EUROPEAN ACADEMIC RESEARCH
Vol. XII, Issue 8/ November 2024

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Etiology of Seizures in Children Aged 6 Months to 10 Years Presenting to Tertiary Care Hospital

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Abstract

Background: *Seizures are a frequent cause of hospitalization among children, leading to significant rates of mortality and morbidity. There exists a limited amount of data on acute seizure episodes from developing countries. This study aims to determine the common etiologies of seizures and to classify the types of seizures in various age groups at the Children Hospital Quetta, a tertiary care center.*

Methods: *This study was a retrospective analysis conducted at a hospital, utilizing data obtained from the records kept in the Department of Pediatrics at Balochistan Institute of Child Health Services, Quetta, covering the period from August 25, 2021, to February 26, 2022. The variables gathered included demographic information, clinical presentations, laboratory test results, brain imaging studies, electroencephalography, as well as diagnoses and the course of hospitalization.*

Results: *A total of 276 patients were admitted for seizures, with 169 males (61.3%) and 106 females (38.7%). Among these patients, 148 (53.5%) had a fever, and 158 (57.5%) were children younger than five years. The most frequently occurring type of seizure was generalized tonic-clonic seizures, which represented 69.9% of the cases. The common causes identified included seizure disorder (33.4%), febrile seizures (30.7%), central nervous system infections, and neurocysticercosis.*

Conclusion: *CNS infections and febrile convulsions are prevalent triggers of seizures in children experiencing fever. It is recommended that neuroimaging be conducted for all febrile children to facilitate the diagnosis of neurocysticercosis. Additionally, children identified with seizure disorders necessitate long-term follow-up studies, which should encompass neurophysiological assessments.*

Keywords: Seizures, electroencephalography, Neurocysticercosis.

INTRODUCTION

The frequency of seizure episodes in the pediatric population highlights a significant public health concern. Understanding the age-related patterns of seizure occurrence is crucial for healthcare providers, as it allows for better monitoring and intervention strategies tailored to younger children. This demographic is particularly vulnerable, necessitating increased awareness and proactive measures. [1]. Seizures represent

approximately 1% of all visits to emergency departments, with around 2% of those visits occurring in pediatric emergency departments.[2] The prevalence of epilepsy, characterized by recurrent unprovoked seizures, appears to be relatively stable across various populations, ranging from 50 to 100 cases per 100,000 person-years.[3] In the majority of studies, febrile seizures have been identified as the most prevalent type within the pediatric demographic, constituting the majority of seizures observed in children under the age of five.[2-4]

In the developing world, infections of the central nervous system (CNS) are the predominant cause of seizures and acquired epilepsy.[4,5] The common causes of these conditions are shaped by geographical differences. Acute seizures are prevalent in cases of meningitis, viral encephalitis, and neurocysticercosis, and are often associated with increased mortality and morbidity, including the potential for subsequent epilepsy.[6-9] The standardized mortality rate (SMR) for individuals with newly diagnosed unprovoked seizures is reported to range from 2.5 to 4.1, contingent upon the study population and design. This rate is particularly elevated in younger patients and those with symptomatic seizures.[10] For the majority of children diagnosed with epilepsy, the long-term prognosis is optimistic, especially for those with idiopathic causes, who are expected to achieve remission.[11]

Determining the appropriate laboratory and imaging tests for children presenting with seizures is not always straightforward. In cases of new-onset non-febrile seizures, children admitted to the emergency department are frequently assessed using cranial computed tomography (CT) scans.[12,13] Nevertheless, some research suggests that routine brain CT scans may not be necessary for these patients. The attending physician must make decisions regarding additional investigations, which may include a septic workup, metabolic assessments, lumbar puncture, and electroencephalogram (EEG) for those experiencing their first seizure episode. There is a notable concern regarding the costs associated with these investigations, particularly in resource-limited developing nations. Misdiagnosis can lead to significant legal implications, increased anxiety for families, prolonged hospital stays, and potentially life-threatening situations.

Most existing studies have primarily concentrated on epilepsy and various clinical seizure types.[15,16] Consequently, this retrospective study aims to evaluate the prevalence of different etiologies, the clinical spectrum of seizure disorders, and the primary outcomes for children admitted with their first acute seizure episode.

Methods

This study was a retrospective analysis conducted at the Department of Pediatrics at Balochistan Institute of Child Health Services, Quetta, covering the period from August 25, 2021, to February 26, 2022, a total of 6,975 children aged between 6 months and 15 years were admitted to the Pediatric Department. Children who experienced seizures after their admission were excluded from the analysis. Data was collected from the medical records of each patient, which included age (ranging from 6 months to 10 years), sex, type of seizure, associated symptoms (such as fever, cough, rhinorrhea, vomiting, diarrhea, and headache), family history of seizures or epilepsy, developmental history, laboratory test results (including white blood cell count, C-reactive protein, serum electrolytes, blood sugar levels, and cerebrospinal fluid analysis), neuroimaging results (CT scans or cranial magnetic resonance imaging), electroencephalography findings, duration of hospital stay, and final diagnosis. The outcomes were categorized into four groups: discharged after recovery, left against medical advice (LAMA),

mortality, and referrals to other institutions. Patients were classified into two groups based on the presence or absence of fever during the seizure: Group 1 included patients with a recorded temperature of 38°C or higher, while Group 2 included those with a temperature below 38°C. The classification of seizure types—generalized tonic-clonic (GTC), absence, myoclonic, partial, and other types—was based on the guidelines established by the Commission on Epidemiology and Prognosis of the International League Against Epilepsy in 1993. Status epilepticus was defined as either a single seizure lasting more than 30 minutes or a series of seizures without recovery of function between episodes lasting over 30 minutes. Febrile seizures were defined according to the 1993 International League Against Epilepsy criteria as seizures occurring in children older than 1 month of age.

Age group (6 months − 5 years), age group (6–10 years). Variables including age, sex, type of seizure, associated symptoms, family history of seizure or epilepsy, developmental history, laboratory test results, neuroimaging examinations, EEG findings, duration of hospital stay, diagnosis and final outcome were compared between febrile and afebrile group. These variables were also compared among children of different age groups.

The analysis employed descriptive statistics and hypothesis testing. Data evaluation was conducted utilizing the Statistical Package for the Social Sciences (SPSS) for Windows Version 20.0 (SPSS). The Chi-square test was applied to investigate the relationships among various variables, while logistic regression was used to assess the strength of these associations. Odds ratios (OR) along with their 95% confidence intervals (95% CI) were computed. A p-value of less than 0.05 was deemed statistically significant.[20,21]

RESULTS

A total of 276 patients were admitted for seizures, with 169 males (61.3%) and 107 females (38.7%). Among these patients, 148 (53.5%) had a fever, and 182 (57.5%) were children younger than five years. The most frequently occurring type of seizure was generalized tonic-clonic seizures, which represented 69.9% of the cases. The common causes identified included seizure disorder 33.4%, febrile seizures 30.7%, central nervous system infections, and neurocysticercosis. Abnormalities in brain imaging were detected in 56 out of 121 patients (45.9%), with neurocysticercosis being the most prevalent abnormality, 59.5% cases noted ($p < 0.001$).

Analysis of patients based on age groups Figure 1; Seizures were more common in males in age group 6 months to 5 years 66.4%) and 6 to 10 years 60.7% Table 1:

Fever was present on admission in 53.5% of children. There were 61.3% males and 38.7% females with male to female ratio of 1.58:1 ($p = 0.003$). Generalized tonic clonic seizures were the commonest seizure type in this study 69.9% and 63.1% of them were febrile ($p < 0.001$).

These were followed by partial seizure 19.8%, absence 2.7%, myoclonic 1.3%. Other seizures types including tonic, atonic comprised remaining 6.4% of cases. Status epileptics was present in 7.3% of children.

Lumbar puncture was performed in 57.5% children with abnormal reports in 25.9%. CSF was reported abnormal in 19.4% of children in the age group 6 months to 5 years. Neuroimaging was done in 43.9%. Neuroimaging had revealed abnormalities in

45.9% and most common finding was neurocysticercosis children. Electro-encephalogram (EEG) was done in 64.2% children and had abnormal reports in 54.8% of cases. Table 2:

Childhood seizure disorder was commonest diagnosis 93 (33.6%) followed by febrile seizures 30.5%, neurocysticercosis 12%, meningitis 6.5%) and encephalitis 6.7%. Other diagnosis made were cerebral palsy 1.8%, tubercular meningitis 1.5%, hypertensive encephalopathy 1.5%. Miscellaneous etiologies including electrolyte imbalance (hypoglycemia, hypocalcaemia), hydrocephalus, neurocutaneous syndrome, intracranial hemorrhage, brain abscess, congenital malformations of central nervous system, hepatic and enteric encephalopathy accounted for remaining 6% of cases. Figure 2:

Final outcome was noted as discharge, death during hospital stay, left against medical advice and those referred to other specialty center for further management. 4.4% of children died in hospital, 4% had left against medical advice, 1.8% cases were referred and remaining were discharged after successful treatment. There was an insignificant difference in outcome between male and female, those with or without fever. Among 10 children with status epileptics only 60% were discharged from the hospital ($p < 0.001$). Most children with diagnosis of neurocysticercosis 98.5% and febrile seizure 97.6% were discharged after recovery. Children diagnosed as encephalitis and tubercular meningitis had high mortality rate only 56.8% and 75% were discharged respectively. Table 3:

DISCUSSION

This study was a retrospective analysis conducted in a tertiary care hospital located in the Balochistan region, focusing on children who were admitted due to acute seizure episodes. The primary objective was to examine the demographics, clinical types of seizures, underlying causes, and outcomes during the hospital stay of these pediatric patients. Neonates and infants younger than six months were excluded from the study, as they often present with conditions such as septicemia, hypoxic-ischemic encephalopathy, and metabolic disorders, which represent a distinct spectrum of diseases. [22].

A majority of research findings reveal that younger children experience a higher incidence of seizures, which tends to decrease as age increases, with males being more frequently affected. [2,5]. The findings of our retrospective study revealed that most children with seizures were below the age of five. In the cohort of children under ten years, males demonstrated a higher prevalence than their female counterparts. Notably, females showed a markedly higher prevalence in the age group over ten years. Furthermore, seizures were associated with fever in 53.5% of the instances. Existing literature suggests that generalized seizures occur much more frequently than partial seizures. [4,5,7]. In this study, generalized tonic-clonic seizures emerged as the most common seizure type, with a notably higher occurrence in febrile children. Conversely, partial seizures were predominantly reported among children in developing countries, where the incidence of neurocysticercosis is significantly elevated.[8]

The necessity of conducting routine neuroimaging for all children admitted with an acute seizure episode remains a topic of debate. [5,12]. In this study abnormal neuroimaging was present in 111 (45.9%) and showed abnormal CT was found more in older afebrile children. There seems role of routine neuroimaging in afebrile children

with seizures in age group more than 5 years in developing countries with high prevalence of neurocysticercosis. AAP recommends lumbar puncture for febrile seizure children aged less than 12 - months [22]. CSF abnormality was more in children of age groups more than 5 years compared to younger age group. Lumbar puncture may be done in selected children guided by physical finding to rule out CNS infections older children. There are many possible etiologies of a first seizure attack in children, including infection, neurologic/developmental causes, traumatic head injury, toxins, and metabolic disturbances [4-6]. Febrile seizures have been reported to be one of the most common causes of seizure attack in children [2-4]. We found that febrile seizures (53.0%) were the main etiology of a first attack of seizure in children less than 5 years of age. Overall, seizure disorder was commonest etiology in children aged 6 months to 15 years (33.6%) followed by febrile seizure (30.5%).

Mortality rate during hospital course among children admitted with acute episode of seizure was similar with reports from other developing countries [4]. There was no significant difference in the outcome among male and female. Fever was not independently associated with increased mortality during the acute illness. Meningitis and encephalitis cause significant childhood mortality and morbidity [4,6]. Children with diagnosis of encephalitis and those with status epileptics had poor outcome with high mortality [23]. Febrile seizure, neurocysticercosis and hypertensive encephalopathy had good outcome with majority of children discharged after recovery.

This study demonstrates that the majority of provoked seizures are linked to central nervous system infections and neurocysticercosis. Many of these cases could potentially be prevented through improvements in sanitation. Since 2009, there has been a routine immunization program for Hemophilus influenzae type b, and the Japanese encephalitis vaccine has been made available in certain districts of Nepal.[24] It is crucial to investigate the burden of other pathogens that cause central nervous system infections and to take preventive actions accordingly. Furthermore, healthcare institutions should be adequately prepared for the emergency management of seizures to minimize mortality and morbidity.

CONCLUSION

Acute seizure episodes are one of the most common reasons for hospitalization, often resulting in elevated mortality rates. Our study reveals that the majority of acute symptomatic seizures are caused by febrile seizures, central nervous system infections such as meningitis and encephalitis, and neurocysticercosis, all of which could be addressed through improvements in healthcare facilities. Moreover, children who present with unprovoked seizures require extensive long-term follow-up studies, including neurophysiological investigations and neuroimaging (CT or MRI), to better comprehend childhood seizure disorders in developing regions.

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Table No 1 Demographic data of patients presenting with seizure

	No fever n = 128 (%)	Fever n = 148 (%)	Total n = 276 (%)	Odds ratio (95%-CI)	P-Value
Sex					
Male	70(54.7)	99(67.1)	169(61.3)	1.691(1.119,2.390)	0.003
Female	58(45.3)	49(32.9)	107(38.7)	1	
Age					
6mo-5 yr	68(33.2)	114(78.6)	182(57.5)	11.15(6.637,18.749)	0.001
6-10 yr	60(30.1)	34(13.6)	94(21.2)	2.123(1.171,3.849)	0.001
Type of seizure					
GTC	71(55.5)	122(82.4)	193(69.9)	2.896(1.415,5.927)	0.004
Partial	36(28.1)	19(12.5)	55(19.8)	0.870(0.394,1.920)	0.730
Absence	7(5.1)	1(0.7)	8(2.7)	0.260(0.051,1.341)	0.108
Myoclonic	4(2.7)	4(1.3)	-	-	
Others	11(8.6)	7(4.4)	18 (6.4)	1	-
Status	11(52.5)	20(47.5)	20(7.3)	1.298(0.681,2.473)	0.428

Table No 2 Analysis of patients with seizure based on age groups

	6 mo-5 yr	Age groups 6–10 yr	Total	P-value
Sex				
Male	211(66.4)	71(60.7)	282 (61.3)	0.002
Female	106(33.4)	46(39.3)	152(38.7)	
CSF analysis				
Normal	175(80.6)	35(58.3)	217 (74.1)	0.001
Abnormal	42(19.4)	25(41.7)	67 (25.9)	
Brain image				
Normal	65(63.7)	34(50.7)	166(54.1)	0.001
Abnormal	37(36.3)	33(49.3)	70(45.9)	
Electroencephalography (EEG)				
Normal	82(53.2)	36(38.7)	118(45.2)	0.001
Abnormal	72(46.8)	57(61.3)	129 (54.8)	
Diagnosis				
Febrile Seizure	84(53)	-	84(30.5)	
Seizure disorder	35(21.8)	28(47.9)	63(33.6)	
Neurocysticercosis	11(3.5)	23(19.7)	34(12)	
Meningitis	10(6)	6(9.4)	16(6.5)	
Encephalitis	11(6.6)	6(9.4)	17(6.7)	0.001
Cerebral Palsy	3(1.6)	4(2.6)	7(1.8)	
Tubercular meningitis	2(1)	2(2.6)	4(1.5)	
Hypertensive encephalopathy	1(0.2)	3(4.3)	4(1.5)	
Others	10(6.3)	3(4.3)	13(6)	

Table No. 3 Outcome in relation to gender, fever, status and diagnosis

	Discharged	LAMA	Died	Referred	P-value
Sex					
Male	154(91)	4(2.5)	9(5)	3(1.5)	NS*
Female	94(87.8)	6(6.6)	3(3.3)	3(2.3)	
Fever					
Present	132(89.2)	5(3.1)	9(5.8)	3(2)	NS*
Absent	116(90.6)	7(5.1)	4(2.7)	2(1.6)	
Status					
Present	12(60)	3(12.5)	5(37)	1(5)	0.0001
Diagnosis					
Febrile Seizure	81(97.6)	2(1.8)	1(0.6)	-	
Seizure disorder	85(91.4)	4(4.3)	3(3.3)	1(1.0)	
Neurocysticercosis	33(98.5)	1(1.5)	-	-	
Meningitis	16(86.1)	-	2(8.3)	1(5.6)	
Encephalitis	12(56.8)	2(16.8)	5(24.3)	2(8.1)	0.0001
Cerebral Palsy	4(80)	1(10)	-	1(10)	
Tubercular meningitis	3(75)	1(12.5)	1(12.5)	-	
Hypertensive encephalopathy	4(100)	-	-	-	
Others	12(69.7)	1(3.0)	3(15.2)	3(12.1)	

Figure 1 Age and sex distribution of children with seizure

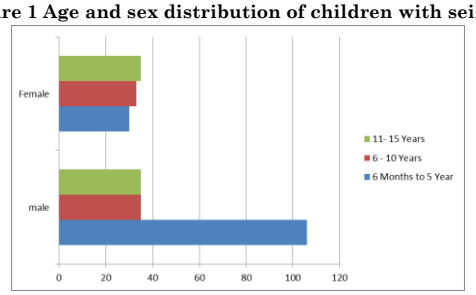

Figure 2 Etiological diagnosis of children with seizures