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Original Article

Role of MRI in Evaluation of Epilepsy in a Tertiary Care Center – A Descriptive Study

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ABSTRACT

Introduction: Epilepsy is a chronic neurological disorder characterized by recurrent unprovoked seizures due to abnormal neuronal activity. Magnetic resonance imaging is an important non-invasive modality for identifying structural epileptogenic lesions and supporting etiological diagnosis, seizure localization, treatment planning, and prognostic assessment.
Aim and Objective: To evaluate the role of MRI in epilepsy patients attending a tertiary care center and to identify the spectrum of structural abnormalities associated with seizure disorders.
Materials and Methods: This descriptive study was conducted at Sapthagiri Institute of Medical Sciences and Research Center over 18 months, from May 2024 to October 2025. A total of 100 patients of both sexes presenting with generalized tonic-clonic, focal, or new-onset seizures were included. Patients with febrile, drug-induced, or traumatic seizures were excluded. MRI findings were analyzed for structural abnormalities and correlated with demographic variables.
Results: The majority of patients belonged to the 21 to 40 years age group (39%), followed by 41 to 60 years (32%). The mean age was 40.21 years. Males constituted 56% and females 44%. MRI was positive in 26% of patients and negative in 74%. Among MRI-positive cases, post-infective lesions were the most common finding (38.5%), followed by mesial temporal sclerosis and tumors, each contributing 23.1%. Vascular malformations accounted for 7.7%, while focal cortical dysplasia and combined mesial temporal sclerosis with tumor each accounted for 3.8%. Sex and age were not significantly associated with MRI positivity.
Conclusion: MRI is a valuable tool in epilepsy evaluation, detecting clinically important structural lesions in one-fourth of patients and helping guide etiological diagnosis and management.

Keywords: Epilepsy; MRI; Seizure; Mesial temporal sclerosis; post-infective lesions.

INTRODUCTION

Epilepsy is one of the most common chronic neurological disorders and is characterized by a persistent tendency of the brain to generate recurrent unprovoked seizures. These seizures result from abnormal, excessive, or synchronous neuronal activity and may present with motor, sensory, autonomic, cognitive, emotional, or behavioral manifestations (1). The World Health Organization estimates that epilepsy affects around 50 million people worldwide, making it a major public health problem with significant medical, social, psychological, and economic consequences. Nearly 80% of people with epilepsy live in low- and middle-income countries, where delayed diagnosis, treatment gaps, stigma, and limited access to advanced investigations remain important challenges (2).

The diagnosis of epilepsy is primarily clinical, supported by electroencephalography, laboratory evaluation, and neuroimaging when indicated. While electroencephalography helps in identifying epileptiform discharges and classifying seizure types, neuroimaging plays a crucial role in detecting structural brain abnormalities that may act as epileptogenic substrates (3). Among available imaging modalities, magnetic resonance imaging has emerged as the investigation of choice for structural evaluation of epilepsy because of its excellent soft-tissue contrast, multiplanar capability, absence of ionizing radiation, and superior sensitivity for subtle cortical and subcortical lesions (4). Compared with computed tomography, MRI is better suited for identifying developmental malformations, mesial temporal abnormalities, low-grade tumors, gliosis, vascular malformations, post-traumatic sequelae, and infective or inflammatory lesions associated with seizures (5).

The role of MRI in epilepsy extends beyond simple lesion detection. It contributes to etiological classification, seizure localization, prognosis, treatment planning, and surgical decision-making. Identification of a structural lesion may change the diagnostic category from epilepsy of unknown cause to structural epilepsy, thereby guiding targeted management (6). For example, detection of mesial temporal sclerosis, focal cortical dysplasia, dysembryoplastic neuroepithelial tumor, ganglioglioma, cavernous malformation, or post-infarct gliosis can help explain seizure onset, predict drug resistance in selected patients, and identify candidates for epilepsy surgery (7). The International League Against Epilepsy has emphasized that structural MRI is of fundamental importance in the diagnosis and treatment of epilepsy, particularly when surgery is being considered (6).

MRI is especially valuable in patients with focal seizures, abnormal neurological examination, developmental delay, refractory epilepsy, seizure onset at extremes of age, change in seizure pattern, or suspicion of an underlying structural lesion (8). It is also important in new-onset epilepsy when clinical features suggest a focal origin or when seizures are not adequately explained by metabolic or systemic factors. NICE guidance on epilepsy recommends appropriate specialist assessment after a first suspected seizure and includes MRI as part of diagnostic evaluation to detect relevant structural abnormalities in people with epilepsy (9).

A major advantage of MRI in epilepsy evaluation is its ability to detect subtle epileptogenic abnormalities that may be missed on routine imaging, especially when standard MRI protocols are used. Dedicated epilepsy MRI protocols include high-resolution 3D T1-weighted imaging, axial and coronal T2-weighted sequences, FLAIR imaging, susceptibility-sensitive sequences, and thin coronal sections perpendicular to the hippocampal axis (6). These improve detection of hippocampal atrophy, signal change, cortical thickening, grey-white matter blurring, abnormal sulcation, old hemorrhage, calcification-related susceptibility, gliosis, and small tumors. Mesial temporal sclerosis is a key MRI-detectable cause of focal epilepsy, showing hippocampal atrophy, T2/FLAIR hyperintensity, loss of internal architecture, and temporal horn dilatation. Its recognition is important because selected drug-resistant cases may benefit from surgery. MRI also detects focal cortical dysplasia, commonly seen in children and young adults, with cortical thickening, abnormal gyration, grey-white blurring, and transmantle signal changes. Additionally, MRI identifies acquired causes such as neurocysticercosis, tuberculoma, post-traumatic gliosis, stroke, vascular malformations, abscess, granulomas, and CNS infection sequelae (10). In pediatric epilepsy, MRI has additional importance because many epilepsies are related to congenital malformations of cortical development, perinatal injury, metabolic disorders, neurocutaneous syndromes, or developmental brain abnormalities. Early structural diagnosis may influence treatment planning, developmental assessment, genetic evaluation, counselling, and long-term follow-up (11). In adults and elderly patients, MRI is useful for detecting tumours, stroke-related lesions, hippocampal sclerosis, degenerative changes, vascular malformations, and other acquired structural causes. Thus, MRI contributes across all age groups, although the likely Etiologies of epilepsy vary according to age, clinical presentation, and seizure semiology. MRI findings should always be interpreted in correlation with clinical history, seizure pattern, neurological examination, EEG findings, and other relevant investigations. A structural lesion on MRI does not automatically confirm epileptogenicity unless its site and features match the clinical and electrophysiological data. Similarly, a normal MRI does not exclude epilepsy, as some abnormalities may be microscopic, genetic, functional, or below conventional imaging resolution. Overall, MRI is an indispensable non-invasive tool for diagnosis, classification, treatment planning, surgical evaluation, prognostication, and follow-up in comprehensive epilepsy care (12).

The present study aims to evaluate the role of magnetic resonance imaging in the assessment of epilepsy by identifying the various etiological factors responsible for seizure disorders. It also seeks to analyze the characteristic MRI features associated with refractory and focal seizures, thereby helping in accurate diagnosis, lesion localization, clinical correlation, and appropriate management planning.

MATERIALS AND METHODS

This descriptive study was conducted at Sapthagiri Institute of Medical Sciences and Research Center over 18 months, from May 2024 to October 2025. The sample size was calculated using the formula $n = 4pq/d^2$, based on a 40% proportion of epileptic patients with MRI findings, 60% q value, and 10% absolute precision, giving a required sample size of 96, rounded to 100 patients. The study included patients of both sexes with generalized tonic-clonic, focal, or new-onset seizures, including children with appropriate consent or assent. Patients with febrile, drug-induced, or traumatic seizures will be excluded.

RESULTS

The majority of patients belonged to the 21–40 years' age group, comprising 39% of the study population, followed by the 41–60 years' group at 32%. Younger patients and elderly participants constituted 15% and 14%, respectively. The mean age was 40.21 years with a wide standard deviation, indicating representation of both younger and older patients. A male predominance was observed, with males accounting for 56% and females comprising 44% of the total study population.

Table 1: MRI Findings (Positive/Negative)

MRI Finding	Frequency (n)	Percentage (%)
Negative	74	74.0
Positive	26	26.0
Total	100	100.0

In the present table, MRI was negative in 74% of epilepsy patients and positive in 26%. This shows that most cases had no detectable structural abnormality on MRI. However, one-fourth of patients showed positive MRI findings, indicating its value in identifying underlying brain lesions. Thus, MRI is useful for etiological evaluation and guiding further management in epilepsy.

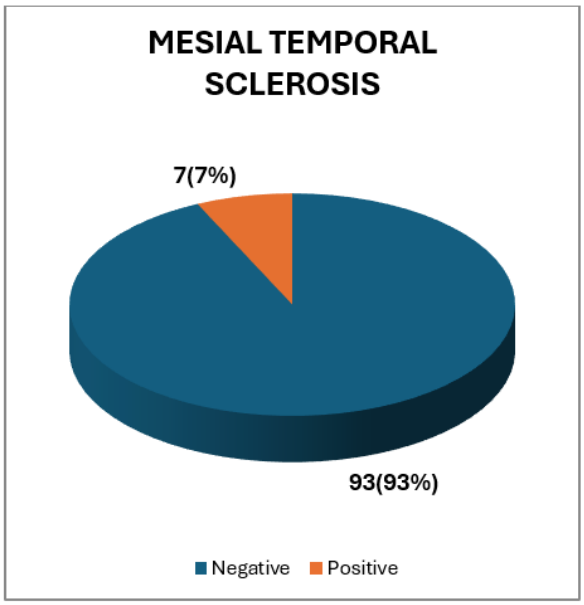


Figure 1: Distribution of Mesial Temporal Sclerosis in the Study Population (n = 100)

In the present figure, mesial temporal sclerosis was absent in 93% of patients and present in 7%. This shows that only a small proportion of epilepsy cases had MRI evidence of mesial temporal sclerosis. However, its detection is important because it is a recognized structural cause of focal epilepsy. Thus, MRI helps identify clinically significant lesions even when their frequency is low.

Table 2: Focal Cortical Dysplasia

Finding	Frequency (n)	Percentage (%)
Negative	99	99.0
Positive	1	1.0
Total	100	100.0

In the present table, focal cortical dysplasia was absent in 99% of patients and present in only 1%. This indicates that focal cortical dysplasia was an uncommon MRI finding in the study population. However, its identification is important as it may represent a structural cause of focal epilepsy. Thus, MRI helps detect even rare epileptogenic abnormalities that may influence further management.

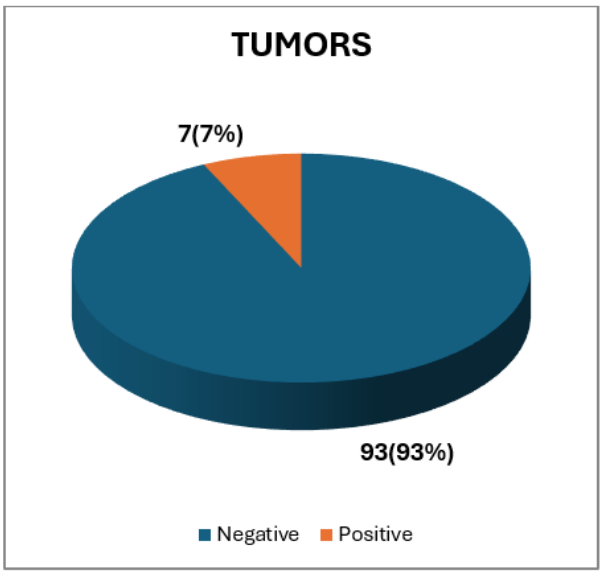


Figure 2: Distribution of Tumors in the Study Population (n = 100)

In the present figure, tumors were absent in 93% of patients and present in 7%. This indicates that tumor-related epilepsy was seen in a small but important proportion of cases. Detection of tumors on MRI is clinically significant because it helps identify a structural and potentially treatable cause of seizures. Thus, MRI plays an important role in etiological diagnosis and further management planning.

Table 3: Post-Infective Lesions

Finding	Frequency (n)	Percentage (%)
Negative	90	90.0
Positive	10	10.0
Total	100	100.0

In the present table, post-infective lesions were absent in 90% of patients and present in 10%. This indicates that post-infective changes formed a notable structural MRI finding in epilepsy cases. Their detection is important because previous CNS infection can act as an epileptogenic focus. Thus, MRI helps identify post-infective sequelae that may guide etiological diagnosis and management.

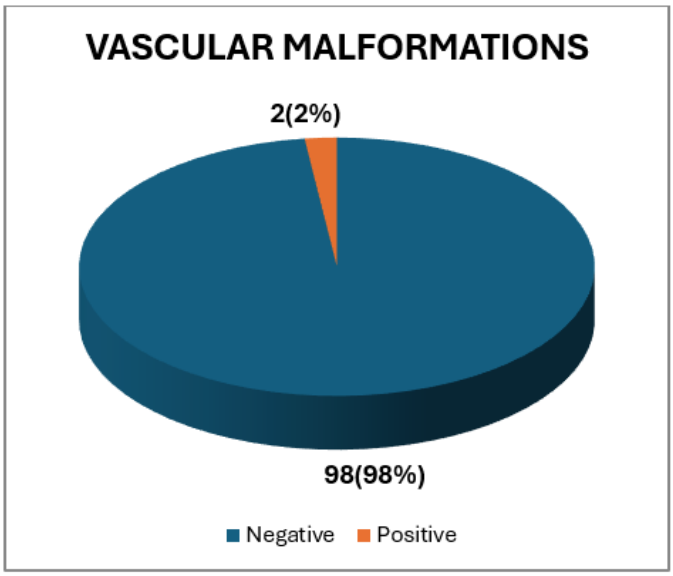


Figure 3: Distribution of Vascular Malformations in the Study Population (n = 100)

In the present figure, vascular malformations were absent in 98% of patients and present in 2%. This indicates that vascular malformations were an uncommon MRI finding in epilepsy cases. However, their detection is clinically important as they may act as structural epileptogenic lesions. Thus, MRI helps identify rare but significant vascular causes of seizures.

Table 4: Comparison of Age with MRI FindingsFrequency Table

Sex	MRI Negative n (%)	MRI Positive n (%)	Total
Male	44 (78.6%)	12 (21.4%)	56
Female	30 (68.2%)	14 (31.8%)	44
Total	74 (74.0%)	26 (26.0%)	100

Statistical Test

Test	Value
Chi-square (χ^2)	1.382
df	1
p-value	0.240

In the present table, MRI positivity was slightly higher among females (31.8%) than males (21.4%). However, the association between sex and MRI findings was statistically non-significant ($\chi^2 = 1.382$, $p = 0.240$). This indicates that MRI abnormalities were not significantly influenced by sex in the study population. Thus, both male and female epilepsy patients require equal MRI-based evaluation.

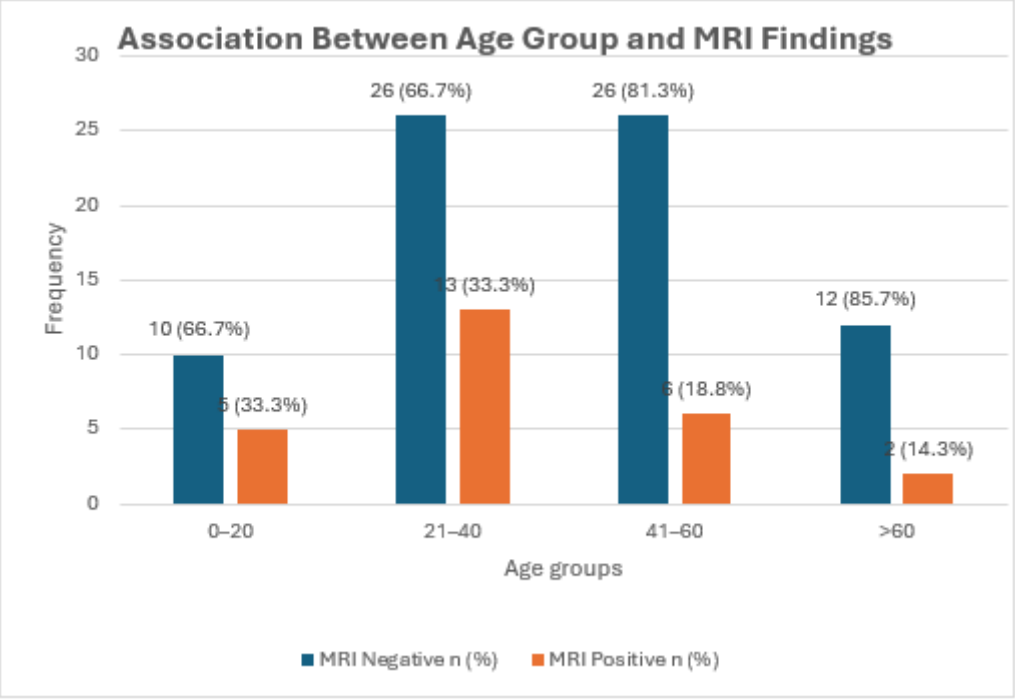


Figure 4: Association Between Age Group and MRI Findings in the Study Population *(n = 100)*

In the present figure, MRI positivity was higher in the 0 to 20 and 21 to 40 years age groups, each showing 33.3% positivity. Positivity gradually decreased in older age groups, with 18.8% in 41 to 60 years and 14.3% in >60 years. This suggests relatively more MRI-detectable abnormalities among younger epilepsy patients. However, age group did not show a statistically significant association with MRI findings.

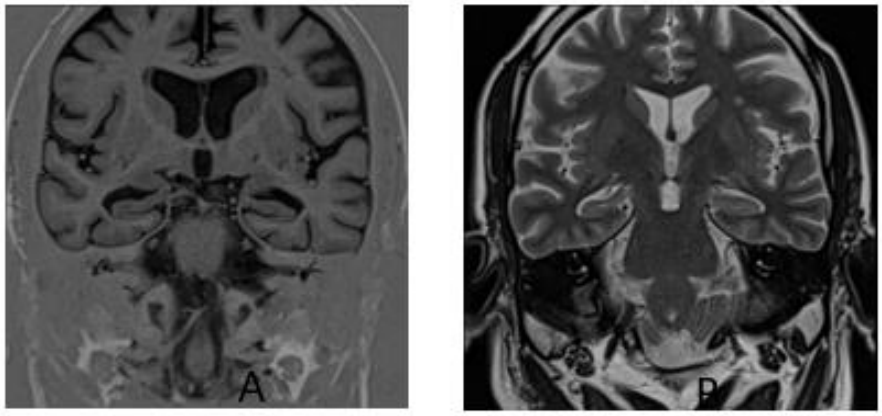
Table 5: Distribution of MRI Positive finding

MRI Finding Exact	Frequency (n)	Percentage (%)

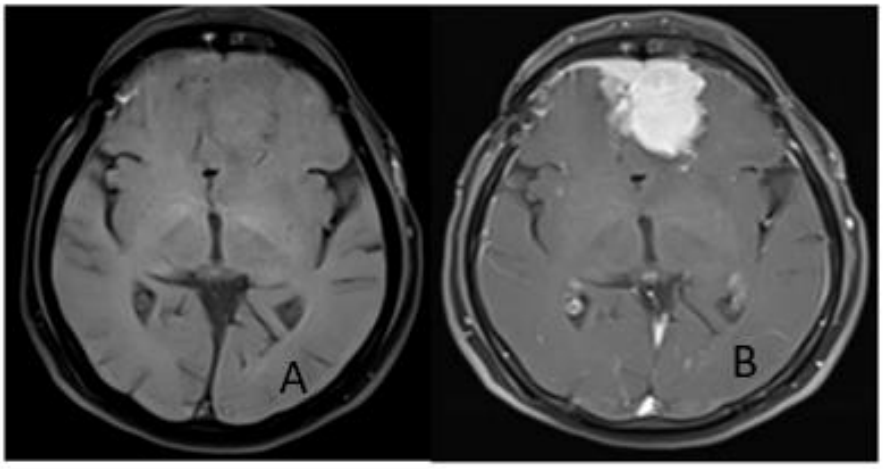
Focal Cortical Dysplasia	1	3.8
Mesial Temporal Sclerosis	6	23.1
MTS + Tumor	1	3.8
Post-infective	10	38.5
Tumors	6	23.1
Vascular Malformations	2	7.7
Total	26	100.0

In the present table, among MRI-positive cases, post-infective lesions were the most common finding (38.5%). Mesial temporal sclerosis and tumors each accounted for 23.1%, followed by vascular malformations (7.7%). Focal cortical dysplasia and combined MTS with tumor were least common, each contributing 3.8%, indicating varied structural causes of epilepsy on MRI.

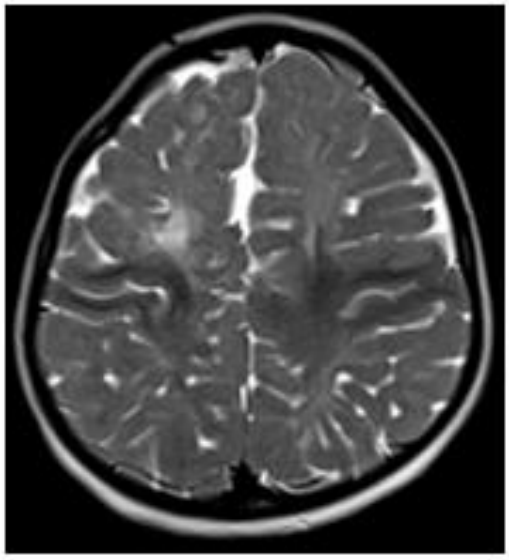
RELATED IMAGES



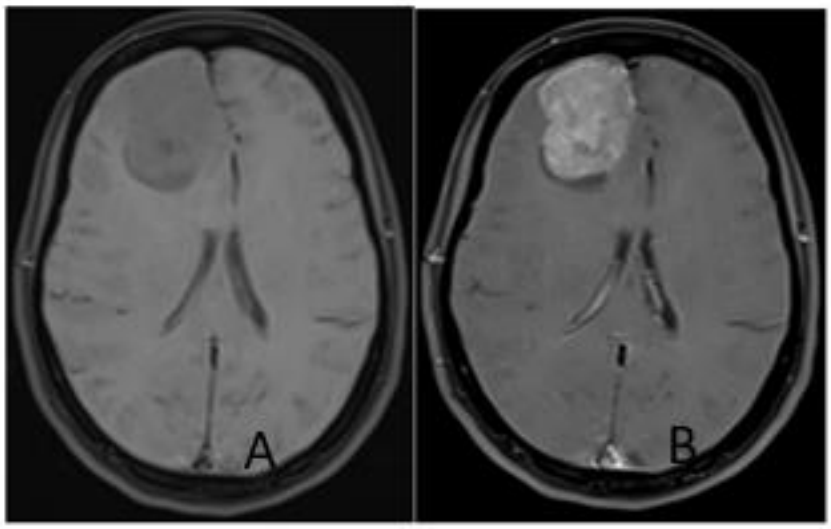
[Figure 1 A, B]. Coronal FLAIR and T2W MRI brain images showing mesial temporal sclerosis A) Left mesial temporal sclerosis B) Right mesial temporal sclerosis.



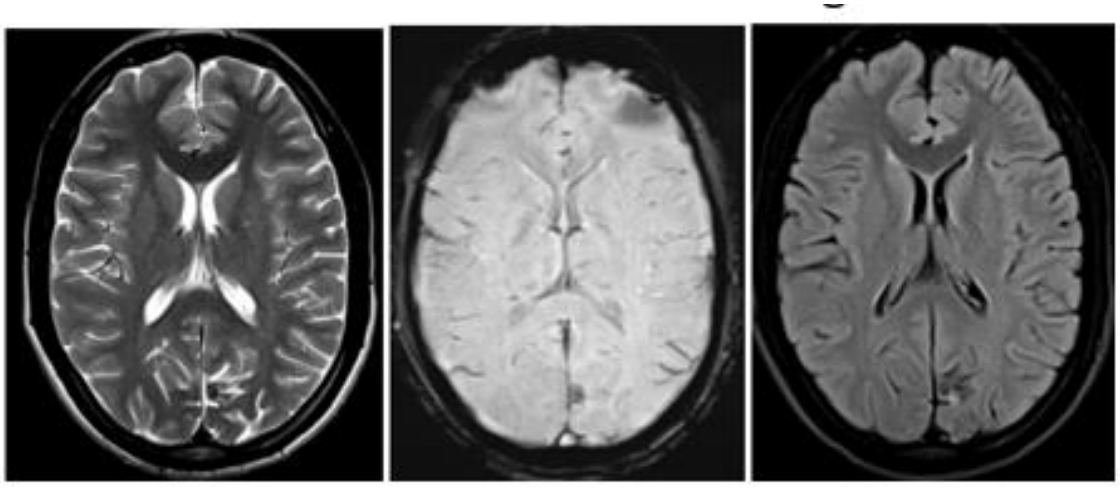
[Figure 2 A, B]. Axial T1 pre and post contrast MRI brain images showing left basifrontal meningioma with avid enhancement.



[Figure 3]. Axial T2W MRI brain image showing right focal cortical dysplasia



[Figure 4 A, B]. Axial T1W MRI brain pre and post contrast images showing right frontal meningioma with heterogeneous enhancement.



[Figure 5 A, B]. Axial T2, SWI and FLAIR MRI brain images showing granular nodular stage of neurocysticercosis at the lingular gyrus of left occipital lobe.

DISCUSSION

The present study evaluated the role of MRI in epilepsy patients attending a tertiary care center and demonstrated that MRI is a valuable non-invasive tool for identifying structural epileptogenic abnormalities. The cohort was mainly composed of young and middle-aged adults, with the highest proportion in the 21 to 40 years age group, followed by 41 to 60 years, and a mean age of 40.21 ± 19.34 years. This differed from predominantly pediatric studies by Raafat BM et al. (2024) (13), Alyoubi RA et al. (2023) (14), Elmi AM et al. (2024) (15), and Mousa W et al. (2025) (16), but was closer to adult-based observations by Shivde S et al. (2025) (17). A slight male predominance was observed, with 56% males and 44% females, comparable to the male predominance reported by Elmi AM et al. (2024) (15), Raafat BM et al. (2024)(13), BHOKTIARI M et al. (2023) (18), and Shivde S et al. (2025) (17). However, sex was not significantly associated with MRI positivity, indicating that structural lesions were not strongly dependent on gender.

MRI abnormalities were detected in 26% of patients, while 74% had normal MRI findings. This yield was lower than the higher abnormality rates reported by Diwan P et al. (2025) (19), and Gajjala J et al. (2025) (20), but closely matched Raafat BM et al. (2024) (13), who found abnormalities in 24.3% of pediatric epilepsy patients. Among MRI-positive cases, post-infective lesions were the most common abnormality, followed by mesial temporal sclerosis and tumors, while vascular malformations and focal cortical dysplasia were less frequent. The predominance of post-infective lesions correlated with Diwan P et al. (2025) (19), who reported granulomatous lesions as the commonest MRI abnormality, and Shivde S et al. (2025) (17), who identified calcified granulomas as frequent neuroimaging findings. This highlights the continued regional importance of infection-related structural epilepsy.

Mesial temporal sclerosis was detected in 7% of patients and formed an important component of MRI-positive abnormalities. Its frequency was lower than that reported by Diwan P et al. (2025) (19), MISBAH I et al. (2024) (21), and Haughey AM et al. (2025) (22), likely because those studies used specialized or refractory epilepsy cohorts. Focal cortical dysplasia was rare in the present study, unlike Diwan P et al. (2025) (19), Mousa W et al. (2025) (16), and Haughey AM et al. (2025) (22), who emphasized its higher frequency and frequent underdiagnosis in refractory epilepsy. Tumors constituted a major abnormality, supporting the observations of LD NK et al. (2024) and Haughey AM et al. (2025) (22) regarding the importance of MRI in characterizing clinically significant structural lesions. Vascular malformations were uncommon but clinically relevant, similar to findings by Alyoubi RA et al. (2023 (14).

Overall, although age, sex, and age-group associations with MRI positivity or exact MRI findings were not statistically significant, younger patients showed a higher trend of MRI positivity. The study confirms that MRI provides meaningful etiological information in epilepsy, especially for detecting post-infective lesions, mesial temporal sclerosis, tumors, focal cortical dysplasia, and vascular malformations, thereby guiding diagnosis, prognosis, treatment planning, and referral decisions in tertiary care practice.

CONCLUSION

In the present study of 100 epilepsy patients, MRI showed meaningful diagnostic value by detecting structural abnormalities in 26% of cases, while 74% had normal scans. Patients were mainly young and middle-aged adults, with slight male predominance, but age and sex were not significantly associated with MRI positivity. Post-infective lesions were the commonest abnormality, followed by mesial temporal sclerosis and tumors, with vascular malformations and focal cortical dysplasia being less frequent. Although younger patients showed higher MRI positivity numerically, this was statistically non-significant. Overall, MRI helped identify clinically important epileptogenic lesions and remains essential in comprehensive epilepsy evaluation.

CONFLICT OF INTREST: None

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