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ORIGINAL RESEARCH

MRI Evaluation of Seizures in Pediatric Age Group Patients in a Tertiary Teaching Hospital

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ABSTRACT

Background: Seizures are a very common presentation in the emergency department. Seizures are characterised by involuntary impairments in motor, sensory, or autonomic functioning. They are brought on by abnormal, excessive neuronal activity that is triggered by paroxysmal electrical discharges from the brain. In children, seizure disorders are a prominent contributor to both morbidity and mortality. Mortality rates in neonates range from 21 to 24 percent, while morbidity rates range from 25 to 35 percent.

Material and Methods: The current study was a prospective hospital-based investigation carried out in the Radiology Division of S.V.S. Medical College and Hospital in Mahabubnagar, Telangana, India. The investigation was conducted between September 2019 and August 2022 in the department of Radiodiagnosis. 148 people made up the sample. Siemens Magnetom Area's 1.5 T MRI equipment was used to capture every image.

Results: From the obtained results, we found the following percentages. 0-1 month (33.10%), 1 month to 1 year (27.02%), 1 year to 5 years (8.10%), and 5 to 15 years (31.75%). Male was 60.81 percent and female was 39.18 percent. 83.67% of infants were term and 16.32% preterm. We found 65.85% male and 34.14 % female neonates. In the table 5 for the period of 1M-1Y, for Sequelae of HII 35%, Bleed 2.5%, Leukodystrophy 05%, Neurodegenerative 10%, Infection 2.5%, Tumour 2.5% and normal was 42.50%. In the table 6 for the period of 1Y-5Y, the percentage was Sequelae of Hii 41%, Leukodystrophy 8.33%, Infection 8.33%, Anomaly 8.33%, Neurocutaneous Syndrome 8.33%, Normal 16.66% and Alerd 8.33%. In the table 6 for the period of 5Y-15Y, the percentage was Sequelae of Hii 17%, Sequelae of Infection (Rasmussen's Encephalitis And Anec) 4.25%, Infection 10.63%, Bleed 2.12%, Infarct 4.25%, Leukodystrophy

2.12%, Neurodegenerative 2.25%, Immune-Mediated 4.25%, Tumour 8.51%, Anomaly 6.38% and Normal 38.29% respectively.
Conclusion: After our investigation, we'll know how well MRI detects lesions underlying pediatric seizures and how well it correlates with MR Spectroscopy.
Keywords: RI Evaluation; seizures; pediatric; patients; tertiary teaching hospital.

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INTRODUCTION

Seizures are one of the most common presentations to the pediatric emergency department.[1] A seizure is an abnormal, excessive neuronal activity due to paroxysmal electrical discharge from the brain and clinically manifests as involuntary motor, sensory or autonomic disturbances.[2] A seizure is a common cause of the hospitalization of children and results in significant mortality and morbidity. This is particularly high in neonates with mortality (21–24%) and morbidity (25–35%).[3] Seizures nearly affect 1% of the world population with an annual incidence of 68/100,000 per year. It is appraised that near to 10.5 million children less than 15 years have a form of epilepsy throughout the world.[4] The prevalence of epilepsy in children in developed countries and underdeveloped countries is approximately 5 in 1000 and 7.5 to 44.3 in 1000 children respectively.[5,6] Studies from India have reported, the prevalence and incidence of seizures as (3.0-11.9 per 1,000 populations) and (0.2-0.6 per 1,000 populations per year) respectively.[7] Among the pediatric age group, seizures during the neonatal period are relatively common, occurring in approximately 1.8 to 3.5 per 1000 live births.[8] Prevalence is greater in the neonatal period (almost 1% in term and 20% in preterm). Most (80%) neonatal seizures occur in the first 1–2 days to the first week of life. The incidence of seizures is particularly high in children below 3 years of age and decreases as the age increase.[9,10] A study by R. A. Umap et al. found that the prevalence is higher in the neonatal period (almost 1% in term and 20% in preterm).[11] The etiology of seizures is better identified in infants compared to children. However, in 12-15% of newborns, the etiology remains unknown.[12] Neonatal seizures occur more frequently in preterm and very low birth weight babies before 5 days of life and the common cause is perinatal asphyxia followed by metabolic abnormalities.[13] Febrile seizures are most common in children followed by infection in developing countries. However, common causes are different in different parts of the world.[14] Common etiology for seizures in children includes infection; inflammation; tumors; congenital abnormalities; leukodystrophies; neurometabolic disorders.[15] In developed countries, MRI of the brain has become a standard imaging modality for pediatric seizures compared to CT or neuro-sonogram.[16] The MRI is the preferred form of Neuroimaging for children with seizures due to lack of radiation, better delineation of pathologies, and excellent anatomical and vascular overview.[17,18] Thus, it helps in identifying the etiology and planning the management of children with seizures.[19] It also helps to know the prognosis which depends on the etiology, site and extent of underlying brain injury.[20] The aim of the study was to establish the etiological diagnosis of seizures in children and to see the age specific causes and incidence of seizures.

MATERIALS & METHODS

The present study was a hospital-based prospective study conducted in the department of Radiology, S.V.S. Medical College and Hospital, Mahabubnagar, Telangana, India. The study was carried out in the dept of Radiodiagnosis between September2019 and August

2022. The Sample size was 148. All the images were obtained by 1.5 T MRI machine siemensmagnetom area. The routine MR sequences obtained were axial and Sagital spin echo T1 weighted images (TR/TE = 460/12; 4mm slice thickness / 1 mm gap), axial fast spin echo T2 weighted images (TR/TE = 5400/117: 4mm slice thickness/1mm gap), axial diffusion-weighted images (TR/TE/b factor= 5075/84/1000) and gradient-echo (GRE) images (TR/TE/Flip angle = 700/30/30). MR angiography (MRA) and MR Venography (MRV) were done when there were changes suggestive of vascular events like hemorrhage and infarct. Procedural Sedation was given by the pediatrician as per the institutional protocol to reduce anxiety and movement to avoid motion artifacts. Data on brain lesions seen on the MRI was collected. The findings in the MRI brain were clinically correlated with the treating physician and the final diagnosis was made. Prior institutional ethics committee clearance was obtained for the study. Informed consent was obtained from the subjects and their parents/guardians for the inclusion of their images in the study.

Inclusion Criteria:

- All pediatric patients aged between 0-15 years referred from the outpatient department and inpatient pediatric department who presented with seizures.

Exclusion Criteria:

- Simplefebrile seizures, hemodynamically and neurologically unstable children, and parents not willing the consent to the sedation and imaging.

Statistical analysis:

Descriptive statistics were used for the analyses of data. Categorical data were expressed as numbers and percentages.

RESULTS

This investigation was a prospective hospital-based study performed by the S.V.S. Medical College and Hospital Radiology Department. Researchers from the Department of Radiodiagnosis conducted their investigation. We used a sample size of 148. Each and every one of these pictures was taken with a 1.5 T MRI scanner from Siemens Magnetom in their dedicated imaging room. The following results obtained while performing the study.

Table No 1: Age group distribution

Age group	n	%
0-1M	49	33.10
1M-1Y	40	27.02
1Y-5Y	12	8.10
5-15Y	47	31.75
Total	148	100

In the table 1 the age group distribution 0-1 month 33.10%, 1month to 1 year is 27.02%, 1year to 5 years is 8.10% and 5 to 15 years is 31.75%.

Table No 2: Gender distribution

Gender	n	%
Male	90	60.81
Female	58	39.18
Total	148	100

In the regards of the gender distribution male was 60.81% and female was 39.18%.

Table No 3: Neonate's distribution

Neonates	**n**	**%**
term	41	83.67
preterm	8	16.32
Total	49	100

With the regards of the neonates distribution as term and preterm was observed as 83.67% and 16.32% respectively.

Table No 4: Neonates distribution

Neonates	**n**	**%**
Vascular(32)		
HII	19	59.37
CSVT	3	9.3
PAIS	2	6.25
Bleed	6	18.75
Combined	2	6.25
(24)		
Anomaly	1	4.16
Metabolic	1	4.16
IEM	1	4.16
Infection	1	4.16
Normal	19	79.16
Transient	1	4.16

In the table 4 neonates distribution was observed for vascular based as HII 59.37%, CSVT 9.3%, PAIS 6.25%, bleed 18.75% and combined was 6.25%. As well as for metabolic, IEM, infection, normal, transient was 4.16% for 1 and 79.16 % for 19.

Table No 5: For the period of 1M-1Y

1M-1Y (40)	**n**	**%**
Sequelae of HII	14	35
Bleed	1	2.5
Leukodystrophy	2	05
Neurodegenerative	4	10
Infection	1	2.5
Tumour	1	2.5
Normal	17	42.50

In the table 5 for the period of 1M-1Y, for Sequelae of HII 35%, Bleed 2.5%, Leukodystrophy 05%, Neurodegenerative 10%, Infection 2.5%, Tumour 2.5% and normal was 42.50%.

Table No 6: For the period of 1-5Y

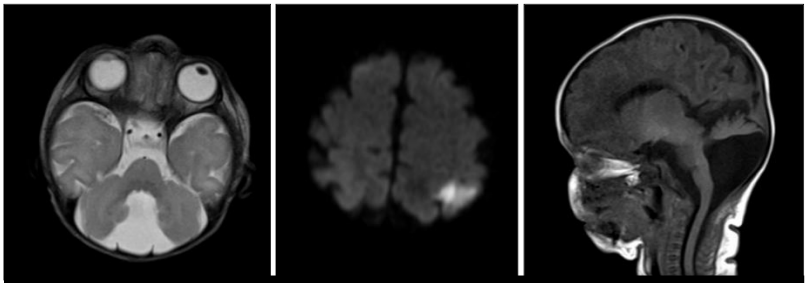
1-5Y (12)	**n**	**%**
Sequelae of Hii	5	41.66
Leukodystrophy	1	8.33
Infection	1	8.33
Anomaly	1	8.33
Neurocutaneous Syndrome	1	8.33
Normal	2	16.66
Alerd	1	8.33

In the table 6 for the period of 1Y-5Y, the percentage was Sequelae of Hii 41%, Leukodystrophy 8.33%, Infection 8.33%, Anomaly 8.33%, Neurocutaneous Syndrome 8.33%, Normal 16.66% and Alerd 8.33%.

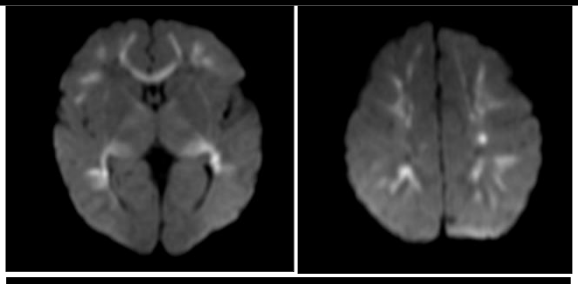
Table No 7: For the period of 5-15Y

5-15Y	47	
Sequelae of Hii	8	17.02
Sequelae of Infection (Rasmussen's Encephalitis And Anec)	2	4.25
Infection	5	10.63
Bleed	1	2.12
Infarct	2	4.25
Leukodystrophy	1	2.12
Neurodegenerative	1	2.12
Immune-Mediated	2	4.25
Tumour	4	8.51
Anomaly	3	6.38
Normal	18	38.29

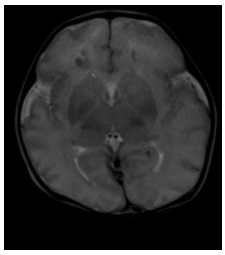
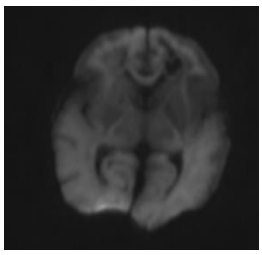
In the table 6 for the period of 5Y-15Y, the percentage was Sequelae of Hii 17%, Sequelae of Infection (Rasmussen's Encephalitis And Anec) 4.25%, Infection 10.63%, Bleed 2.12%, Infarct 4.25%, Leukodystrophy 2.12%, Neurodegenerative 2.25%, Immune-Mediated 4.25%, Tumour 8.51%, Anomaly 6.38% and Normal 38.29% respectively.



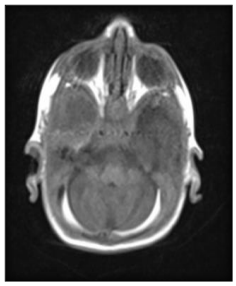
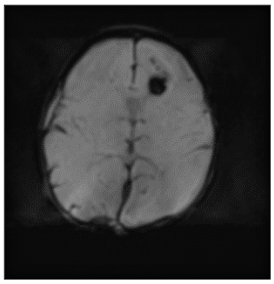
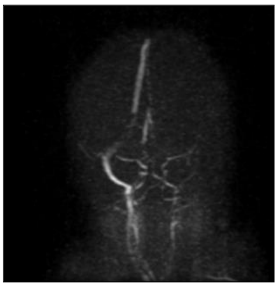
1. (a,b,c)-MRI of Neonate shows Dandy walker malformation and Perinatal Arterial Ischemic Stroke (PAIS)



1. (d,e) DWI images of neonate shows periventricular white matter restriction seen in Parechovirus infection.

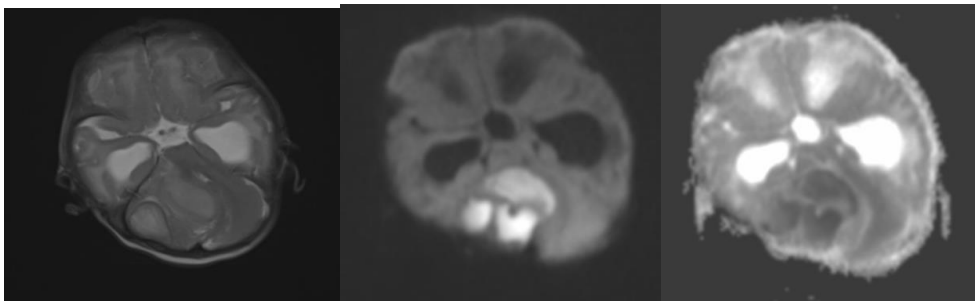
1. (f,g) Neonate with perinatal asphyxia history , T2 and DWI images show absent posterior limb sign with basal ganglia thalami pattern of severe hypoxic ischemic injury.

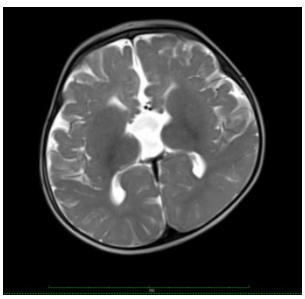
1. (h,i) Neonate MRI T1 and MR venogram shows Cerebral sinus venous thrombus involving transverse sinus

(j) Neonate MRI SWI image shows focal bleed in left frontal region

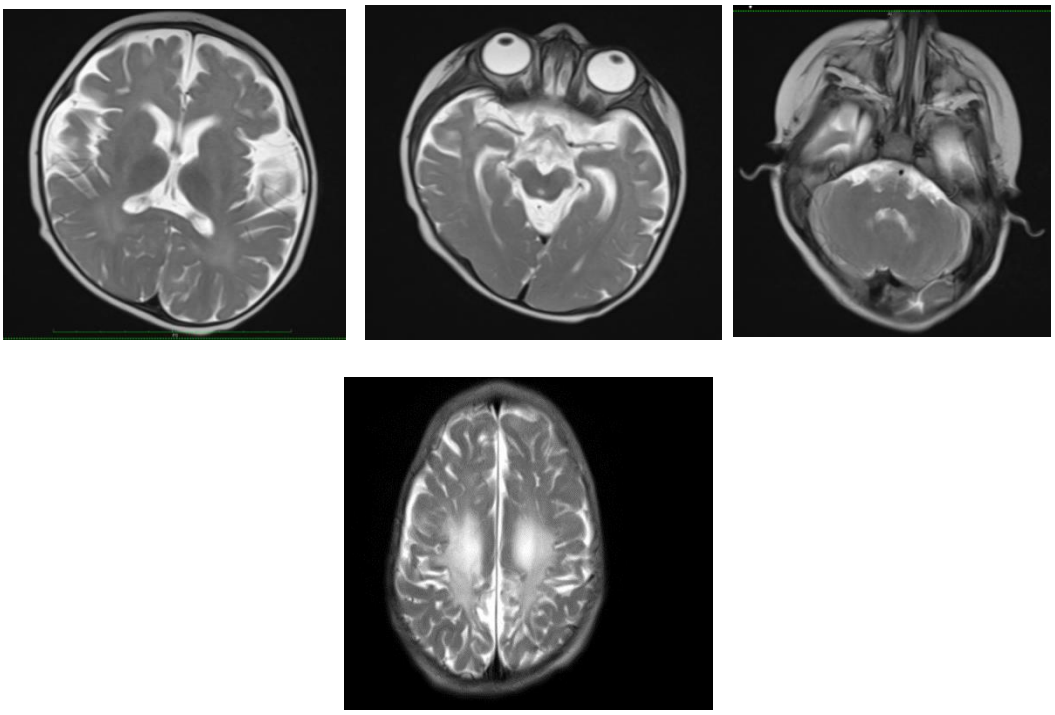
Figure 1: Different spectrum of etiologies in neonates presenting with seizures



2. (a,b,c) 2months infant MRI T2 ,DWI and ADC shows Cerebellar abscess

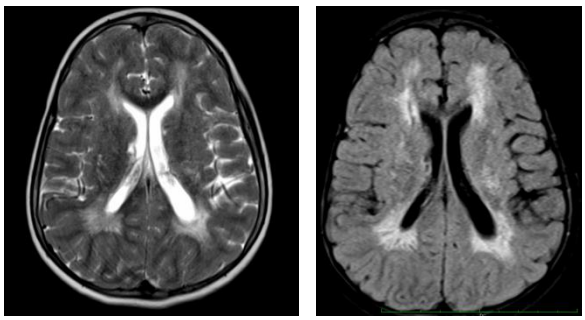


2. (d) 11months infant MRI shows ‘Racing car sign’ seen in Corpus callosal agenesis

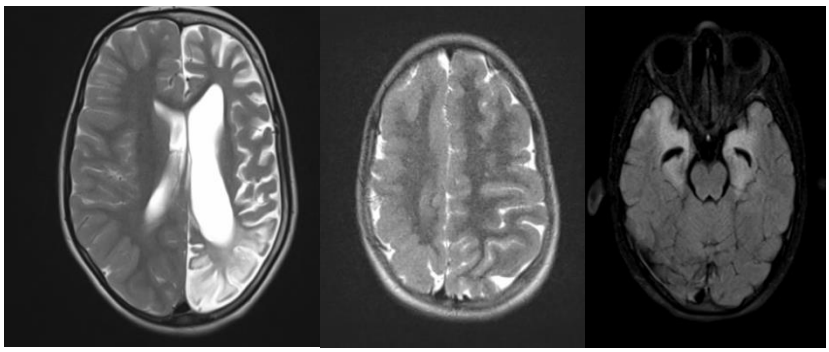


2. (e,f,g) 7months infant MRI T2 sequences show Bilateral swollen T2 hypointense thalami, enlarged optic nerves and T2 hyperintense dentate hila seen in Krabbes disease

Figure 2: Different spectrum of etiologies in infants in age group 1month -1year



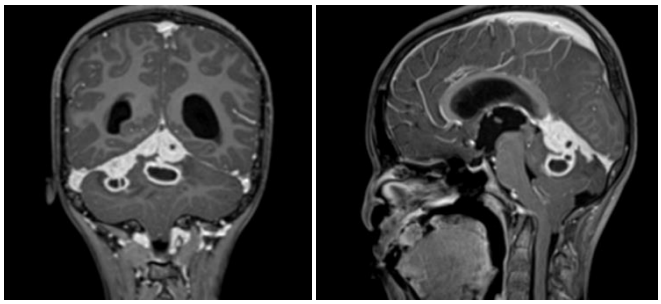
3. (a,b) MRI of 7yrs child shows bilateral symmetrical confluent T2 and FLAIR periventricular hyperintenities typical of Metachromatic leukodystrophy



3. (c) 8yrs child MRI T2 imag shows Diffuse left cerebral atrophy with ex vacuo dilatation of left lateral ventricle seen in Rasmussens encephalitis

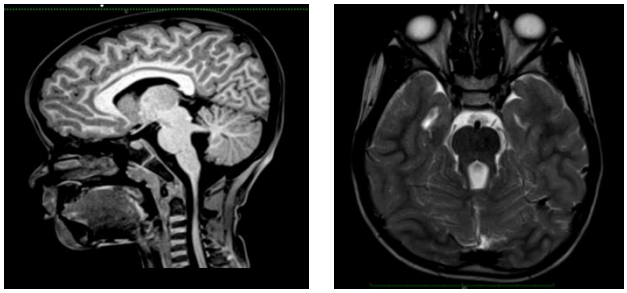
3. (d) 9yrs child MRI shows Right cerebral polymicrogyria

3. (e)10yrs child MRI shows asymmetrical bilateral medial temporal lobes involvement seen in HSV encephalitis



3. (f,g) CEMRI of 13yrs child with infection shows nodular patchy enhancement of dura and ring enhancing lesions in cerebellar hemisphere

Figure 3: Different spectrum of etiologies in children with seizures in age group 5-15yrs



4. (c,d) 4yrs child MRI shows Molar tooth appearance and thickened superior cerebellar peduncles characteristic of Joubert syndrome.

Figure 4: Different spectrum of etiologies in children of age group 1-5yrs

DISCUSSION

From the above obtained results we found the different percentage of the different parameters as bellow. As per the age group distribution 0-1 month 33.10%, 1month to 1 year is 27.02%, 1year to 5 years is 8.10% and 5 to 15 years is 31.75%. In the regards of the gender distribution male was 60.81% and female was 39.18%. With the regards of the neonates distribution as term and preterm was observed as 83.67% and 16.32% respectively. While, Munde A S et al., showed out of 100 patients, the age group of 10 to 12 years had the highest percentage of participants (33%) followed by 0 to 3 years (29%). Average age was 6.2 years and Gulati P et al., reported similar findings, with the majority of their patients falling into

the 6–12 age range. Study's mean age is marginally lower than that of Wongladarom S et al.'s, (mean age was 7 years and 5 months).[26,27] 58% of the 100 patients in our study were men, and 42% were women. 2:1 male to female ratio. Our research is consistent with that of Sanghvi J P et al., in which there were 31.7% women and 60.5% men.[26,27] Additionally, it agrees with the study conducted by Amirsalari S et al., which had 57.7% boys and 42.5% girls as participants. Neonates distribution was observed for vascular based as HII, CSVT, PAIS, bleed and combined was 59.37, 9.3, 6.25, 18.75, 6.25 respectively. As well as for metabolic, IEM, infection, normal, transient was 4.16% for 1 and 79.16 % for 19. In the table 5 for the period of 1M-1Y, for Sequelae of HII 35%, Bleed 2.5%, Leukodystrophy 05%, Neurodegenerative 10%, Infection 2.5%, Tumour 2.5% and normal was 42.50%. In the table 6 for the period of 1Y-5Y, the percentage was Sequelae of Hii 41%, Leukodystrophy 8.33%, Infection 8.33%, Anomaly 8.33%, Neurocutaneous Syndrome 8.33%, Normal 16.66% and Alerd 8.33%. In the table 6 for the period of 5Y-15Y, the percentage was Sequelae of Hii 17%, Sequelae of Infection (Rasmussen's Encephalitis And Anec) 4.25%, Infection 10.63%, Bleed 2.12%, Infarct 4.25%, Leukodystrophy 2.12%, Neurodegenerative 2.25%, Immune-Mediated 4.25%, Tumour 8.51%, Anomaly 6.38% and Normal 38.29% respectively.

The most important discovery was that utilizing a standardised scoring system alongside MR imaging of high quality for new-onset seizures indicated a higher rate of overall aberrant findings when compared to studies that were conducted in the past. From these data, a variety of generalizations and observations are possible. Instead, abnormalities in the white matter were more frequently related with the onset of the first seizure that was identified. In addition, volume loss, which was assumed to be a non-significant aberration a priori, was shown to occur more frequently than anticipated in this cohort. This finding is similar with the findings of Shinnar and colleagues.[26,27]

A study that was carried out in 2018 by Jason Coryell and William D. Gaillard discovered irregularities in 290 of the 775 children who had just been diagnosed with epilepsy. These children were all under the age of three. In 97 of these children, the anomalies included acquired injuries; in 56 of these children, cortical growth deformities were present; and in 51 of these children, diffuse brain development disorders were present. According to the findings of their research, MRI is of the biggest importance in determining the diseases.There have only been a few studies in India that have used MRI technology to study children's brains.In a developing nation like India, the purpose of this study was to determine the underlying cause of children seizures diagnosed by MRI. According to this study, the inflammatory granuloma was the most common cause of seizures, and the report suggests MRI as the primary investigation in cases of epileptic seizures.[27]

Aarti Anand and colleagues carried out a study using MRI on a total of 95 young patients at one of Nagpur's tertiary care facilities. Children with epilepsy who were younger than 12 years old were included in their research study by the authors.[28] They did not include children who had a history of trauma or who had febrile seizures in their study. In their investigation, they discovered that infection was the most common cause, accounting for 25 of the 95 children studied. It was discovered that tuberculosis was the most common infectious cause, as it was diagnosed in seven out of the twenty-five individuals who were examined. The previous study conducted by Amirsalari S et al., which had 57.7% boys and 42.5% girls as participants. 95-patient study, the majority of patients, 60% had generalised seizures at presentation, 29% had focal seizures, and 11% had seizures of an undetermined kind. Study's findings were comparable to those of a study conducted by Rasool A et al., which looked at 276 patients. Generalized seizures made up the majority of seizure types in this study (42%), followed by partial seizures (31.2%) and complex febrile seizures (23.2%). Mande A S et al., findings and the Chaurasia R et al. study, in which generalised seizures

were the primary kind of seizure in 76.7% of patients, are complementary. 85 patients (85%) in this study's total of 100 participants had abnormal MRI findings. research was comparable to that of Kuzniecky R et al., in which 84% of patients had abnormalities found by MRI. According to Resta et al., 51.3%, Wang et al., 41.7%, and Chang et al., 48.9% of patients had favourable MRI results. Greater percentage, which is likely the result of tight exclusion criteria, demonstrates the importance of patient selection in MR positive rates. In Mande A S et al., analysis, infections accounted for 35% of cases of epilepsy, whereas anoxia and hypoxia ischemic encephalopathy (HIE), other causes (14%) and abnormalities of cortical development (MCD) (8.2%) were next in line. Anoxia, hypoxic-ischemic encephalopathy, and infection were the most frequent etiologies in a study of 95 children under the age of 12 years, with Aarti Aanand et al. reporting findings that were broadly consistent with these findings. Infection was the most frequent aetiology, followed by Mesial temporal sclerosis and localised cortical dysplasia, according to Ojaswi B. Khandediya et al. In investigation, a single temporal lobe lesion caused epilepsy in 6 individuals. Other common causes included mesial temporal sclerosis (4 patients), gliomas, and gangliogliomas (1 patient each). research was consistent with that of J. D. Grattan Smith et al., who found that in 30 out of 53 children (57%), mesial temporal sclerosis was the most frequent cause of temporal lobe epilepsy, followed by tumours in 8 (15%), cavernous angiomas in 1 (1.8%), and ectopic grey matter in 1 (1.8%) of patients. According to Sales LV et al., out of 31 individuals with temporal lobe epilepsy, mesial temporal sclerosis, dysplasia, tumours, and arachnoid cysts were the most common pathologies.[28,29]

In the Gulati P, Jena A.N. et al., 8 study, of 345 patients with aberrant MRI results, 98 (28.1%) had tuberculoma, which was followed by 86 (24.9%) for neurocysticercosis. According to a study by Chaurasia R et al., neurocysticercosis (30.3%), encephalitis (7.9%), and CNS tuberculosis were the most common causes of epilepsy. Our research contrasts with that of Parihar Ravi Kumar et al., who found that neurocysticercosis (55.81%) and tuberculoma (29.91%) were the two most common etiologies. Focal cortical dysplasia was the most prevalent pathology observed in 16 patients (29.6%) of the 24 patients with malformations of cortical development in the study by Mittal GK et al., followed by schizencephalyin8(14.8%), polymicrogyriain8(14.8%), and DNETin6(11.1%). Similar results were seen in the Mande A S et al., investigation. The most frequent etiological factor identified in this study for the age group 0-3 years was perinatal asphyxia, seen in 55% of cases, followed by CNS infection in 15%, abnormalities of the central nervous system in (9%), head injuries in (8%), congenital, and preterm in (5%). Also it was consistent with that of Parihar Ravi Kumar et al., who examined the causes of partial seizures in children between the ages of 28 days and 18 years.[28,29,30] Infection was the most frequent cause of illness in 6 patients (66.6%) in the age range of 28 days to 5 years, 18 patients (85.7%) in the range of >5 to 10 years, and 12 patients (92.3%) in the range of >10 to 18 years. With growing age group, infection had considerable load in developing epilepsy. Our study also refers to the Gulati P et al. study, in which 170 children with chronic seizures were examined, regarding the aetiology in the older age range. Age groups were divided into the following groups: 0–1 year, 1-3 year, 3-6 year, and 6–12 year. The etiologies were divided into four groups: atrophy, vascular, infections (including tuberculomas, neurocysticercosis, and meningitis), and other causes.[30] In the age group of 6 to 12 years, infection was the most frequent cause, seen in 51.1% of cases, followed by other in 16.4%. Infection was seen in 4.7%, 4.1%, and 3% of children in the age groups 0-1, 1- 3, and 3-6 years, respectively.

Their research was found to be consistent with the findings of a previous study carried out by Chaurasia et al., Kumar et al., and Gulati et al., in which researchers likewise identified infection as the primary driving factor.[31,32] The analysis places a significant amount of

emphasis on the utilisation of MRI as an imaging technology for the assessment of seizure disorders. An examination of 366 children who had been given a diagnosis of epilepsy was carried out by Andrew J. Kalnin, MD, and colleagues. In their investigation of seizures that were not brought on by fever, they made use of a method known as non-contrast 1.5 Tesla MRI. Mesial temporal sclerosis, unilateral and bilateral heterotopias, cortical dysplasia, neurocutaneous disorders, and a few neoplasms were the most prevalent structural anomalies that were found. According to the findings of their research, MRI is a very helpful tool for showing the degree, the shape, and the distribution of the lesions that are associated with seizures.[32,33]

CONCLUSION

After we have finished our research, we will have a better understanding of how successful magnetic resonance imaging is in detecting lesions that are the underlying cause of seizures in paediatric children and how well it correlates with the findings of MR Spectroscopy. This will be the case because we will have a better grasp of how successful magnetic resonance imaging is in detecting lesions that are the underlying cause of seizures in paediatric children. It will be vital to establish a balance between the potential benefits of MRI in discovering more subtle imaging results and the requirement to avoid unnecessarily contributing to the rise in the price of medical imaging. Striking this balance will be essential if a solution is to be found.

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