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NEUROIMAGING FINDINGS IN CHLDREN WITH SEIZURES – 1 MONTH TO 17 YEARS – A HOSPITAL BASED PROSPECTIVE OBSERVATIONAL STUDY

KEY WORDS: Childhood Seizures, Neuroimaging, Developmental Delay

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ABSTRACT

Introduction: Seizure is a transient occurrence of signs and or symptoms resulting from abnormal excessive neuronal activity in the brain. Among those who present with seizures some are specific to certain etiologies such as CNS infections, birth asphyxia or tumors but the cause of almost 70% of seizures is still unknown. Neuroimaging plays a vital role in diagnosis, localization and evaluating the prognosis of seizures in children. **Objectives:** To correlate the MRI or CT with clinical profile of children presenting with childhood seizures and to determine the etiological diagnosis of childhood seizures by neuroimaging and the probable risk factors associated with it. **Methods:** A total of 57 children between the age group of 1 month to 17 years presenting with seizures were admitted to MVJ hospital who fulfill the inclusion and exclusion criteria were recruited for the study, from December 2020 to June 2022. Children underwent imaging if there was evidence of seizure/abnormal neurologic exam/developmental delay, neuro- regression with seizures/ failure to control or worsening seizures or status epilepticus and raised intracranial pressure. **Results:** The study showed that 20 out of the 57 were to due to infectious causes (35.1%). Structural abnormality ranked the next highest (8.8%) followed by vascular (7%). 24 out of the 57 cases were idiopathic seizures (42.1%). **Conclusions**: Neuroimaging played a vital role in establishing the diagnosis, especially MRI played an incredible role in understanding the anatomy and structural lesions. Infectious diseases were the most common cause of seizures in this study. There was a strong association between positive neuroimaging findings and childhood seizures.

INTRODUCTION

Epilepsy is a disease characterized by an enduring predisposition to generate epileptic seizures and by the neurobiological, cognitive, psychological, and social consequences of this condition. An epileptic seizure is considered to be associated with abnormal neuronal activity due to excessive or unsynchronized electrical discharge resulting from abnormalities in the inhibitory and/or excitatory pathway of the central nervous system.[1] Seizures are common in children and 5% of all medical attendances to accident and emergency departments are related to seizures. The role of emergent neuroimaging for those children with first afebrile seizure is, however, not well-defined[2].

Approximately 30 percent of patients who have first afebrile seizures develop epilepsy later in life and the risk is approximately 20 percent if neurological exam, EEG and neuroimaging are normal.

Among the patients presenting with seizures some are specific to certain aetiologies such as postnatal insults like birth trauma, CNS infections or brain tumours but the cause of 70 percent of all seizure cases is still unknown[3].

Seizures in children can cause a lot of distress to parents and caregivers, with a lot of questions for the attending physician about prognosis and treatment plan.

Seizures can post a diagnostic dilemma even for doctors.

The aim and utility of imaging studies in seizures helps in diagnosis, localization, evaluating patho-physiology and prognosis[4].

METHODS

This prospective observational study was carried out in the Department of Pediatrics at MVJ Medical College and Research Center after obtaining approval from the Institutional Ethics Committee. All children between 1 month-17 years with seizures that fulfill the criteria were enrolled for neuroimaging after obtaining informed consent from parents. Exclusion criteria were children with febrile seizures, transient metabolic derangements like hypoglycaemic and hypocalcemic seizures, drug induced seizures, patients who are uncooperative, inadequate MRI findings, children with seizures associated with electrolyte abnormalities, patients with acute head injury and pseudo seizures.

The sample size was calculated by using the most common aetiology of seizures as detected by MRI which was infective cause (42.59%) from a previous study[7]. Using the Daniel's formula, a sample size of 60 subjects was included in the study for a period of one year.

Children with epilepsy underwent imaging if one of the following is present:

- If there is evidence that it is a focal seizure from history and characteristics of seizure.
- Abnormal neurologic exam which includes focal deficits and developmental delay/ neuro regression.
- Failure to control seizures/ worsening seizures or changes in seizure manifestations in children who are known case of seizure disorders.
- New onset seizures that present with raised intracranial pressure or status epilepticus.[8]

A detailed history was taken in all patients followed by complete neurological and systemic examination.

All routine investigations like blood counts, and CSF analysis was done in children with fever and EEG recording was done whenever possible. Detection of abnormal spikes on EEG was indicative of epilepsy but a normal EEG does not rule out the possibility of epilepsy because inter-ictal EEG can be normal in 40% of the patients.

Patients underwent neuroimaging depending on age, suspicion from history, availability and affordability. Sedation was given because lack of head movement was essential.[7]

Statistical method - Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square was used as test of significance. Continuous data was represented as mean and standard deviation. P value <0.05 was considered as statistically significant.

RESULTS

In this prospective observational study that was performed on 57 children from the age group of 1 month to 17 years that presented with seizures for over a period of 1 year, the age group of 1-5 years had the highest incidence of seizures followed by the adolescent group. (Table 1)

Female: male = 1.2:1, which means female preponderance existed in our study (table 2).

Table 1 - Baseline Characteristics Of Study Population (age Distribution)

		Count	%
Age	<1 year	8	14.0%
	1 to 5 years	20	35.1%
	6 to 10 years	14	24.6%
	>10 years	15	26.3%
	Total	57	100.0%

Table 2 – Sex Wise Distribution

		Count	%
Sex	Female	32	56.1%
	Male	25	43.9%

In our study we found that the most common presentation of seizure was generalized tonic clonic type (GTCS) followed by focal seizures which was 61.4% and 14% respectively (table 3).

The study showed idiopathic cause of seizure was seen in 24 out of 57 cases (42.1%) which showed normal imaging and normal CSF findings. Infective cause constituted 20 out of the 57 cases (35.1%). Neurocysticercosis constituted 8.8% of all cases. (Table 4)

Table 3:Type of Seizure distribution

		Count	%
Type of Seizure	Absence Seizures	2	3.5%
	Atonic GTCS	1	1.8%
	Focal Seizures	8	14.0%
	Focal with Secondary Generalization	2	3.5%
	GTCS	35	61.4%
	Myoclonic Epilepsy	1	1.8%
	Status Epilepticus Focal	4	7.0%
	Status Epilepticus GTCS	3	5.3%
	Tonic Seizures	1	1.8%

Table 5: Etiology distribution

		Count	Column N %
Etiology	Infections	15	26.3%
	NCC	5	8.8%
	Vascular	4	7.0%
	Structural	5	8.8%
	Tumors	2	3.5%
	Idiopathic/Epilepsy	24	42.1%
	Neurometabolic Disorder	2	3.5%

In our study, 53 out of the 57 cases underwent MRI study, out of which 28 were imaging positive and 25 had normal study. (Table 6). A total of 32 out of 57 cases were imaging positive (CT and MRI both). (56.1%)

Table 6: MRI, CT scan and EEG findings distribution

	Positive	
	Count	Row N %
MRI	28	49.1%
CT	4	7.0%

The most commonly observed risk factor for seizures in our study was developmental delay despite the absence of significant antenatal or natal history (19.3%), past history of febrile seizures progressing to epilepsy was seen in 7% of the cases (table 7)

Table 7: Risk factors distribution

		Count	Column N %
Risk Factors	Developmental delay	11	19.3%
	Past H/o Febrile Seizures	4	7.0%
	Neonatal Seizures	2	3.5%
	Preterm	3	5.3%
	No Risk factors	37	64.9%
	Total	57	100.0%

The study showed that 17.5% had a positive family history of seizures and 28.1% had an abnormal CNS examination at the time of presentation.

Among the 20 cases which were infectious diseases, 15 underwent CSF analysis as well. It showed that 33.3% of the cases despite having a normal CSF showed imaging abnormalities and 46.6 % had an abnormal CSF but normal imaging findings.

Table 8: CSF and MRI correlation

Csf Normal Imaging Changes	Csf Abnormal Imaging Changes	Csf Abnormal Imaging Normal
5 (33.3%)	3 (20%)	7 (46.6%)

18 out of the 57 cases had neurologic deficits at the time of discharge (31.6%), 2 out of the 57 resulted in death (3.5%) and 37 out of the 57 cases had no deficits (64.9%) (table9).

Table 9: Outcome distribution

		Count	%
Outcome	No Deficits	37	64.9%
	Deficits	18	31.6%
	Death	2	3.5%

DISCUSSION

In our study, we used neuroimaging as the main modality to ascertain the cause of diagnosis. MRI was used predominantly and CT was used in case bleed was suspected to localize the site of bleed, to look at calcified lesions or if child was unstable to be shifted for MRI.

CT scan is used in emergency situations and also as a complement to MRI. In this way, imaging contributes to establish the nature and define the extension of epileptogenic lesions, thereby guiding therapeutic management. MRI also allows follow-up of the consequences of repeated seizures (such as mesial temporal sclerosis and selective neuronal necrosis) on the cerebral parenchyma and plays a role in the establishment of a prognosis.[8]

In 2017 a study by Anand A et al showed that it is important to arrive at an accurate diagnosis of cause of seizure for treatment decision. This study concluded that generalized seizures constituted the major seizure group being present in 66.3%, focal seizures being the second most common. Infections were the most common etiology followed by anoxia.[5]

In another study by Jenifer VN et al conducted at ESIC MC and PGIMSR in Bengaluru was done to find the etiology of complex partial seizures (CPS). This established that most children were detected to have structural lesions of which Neurocysticercosis was most common followed by tuberculoma and hippocampal sclerosis. MRI not only identifies specific epileptogenic substrates, but also determines the specific treatment and predicts prognosis and should be the imaging modality of choice in the evaluation of CPS.[6]

In our study, neuroimaging played a crucial role in diagnosing certain rare conditions like acute necrotizing encephalitis and acute disseminated encephalomyelitis. Despite a normal CSF, the imaging results helped us to arrive at a diagnosis which aided us in treatment decisions and explaining the parents, prognosis and outcome.

MR spectroscopy helped us to differentiate between NCC and

tuberculoma, with lipid peaks being elevated in tuberculoma and amino acid peaks were high in NCC.

In 2019 a study conducted by S Zakir et al showed that recent advances in neuroimaging have revolutionized the management of epilepsy, especially in refractory epilepsy. Structural neuroimaging continues to evolve with advances in MRI techniques, making it possible to scan previously undiagnosed lesions. CT scans still have an important role for diagnosis in acute emergency conditions and in cases in which MRI is not available.[7]

Ray et al in their study found that there was a 16.6% association between febrile seizures and seizure disorder. RR of 1.93 means a strong association between febrile seizures and subsequent development of epilepsy.[4]

CONCLUSION

Magnetic resonance imaging (MRI) is the technique of choice to identify an underlying cause in symptomatic seizures. This can help in prognosis and in better management plan of seizures especially those which are refractory in nature. In a developing country like India, infectious disease is the most common cause of seizures in the pediatric population.

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