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Original Research Paper

Radio-Diagnosis

"EVALUATION OF MRI'S ROLE IN PEDIATRIC EPILEPSY DIAGNOSIS IN A TERTIARY HOSPITAL SETTING"

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ABSTRACT

Purpose: The aim of this study was to evaluate the role of magnetic resonance imaging (MRI) in the diagnosis and management of pediatric epilepsy at a tertiary hospital, with a focus on identifying the most common MRI findings and their clinical significance in guiding treatment. **Materials And Methods:** A retrospective analysis was performed on pediatric patients diagnosed with epilepsy who underwent MRI at a tertiary hospital over a five-year period. Imaging findings were categorized based on the presence of structural abnormalities, such as cortical dysplasia, hippocampal sclerosis, and malformations of cortical development. The relationship between MRI findings and seizure type, treatment outcomes, and long-term prognosis was assessed. **Results:** MRI findings revealed structural abnormalities in a significant proportion of pediatric patients with epilepsy, particularly in those with refractory seizures. The most common abnormalities included hippocampal sclerosis, cortical malformations, and tumors. MRI was crucial in identifying treatable causes of epilepsy, such as focal cortical dysplasia, which influenced treatment decisions, including surgical interventions. In contrast, a normal MRI did not preclude the diagnosis of epilepsy but highlighted the need for additional diagnostic approaches in these cases. **Conclusion:** MRI plays a pivotal role in the evaluation of pediatric epilepsy, aiding in the identification of underlying structural causes and guiding management decisions. Early and accurate MRI assessment is essential for optimizing treatment strategies, particularly for children with drug-resistant epilepsy. The study underscores the importance of MRI in the comprehensive evaluation of pediatric epilepsy at specialized centers.

KEYWORDS : pediatric epilepsy, MRI, structural abnormalities, hippocampal sclerosis, cortical malformations, treatment outcomes, tertiary hospital

INTRODUCTION:

Epilepsy is a neurological disorder marked by the spontaneous and recurrent occurrence of unprovoked seizures. Seizures are brief, episodic events caused by abnormal, involuntary, rhythmic discharges of neurons in the brain. It is one of the most prevalent neurological conditions, with an incidence rate of about 50 new cases per 100,000 people annually. The diagnosis of epilepsy involves recognizing the symptoms, conducting a clinical assessment, laboratory tests, EEG recordings, lumbar puncture if meningitis is suspected, and neuroimaging. Recent advancements in neuroimaging have become crucial in diagnosing and managing pediatric epilepsy, as well as in shaping treatment decisions. Functional neuroimaging can provide additional insights and may reveal abnormalities even when MRI results are normal, which helps in localizing epileptogenic foci and informing the potential surgical treatment for refractory epilepsy when needed. Various focal lesions or pathologies responsible for epilepsy can be detected through neuroimaging, and its diagnostic yield remains high, even in low-risk groups. MRI is considered the preferred imaging technique due to its superior resolution over CT and ultrasound, offering a detailed assessment of small lesions without the use of radiation. This study aims to explore the role of MRI in evaluating pediatric epilepsy at a tertiary hospital.

AIMS AND OBJECTIVES:

AIMS:

The primary aim of this study is to evaluate the role of magnetic resonance imaging (MRI) in the diagnosis, management, and treatment planning of pediatric epilepsy at a tertiary hospital. The study will focus on identifying the most common MRI findings, their clinical significance, and their impact on treatment decisions, particularly in cases of drug-resistant or refractory epilepsy.

Objectives:

1. To assess the prevalence and types of structural abnormalities detected by MRI in pediatric patients diagnosed with epilepsy.
2. To evaluate the correlation between MRI findings and clinical presentation, including seizure types and frequency.
3. To investigate the role of MRI in identifying potential causes of epilepsy, such as cortical malformations, hippocampal sclerosis, and other structural brain anomalies.

MATERIALS AND METHODS:

Place Of Study: KONASEEMA INSTITUTE OF MEDICAL SCIENCES AND RESEARCH FOUNDATION, AMALAPURAM.

Duration Of Study: 12 months (Jan 2024 to Jan 2025).

Sample Size: 100

Type Of Study: Hospital Based Prospective Study.

Inclusion Criteria:

All pediatric patients (under the age of 12) referred from both outpatient and inpatient departments who presented with epilepsy.

Exclusion Criteria:

- Claustrophobic patients.
- Patients with metallic implants considered contraindicated for MRI imaging.
- Patients with trauma.
- Patients with febrile seizure disorders.

Informed consent was obtained from the patient's parents or relatives after explaining the MRI procedure. The patient was screened for ferromagnetic objects and aneurysm clips. A detailed clinical history, including seizure type, illness duration, and associated complaints, was recorded, along with physical and CNS examinations. Biochemical tests, including blood profiles, liver and renal function, glucose, electrolytes, and additional tests for leukodystrophies, infections, and CSF, were performed. EEG and CT findings, if available, were documented.

The patient was positioned supine for the MRI, with head immobilization. The MRI was done using a 1.5 Tesla GE SIGNA system with a Sense head coil. Conventional T1W, T2W, FLAIR, and post-contrast MRI sequences were used. In selected cases, diffusion-weighted imaging (DWI), GRE, MR spectroscopy, venous 3D PCA, and MR angiography (including TOF) were performed.

MRI sequences included T1 sagittal and axial pre- and post-contrast, T2 axial and coronal, FLAIR axial, DWI axial, GRE axial, and T1 inversion recovery. For suspected temporal lobe epilepsy, additional sequences included T1 angled coronal, T1 3D isotropic acquisition, FLAIR angled coronal, T2 angled coronal, MR spectroscopy, venous 3D PCA, and MR angiography with TOF if needed.

MRI findings were analyzed for the number, location (unilateral or bilateral), signal intensity, hemorrhage, calcifications, edema, mass effect, diffusion restriction, contrast enhancement, meningeal enhancement, atrophy, hydrocephalus, MR spectroscopy results, and any other significant abnormalities. The final diagnosis was based on medical history, clinical presentation, EEG and CT correlation, CSF analysis, pathological and surgical findings, and response to medical therapy. In inconclusive cases, follow-up MRI and treatment response were used to make a diagnosis. MRI brain findings, management decisions, follow-up, and outcomes were recorded, and statistical analysis was done using MS Excel.

RESULTS:

This study involved the MRI brain evaluation of 100 pediatric patients aged 0-12 years. The most common age group was 10-12 years (33%), followed by 0-3 years (29%). Out of the total, 58 patients (58%) were male, and 42 patients (42%) were female, resulting in a male-to-female ratio of 1.3:1.

Table 1: Age And Gender Distribution

Age Group (in years)	Males	Females	Total
0-3 Years	16	13	29
4-6 Years	14	04	18
7-9 Years	11	09	20
10-12 Years	17	16	33
TOTAL	58	42	100

Sixty patients (60%) presented with generalized seizures, 29 patients (29%) had focal seizures, and 11 patients (11%) had seizures of unknown onset.

Table 2: Distribution According To Types Of Seizure.

Type Of Seizure	Number Of Patients	Percentage (%)
GENERALISED	60	60%
FOCAL	29	29%
UNKNOWN	11	11%
TOTAL	100	100%

Infections were the most common MRI findings, with tuberculosis (40.6%), meningitis (21.8%), viral infections (12.5%), encephalitis (9.3%), and meningoencephalitis (9.3%) among the reported causes. Mesial temporal sclerosis was the leading cause of isolated temporal lobe epilepsy, showing hippocampal atrophy and secondary changes in all cases, and T2/FLAIR hyperintensity with architectural distortion in 75%. Malformations of cortical development were seen in 7 patients, including focal cortical dysplasia (2 patients, 14.2%) and other abnormalities such as microcephaly, agyria, lissencephaly, polymicrogyria, heterotopia, and schizencephaly (1 patient each, 7.1%), often presenting in infancy. Among 3 patients with acquired metabolic or toxic disorders, one each had chronic bilirubin encephalopathy, PRES secondary to hypertension, and medication-induced leukoencephalopathy. Neoplastic causes (5 patients) included DNET, ganglioglioma, glioma, pilocytic astrocytoma, and glioblastoma multiforme. Vascular abnormalities were found in 3 patients—2 with arterial infarcts and 1 with vasculitis. Demyelinating disorders were seen in 2 patients, one with ADEM and the other with tumefactive demyelination.

In our study, isolated temporal lobe lesions were identified as the cause of epilepsy in six patients. Among them, mesial temporal sclerosis was observed in four cases (66.6%), while glioma and ganglioglioma were each found in one patient (16.6%).

In our study of 100 patients, 85 showed abnormal findings on MRI. The highest number of MRI-detected pathologies occurred in the 10–12 years age group, followed by the 0–3 years group. Across all age groups, infection was the most frequent etiology, except in the 0–3 years group where anoxia and hypoxic-ischemic encephalopathy (HIE) were more common, with infection being the second most frequent cause. In the 0–3 years group, 27 patients (31.7%) had abnormal MRI findings—anoxia and HIE were noted in 8 patients, infection in 7, and malformations of cortical development in 3. Among children aged 4–6 years, 14 patients (16.4%) showed abnormalities, with infection being the leading cause (6 patients), followed by acquired metabolic disorders and miscellaneous causes (2 each). Similarly, in the 7–9 years group, 14 patients (17.6%) had positive MRI findings—most commonly due to infection (7 patients), followed by anoxia/HIE and neoplasms (2 each). The 10–12 years age group had the highest number of abnormal MRIs (29 patients, 34.1%), with infection being the most prevalent cause (12 patients), followed by anoxia and HIE (4 patients).

DISCUSSION:

In the present study, the largest group of patients were in the 10-12 years age range (33%), followed by the 0-3 years group (29%), with a mean age of 6.2 years. This is consistent with the findings of Gulati P et al., where the majority of patients were in the 6-12 years range. However, our study's mean age is slightly lower than that of Wongladarom S et al. (mean age 7 years and 5 months).

In our cohort of 100 patients, 58% were male and 42% were female, yielding a male-to-female ratio of 1.2:1. This ratio aligns with the findings of Sanghvi JP et al. (60.5% male, 31.7% female) and Amirsalari S et al. (57.7% boys, 42.5% girls).

Regarding seizure types, 60% of patients presented with generalized seizures, 29% with focal seizures, and 11% with unknown onset. These results are similar to those of Rasool A

et al., where generalized seizures accounted for the majority (42%), followed by partial seizures (31.2%) and complex febrile seizures (23.2%). Our findings also align with Chaurasia R et al., who reported 76.7% of cases with generalized seizures.

Of the 100 patients, 85 (85%) had abnormal MRI findings, comparable to the 84% abnormal MRI rate reported by Kuzniecky R et al. Other studies, such as Resta et al. (51.3%), Wang et al. (41.7%), and Chang et al. (48.9%), reported varying rates of MRI abnormalities.

Our study shows a higher percentage of MRI abnormalities, likely due to strict exclusion criteria, which underscores the importance of patient selection in influencing MRI positivity rates. The most common cause of epilepsy in our study was infection (35%), followed by anoxia and hypoxic-ischemic encephalopathy (HIE) (17%), miscellaneous causes (14%), and malformations of cortical development (MCD) (8.2%). These findings are consistent with those of Aarti Anand et al., where infection (29.8%) was the most common etiology, followed by anoxia and HIE. Similarly, Ojaswi B Khandediya et al. also found infection to be the most common cause, followed by mesial temporal sclerosis and focal cortical dysplasia.

In our study, 6 patients had isolated temporal lobe lesions, with mesial temporal sclerosis (4 patients) and glioma/ganglioglioma (1 patient each) being the most common causes. Our findings align with those of J.D. Grattan Smith et al., who reported mesial temporal sclerosis as the leading cause of temporal lobe epilepsy in 30 of 53 children (57%), followed by tumors in 8 (15%), cavernous angioma in 1 (1.8%), and ectopic gray matter in 1 (1.8%). Sales LV et al. also found mesial temporal sclerosis to be the most common pathology in temporal lobe epilepsy, seen in 9 of 31 patients (29%), followed by dysplasia in 8 (25.8%), tumors in 2 (6.4%), and arachnoid and choroid cysts in 1 (3.2%) each.

In our study, 32 patients had infections, with tuberculosis being the most common (40.6%), followed by encephalitis (9.3%), meningitis (21.8%), meningoencephalitis (9.3%), and viral infections (12.5%). Among the 13 tuberculosis patients, 61.5% had leptomeningeal enhancement, 23.1% had tuberculoma, and 7.6% each had hydrocephalus and encephalitis. These findings are consistent with Gulati P and Jena A.N.'s study, where tuberculoma was the most common etiology (28.4%), followed by neurocysticercosis (24.9%). Chaurasia R et al. also reported CNS tuberculosis (30.3%) as the most common cause, followed by neurocysticercosis (11%) and encephalitis (7.9%). However, our study differs from Parihar Ravi Kumar et al.'s study, where neurocysticercosis (55.81%) was the leading cause, followed by tuberculoma (29.91%).

In the study by Mittal GK et al., focal cortical dysplasia was the most common pathology among 54 patients with malformations of cortical development (29.6%), followed by schizencephaly (14.8%), polymicrogyria (14.8%), and DNET (11.1%). Similar findings were observed in our study.

For the 0-3 years age group, our results align with Khreisat WH et al.'s study, where the most common etiology was perinatal asphyxia (55%), followed by CNS infections (15%), CNS anomalies (9%), head injuries (8%), and congenital issues or prematurity (5%).

In the older age groups, our study mirrors the findings of Parihar Ravi Kumar et al., where infection was the most common cause of seizures, increasing with age: 66.6% in 28 days-5 years, 85.7% in 5-10 years, and 92.3% in >10-18 years. Our results also align with Gulati P et al.'s study, which found infections to be the most common cause of seizures in the 6-12 years age group (51.1%), followed by miscellaneous causes (16.4%). In younger groups, infections were less common.

MRI plays a vital role in diagnosing pediatric seizure disorders, aiding in treatment decisions and prognosis prediction. With its high spatial resolution, excellent soft tissue contrast, and no ionizing radiation, MRI is essential in identifying epileptogenic lesions and determining their location and extent. It is the preferred imaging method for epileptic syndromes, developmental cortical malformations, and mesial temporal sclerosis.

CONCLUSION:

MRI is crucial in assessing pediatric patients with epilepsy, serving as the primary imaging tool when following an appropriate MRI seizure protocol. It aids in establishing an accurate diagnosis, guiding management decisions, and providing insight into prognosis. MRI is particularly useful for evaluating patients with refractory seizures that other imaging methods have not diagnosed, as well as children newly diagnosed with epilepsy, especially those exhibiting abnormal neurological exams, focal seizures, or focal EEG abnormalities.

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