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# SPECTRUM OF ELECTROENCEPHALOGRAM FINDING IN CHILDREN WITH NEWLY DIAGNOSED EPILEPSY –AN EXPERIENCE AT A TERTIARY CARE HOSPITAL

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## ABSTRACT:

**Background:** Epilepsy is the most common neurological disorders that affect all age groups. It is characterized by at least two unprovoked seizures more than 24 hours apart. The most common investigation used for both diagnosis and management is an Electroencephalogram (EEG), which is relatively cheap and easy to perform. However, EEG requires technical expertise and is prone to misinterpretation.

**Objective:** To determine the frequency of abnormal EEG findings in children with newly diagnosed epilepsy at tertiary care hospital.

**Method:** It was a retrospective descriptive, cross-sectional study. Children with diagnosis of epilepsy admitted at Aga Khan University Hospital from January 2016 to December 2018, who underwent EEG were included in this study. Demographics, duration of seizure, type of seizure, day the EEG was performed, and EEG findings were collected on a structured proforma. Data analysis was done SPSS version 19.

**Results:** During the study period of three years, 225 newly diagnosed patients with epilepsy were included in the study. The mean age was  $70.16 \pm 54.4$  months and male to female ratio was 1.5:1. Mean duration of seizure was  $5.18 \pm 4.17$  minutes. Generalized seizures seen in 86.7% and focal seizures in 13.3% of patients. In 45.3% of children EEG was done within 24 hour. EEG abnormalities were seen in 55.2% patients. Abnormalities were noted in background in 15.6%, interictal epilepticus discharges (IED) in 20.9% and IED with back ground slowing found in 18.7% of the patients.

**Conclusion:** Our results re-emphasized that epilepsy is a clinical diagnosis and EEG can be normal in approximately half of the patients with epilepsy. We recommend that children with suspicion of epilepsy should be evaluated clinically and order EEG within 24 hours of seizures.

**Key words:** Electroencephalogram (EEG); Epilepsy; Epileptic discharges.

**INTRODUCTION:** Epilepsy is the most common neurological disorders. It is characterized by two or more than two unprovoked seizures more than 24 hours apart<sup>(1)</sup>. Around 10.5 million children under 15 years of age have epilepsy worldwide. This represents one fourth of the world epilepsy population. Of these, 40% are younger than 15 years and 80% are residing in the developing countries<sup>(2)</sup>. In Pakistan an age-specific prevalence rate of 9-99 in 1,000 (14-8 in 1,000 in rural and 7-4 in 1,000 in urban areas) for epilepsy were estimated in 1994, from a population based study<sup>(7)</sup>. The diagnosis of epilepsy is not straightforward, and so the misdiagnosis is not rare<sup>(3)</sup>,

as paroxysmal events such as psychogenic seizures or movement disorders occur more in children and adolescents<sup>(4)</sup>. A detailed and reliable information of the event by an eyewitness is the most important part of the diagnostic evaluation, but that may not be available always<sup>(5, 6)</sup>. The conventional EEG is non-invasive relatively cheaper procedure, and important investigative tool in the diagnosis and management of epilepsy. However, its effectiveness depends on the technician and the interpretation by experienced neurophysiologist<sup>(8-11)</sup>. Around, 12-50% of patients with epilepsy may have initial normal inter-ictal EEG, this percentage may falls to 8% with repeated

serial EEGs <sup>(11, 12)</sup>. More than half of the individuals undergo EEG due to the suspicion of epilepsy. The EEG either confirms or may direct towards the diagnosis <sup>(9, 12)</sup>. Epileptiform discharges are also seen in 2–5% of children without epilepsy, especially in the Centro-temporal regions <sup>(13)</sup>. Furthermore, a number of normal benign variant patterns in EEG are often misinterpreted as epileptiform discharges especially in children <sup>(14)</sup>. Due to complex study, misinterpretation is common that leads to the misdiagnosis of epilepsy <sup>(15)</sup>. A study from the United Kingdom demonstrated that one third of the patients with epilepsy were misdiagnosed <sup>(16)</sup>. Despite the large amount of data, the predictive role of EEG in Epilepsy is still controversial <sup>(10)</sup>. Video EEG has increased the yield for diagnosis of epilepsy, but it is expensive and time consuming procedure <sup>(6)</sup>. The aim of this study was to see the abnormal EEG proportion in clinically diagnosed epilepsy in healthy children to provide insight to the efficiency of conventional EEG in the evaluation of children with epilepsy.

## METHODS:

A retrospective analysis of all epilepsy patients with age ranging from 1 month to 18 years admitted with newly diagnosed Epilepsy (ICD-9-CM code 780.39) under care of Pediatric Neurology services at Aga Khan University Hospital was done from January 2016 to December 2018 after approval from Ethical review committee (ERC: 2018-0509-545). Children with developmental delay, cerebral palsy, known structural brain anomaly, space occupying lesion and EEG done outside our hospital were excluded. Diagnosis of epilepsy was based on the history given by caregivers who had observed the seizure and confirmed by a pediatric neurologist <sup>(17)</sup>. The EEG was performed by a qualified technician according to international protocol and reported by a pediatric neurologist. Medical record was retrieved using a coded system from the Health Information Management Services (HIMS). A structured form was used to document EEG patterns which were categorized as normal, abnormal with either background slowing or interictal epileptiform discharges (IED) or both, types of seizure, total duration of seizures, and day of admission when the EEG was performed along with demographics. SPSS version 19 was used for data analysis. The descriptive statistics, frequency and percentage were computed for qualitative variables like type of seizures, abnormality on EEG, diagnosis and for gender. Mean and standard deviation were computed for quantitative variables like age and duration of seizures and univariate analysis

was done to see correlation.

## RESULTS:

During the period of three years, a total of 225 children admitted with the diagnosis of Epilepsy were included. Patient characteristics shown in the table 1. EEG was performed in 45.3% of patients within 24 hours and 18% showed IED. The EEG findings are summarized in Table 2.

**Table 1: Clinical characteristics of children with epilepsy (n=225)**

Variable	Value
Mean Age (months) ± SD	70.16 ± 54.4 months
<b>Age distribution years</b>	<b>n (%)</b>
≤ 1 year	31 (13.8)
1 -5years	84 (37.3)
5.1 -10 years	64 (28.4)
10.1 -15 years	38 (16.95)
≥15 years	8 (3.6)
<b>Gender</b>	<b>Male</b> 136 (60.4)
	<b>Female</b> 89 (39.6)
Male to female ratio	1.5:1
<b>Mean duration of seizure(SD)</b>	<b>5.18 ± 4.17 minutes</b>
<b>Seizure type</b>	
1)Generalized seizures	195 (86.7)
2) Focal seizures:	30 (13.3)
<b>Seizure duration</b>	
≤5min	156 (69.3)
5-10min	36 (16)
≥10min	33(14.7)
<b>EEG perfomed</b>	<b>IED with and without back ground slowing</b>
Within 24hours of seizure	41(18.2)
48hours of seizure	16(14.8)
72hours of seizure	10(4.4)
>72hours of seizure	18(8)

**Table 2: Full EEG Findings in children with epilepsy**

EEG Findings	n= 225
Normal	101 (44.8%)
Background slowing	35 (15.6%)
<b>Interictal discharges (total)</b>	<b>47 (20.9%)</b>
1) Absence seizure	5 (2.3%)
2) Generalized seizure	33 (14.6%)
3) Focal seizure	9 (4%)
<b>Both background slowing and interictal discharges (IED)</b>	<b>42 (18.7%)</b>
1) Hypsarrhythmia	5 (2.22%)
2) Burst suppression	3 (1.33%)
3) Generalized seizure	17 (7.55%)
4) Focal seizure	17 (7.55%)

## DISCUSSION

Epilepsy is one of a common disease with high misdiagnosis rate <sup>(13, 16, 18)</sup>. So we aimed to focus on EEG finding in epilepsy patients, as epilepsy associated with high parental anxiety and have negative impacts on the life of children with epilepsy <sup>(19)</sup>. Diagnosis of epilepsy rely on detail clinical history regarding epileptic event is essential for example unexplained falls, absent mind states, and history of jerks and fall of object in early morning with detail neurological examination for diagnosis and exclusion of other possible causes is essential. Parents must be advised to record such type

of events if possible<sup>(20)</sup>. EEG is the very informative investigation for the diagnosis of epilepsy<sup>(5, 8,11)</sup>. But sometimes a normal EEG does not exclude epilepsy, as around 10% of epilepsy patient never show IED on EEG and this is important to know. On the other hand an abnormal EEG demonstrating IED does not indicate that an individual has a epilepsy, as IED may seen in healthy children who never had epilepsy, and some time IED found in children with neurological disease which may not complicated by epilepsy. The EEG recording time is very important, the EEG done within 24 hours of a seizure showed more IED( 51%),as compared to those who had later EEG (34%)<sup>(21)</sup>. A study done Mark A king et al showed 51% IED in patient whose EEG was performed with 24hours of seizure<sup>(22)</sup>. We also observed in our study that 33% of IED abnormalities were detected in EEG that was performed with 48hours of seizure. A study by wirrell EC et al showed that Inter-ictal discharges were observed in the first EEG in around 18%-56% of patients with new onset seizures<sup>(23)</sup>. In previous studies 12-50% of patient with epilepsy have normal EEG, in our study we also found 45% children with epilepsy have normal first EEG<sup>(11, 12)</sup>. A study by Mark A king et al showed 43% of IED in normal conventional EEG, that percentage increased to 61% when second sleep derived EEG was performed<sup>(23)</sup>. EEG has specificity between 78-98% that is better than sensitivity that is ranges from 25-56%<sup>(21)</sup>. EEG recording with use of photic stimulation, hyperventilation as provocative techniques and EEG during sleep doubles the sensitivity of EEG in patient with epilepsy. It provides not only the overview but very efficient way to localized epileptogenic zone<sup>(5, 8, 11)</sup>.

In Mark A king et al study reported patient with generalized epilepsy have more IED in first EEG (68%) and in second sleep derived EEG (92%) ,as compare to focal epilepsy in which first EEG 44% have IED and sleep derived have 60% IED<sup>(23)</sup>. Tantum W.O et al also describes that an EEG without IEDs is more likely to occur in focal seizures than in patients with generalized seizure<sup>(24)</sup>. In our study we also found more IED in patient with generalized epilepsy (28%) then focal epilepsy (11.5%). We did not found any correlation with duration of seizure with IED in EEG (P =0.009). Furthermore the ILAE revised the definition of epilepsy in 2014 and include a single unprovoked seizure with the chances of recurrent seizures of 60% or more. Therefore, an EEG containing IEDs following a first seizure will confer a diagnosis of epilepsy with implications for treatment with anti-epileptic drugs to prevent seizure.<sup>(24)</sup>.

## Limitation

- 1- Retrospective cross-sectional study
- 2- Sensitivity and associations could not be established due to the study design

## CONCLUSION:

In our study 44.8% of children presented with seizure were diagnosed epilepsy on clinical grounds by pediatric neurologist, they have normal first EEG, 39.6% of epilepsy patient had IED in first EEG, and remaining 15.6% had back ground slowing. More EEG abnormalities were detected in EEG that was performed within 48 hours of seizure. We recommend that children with suspicion of epilepsy should be evaluated clinically by a pediatric neurologist before initiating anticonvulsant therapy and if possible order EEG within 24 hours of seizures. We further recommend that similar studies may be carried out with multiple settings to reach the firm conclusion.

## DISCLOSURE

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Conflicts of interest: None

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**Sanam B Rajper;** data collection, data analysis, manuscript writing, manuscript review

**Khairunnisa Mukhtiar;** data analysis, manuscript writing, manuscript review

**Fozia Baloch;** manuscript writing, manuscript review

**Shahnaz Ibrahim;** manuscript writing, manuscript review

**Abdul Rashid Memon;** manuscript writing, manuscript review