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Clinical Outcomes and Frequency of Electroencephalographic Abnormalities in Patients with First Unprovoked Seizure in a Tertiary Care Hospital: A Cross-Sectional Study

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ABSTRACT

Epilepsy is a common medical condition that has widespread neurobiological, cognitive, psychological, and social consequences. Recurrent seizures are a common feature of this illness. Individuals experiencing their first unprovoked seizure generally present with Electroencephalographic (EEG) abnormalities, which might reflect a broad range of underlying neurophysiological changes. Identifying and measuring these abnormalities is critical for differentiating between epileptic and non-epileptic seizures, determining suitable treatment techniques, and predicting future seizure risk. **Objective:** To determine the frequency of abnormal EEG in patients presenting after first unprovoked seizures. Early detection of these abnormalities will better guide for better management and to predict recurrence. **Methods:** The study was a six-month cross-sectional retrospective held at the Punjab Institute of Neurosciences, Lahore, Pakistan from January 2024 to June 2024. This study employed the non-probability consecutive sampling method. The study included 95 patients who met the inclusion and exclusion criteria. Previous medical data included a complete patient history, clinical examination, and EEG results. Data were then analyzed using SPSS version 21.0. **Results:** Out of 95 patients, 52.63% were male and 47.37% were female, averaging 52.6 + 5.6 years. A total of 46 individuals (48.42%) had abnormal EEG irrespective of age, gender, length of symptoms, and awareness of symptoms. **Conclusion:** This study concluded that EEG abnormalities are highly frequent among individuals following their first unprovoked seizure.

INTRODUCTION

Epilepsy affects up to 1% of the global population. It is the second most prevalent neurological disease after stroke which is affecting around 50 million individuals globally, mostly in poor countries. It impacts 5 to 10 persons per 1,000 worldwide, with Pakistan having around 1.38 million cases [1]. It is known as a persistent tendency to develop spontaneous seizures, which can have cognitive, social, and psychological consequences. It can develop at any age, it usually appears in early childhood or beyond the age of 60, and the type of seizures differs depending on the part of the brain affected; however, most seizures are well controlled with antiepileptic medicines and patients have regular lives [2]. Seizures are brief episodes of abnormal brain activity. Most people experience them at some point in their lifetime

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[3]. Unprovoked seizures are defined as seizures that occur in the absence of any underlying causes or more than seven days after an acute injury or insult [4]. A First unprovoked seizure is a disturbing experience for both patients and their families and raises anxiety about recurrence of seizure. Correct diagnosis after a first unprovoked seizure is important to distinguish it from other conditions to identify the cause, and for optimal treatment management [5]. Although all initial unprovoked seizures were formerly treated, recent studies have demonstrated that the risk of recurrence is not assured. Moreover, the treatment options are now based on the individual's risk of recurrence and the impact on life quality [6]. The first stage in diagnosing epilepsy is to take a complete history from patients and witnesses to evaluate if the first unprovoked seizure is epileptic or not, followed by investigations such as EEG or MRI [7]. EEG is an important tool for diagnosing and managing epilepsy, particularly after a first unprovoked seizure, since it identifies epileptiform activity, measures the risk of recurrence, and gives direction for treatment options. EEG is unlikely to detect the possibility of a subsequent seizure after the first unprovoked seizure. However, it can aid in the identification of seizure tendencies, especially in individuals under 25 [8]. Early EEG (within 24 hours) and EEG in sleep-deprived or ambulatory patients improve diagnostic accuracy and predict recurrence of seizures [9]. While EEG should be conducted immediately following the incident, although it may not be available in emergencies. Sleep-deprived or repeat EEGs can improve diagnosis accuracy in unclear circumstances [10]. Patients with a First Single Unprovoked Seizure (FSUS) face diagnostic challenges in assessing the risk of recurrence and need for anti-seizure medication [11]. EEG is critical for the early diagnosis and treatment of unprovoked seizures, especially non-convulsive status epilepticus and mild seizure activity. Its capacity to detect early electrical disruptions in the brain allows for earlier intervention, which dramatically improves prognosis and guides therapy in critical care and epilepsy management [12]. Understanding the distinct seizure patterns of aged individuals, especially in the context of neurodegenerative alterations and vascular risk factors, is critical for appropriate diagnosis and therapy. Future research should look at bigger cohorts and incorporate longitudinal follow-ups to understand the impact of age-related variables like stroke and dementia in the emergence of secondary epilepsy. This intelligence will assist healthcare practitioners to modify treatment techniques, enhance patient outcomes, and allocate resources more effectively. Furthermore, developments in EEG methods, such as extended monitoring and video-EEG integration, may improve the identification and diagnosis of mild seizure activity, particularly in the older population.

The objective of this study was to determine the clinical outcomes and frequency of abnormal EEG in patients with first unprovoked seizures. Early diagnosis of these abnormalities will better guide therapeutic options, such as starting anti-epileptic drugs, which may help avoid further recurrence.

METHODS

This cross-sectional, retrospective study was carried out at the Department of Neurology, Punjab Institute of Neurosciences, Lahore, Pakistan, after the approval of IRB No. (1902/IRB/PINS/approval/2024). The sample size was calculated using the WHO calculator, taking into account a 95% confidence level, 10% relative precision, and an expected 57.6% frequency of abnormal EEG in first-seizure patients. Participants were chosen via non-probability sequential sampling. The study included both males and females aged 25 to 70 years who had their first seizure activity, as per operational definitions and were willing to participate. Exclusion criteria included an incomplete history, unwitnessed seizures, and a history of underlying disorders such as brain lesions, fever, prior encephalitis, or traumatic brain damage. Providing informed consent, 95 individuals who fulfilled the inclusion and exclusion criteria were enrolled from the pre-existing records in the electrophysiology laboratory at Punjab Institute of Neurosciences. Patient information was entered into a pre-designed form, thorough histories and examination data entered. EEG findings of each patient were entered on the same form. All subjects were treated under hospital practice, and their information was kept anonymous. The data were entered into SPSS version 21.0 for analysis. The statistical analysis was carried out with SPSS version 21.0. Quantitative data such as age was presented as mean ± SD, whereas qualitative data (gender, duration of symptoms, and symptom awareness) were provided as frequencies and percentages. Data were stratified by age, gender, and seizure length, and effect modifiers were identified using chi-square testing. A p-value < 0.5 was considered statistically significant.

RESULTS

A total of ninety-five patients participated in this study. In this study, 43.16% of patients were between the ages of 25-50 years while 56.84% of patients were between the ages of 51-70 years. The mean age of patients was 52.6+ 5.6 years. Regarding gender distribution, 52.63% of patients were male while the remaining 47.37% of patients were female.

Table 1: Demographic Characterization of the Study Population (n=95)

Age and Gender Distribution	Number of Patients Frequency (%) / Mean ± SD
Age (Years)	
25-50	41 (43.16)

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51-70	54 (56.84)
Mean ± SD	52.6 ± 5.6 Years
Gender	
Male	50 (52.63)
Female	45 (47.37)
Total	95 (100)

With regards to the frequency of abnormal EEG, 48.42% of patients had abnormal EEG whereas the remaining patients had normal EEG. Approximately 80% of patients experienced symptoms for less than one minute, whereas 20% experienced symptoms for more than one minute.

Table 2: Frequency of Abnormal EEG and Duration of Symptoms (n=95)

Frequency of Abnormal EEG and Duration of Symptoms	Number of patients Frequency (%)
Abnormal EEG	
Yes	46 (48.42)
No	49 (51.58)
Symptom Duration	
≤1 minute	76 (80)
>1 minute	19 (20)
Total	95(100)

When this data stratified by age group, 20 patients discovered out of 41 (48.78%) in the 25-50 year age group had abnormal EEG, whereas 26 patients out of 54 (48.14%) in the 51-70 year group had abnormal EEG. The Chi-square was 0.0037, with a p-value of 0.951, indicating that it was not significant. When this data stratified by gender, 24 male patients found out of 50 total male patients, or 48%, had abnormal EEG, whereas 22 female patients out of 45 total female patients, or 48.88%, had abnormal EEG, with a Chi-square of 0.0075 and a p-value of 0.931, indicating non-significance. On further stratification of data according to the duration of disease, it was seen that 37 patients out of 76 i.e. 48.6% with symptoms duration < 1 minute had abnormal EEG compared to 9 patients out of 19 i.e. 47.36% with symptoms duration > 1 minute had abnormal EEG with Chi-square of 0.010 and p-value of 0.918 i.e. non-significant.Further analysis of the data based on awareness of symptoms revealed no significant correlation between symptom awareness in epileptic patients with abnormal EEG findings and those with normal EEG results, as evidenced by a p-value of 0.678.

Table 3: Stratification of Patients with Abnormal EEG (n=95)

Variables	Abnormal EEG (Yes)	Abnormal EEG (No)	Total	Chi-Square Test	p-Value
Age (Years)					
25-50	20	21	41	0.0037	0.951
51-70	26	28	54		
Gender					
Male	24	26	50	0.0075	0.931
Female	22	23	45		
≤1 minute	37	39	76	0.010	0.918
>1 minute	9	10	19		
Awareness of Symptoms					
Yes	38	42	80	0.172	0.678
No	8	7	15		
Total	46	49	95		

DISCUSSION

Epilepsy-related seizures are defined by transient signs and symptoms caused by alterations in brain activity [13]. Electroencephalography (EEG) is routinely performed in patients presenting with first-ever seizures to see if there is any abnormal wave pattern [14]. Current study "Clinical Significance and Frequency of Electroencephalographic Abnormalities in Patients with First Unprovoked Seizure in a Tertiary Care Hospital: A Cross-Sectional Study" was conducted at Neurology department Punjab Institute of Neurosciences Lahore. This study found that abnormal EEG was observed in 48.42% of individuals who experienced their first seizure. These findings are consistent with other investigations. According to one study done in Japan, 55.2% of patients had abnormal EEG after their first seizure [15]. In one Australian research, aberrant EEG was seen in 77% of individuals experiencing their first seizure [16]. In another research done in Malaysia, 55% of patients with clinical features indicative of epilepsy were identified with abnormal EEG [17]. One research done at the Mayo Clinic's neurology department in the United States reported that aberrant EEG tracing was present in 12-50% of adult patients [18]. One study conducted in Canada to assess the role of EEG in patients presenting to the first seizure clinic showed that EEG was abnormal in 41% of patients after the first seizure [19]. Another study conducted in New York showed that EEG was abnormal in 42% of patients [20]. Another study conducted in Singapore showed that in patients who had their first seizure, EEG was abnormal in 29.4% of patients [21]. A study conducted in Israel showed that when EEG was performed after the first ever seizure, it was positive in 69% of patients [22]. The same results were found in a study performed at Heidelberg University Germany where standard EEG was abnormal in 70.7% after first-ever seizure [23]. On stratification of data according to age, any significant correlation was not found between abnormal EEG in different age groups after the first seizure activity i.e. p value was 0.951 (non-significant). In one study conducted in China, abnormal EEG was significant in patients with first-ever seizures [24]. A study conducted in India recommends performing an EEG in all patients presenting with a first seizure [25]. There are significant clinical implications of the findings in this study. An abnormal EEG result was seen in nearly half of the patients in this study presenting with a first unprovoked seizure emphasizes the utility of EEG in identifying those at higher

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risk for recurrent seizures, helping in the diagnosis of epilepsy. Early detection of EEG abnormalities will guide clinicians in making timely decisions about management and monitoring strategies, improving patient outcomes. Additionally, EEG abnormalities were not associated with age, EEG can be considered a useful diagnostic tool in all age groups. This study supplements the existing literature by providing localized data from Punjab Institute of Neurosciences in Lahore, addressing an existing gap regarding data of EEG abnormalities in Pakistan's Population. There was limited data on EEG findings after first unprovoked seizure from Pakistan, and these findings are consistent with studies from South Asian region, showing similar EEG abnormality rates. This study contributes to the existing literature that EEG should be performed following a first seizure, aiding in its status as a routine procedure in epilepsy diagnosis. The findings of this study provide an outline for further evaluation of the predictive utility of EEG in patients presenting with first seizure, especially among diverse groups. Future research should probe into whether distinguished EEG patterns are linked with recurring seizures or epilepsy subtypes, thus helping in prognosis and individualized management approaches. In addition, this study encourages multi-centre and prospective studies to create uniform protocols for utilizing EEG in first-seizure cases, which may lead to more widely accepted guidelines.

CONCLUSIONS

In conclusion, EEG abnormalities are prevalent in individuals experiencing their first unprovoked seizure. These findings align with the international research and reveals that abnormal EEG pattern was seen in 48.4% of patients. This study emphasizes the clinical significance of EEG as a useful tool for determining the risk of seizure recurrence and likely development to epilepsy. Thus improved EEG practice may contribute to better individualized management for patients with seizure disorder.

Authors Contribution

Conceptualization: RM
Methodology: MM, MTR, AN
Formal analysis: SH, AN, TH
Writing, review and editing: RM, MM, MTR, SH, TH

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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