



Role of Magnetic Resonance Imaging in Evaluation of Pediatric Seizures (0-18 Years)

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Abstract

Seizures are a common ailment in childhood and neuroimaging plays an important role in the localization of seizure focus and identification of the etiological factors causing it. The objectives of this study are to identify structural abnormalities and etiological factors in the brain that may be the cause for seizures as well as to find out the common imaging abnormality in paediatric patients with seizures.

Keywords: Epilepsy, MRI, Seizure, chronic condition, Paroxysmal.

Introduction

Seizure is a paroxysmal alteration in neurologic function resulting from abnormal excessive neuronal electrical activity ⁽¹⁾.

Epilepsy is a chronic condition characterized by recurrent seizures unprovoked by an acute systemic or neurologic insult. An epileptic seizure is a clinical

manifestation of abnormal, excessive neuronal activity arising in the grey matter of the cerebral cortex ⁽²⁾

Epilepsy is common sparing no age, race or ethnic background. Epilepsy is first most common chronic condition seen by a paediatrician.

Epilepsy is second commonest neurological disorder after headache in India ⁽³⁾. Syndromes dominated by generalized tonic clonic or partial seizures account for 75% of childhood epilepsy. Syndromes dominated by absence seizures account for approximately 15%, and the secondary generalized epilepsies account for 10%.

Introduction of MRI for evaluation of seizures has been a great boon both for the diagnosis of cerebral lesions as well as clinical management of patients with neurologic disorders. MRI has increased our understanding of the underlying disease process as well as revolutionized evaluation and management of epilepsy ⁽⁴⁾. For medically refractory epilepsy it is crucial to precisely identify

epileptogenic foci that are potentially amenable to surgical resection for possible cure.

Postoperative MR may detect reasons for failure such as inadequate resection and can monitor tumour recurrence on follow up imaging MR is especially useful for prognosticating postoperative seizure control ⁽¹⁾

The purpose of the study is intended to know the prevalence of various seizure types and its neurological imaging finding in our population and guide the clinicians about the prevalence state of various seizure types and various disease prevalent states in our population.

Methods

A prospective study of 50 patients with clinical impression of seizures from august 2022 to May 2024 were subjected to MRI scanning

Source of data: Rajarajeswari Medical College and Hospital.

Study period: 21 months from August 2022 to May 2024.

Study design:

- Time bound hospital based prospective study.
- All patients up to 18 years of age who were referred to Department of Radio- Diagnosis with clinical symptoms and signs of seizures.
- Study was performed with MRI machine (SIEMENS).
- 50 cases were studied.
- Depending on the radiological features a provisional diagnosis was made correlating the clinical features.

Inclusion criteria

- Individuals between 0-18 years of age.
- Patients referred to the department of Radio- Diagnosis suspecting seizure disorders.

Exclusion criteria

- Patients above the age of 18 years.
- Claustrophobia or anxiety disorders exacerbated by MRI.

If he/she has a contraindication to MR scanning implanted metal clips or wires of the type which may concentrate radiofrequency fields or cause tissue damage from twisting in a magnetic field.

Data Acquisition:

- All the MRI scans in this study were performed using 1.5 Tesla Siemens MRI MAGNETOM Avanto Tim (76 x 18) scanner.
- Yamane Equation was used for sample size estimation

$n = N / 1 + Ne^2$ Where N is the population size

e is the margin of error (For 95% confidence level, margin of error = 0.05)

For our study number of cases per month is 2. Hence, for study duration of 24 months

$$N = 2 \times 24 = 48$$

$n = 48 / 1 + (0.05)^2 \times 48 = 42.8 \sim 50$ cases over the duration of 21 months.

MRI Protocol

- A head coil was used.
- T1 axial and coronal
- T2 axial and coronal
- FLAIR axial
- DWI axial and ADC maps.
- Additional imaging sequences, planes were acquired when required.

Results

Age wise distribution of seizures in pediatric population

The age of the studied patients with seizures ranged from 2 days to 18 years. The patients involved in the

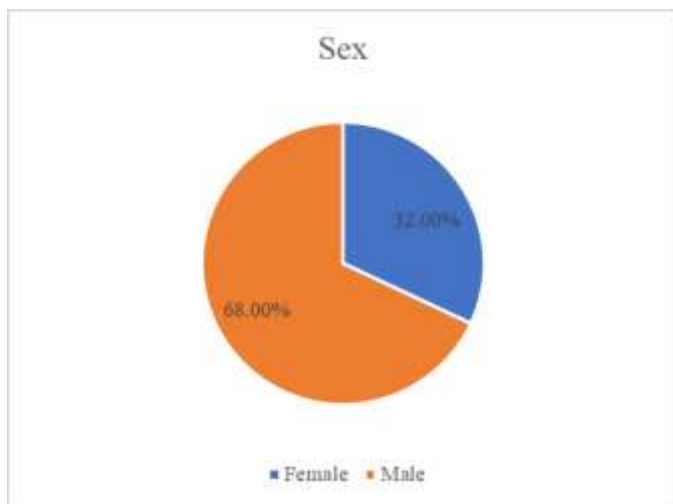
study were divided into 5 age groups viz. <1 year, 1-5 years, 6-10 years, 11- 15 years, 16-18 years. There were twenty patients (40%) in <1-year age group which comprised the majority, eight (16%) in 1-5-year age group, five (10%) in 6-10-year age group, 10 (20%) in 11-15-year age group, seven (14%) in 16-18-year age group.

Table 1: Age distribution of children with Seizures

		Count	%
Age	<1 year	20	40.0%
	1 to 5 years	8	16.0%
	6 to 10 years	5	10.0%
	11 to 15 years	10	20.0%
	16 to 18 years	7	14.0%
	Total	50	100.0%

Gender distribution of seizures in paediatric population

Among the patients studied, 16 (32%) were female and 34 (68%) were male.



Graph 1: Pie diagram showing Gender distribution of children with Seizures

Presenting features

Majority of the patients in the study population presented with history of fever i.e 13 patients (26%), history of loss of consciousness 12 (24%) and vomiting

4 (8%) History of headache (2%) and hypoglycaemia (2%) was elicited from one patient each.

Table 2: Presenting Features

	Presenting Features	
	Count	%
Fever/Loss of consciousness	13	26.0%
Birth asphyxia	12	24.0%
Vomiting	4	8.0%
Headache	1	2%
Hypoglycaemia	1	2%

Clinical diagnosis of seizure type

In the given study population majority of the patients were clinically diagnosed with generalized tonic clonic or neonatal seizure types i.e 18 patients (36%) with generalized tonic clonic seizures and 16 patients (32%) with neonatal seizures. 5 patients (10%) were diagnosed with simple partial seizures, 4 patients (8%) with complex partial seizures, 3 patients (6%) with febrile seizures and 2 patients (4%) with absence seizures.

Table 3: Clinical Diagnosis of Type of Seizure

		Count	%
Clinical Diagnosis	GTCS	18	36.0%
	Neonatal seizures	15	32.0%
	Simple partial seizures	5	10%
	Complex partial seizures	4	8.0%
	Febrile seizures	3	6.0%
	Absence seizures	2	4.0%
	GDD	1	2.0%
	Hypoglycaemic Seizures	2	2.0%
	Total	50	100.0%

MRI findings

Among the patients studied 16 patients (32%) were given a normal report post MR imaging of the brain and 34 patients (68%) were diagnosed with MRI abnormalities. Hence a significant number of patients were seen to have an abnormal MRI brain when presenting with seizures.

Table 4: MRI findings

		Count	%
MRI	Normal	16	32.0%
	Abnormal	34	68.0%
	Total	50	100.0%

MRI findings among subjects with abnormal MRI

Among the patients with abnormal MRI diagnosis, majority i.e 13 patients (38%) were reported as hypoxic ischemic encephalopathy. Post ictal edema in 5 patients (14%), tuberculoma in 5 (14%), neurocysticercosis in 3 (8%) neoplasm in 2 (5%), hypoglycemic encephalopathy in in 2 (5%)

Table 5: MRI Findings among subjects with abnormal MRI

	+	
	Count	Percentage
Hypoxic ischemic injury	13	38%
Post ictal edema	5	14%
Tuberculoma	5	14%
Neurocysticercosis	3	8%
Neoplasm	2	5%
Hypoglycemic encephalopathy	2	5%
Others	4	11%

Table 6: Causes of seizures in different studies versus our study

	Alyoubi.RA et.al ⁽⁴²⁾	Kalnin.AJ et.al ⁽⁴⁴⁾	Ankita.S Munhe ⁽⁴³⁾	In our study
Hypoxic ischemic injury	45%	23%	17%	38%
Post ictal edema	0	0	5%	14%
Developmental anomalies	18.5%	12%	8.2%	0

Discussion

In present study all patients under the age of 18 years with a clinical history of seizures were taken for MRI of brain. The most common seizure type noted was GTCS comprising 36% (18 patients) of the total study population. Absence seizures and febrile seizures were among the least common seizure types seen. A clinical history of hypoglycaemia was elicited from 2% of patients. Our study has similar results as that of study done by Rasool A et al.,⁽⁵⁾ in which 276 patients were studied. In this study it was found that generalized seizures constituted the major seizure group (42%), followed by partial seizures (31.2%) and complex febrile seizure (23.2%). Our study also correlates with the study done by Chaurasia R et al.,⁽⁶⁾ in which generalized seizures accounted for the major number of patients seen in 76.7%.

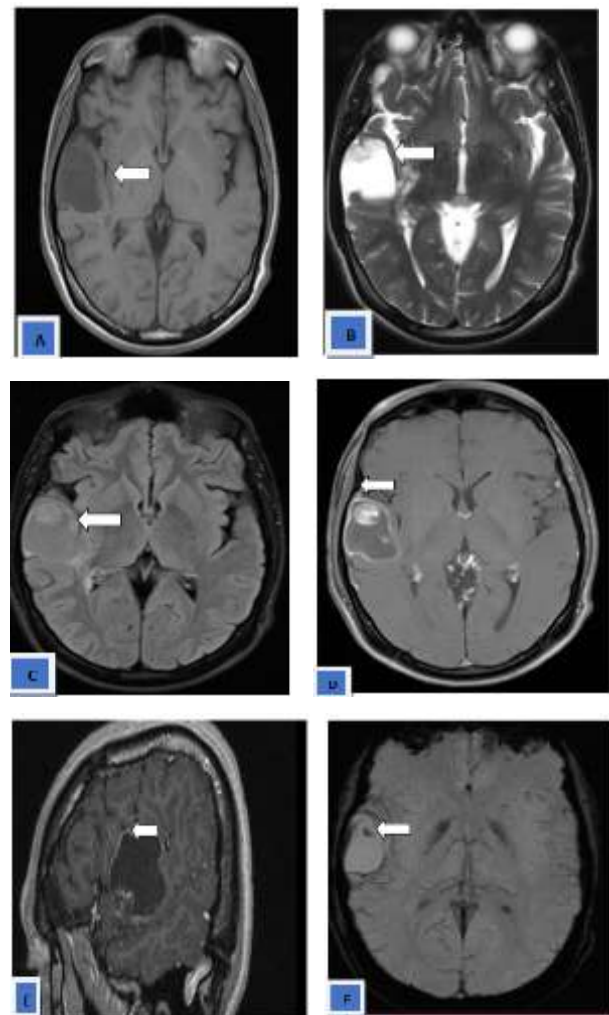
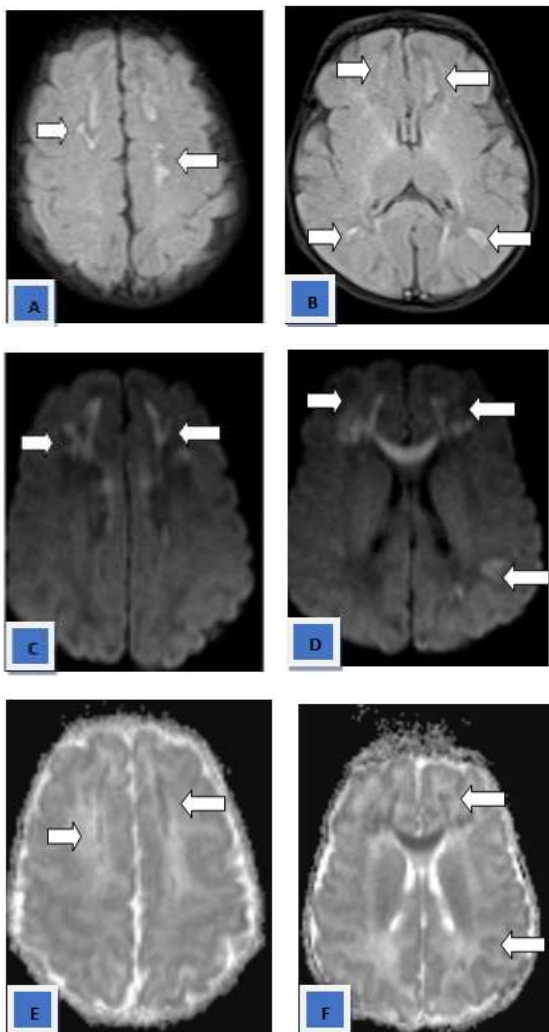
In study done by Alyoubi.RA et.al⁽⁷⁾ and Ankita.S Munhe⁽⁸⁾ the most common cause was HIE. In another study done by Kalnin.AJ et.al⁽⁹⁾ most common cause was ventricular enlargement . The gender characteristics of the present study were similar to published literature by Alyoubi.RA et.al⁽⁷⁾ that revealed male predominance.

Infections	14%	6%	37%	22%
Neoplasm	0	0	3%	5%
Hypoglycemic encephalopathy	0	0	0	5%
Others	11.1%	9%	17%	11%
Vascular	12.5%	0	12%	0
Ventricular enlargement	0	51%	0	0

Out of the 50 patients studied, 68% of patients had an abnormal MRI of brain while the remaining 32% were normal. majority i.e 13 patients (38%) were reported as hypoxic ischemic encephalopathy. Post ictal edema in 5 patients (14%), tuberculoma in 5 (14%), neurocysticercosis in 3 (8%), neoplasm in 2 (5%), hypoglycemic encephalopathy in in 2 (5%)

Figure 1: Case of hypoxic ischemic injury in 4 year old female patient who had history of birth asphyxia and presented with 2 episodes of GTCS. A,B. FLAIR hyperintensities (arrows) in bilateral centrum semiovale and bilateral frontal and parietal lobes.

C. Diffusion restriction with corresponding low values on ADC



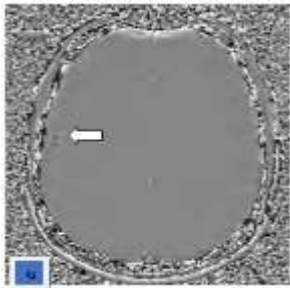


Figure 2: Case of Ganglioglioma in 18 years old male patient presented with GTCS since 2 years. A. Axial T1W sequence, B. Axial T2W sequence, C. Axial FLAIR sequence, D. Axial T1 C+, E. Sagittal T1 C+: T1 hypointense, T2 hyperintense cystic lesion which shows FLAIR suppression and enhancing mural nodule in right superior temporal sulcus. F.SWI sequence G.PHASE sequence: Few foci of blooming within the mural nodule.

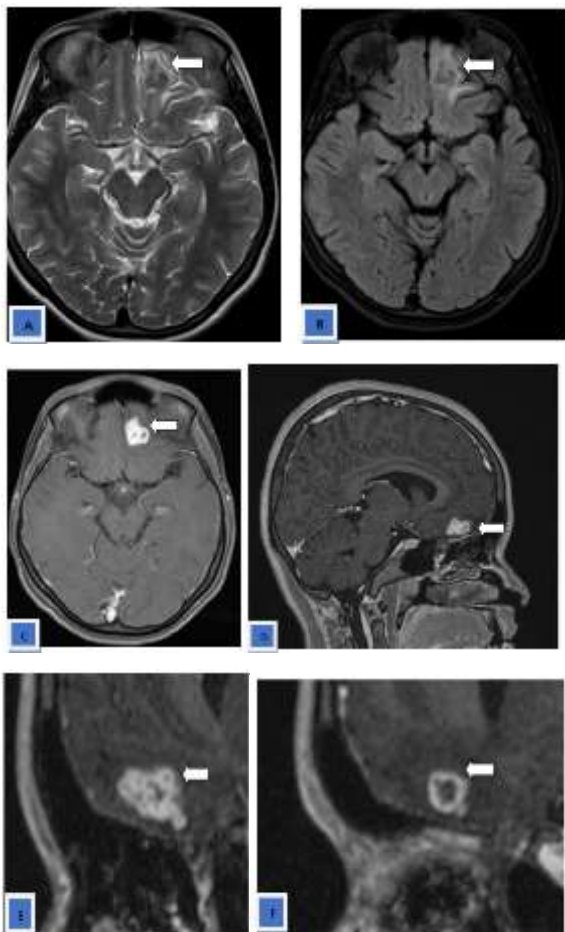


Figure 3: Case of tuberculoma in 13 year old female patient presented with focal seizures and fever. A. Axial T2W sequence, B. Axial FLAIR sequence: T1 and FLAIR hypointense, T2 hyperintense conglomerate lesions with surrounding vasogenic edema in left basifrontal region. C. Axial T1 C+, D,E,F. Sagittal T1 C+: On post contrast study lesions show intense peripheral enhancement

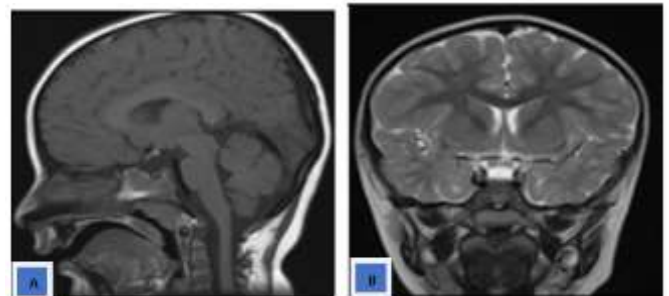


Figure 4: (A and B): Pituitary stalk interruption syndrome in a 6-year-old male child presenting with hypoglycemia, short stature, seizures and DD. T1W sagittal MR image showing posterior pituitary bright spot in the region of hypothalamus, abutting the optic chiasma (ectopic) and anterior pituitary is small in size measuring 2.4 mm craniocaudally and volume of 43 cc. T2W coronal MR image showing absent pituitary stalk.

Conclusion

Assessment of the patient presenting with seizure disorder is a common problem in clinical practice. The present could establish spectrum of findings, various etiologic factors for seizures, and the most common imaging abnormality.

MR imaging is superior neuroimaging with no radiation exposure and could be the first investigation of choice in epileptic syndrome, acute cerebrovascular disease with seizure, developmental cortical malformations, and vascular malformations, It's ability in identifying subtle lesions, location, extent of the lesions and number of findings are excellent.

Hence, we conclude that MRI plays a significant role in patients presenting with seizures with MRI seizure protocol to confirm or rule out any organic or developmental lesions.

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