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Clinical profile of seizures in pediatric population with correlation to neuroimaging in a tertiary care hospital: a single-center experience from eastern India.

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Abstract:
Background: *Seizures are a common medical emergency, frequently faced by every pediatrician. Studies delineating the clinical profile and the role of neuroimaging in diagnosis and subsequent management of pediatric seizures are relatively meager in this part of the country. The current study aimed to provide a baseline profile of pediatric seizures and the importance of neuroimaging, in diagnosing the etiology.*
Methodology: *The study was conducted over a period of one year. Patients presenting with seizures, in the age group of 1 month to 12 years, to the emergency and the Paediatric Neurology Clinic of the institution (Midnapore Medical College and Hospital, West Bengal) were enrolled in the study. Demographic data, detailed history regarding disease and thorough clinical examination findings were recorded for each patient. Each patient was subjected to magnetic resonance imaging (MRI) of the brain once stabilized and the findings were recorded.*
Result: *43% (n=86/200) of the patients, were in the age group 1 year to 5 years. The male: female ratio was 1.4:1. 67.5% of the study sample had generalized seizures and 32.5% had focal convulsions. Among the patients with generalized seizures, 57.7% had Generalized Tonic Clonic Seizures (GTCS), while among the patients having focal seizures, 83.7% had simple partial seizure (SPS) and had complex partial seizures (CPS). 57% of the sample population had abnormal brain MRI findings, while 43% had normal imaging. Among the focal seizure group, 78% of patients had abnormal neuroimaging, while 46.6% of the generalized seizure group had abnormal neuroimaging. Cysticercal granuloma accounted for the majority (26.2%) of the cases of focal seizures. 96% of those with focal seizure and abnormal neuroimaging belonged to the simple partial seizure group, while 4% belonged to the complex partial seizure group.*
Conclusion: *Our study thus highlights the importance of neuroimaging in detecting the underlying etiology of seizures with more abnormalities being detected in the focal seizure group than in the generalized seizures.*
Keywords*: seizures, pediatric, magnetic resonance imaging,*

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I. Introduction:

Seizures, defined as a transient occurrence of signs and symptoms resulting from abnormal, excessive or synchronous neuronal activity in the brain **[1]**. About 4-10 % of pediatric population has been estimated to encounter at least a single seizure within the first 16 years of life **[2]**. Once the diagnosis of seizure is confirmed, it should be characterized and thorough investigations should be undertaken to determine its etiology. The underlying etiology of a seizure can be infectious, neurodegenerative, metabolic, traumatic, vascular, toxicologic or idiopathic. One- fifth of the total children presenting with seizures, but without any acute symptomatic etiology, may develop epilepsy.

Neuroimaging plays an important role in the etiological diagnosis of seizures. It has an important role in children with focal seizures, recurrent seizures, focal neurodeficits, neurocutaneous syndromes, neurodegenerative disease, neurometabolic diseases . Immunosuppressed patients and those with coagulopathy are also potential candidates for neuroimaging. **[3], [4].**Computed tomography (CT) scans are mainly utilized for the acute evaluation of patients with suspected acute stroke syndromes and traumatic brain injury.

Magnetic resonance imaging (MRI) is considered better than CT scans for diagnosing structural malformations of the brain **[5]**.

Proper diagnosis and classification of seizures are always challenging in children. The problem is even more profound in countries like India, due to lack of advanced and, in some cases, basic imaging and other diagnostic modalities, especially those in rural settings. This study aims to provide a baseline profile of paediatric seizures and the importance of neuroimaging findings in diagnosing the etiology, which may further help in designing and implementing proper treatment protocols.

II. Materials And Methods:

An observational, cross –sectional, single-centre study was conducted over a period of one year (March 2019 - February 2020) in a tertiary care hospital in Eastern India after obtaining institutional ethical clearance.

Inclusion criteria: All consecutive children, with seizures, attending the emergency and Paediatric Neurology clinic of the institution, falling in the age group of 1 month to 12 years were included in the study.

Exclusion criteria: Children less than 1 month of age and those presenting with seizures following head injury and poisoning were excluded from the study.

Data was collected from 200 consecutive patients with proper informed consent from the patients and their parents. Thorough history was taken for each patient including age, sex, and area of residence and the characteristics of seizures (duration, timing and frequency). Associated history of fever, birth asphyxia, developmental delay, family history of seizures was also taken. Each patient was subjected to detailed neurological examination. Seizures were classified as focal onset and generalized onset according to the latest ILAE 2017 (The International League Against Epilepsy) classification. Magnetic Resonance Imaging (MRI) was used as the neuroimaging modality of choice for almost all patients, except for haemodynamically unstable patients presenting with signs and symptoms suggestive of acute cerebrovascular event (hemorrhagic/ischemic stroke) for which CT scan was done as an emergency neuroimaging protocol. Later on, when the patient was stabilized, MRI was done to further confirm the diagnosis. 1.5 Tesla MRI machine available in our institute was used. T1 weighted, T2 weighted, FLAIR and Diffusion weighted sequences were obtained for all patients. MRS (Magnetic Resonance Spectroscopy) and MRA/MRV (Magnetic Resonance angiography/venography) was obtained wherever necessary. Statistical analysis was done using SPSS version 27.0.

III. Results

Clinical profile: The clinical profile of the study sample has been summarized in Table 1. 43% (n=86/200) of the patients, were in the age group of 1 year to 5 years, followed by 32.5% (n=65/200) in the age group of 5- 12 years, and lastly 24.5% (n=49/200) were in the age group of 1month to 12 months. 58.5% (n=117/200) patients were males while 41.5% (n=83/200) were females. The male: female ratio was 1.4:1. 82.0% (n=164/200) of the patients lived in rural areas, while 18.0% (n=36/200) of them lived in urban areas. In our study, 67.5% (n=135/200) of the patients had generalized seizures and 32.5% (n=65/200) of the patients had focal seizures. Out of total 135 patients with generalized seizures, 57.7% (n=78/135) had Generalized Tonic Clonic Seizures (GTCS), 21.4%(n=29/135) had tonic seizures, 4.4% (n=6/135) had Clonic seizures, 2.9% (n=4/135) had absence seizures, 0.7 % (n=1/135) had atonic seizure, 6.6% (n=9/135) had epileptic spasms and 5.92% (n=8/135) had myoclonic seizures. Among the 65 patients having focal seizures, 83.7% (n=54/65) had simple partial seizure (SPS) and 16.93% (n=11/65) had complex partial seizures (CPS).

Variable		**Frequency**	**Percentage**
Age	1 m - 12 months	49	24.5%
	1year- 5years	86	43%
	5 years – 12 years	65	32.5%
Sex	Female	83	41.5%
	Male	117	58.5%
Residence	Rural	164	82%
	Urban	36	18%
Types of generalized seizures (n=135)	GTCS	78	57.7%
	Tonic	29	21.4%
	Clonic	6	4.4%
	Absence	4	2.9%
	Atonic	1	0.7%
	Myoclonic	8	5.9%
	Epileptic spasm	9	6.6%

Types of focal seizures (n=65)	SPS	54	83.1%
	CPS	11	16.9%

Table 1 : Clinical profile of study sample (N = 200)

- **Neuroimaging findings:** The neuroimaging findings of all the patients have been summarized in Table 2. Out of total 200 patients, 57% (n=114/200) had abnormal brain MRI findings, while 43% (n=86/200) of them had normal findings. The current study showed that, out of the 114 patients with abnormal brain MRI findings, 78% (n=51/65) of patients with focal onset seizures had abnormal neuroimaging, while 46.6% (n=63/135) of patients with generalized onset seizures had abnormal neuroimaging ($z = 4.254$; $p<.00001$) [Table 3, Chart 1]. Out of total 65 patients with focal seizure, cysticercal granuloma accounted for the majority (26.2%; n=17/65) of the cases closely followed by hypoxic ischaemic changes (21.5%; n=14/65). [Table 2]. The comparison between MRI abnormalities in simple and complex partial seizures showed that amongst the patients with abnormal brain MRI findings, 96% (n=48/50) belonged to the simple partial seizure group, while 4% (n=2/50) belonged to the complex partial seizure group ($\chi 2$ (N=65) = 25.73; $p<.00001$) [Table 4,Chart 2]

Variable		**Frequency**	**Percentage**
MRI (n=200)	Abnormal	114	57%
	Normal	86	43%
MRI findings in focal seizures (n=65)	Focal cortical dysplasia	2	3%
	Hypoxic ischaemic Changes	14	21.50%
	Cysticercal granuloma	17	26.20%
	Tuberculoma	6	9.20%
	Kernicterus	2	3%
	Infarct	5	7.70%
	Cortical sinus venous Thrombosis	2	3%
	Normal	14	21.50%
	Others	3	4.60%

Table 2 : Distribution of neuroimaging (MRI brain findings)

MRI	**Focal onset**	**Generalized onset**	**Z score**
			P value
Abnormal	51(78.4%)	63(46.6%)	Z=4.254
Total	65	135	P <0.00001

Table 3: Comparison of MRI abnormality between focal and generalized onset seizure groups

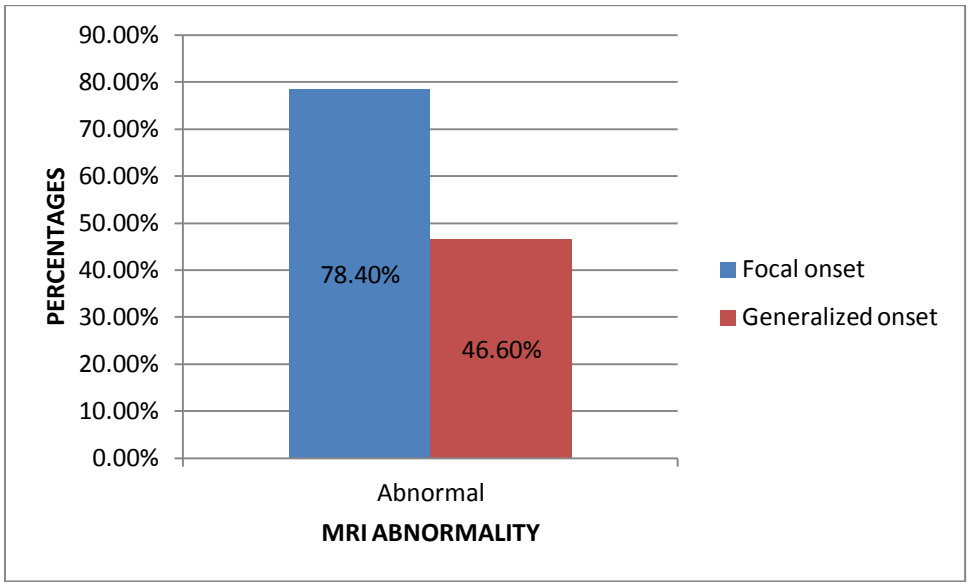

Chart 1: Comparison of MRI abnormality between focal and generalized onset seizure groups

MRI	SPS	CPS	Total	Pearson Chi square Statistic p value
Abnormal	48(96%)	2(4%)	50(100%)	
Normal	6(40%)	9(60%)	15(100%)	25.73 p<0.00001
Total	54(83.07%)	11(16.93%)	65(100%)	

Table 4 :Comparison of MRI brain findings in Simple and Complex Partial Seizures

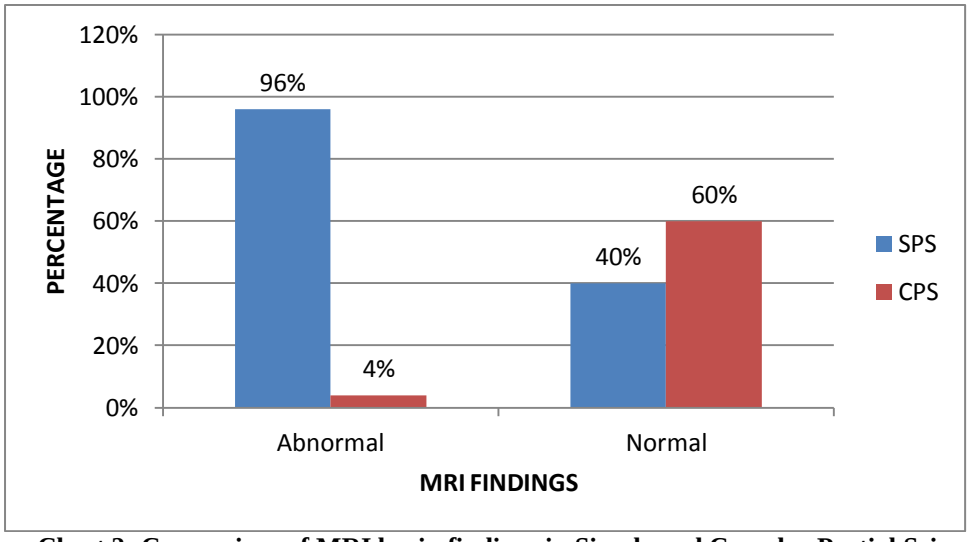

Chart 2: Comparison of MRI brain findings in Simple and Complex Partial Seizures

CT scan was done in patients presenting with active convulsions, having focal neurodeficits and hemodynamic instabilities, in order to rule out cerebrovascular events. Out of the 13 patients, on whom CT scan was done as emergency imaging, 7 patients had infarct, 1 had empty delta sign, 1 had hypodensity and 4 were normal. All the 13 patients were later subjected to MRI brain to correlate the findings.

IV. Discussion:

The current study showed that most of the patients belonged to the age group of 1 year to 5 years with a male predominance. The findings are broadly in agreement with most of the studies conducted previously **[6], [7], [8]**. Maximum patients hailed from rural areas which could be due to the the fact that the study was conducted in a tertiary care hospital which caters mainly, to the rural population of three districts of Eastern India. Majority of the study population (67.5%) had generalized seizures while 32.5% of the patients had focal convulsions. Generalized Tonic Clonic Seizures (57.7%) accounted for the majority of the cases of generalized seizures, followed by tonic seizures (21.4%). Clonic seizures, absence seizures, atonic seizures, epileptic spasms and myoclonic seizures accounted for the rest. Among the patients having focal seizures, 83.7% had simple partial seizure (SPS) and 16.93% (n=11/65) had complex partial seizures (CPS). The sex wise distribution of the two seizure groups showed that generalized seizures were more common in both males and females. However the tests of significance conducted for the two seizure types between both the sexes were statistically insignificant. Generalized seizures were reported as more common than focal seizures in almost all of the previous studies **[6], [7], [8]** with generalized tonic clonic seizure being the predominant type.

Predominance of generalized epilepsies can be possibly attributed to the fact that they are more theatrical and hence, more likely to be noticed and brought to medical attention.

Brain MRI (1.5 Tesla) findings of all 200 patients revealed that 57% (n=114/200) had abnormal findings while 43% (n=86/200) had normal findings. In a study conducted by *Sahdev R et al* **[9]** neuroimaging revealed about 31.4 % abnormal findings of significance. Similar findings of 31% abnormalities were noted in the *Kalnin AJ* **[10]** study. The *Adhikary S et al* **[11]** study reported 45.9% abnormal MRI findings.The slightly high percentage of abnormal findings noticed in our study compared to other studies, can be attributed to the fact that 33% of the total patients had underlying structural etiology and 28% had infectious etiology which were detectable on MRI. The predominance of rural population in the study sample can be a cause for the increased incidence of CNS infections like neurocysticercosis. Most of the structural etiology was attributable to hypoxic ischaemic changes. History of associated birth asphyxia was present in 21% of the study population. This can be explainable by the high patient load in our hospital which caters to the population of three districts. Also, social beliefs and stigma regarding hospital delivery is still prevalent in the rural areas of India which leads to increased number of home deliveries which are unattended by medical professionals. This in turn leads to undetected perinatal insults which later on presents with structural epilepsy and abnormal imaging findings.

The current study showed that, 78% (n=51/65) of patients with focal onset seizures had abnormal neuroimaging, while 46.6% (n=63/135) of patients with generalized onset seizures had abnormal neuroimaging (p<.00001). So, percentage of MRI abnormality detected in focal onset seizure group was more than that in generalized onset seizure groups. Idiopathic generalized epilepsies and several syndromic epilepsies presenting with generalized seizures, had normal neuroimaging findings. Neuroimaging may be less useful in certain generalized epilepsy syndromes such as absence epilepsy, juvenile myoclonic epilepsy or focal epilepsy syndromes such as benign rolandic epilepsy, benign occipital epilepsy and Panayiotopoulos syndrome **[12]**. This finding in our study is in agreement with previous studies conducted using CT scan as the neuroimaging modality of choice. Neuroimaging has been reported as abnormal in 50 % patients with partial seizures and in 34.6 % with generalized seizures in a study conducted by *Baheti et al*. **[13]**. Similar observations were reported by *Yang et al* who observed abnormal CT scan in 73 % patients with partial seizures**. [14].** Cysticercal granuloma (26.2%) was identified as the major underlying etiology of focal seizures. Similar findings were noticed in *Sahdev R et al* **[9],** where the most common cause of seizures was found to be inflammatory granuloma representing neurocysticercosis / tuberculoma, both of which are potentially treatable causes of seizures which would be difficult to diagnose without imaging. The comparison between MRI abnormalities in simple and complex partial seizures showed that, among the patients with abnormal brain MRI findings, 96% belonged to the simple partial seizure group, while 4% belonged to the complex partial seizure group (p<.00001). IAP expert committee guidelines for diagnosis and management of epilepsy on neuroimaging recommend high resolution MRI for delineating epileptogenic zone and eloquent cortex in pre-surgical evaluation. In our institution low resolution 1.5 Tesla MRI is installed, and perhaps this can be one of the reasons for low rates of detection of epileptogenic foci in complex partial seizures.

V. CONCLUSION:

Seizures are a common presentation in the Pediatric emergency departments in developing countries. Based on clinical presentation and investigations, etiological cause can be identified to a large extent and this helps in initiating appropriate treatment at the appropriate time to reduce the morbidity and mortality. Our study, done in a tertiary care hospital in a rural setting, provides a baseline clinical profile of seizures in the population and shows the importance of neuroimaging in diagnosing the etiology, with more abnormalities being detected in the focal seizure groups than generalized seizures. High resolution neuroimaging modalities need to be installed in tertiary care hospitals for quicker and accurate diagnosis.

The limitation of the current study is that it is a single-centre study, which limits the study population being evaluated. Also, the unavailability of high-resolution neuroimaging machines in the institution may have resulted in lesser detection of pathology.

Conflict of Interest: None.
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