Original Article

Assessment of Frequency of EEG Findings In Children With Epilepsy

Faiqa Hassan[1*], Shazia Ali[2], Misbah munir[3], Ali Masood[4], Munazza Suharwardy Obaid[4], Ramsha Urooj Baig[5] & Faiza Zakaria[5]

[1]Memon Medical Institute Hospital, Karachi, Pakistan
[2]Shaheed Nawab Ghos Bakhash Raisani Memorial Hospital, Mastung, Pakistan
[3]Mekran Medical College, Balochistan, Pakistan
[4]DOW Hospital, Karachi, Pakistan
[5]DOW University of Health Sciences, Karachi, Pakistan

A R T I C L E   I N F O

A B S T R A C T

Epilepsy impacts around 46 million individuals worldwide, with an exacerbated incidence and mortality in lower-income settings Objective: To evaluate the use of EEG in determining the diagnosis of epilepsy, with its particular subtypes. This study also assessed the vital correlation between age and sex with subnormal EEG findings. Methods: It is a cross-sectional study conducted at MMI Pead'sMemon Hospital, Karachi, from January 2020 to December 2020. Age ranges between 1 month and 18 years. Study evaluated the correlation of EEG findings. The EEG patterns wasalso assessed. EEG patterns were categorized as normal, abnormal with either background slowing or interictal epileptiform discharges (IED) or both, types of seizure and day of admission when the EEG was performed. Using SPSS latest version, association of age, and sex with abnormal EEGs was determined Results: Two-third of the children reported normal EEG, whereas abnormal background findings were observed in the remaining one-third. Inter-ictal epileptic discharge was noted on 18 EEG reports. This finding was most frequent in children within the age bracket of 30 months to more than 67 months. A combination of inter-ictal epileptic discharge and abnormal background findings were noted in children older than 49 months. However, hypsarrhythmia was noted in 2 subjects, both under 30 months of age. With regards to diagnosis, majority of the children categorized as having generalized epilepsy were over 67 months of age. Focal epilepsy was the second most frequent diagnosis, with majority under 30 months of age. On the association of EEG findings with sex, out findings were insignificant.Conclusions: EEG has been determined as the investigation of choice among patients with epilepsy, however it may have certain limitations in providing an accurate diagnosis, and must not be relied on as the sole determinant of epilepsy.

I N T R O D U C T I O N

Epilepsy is a neurological disorder characterized by paroxysmal episodes of unprovoked seizures, which occur due to exorbitant discharge of electrical activity in the brain. This alteration in the activity of neurons results in temporary abnormalities of muscle tone, movements, or behavior [1]. Epilepsy exhibits bimodal distribution, with children and the elderly most frequently afflicted with the disease [2]. A systematic analysis for the Global Burden of Disease Study revealed a staggering number of 45.9 million individuals afflicted with all-active epilepsy worldwide in 2016 [3]. In the United States, one in 26 people develop epilepsy during their lifetime England [4]. In comparison, the incidence, as well as the excess premature mortality associated with epilepsy is exacerbated in lower-income settings. Within Pakistan, the prevalence of Epilepsy has been quantified as 9.99 in a population of 1,000 [5]. In addition to examining the patient, as well as obtaining a detailed history, an electroencephalogram (EEG) serves as the cornerstone of the diagnosis, classification of the seizure, and subsequent prognosis of the patient. Interictal

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epileptiform discharges—such as spikes and sharp waves—along with ictal EEG findings provide a strategic roadmap for an effective treatment plan in patients, particularly children, with epilepsy [6]. Among children, EEG not only assists in distinguishing between varying childhood epileptic syndromes, Interestingly, EEG results must be taken with caution, due to the occurrence of abnormal findings in normal individuals, and normal findings in patients afflicted with the disease [7]. Primary aim of study included an assessment of the proportion of epilepsy patients with abnormal EEGs and the subsequent diagnosis of the patients.

METHODS

A cross-sectional study was conducted at MMI Pead's Memon Hospital, Karachi from January 2020 to December 2020. The sample size was 105, which was calculated using the standard formula for calculating the sample size on the basis of prevalence. Prevalence was taken at 50% because no relevant data was available. The bound of error was 5% with a 95% confidence interval. Non-probability consecutive sampling technique was utilized. Inclusion criteria consisted of all patients between the age of 1 month to 18 years referred to the neurology department for an EEG, while patients who either refused to give consent or had an EEG done outside of hospital were excluded from study. Children with known structural brain anomalies or space-occupying lesions were also excluded. A self-designed questionnaire was used for the collection of data. The questionnaire contained information such as the patient's demographics (age, sex), pertinent history (drug, family, substance abuse, if an activation procedure was performed during EEG), provisional diagnosis made by the physician referring for EEG. Additionally, the EEG records were reviewed for relevant findings. The data was analyzed using Statistical Package for the Social Sciences (SPSS) latest version. Quantitative variables were presented as mean and standard deviation, while qualitative variables were presented as frequency and percentages. The outcome variable was the correlation of EEG with the provisional diagnosis. Independent Chi-square tests were conducted to assess the association of abnormal EEGs with age and sex.

RESULTS

A total of 117 individuals were selected for the study, with the majority being males (56.8%) followed by 42.4% females. In terms of age, almost 2/3rd of the subjects (61.7%) fell under the age bracket of fewer than 30 months, whereas only about 12% of the participants lay in the 49-66 months age bracket with the mean age of 36.15 months being reported. As for the EEG diagnosis, a significant majority of study sample had a normal EEG with

generalized and focal epilepsy having more or less the same frequencies at 13 and 12 respectively in study (Table 1).

Variables	Frequency	Percentage
Sex		
Male	67	56.8
Female	50	42.4
Age in Months		
<30	61	61.7
31-48	22	18.6
49-66	14	11.9
>67	20	16.9
Mean age	36.15	
S.D	±22.15	
Diagnosis on EEG		
Normal	67	56.8
Generalized Epilepsy	13	11
Focal epilepsy	12	10.2
Other	25	21.2

Table 1: Demographic data

	Epileptic Discharges	Sex		Total	P-value
		Male	Female		
EEG findings	Normal	39	27	66	0.216
	Abnormal background	12	14	26	
	Interictal epileptic discharge	12	6	18	
	Presence of Abnormal background and Interictal epileptic discharge	4	1	5	
	Hypsarrhythmia	0	2	2	
	Total	67	50	117	
	Seizure Types	Sex		Total	P-value
		Male	Female		
Diagnosis on EEG	Normal	40	27	67	0.221
	Generalized Epilepsy	09	04	13	
	Focal Epilepsy	08	04	12	
	Other	10	15	25	
	Total	67	50	117	

Table 2: EEG findings and their diagnosis in relation to sex

On the superficial evaluation of the data, a majority of males (39) females (27) reported a normal EEG. The number of abnormal background findings on the EEG was more or less the same among both sexes. Inter-ictal discharges on their EEG were more commonly seen among male subjects/children as opposed to only 6 female children. Likewise, the presence of abnormal background and interictal epileptic discharge together was also predominant among male children (4) as compared to females (only 1). In contrast, Hypsarrhythmia was only found in the female subjects (2). However, on analysis, these findings were observed to be insignificant (p value=0.216) (Table 2). With regards to the diagnosis of epilepsy in relation to sex, male subjects were found to have a greater number of normal (40), generalized epilepsy (9), and focal epilepsy diagnosis on EEG. Other diagnoses

including infantile spasms and febrile seizures were more common in female subjects. However, on analysis, these findings were observed to be insignificant (p value=0.221) (Table 3).

Epileptic Discharges		Range of Ages*(in months)				Total	P-value
		1	2	3	4		
EEG Findings	Normal	44	14	3	5	66	0.001
	Abnormal background	8	5	7	6	26	
	Interictal epileptic discharge	7	2	2	7	18	
	Presence of Abnormal background and Interictal epileptic discharge	0	1	2	2	5	
	Hypsarrhythmia	2	0	0	0	2	
	Total	61	22	14	20	117	
Seizure Types		Range of Ages*(in months)				Total	P-value
		1	2	3	4		
Diagnosis on EEG	Normal	44	15	03	05	67	0.000
	Generalized Epilepsy	02	01	01	09	13	
	Focal Epilepsy	05	02	04	01	12	
	Other	10	04	06	05	25	
	Total	61	22	14	20	117	

Table 3: EEG findings and associated diagnosis with respect to age
Ranges in months *1=<30, 2=31-48, 3=49-66, 4=>67

A variety of findings were observed on the EEG. Even though around 2/3rd (66 in total) of the children reported normal EEG, abnormal background on the EEG was noted in around 1/3rd of the EEG reports with the majority of children falling under 30 months of age in both EEG findings. Other findings included inter-ictal epileptic discharge which was noted on 18 EEG reports. This finding was dispersed along with all age groups with the most falling under less than 30 months and more than 67 months age group. A few (5 in total) reported both inter-ictal epileptic discharges along with an abnormal background on the EEG with the majority of children being in the more than 49 months age bracket. Hypsarrhythmia was only noted in 2 subject both being under 30 months of age. On analysis, these findings were significant (P value=0.001). In terms of the diagnosis on EEG, most children (13 in total) were diagnosed with generalized epilepsy with the majority being over 67 months of age. Focal epilepsy was the second most common diagnosis with a total of 12 children, with the majority of them lying under 30months of age. These findings were found to be significant (p value= 0.000).

DISCUSSION

EEG is one of the most significant modality of choice when it comes to the diagnosis of epilepsy [8]. Study was solely based on the diagnosis from EEG findings. As per our data, 56.8% (39) were boys contrasting to 42.4% (27) of females who were a part of study. From findings during EEG data collection, out of the total of 117 subjects who came in for an EEG, the majority reported a normal EEG with a greater number being male children. This trend is to similar findings being reported in studies from Estonia, Germany, and others [9]. Regardless of the fact that more boys had a normal EEG, they also had a greater number of abnormal EEG findings as compared to girls, such as interictal epileptic discharge with or without abnormal background were predominantly seen in males. An analogous trend of males having more reported cases than females with general epilepsy (9 boys) and focal epilepsy (8 boys) being more prevalent in male subjects than females (4 and 4 respectively). A similar pattern was noted in a study that dealt with idiopathic generalized epilepsy which reported a stark male preponderance in syndrome diagnosis on EEG [10]. Other diagnosis infantile spasm and febrile seizureswere slightly more prevalent in females (15 girls as compared to 10 boys). A significant majority of participants lied in the youngest age bracket of study which was less than 30 months. Generalized epilepsy and focal epilepsy shared more or less the same number of cases however other diagnosis were more prevalent in study subjects. The highest number of normal EEGs were 44 in number. These findings are in line with similar findings observed in a study that reported a prevalence of only 0.76% in their cohort of children less than 5 years of age[11]. According to a study interictal epileptic discharges may be the only abnormal finding on an EEG done routinely[12] and in this study interictal epileptic discharges were noted to be present the most in age groups of less than 30 months and greater than 67 months (7 cases in each age group) while the least number of interictal discharges were seen in the EEG of children aged between 31-49 months (4 cases). However, the presence of abnormal background along with interictal epileptic discharges grew in number with the increasing age of our subjects as only 1 case finding was observed in the 31-48 months of age bracket which increased to 4 cases in the age brackets of 49-66 and >67 months. Interestingly, hypsarrhythmia was only noted in 2 children younger than 30 months of age. A study reported hypsarrhythmia in association with infantile spasms in all of their subjects, so further evaluation of the type of seizure in showing hypsarrhythmia can be initiated in the future[13]. Coming towards diagnosis on EEG with respect to age, the youngest age group of less than 30 months reported the highest number of normal EEGs (44), 30 months age bracket reported the highest number of focal epilepsy cases diagnosed on EEG (5 cases) followed by generalized epilepsy with only 2 cases diagnosed. This trend is established by a study that says that focal seizures are more likely to be seen than generalized[14]. There should be proper evaluation and need to be discussed by researcher regarding the roles of genes versus acquired causes in seizure; that a normal brain can develop epilepsy by any insult or any congenital cause [15] so further

research in the molecular genetics will guide and provide the details regarding classification of epilepsy and will help in disease specific treatment[16]. Provocation techniques such as hyperventilation and photic stimulation [17,18], anti-epileptic drug reduction[19], sleep derived EEGs, and long-term EEG monitoring or ambulatory EEG, could potentially assist medical personnel in catering to patients presenting with diagnostic and therapeutic challenges. Further, multi-centre studies within populations with varying demographic profile are essential in determining the correlation of EEGs with variables such as sex and age, and the efficacy of EEGs in the diagnosis and long term treatment of a patient with epilepsy[20]. Since there is a dearth of studies evaluating the correlation of EEG with varying socio demographic profiles, as well as alternative measures such as ambulatory EEGs in accurately determining diagnosis and treatment of epilepsy within Pakistan we must look into such studies in future.

CONCLUSION

Study findings have important implications. It has been seen that EEG is a standard investigative procedure for epilepsy diagnosis following a seizure, but in this study, it was seen that EEG findings present with certain limitations, and must not be taken as a confirmed diagnosis of epilepsy.

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