



STUDY OF ELECTROENCEPHALOGRAPHIC CHANGES IN CASES OF EPILEPSY WITH REGARD TO ITS TYPE, FOCUS OF ORIGIN AND LATERALIZATION

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ABSTRACT **INTRODUCTION:** EEG (Electroencephalogram) is a medical imaging technique that reads scalp electrical activity generated by brain structures. One way to investigate electrical signals of the brain is to record scalp potential resulting from brain activity. The recorded signal i.e. the potential difference between the two positions is called electroencephalogram. So the purpose was to study the electroencephalographic changes in cases of epilepsy with the help of morphology of EEG waves with regard to its type, focus of origin and lateralization.

MATERIAL AND METHODS: This was a prospective 200 admitted epileptic children were assessed. Males and females in the age group 1 year -18 years who were k/c/o epilepsy. Epileptic children admitted in our hospital with an active seizure episode were included in the study.

OBSERVATION AND RESULTS: Maximum number (107 cases) 61.1% of the epileptic children have normal interictal EEG records as compared to only 38.9% (68 cases) with abnormal interictal EEG. Most of the abnormal interictal EEG 39 cases (57.4%) comprised of normal background as against 29 cases (42.6%) with abnormal background.

CONCLUSION: Lesser the degree of control of seizures, higher is the probability of abnormal interictal EEG record of epileptic children. All children with fully controlled seizure have a normal interictal EEG record.

KEYWORDS :

INTRODUCTION

Modern medicine applies variety of imaging techniques of the human body. EEG (Electroencephalogram) is a medical imaging technique that reads scalp electrical activity generated by brain structures. The brain works by transmitting electrical signals between neurons.^{1,2} One way to investigate electrical signals of the brain is to record scalp potential resulting from brain activity. The recorded signal i.e. the potential difference between the two positions is called electroencephalogram. The EEG is defined as electrical activity of an alternating type recorded from the surface of the scalp after being picked up by metal electrodes and conductive media. In clinical context, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20-40 minutes, as recorded from multiple electrodes placed on the scalp.^{3,4,5} Diagnostic applications generally focus on the spectral content of the EEG, that is, the type of neural oscillations that can be observed in EEG signals. During more than 100 years of its history, encephalography has undergone massive progress. But only during the last 50 years, with the breakthrough in digital technology, has EEG become a standard method in clinical practice. The existence of electrical currents in the brain was discovered in 1875 by an English physician Richard Caton, Caton observed the EEG from exposed brains of rabbits and monkeys.^{6,7} German neurologist used his ordinary radio equipment to amplify the brain's electrical activity measured on the human scalp. He announced that weak electric currents generated in the brain can be measured without opening the scalp and depicted graphically on a strip of paper.^{8,9,10} The activity that he observed changed according to the functional status such as in sleep, anaesthesia and lack of oxygen and in certain neural diseases like epilepsy. Berger laid the foundations for many of the present applications of electroencephalogram. He also used the word electroencephalogram as the first for describing brain electric potentials of humans. Later in 1934, Adrian and Mathews^{11,12} published the paper verifying the concept 'human brain waves'. For centuries epilepsy was considered as a damning curse from the Gods or a strange type of insanity. Today epilepsy is known to be a neurological disorder that 8 predisposes individuals to experience recurrent seizures. Epilepsy is the most common serious neurological condition^{13,14}. Epilepsy starts in childhood in 60% of cases and most of the clinically significant aspects of the disease occur during childhood. Specifically in children and young adults, genetic disorders, congenital abnormalities and birth trauma affecting the brain are most often blamed for the onset of epileptic seizures. EEG's sensitivity and specificity depend on several factors such as age and recording procedures, for example, sleep recordings and activation procedures (hyperventilation, photic stimulation). EEG reveals characteristic findings in several epilepsy syndromes.¹⁵ Rarely, epileptiform discharges are recorded in healthy, young children. Ictal EEG

recording is considered to be critical in localizing epileptogenic zone. Although surface EEG recordings are less sensitive than invasive studies, they provide the best overview and therefore the most efficient way to define the approximate localization of the epileptogenic zone. Invasive recordings are used in whom the epileptogenic focus either cannot be located with non-invasive diagnostic methods or is adjacent to eloquent cortex. The most commonly used invasive electrodes are stereo tactically implanted depth electrode and subdural strips or grid electrodes. So the purpose was to study the electroencephalographic changes in cases of epilepsy with the help of morphology of EEG waves with regard to its type, focus of origin and lateralization

MATERIAL AND METHODS

This was a prospective study that was conducted in Niramay Hospital and Research Centre, Satara with strength of one hundred and seventy five children during the course period of June 2016 - April 2017. A written approval was taken from the guardians of the patients before conducting the study, provided that no invasive techniques were done to the children.

500 children admitted with convulsions in our hospital formed our population. Of them only epileptic children, which meant only known cases of epilepsy formed our sample for study. Subjects were considered epileptic if they had two or more afebrile seizures unrelated to acute metabolic disorders or to withdrawal of drugs; even a single febrile convulsion was excluded. Seizures were classified according to international classification of seizures (1981) as it was more practical and applicable.

According to our study schedule, 200 admitted epileptic children were assessed and their parents interviewed. But only 175 cases agreed to participate in the study and allowed us to perform the EEG test resulting in a drop-out rate of 12.5%. Therefore they were later excluded from the study.

Males and females in the age group 1 year -18 years who were k/c/o epilepsy. (subjects were considered epileptic if they had two or more afebrile seizures unrelated to acute metabolic disorders or to withdrawal of drugs) Epileptic children admitted (indoor patients) in our hospital with an active seizure episode were included in the study. Typical/atypical febrile convulsions (single or more than one episode), Provoked convulsions related to acute metabolic disorders or to withdrawal of drugs or any other type of provoked seizure were excluded in the study.

The data was collected by the observation of seizure in a child with known epilepsy which was derived from the record study of the child.

At this stage, epileptic cases were assessed by an interview schedule that was asked to the parents of the epileptic children. Clinical examination included the following items. Detailed history including analysis of seizures like presence of any aura preceding the convulsions, time of onset, duration of symptoms, whether focal or generalized seizure, associated symptoms during the ictal and post-ictal phase, last seizure episode, longest seizure free interval and history of receiving antiepileptic medications. (after a qualified neurologist) . History of neurologic complaints and other system affection.

Past history enquiry of prenatal and perinatal risk factors, developmental milestones, immunization, trauma, encephalitis and other neurological, medical diseases or psychiatric disorders. Family history of consanguinity, epilepsy, febrile convulsions, other neurological disorders, psychiatric disorders or general medical conditions . A full thorough neurological examination including mental state examination and anthropometry was conducted.

It is customary to perform EEG studies 48 hours or more after a suspected seizure, because obtaining an EEG shortly after a seizure may yield misleading findings (Browne and Holmes, 2001).

In our study, EEG was done 72 hours after a seizure episode using a 24 channel digital RMS EEG-24. Patients were not asked to stop their medication; they had their breakfast meal. They were advised to wash their hair the previous night and not apply any oil for the ease of electrode placement using an adhesive. On the day of doing an EEG, the children were made to sleep one hour prior to the procedure. The sleeping child was then placed on the table and the 24 leads of the EEG machine were placed on the scalp with the help of an adhesive using the 10-20 international system of electrode placement. EEG was recorded under standard conditions with eyes closed. Provocation techniques included photic stimulation and hyperventilation. Data collected from the epileptic children were given to an expert statistician for calculation of percentages. Special tests used were the Chi-square test and p value was calculated when needed.

OBSERVATION AND RESULTS

One hundred and seventy five known cases of epilepsy were studied in detail at the Paediatric Department, Niramay Hospital and Research Centre, Satara and their EEG done.

Table :1 Relation between inter-ictal EEG and treatment regularity

Treatment Regularity	Normal EEG		Abnormal EEG		Total
	Count	%	Count	%	
Patients on regular treatment	63	62.4	38	37.6	101
Patients on irregular treatment	44	59.5	30	40.5	74
Total	107		68		175

Chi Square Test
p value = 0.696 (Not-significant)
Chi Square = 0.153

Table :2 Relation between inter-ictal EEG and treatment adequacy

Adequacy of treatment	Normal EEG		Abnormal EEG		Total
	Count	%	Count	%	
Patients on regular adequate dose	58	63.7	33	36.3	91
Patients on regular inadequate dose	5	50	5	50	10
Patients on irregular inadequate dose	44	59.5	30	40.5	74
Total	107		68		175

Chi Square Test
p value = 0.648 (Not-significant)
Chi Square = 0.868

DISCUSSION :

Our data are only partially comparable with those of the other published populations because of the different sampling procedures and contexts of our community beliefs. Therefore the dominance of the

diagnostic category of generalised tonic-clonic seizures is consistent with certain reported studies^{16,17,18}

Maximum number (107 cases) 61.1% of the epileptic children have normal interictal EEG records as compared to only 38.9% (68 cases) with abnormal interictal EEG. Most of the abnormal interictal EEG 39 cases (57.4%) comprised of normal background as against 29 cases (42.6%) with abnormal background.

There were almost equal number of paroxysmal generalised discharges 33 cases (48.5%) and focal discharges 35 cases (51.5%) on abnormal interictal EEG. Most of the paroxysmal generalised interictal EEG comprised of sharp waves (63.63%) followed by spike waves (21.21%) and lastly spike-slow wave complex (15.15%).

Maximum number of focal discharges on interictal EEG was bilateral (75%) as compared to unilateral discharges (25%).

Maximum number of abnormal interictal focal discharges arised from the temporal area (48.57%) of which 31.42% were frontotemporal and 17.14% were centrottemporal, followed by 34.28% from frontal, 11.42% from occipital and 5.7% multifocal.

Maximum number 21 cases (60%) of the focal interictal EEG discharges comprised of sharp waves followed by 10 cases (28.57%) of slow waves and only 4 cases (11.42%) of focal spikes and polyspikes. Female epileptic patients have a higher percentage (46.5%) of abnormal interictal EEG record as compared to males (31.5%). More the frequency of epileptic attacks in epileptic patients, higher is the probability of abnormality on interictal EEG record.

Epileptic children with seizure attacks once or more per day have 88.9% abnormal EEG as against those with once per year or few years who do not have any abnormal inter-ictal EEG. More the duration of illness in epileptic patients, higher is the probability of abnormal interictal EEG record. 91.4% of the epileptic children with duration of illness more than three years have an abnormal interictal EEG while only 16.7% of them with duration less than one year have an abnormal EEG. Mixed type of seizures have the highest probability of abnormal interictal EEG record followed by partial seizures and lastly the generalised type of seizures.^{19,20,21} 100% of the epileptic children with mixed type of seizures have an abnormal interictal EEG record while 38.3% of them with partial seizures and 36.7% of them with generalised seizures have an abnormal interictal EEG record.

Lesser the degree of control of seizures, higher is the probability of abnormal interictal EEG record of epileptic children. 63.7% of the epileptic children with uncontrolled seizures have an abnormal interictal EEG record while 4.9% of them with partially controlled seizure have a normal interictal EEG record.

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