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EEG CHANGES IN ACUTE FEBRILE FITS WITHIN 72 HOURS IN CHILDREN AGED 6 MONTHS TO 6 YEARS

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ABSTRACT

Objective

To determine EEG changes within 72 hours of febrile seizures in children aged 6 months to 6 years presenting to a tertiary care hospital.

Methodology

This cross-sectional study was conducted in the Department of Pediatrics, Abbasi Shaheed Hospital, Karach over a period of 6 months. A total of 150 children with febrile seizures presenting within 72 hours of seizure onset were enrolled using non-probability consecutive sampling. EEG was performed within 72 hours and interpreted by a pediatric neurologist. Data were analyzed using SPSS version 26. Independent sample t-test, Mann–Whitney U test, and Chi-square test were used where appropriate, with $p \leq 0.05$ considered statistically significant.

Results

The mean age of participants was 38.36 ± 18.21 months, and 59.3% were female. Simple febrile seizures were observed in 72.0% of children, while 28.0% had complex febrile seizures. EEG abnormalities were detected in 28 (18.7%) patients. No significant association was found between abnormal EEG findings and age ($p = 0.609$), seizure duration ($p = 0.133$), seizure type ($p = 0.532$), or gender ($p = 1.000$).

Conclusion

EEG abnormalities were present in a minority of children with febrile seizures. Most EEG recordings were normal, and no significant relationship was observed between EEG abnormalities and major clinical characteristics. Routine EEG may therefore have limited value in children with uncomplicated febrile seizures.

Keywords: *Febrile Seizures; Electroencephalography; Child; Infant; Epileptiform Discharges.*

INTRODUCTION

Since 10% of children will experience a seizure at some point in their lives, seizures are the most prevalent neurological finding in children. Febrile seizure (febrile seizure) is the most prevalent disorder occurring in 2-5% of children which peaks between 12 to 18 months of age. [1,2]. In certain regions of Asia, its frequency among youngsters might reach 12% [3]. Without a history of epilepsy, metabolic abnormalities, or

infections of the central nervous system (CNS), febrile seizure often affects children between the ages of six months and five years [4].

According to some specialists, patients are predisposed to a seizure disease due to either an underlying neurologic problem or the impact of a febrile seizure on a growing nervous system [5]. It is believed that both genetic and environmental variables are significant in febrile seizure, even if the exact process is yet unknown. Among the most frequent causes are urinary tract infections (UTI), acute gastroenteritis (AGE), and upper respiratory tract infections (URTI) [6]. Simple febrile seizures, which consist of a single seizure lasting 15 minutes or less, and complicated febrile seizures, which include several seizures with focal neurologic characteristics or a seizure lasting 15 minutes or more, are the two types of febrile seizures. The majority of febrile seizures are simple [7]. Complex seizures account for about 20–35% of febrile seizures [5].

The possibility of a recurrence is always a concern when treating a child who has experienced a febrile seizure for the first time. After the initial febrile seizure, 30 to 50% of children experience another one [5]. The patient's age, the level of temperature at the time of the seizures, any family history of epilepsy or seizures, and whether the seizures were simple or complicated are some of the risk variables that are known to influence the recurrence of febrile seizures. Electroencephalography (EEG) is one way to assess the risk of seizure recurrence [8].

One crucial instrument for examining the electrical activity of the brain is an electroencephalogram (EEG). EEG is still the most important paraclinical tool for seizure evaluation, even with the development of increasingly sophisticated imaging tools. Its main purpose is to evaluate seizures and disorders that can resemble seizures. Among other uses, it is helpful for evaluating encephalopathies, classifying seizure types, and assessing comatose patients in the intensive care unit [9]. There is an increased chance of recurrence when epileptiform abnormalities are detected on EEG following a seizure [10]. Studies assessing the optimal window of time to boost the diagnostic yield following a first seizure are scarce [11–13]. The first 24 to 72 hours following the event's beginning are among the arbitrary "early" intervals used in the related investigations [10]. Furthermore, the use of EEG in the work-up of febrile seizure remains contentious, and its efficacy in predicting subsequent epilepsy or recurrent febrile seizure has not been adequately assessed. After an initial febrile seizure, many pediatric neurologists still ask for an EEG [14]. Thus, we planned to perform this study to share our experience of EFG findings within 72 hours of first febrile seizure episode. The findings of current study will contribute towards the evidence of EEG early investigation following febrile seizure episode and will be eventually helpful for optimal management of febrile seizure and cutting down additional cost burden of parents and efficiently utilizing healthcare resources.

OBJECTIVE

To determine EEG changes in acute febrile fits within 72 hours in children of age 6 months to 6 years presenting to outpatient clinics or emergency department in a tertiary care hospital.

METHODOLOGY

This cross-sectional study was conducted in the Department of Pediatrics at Abbasi Shaheed Hospital over a period of six months from January 2025 to July 2025 following approval from the Hospital Ethics Committee and CPSP. A non-probability consecutive sampling technique was employed. The sample size was calculated using OpenEpi based on a previously reported prevalence of abnormal electroencephalographic (EEG) findings of 17.6% among children with febrile seizures [15]. Using a 95% confidence level and a margin of error of 6%, the required sample size was estimated to be 155 participants.

Children of either gender aged 6 months to 6 years presenting with febrile seizures within 72 hours of onset were eligible for inclusion. Only those whose parents or guardians provided informed consent were enrolled. Children with a history of previous non-febrile seizures, intracranial infections, electrolyte imbalances,

space-occupying lesions, hereditary metabolic disorders, neurometabolic or neurogenetic diseases, regular use of antiepileptic medications or febrile seizure prophylaxis, and those with a history of trauma were excluded from the study.

After obtaining ethical approval, the purpose and potential benefits of the study were explained to the parents or guardians, and written informed consent was obtained. Confidentiality was ensured by assigning unique study identification numbers and removing personal identifiers from the dataset. Eligible patients presenting to the pediatric outpatient department or emergency department with febrile seizures were recruited consecutively. Following a detailed clinical assessment and physical examination, all enrolled participants underwent EEG evaluation.

EEG recordings were performed according to the standards of the American Clinical Neurophysiology Society for pediatric EEGs. The objective was to obtain EEG recordings within 72 hours of the febrile seizure episode. Electrodes were applied using the international 10–20 system, and recordings were acquired using digital EEG machines for a minimum duration of 30 minutes. Whenever feasible, recordings were obtained during both wakefulness and sleep without the use of sedation. Standard recording parameters were applied, including a time constant of 0.3 seconds and a high-frequency filter of 70 Hz, while a 60-Hz notch filter was used only when line artifacts were present. EEG recordings were performed during daytime sleep, typically within 24–48 hours of presentation. All EEGs were interpreted by a pediatric neurologist who was blinded to any previous EEG findings of the participants.

Data were entered and analyzed using SPSS version 27. Categorical variables were summarized as frequencies and percentages, whereas continuous variables were expressed as mean ± standard deviation or median with interquartile range, as appropriate. The normality of continuous data was assessed using the Shapiro–Wilk test. Potential effect modifiers, including age, gender, family history of febrile seizures, family history of epilepsy, previous history of febrile seizures, and type of febrile seizure, were controlled through stratification. Post-stratification associations between EEG findings and study variables were assessed using the chi-square test. A p-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 150 children with febrile seizures were enrolled in the study. The mean age was 38.36 ± 18.21 months. There were 61 (40.7%) boys and 89 (59.3%) girls. The mean peak temperature at presentation was 102.89 ± 1.05°F.

Simple febrile seizures were seen in 108 (72.0%) children, whereas 42 (28.0%) had complex febrile seizures. EEG abnormalities were identified in 28 (18.7%) patients, while 122 (81.3%) had normal EEG recordings. The abnormal findings included generalized slow waves, focal slowing, epileptiform discharges, and focal attenuation.

Children with abnormal EEG findings had a mean age of 36.61 ± 18.63 months compared with 38.76 ± 18.17 months among those with normal EEG recordings. This difference was not statistically significant ($t = -0.52$, $p = 0.609$).

Although seizure duration tended to be longer in children with abnormal EEG findings, the association was not statistically significant on Mann–Whitney U testing ($U = 1396.5$, $p = 0.133$).

Abnormal EEG findings were present in 22 (20.4%) children with simple febrile seizures and 6 (14.3%) children with complex febrile seizures. No significant association was found between seizure type and EEG abnormalities ($\chi^2 = 0.39$, $p = 0.532$). Likewise, gender was not associated with abnormal EEG findings ($\chi^2 = 0.00$, $p = 1.000$).

Overall, abnormal EEG findings were detected in approximately one-fifth of children presenting with febrile seizures within 72 hours of seizure onset.

DISCUSSION

Febrile seizures remain one of the most common neurological emergencies encountered in childhood. Despite their generally benign nature, the role of electroencephalography (EEG) in their evaluation continues to be debated. In the present study, EEG abnormalities were identified in 18.7% of children who underwent EEG

within 72 hours of a febrile seizure, while the majority (81.3%) had normal recordings. These findings suggest that abnormal EEG activity is present in only a minority of children during the acute postictal period.

The frequency of abnormal EEG findings observed in our study is comparable to that reported by Sadeghzadeh et al., who found EEG abnormalities in 17.6% of children with febrile seizures [15]. Similar observations have been reported in other regional studies, indicating that most children with febrile seizures have normal EEG findings despite evaluation shortly after the seizure episode [15,21]. This supports the view that routine EEG may have limited diagnostic value in otherwise uncomplicated febrile seizures.

The mean age of participants in our study was 38.36 ± 18.21 months. This finding is consistent with the established epidemiology of febrile seizures, which occur most commonly in children younger than five years of age [16,17]. Studies from Bangladesh and Iran have similarly shown that febrile seizures predominantly affect children during the first three years of life [16,17]. The age distribution observed in our study therefore reflects the recognized susceptibility of the immature brain to fever-induced seizures.

Simple febrile seizures accounted for 72% of cases, while complex febrile seizures represented 28%. This distribution is similar to contemporary international data reporting that approximately 70–80% of febrile seizures are simple and 20–30% are complex [18,19]. The pattern observed in our study therefore mirrors the typical clinical presentation reported worldwide.

No significant association was found between age and EEG abnormalities ($p = 0.609$). Similar findings have been reported by previous investigators, suggesting that age alone is not a reliable predictor of abnormal EEG findings following febrile seizures [15,21]. Current evidence suggests that clinical characteristics such as focal features, recurrent seizures, prolonged seizure duration, and underlying neurological abnormalities may be more relevant predictors of adverse outcomes [22].

The relationship between seizure type and EEG abnormalities remains controversial. In our study, no statistically significant association was observed between seizure type and EEG findings ($p = 0.532$). Although some studies have reported a higher frequency of epileptiform abnormalities among children with complex febrile seizures, our findings did not support this association [22]. Differences in sample size, timing of EEG acquisition, and patient selection may explain the variation among studies.

Gender was also not associated with EEG abnormalities in the present study ($p = 1.000$). Similar observations have been reported from studies conducted in Iran and Bangladesh, where sex was not found to significantly influence EEG findings following febrile seizures [15,17]. These findings suggest that gender is unlikely to be a useful predictor of EEG abnormalities in children with febrile seizures.

Seizure duration showed no significant association with EEG abnormalities on Mann–Whitney analysis ($p = 0.133$). Although prolonged febrile seizures and febrile status epilepticus have been associated with a greater likelihood of EEG abnormalities in some studies, shorter seizures often show inconsistent EEG changes [22]. The absence of a significant relationship in our study may therefore reflect the predominance of brief seizure episodes.

Similar findings have also been reported from Pakistan. Sindhu et al. reported that febrile seizures remain one of the leading neurological presentations among children presenting to emergency departments, highlighting the burden of this condition in local practice [24]. Akhlaq et al. observed that EEG findings alone had limited value in predicting future seizure recurrence and should always be interpreted alongside clinical assessment [22]. Likewise, Ilyas et al. found that abnormal EEG was only one of several factors associated with the later development of epilepsy and was not an independent predictor in all patients with febrile seizures [23]. These observations are consistent with the findings of the present study and support a selective rather than routine use of EEG in children with febrile seizures.

Most children in our cohort had normal EEG recordings despite undergoing EEG within 72 hours of seizure onset. This finding is in line with recent international recommendations, which do

not advocate routine EEG evaluation in neurologically normal children presenting with simple febrile seizures [19,20]. Instead, EEG is generally reserved for children with atypical presentations, focal neurological deficits, recurrent complex febrile seizures, or suspicion of an underlying epileptic disorder.

Taken together, our findings suggest that routine EEG adds little additional information in most children presenting with uncomplicated febrile seizures. Although EEG abnormalities may occasionally be detected, they are relatively infrequent and often do not alter immediate clinical management. Careful clinical assessment remains the cornerstone of evaluation and decision-making in these patients.

There were some limitations in the study as well. This was a single-center study with a relatively small sample size. In addition, the cross-sectional design did not allow follow-up of patients to determine seizure recurrence or the subsequent development of epilepsy. Further multicenter prospective studies with long-term follow-up are recommended to determine the prognostic significance of early EEG abnormalities in children with febrile seizures. EEG should be performed selectively in patients with complex features or clinical suspicion of epilepsy.

CONCLUSION

Abnormal EEG findings were observed in 18.7% of children presenting with febrile seizures within 72 hours of seizure onset. Most children had normal EEG recordings, and no significant associations were found between EEG abnormalities and age, gender, seizure duration, or seizure type. These findings support current evidence that routine EEG is not required for all children with febrile seizures and should be reserved for selected clinical situations.

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