed epilepsy cases coming within 48 hours of seizure episode and all 7 clinically diagnosed cases coming within 24 hours of seizure episode. However cases that arrived after 3 to 7 days of attack had only 87.88% sensitivity of EEG detection. And cases coming after a week or one month of attack had 13.55 % sensitivity of EEG diagnosis.*
Conclusion: *It was found that EEG, in the patients presenting immediately after the 1st day or 2nd day of the seizure episode, was more successful in detecting Epilepsy.*
Keywords: *EEG, Epilepsy, Inter-ictal Period, Seizure.*

Introduction

Epilepsy, originally known as 'Sacred Disease', has been tormenting mankind, since a very long time back. It was called as the curse of the moon goddess 'Selene' in Greek literature. However Hippocrates made the first scientific attempt to state that the disease is nothing to be sacred and has a natural cause. Jackson studied epilepsy on a pathological and anatomical basis in the 18th century. And finally 'human brain waves' were confirmed by a scientist, 'Hans Berger', who developed an innovative procedure to record abnormal brain waves that originate in a epileptic brain. The procedure was called Electro-encephalogram or EEG.

Electroencephalogram is the procedure of recording of the potentials on the skull generated by currents emanating spontaneously from nerve cells in the brain, with fluctuations in potential, seen as waves. Thus it represents spontaneous electrical activity of the brain and records the potential changes of the brain across times by means of electrodes placed on the scalp or in the brain itself.

Epilepsy is a disease of the brain, characterized by at least two unprovoked seizures, occurring > 24 hours apart and having a general recurrence risk. [1] It is due to an abnormal excessive or synchronous neuronal activity in the brain. These highly synchronized discharges of cerebral neurons are reflected in EEG as recurrent waves having very high amplitude, presenting as spikes or a combination of spikes.

Inter-ictal period is the time interval between two seizure episodes. Some authors have thought upon the inter-ictal period as a physiological adaptation

by an epileptic brain. There are characteristic changes in the EEG, sometimes seen in the inter-ictal period, with distinct evolution of brain wave pattern, immediately following a seizure episode or just before a seizure episode.

In 1980, Gotman et al. had found that there was prolonged & marked increase in inter-ictal spikes after a seizure. Drugs had little effect on the rate of spike activity & there was no increase of spiking prior to seizures.[2] Tedras GM et al. in 2012 said that the epileptiform transients such as spikes & sharp waves are the inter-ictal marker of a patient with epilepsy and are the EEG signature of a seizure focus.

In the present era, when highly developed medicines have come up to control epileptic attacks, it will be immensely helpful, if we can predict such an upcoming epileptic attack by innovative diagnostic procedures; of which EEG gives us some hope if we can know and analyze the interictal period evolution.

Aim & Objectives

The study was done with the aim of determining the significance of Inter-Ictal period in detection of Epilepsy by EEG.

Objective of the study was to ascertain the importance of inter-ictal period in the diagnosis of epilepsy by EEG, so that a proper & correct diagnosis can be made if the patient is made to undergo an EEG investigation in right time after a seizure attack.The knowledge thus achieved about the inter-ictal period can ensure proper treatment of the epileptic patients to prevent further attacks.

Material & Methods

The study was done for a period of one year from June 2014 to August 2015. All clinically diagnosed Epilepsy cases attending Neurology OPD and Indoors of Assam Medical College & Hospital and also cases referred to Neurology from other departments of Assam Medical College were taken as study cases. However critically ill patients, patients with uncontrolled hypertension, acute stroke etc were excluded from the study.

A Performa was prepared to enquire about the history and record the physical examination findings of the patients. In the history, the time since the last seizure episode i.e. the inter-ictal period was specifically enquired upon. The patient was explained about the EEG procedure and consent was taken.

The scalp of the patient was properly cleaned and Bentonite paste applied at the electrodes. "24 channel EEG NEUROPAGE PLUS Electroenceph-alograph NP- 3200 P" was the apparatus used for recording an EEG. Using the conventional international 10-20 system of electrode placement, a 24 channel EEG was run for about twenty minutes in bipolar montage, with the patient lying down relaxed in the supine position. The filters & sensitivity were adjusted for every patient.

Certain activation procedures like hyperventilation & sleep were occasionally used to obtain better EEG recordings.

Results & Observations

The total number of cases obtained during the one year of study was 113.The study population was divided into five age groups. (Table 1).

The study population had the predominance of 'the children age group' (45.1 %) during the one year of study. This was followed by the 'younger adult age group. (25.66 %). The sex distribution was almost equal in both the sexes with the males (50.4 %) slightly greater than females (49.5 %).The male, female ratio being 982 female per 1000 male.

Of this 113 clinically diagnosed epilepsy cases, 63 cases were confirmed positive as epilepsy by electro-encephalogram. (Figure 1). EEG could detect 63 cases with positive IEDs with greater predominance of the female population (71.43%) (Table 2) and the adolescent age group (66.67%). (Figure 2).

Inter-ictal period was enquired in the history and noted down against the EEG finding of all the patients. It was seen that, out of all the 7 cases that came within 24 hours of a seizure episode, all the 7 cases were detected by EEG. Similarly, out of the 22 cases that came within 48 hours of a seizure

episode, all the 22 cases were detected by EEG. However, out of 33 cases that came within one week to one month after a seizure episode, only 29 cases were detected by EEG. And out of 38 cases that came after one month to one year of a seizure episode, only 5 cases were detected by EEG. And 13 cases that came after one year of seizure episode, none were detected by EEG. Usually, cases that came after one year were either on anti-epileptic drugs or came just for regular checkups. (Table 3).

Thus, in our study, EEG was 100% sensitive in detecting IEDs in patients coming within 24 to 48 hours of a seizure episode. However cases that arrived after 3 to 7 days of attack had only 87.88% sensitivity of EEG detection. And cases coming after a week or one month of attack had 13.55 % sensitivity of EEG diagnosis.(Fig.3).

Table1. Table showing distribution of the study population

AGE GROUP	Age in years	No. of Male patients	No.of Female patients
1.Neonates & Infants	<=1	3	0
2. Children	>1 to ≤12	24	27
3.Adolescents	>12 to ≤18	6	15
4.Younger Adults	>18 to ≤ 35	16	13
5.Older Adults	>35	8	1
TOTAL		57	56

Figure 1. Analysis of the EEG detected epilepsy cases.

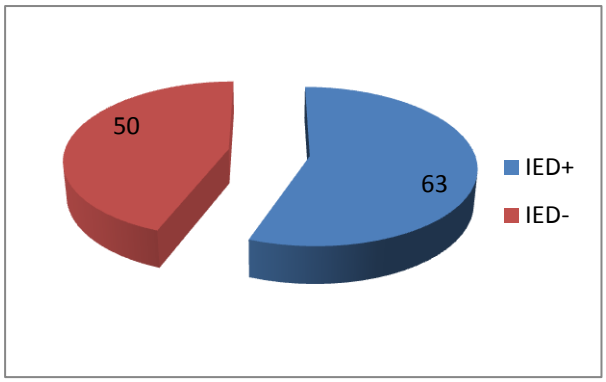


Table 2: Table to compare EEG detected cases in both the sexes.

Sex	IED + CASES	IED - CASES
MALE	23 (40.35%)	34 (59.65%)
FEMALE	40 (71.43%)	16 (28.57%)
TOTAL	63	50

Figure 2:- Analysis of EEG detected cases in different Age groups.

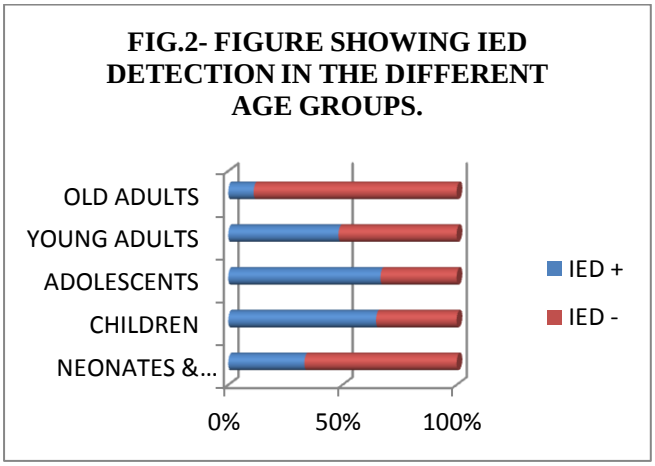
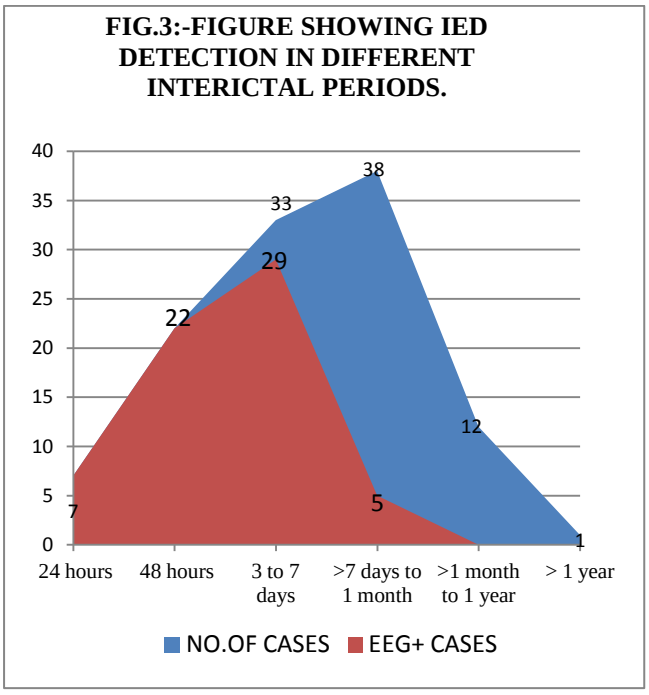


Table 3. Table showing cases detected by EEG in different inter-ictal periods

Inter-Ictal period	No. of cases	EEG + cases	%	p-value
24 hours	7	7	100	0.001
48 hours	22	22	100	
3 to 7 days	33	29	87.88	
>7 days to 1 month	38	5	13.59	
>1 month to >1 year	13	0	0	

The significance of the inter-ictal period can be thus represented in the following diagram.

Figure 3. Analysis of the cases detected by EEG in differentinter-ictaI period



Discussion

It has been observed that our study has found results, very similar to some other studies conducted at different times at different places.

Lawrence et al. in 2010 quoted that among 141 patients, evaluated after a first seizure, IEDs were observed more often when the EEG was obtained within 24 hours of the seizure than when obtained later.[3]

Even Edward B Bromfield in 2012, said that, in general, IEDs are most likely to appear in the recordings of children, within hours or days of a seizure, and in association with idiopathic or symptomatic generalized epilepsies.[4]

Pillai et al. in 2006, too said that IEDs are more likely to occur in an EEG recorded soon after a seizure. [5]

Our study matches with the above studies as we also found a greater number of IED s in the EEG recordings taken within 24 to 48 hours of seizure than the later.

Similar finding was also found by Sunderam et al. in 1990,where it was quoted that apart from sleep, several other factors have been shown to increase the likelihood of ED and these include i) recording within 48 hours of a seizure and ii) ongoing seizure frequency of at least one attack per month.[6]

Conclusion

In our study, it was thus found that, EEG, in the patients presenting in the 1st day or the 2nd day after the seizure, was more successful and sensitive in recording IEDs. Younger people coming immediately after a seizure were better detected by EEG.

Epilepsy has been an age old dreaded disease that has been successfully exposed by EEG to a very good extent. It appears quite amazing that an epileptic brain functions almost normally in between seizures in a good number of people; that raises the possibility that indeed the inter-ictal period might be a physiological adaptation to the abnormal changes, as certain theories have said. However for knowing this, we would require a more detail analysis of the waveforms and working in the molecular level which was beyond the scope of our present study. Nevertheless, EEG stays the most sensitive investigative procedure to diagnose epilepsy, provided patients present just immediately after a seizure attack. Thus patient education about the above fact may lead to better control of the disease in future if right diagnosis can be made at the right time and treatment started accordingly to control and prevent the epileptic attacks.

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Abbreviations

ED	:	Epileptiform Discharges
EEG	:	Electroencephalogram
EEG –	:	EEG with no changes
EEG +	:	EEG with changes
IED	:	Interictal Epileptiform Discharge
IED –	:	IED absent
IED +	:	IED present
IEDs	:	Interical Epileptiform discharges