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Role of Brain Magnetic Resonance Imaging in the Evaluation of Seizure Disorders at a Tertiary Care Centre in Rajasthan, India: A Descriptive Observational Study

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Abstract

Background

Magnetic resonance imaging (MRI) with a dedicated epilepsy protocol is the most sensitive non-invasive tool for identifying structural epileptogenic substrates, yet contemporary regional data from Rajasthan are scarce.

Objective

To describe the spectrum, anatomical distribution, and management impact of MRI brain abnormalities in patients with seizure disorders presenting to a tertiary care centre in Rajasthan.

Methods

A hospital-based, descriptive observational cross-sectional study enrolled 90 consecutive patients of any age referred for MRI brain after a clinical diagnosis of seizure disorder. All examinations were performed on a 1.5-Tesla scanner using a dedicated epilepsy protocol aligned with the Harmonised Neuroimaging of Epilepsy Structural Sequences (HARNESS-MRI) framework with axial T1, T2, fluid-attenuated inversion recovery, and diffusion-weighted sequences plus high-resolution coronal T1- and T2-weighted images perpendicular to the long axis of the hippocampus; gadolinium was used when indicated. Two neuroradiologists independently interpreted the images. Demographic, clinical, and management data were summarised descriptively.

Results

Mean age was 27.07 ± 22.46 years (median 23.00, IQR 7.25-39.75); 62 of 90 patients (68.89%) were men, and generalised seizures predominated in 74 of 90 patients (82.22%). Any structural or signal abnormality was identified on MRI in 64 of 90 patients (71.11%; 95% CI 61.7-80.5); aetiologically relevant findings were present in 56 of 90 patients (62.22%). Mesial temporal sclerosis, tumours, and peri-ictal or post-ictal changes were the most common specific findings (eight patients each; 8.89%), followed by vascular and congenital lesions (seven patients each; 7.78%). Mesial temporal sclerosis was exclusively identified in patients with focal seizures with secondary generalisation (8 of 11 patients; 72.73%). The parietal lobe was the most frequent anatomical site (22 of 64 patients; 34.38%). Targeted medical therapy was initiated in 37 of 90 patients (41.11%), surgical lesionectomy recommended in 5 of 90 patients (5.56%), and management was changed in 48 of 90 patients (53.33%) overall. Conventional sequences disclosed abnormalities in 34 patients; addition of high-resolution coronal hippocampal sequences and contrast-enhanced imaging identified lesions in a further 30 patients.

Conclusion

Dedicated epilepsy-protocol MRI revealed structural abnormalities in over 70% of patients and altered management in the majority. Routine high-resolution MRI is justified in the initial evaluation of seizure disorders in this region.

Categories: Neurology, Radiology
Keywords: epilepsy, magnetic resonance imaging, mesial temporal sclerosis (mts), neurocysticercosis (ncc), seizure activity

Introduction

Epilepsy is among the most common chronic neurological disorders, affecting approximately 50 million people worldwide; nearly 80% of people live in low- and middle-income countries (LMICs), where access to

specialised diagnostic services is often limited [1-4]. India is estimated to harbour 10-12 million people with active epilepsy, with rural and socioeconomically disadvantaged populations bearing a disproportionate burden of illness, disability and stigma [5,6]. Aetiologies are heterogeneous and span perinatal hypoxic-ischaemic injury, central nervous system infection, traumatic brain injury, vascular insult, neoplasia, and genetic or developmental abnormalities [5-8]. Mortality, premature death and lost productivity contribute to a substantial public health cost that is greatest where diagnostic infrastructure is the least developed [2,4].

The 2014 International League Against Epilepsy (ILAE) operational definition reframed epilepsy as a disease, formally recognising that a single unprovoked seizure with a high recurrence risk warrants the same management as recurrent unprovoked seizures [9]. The 2017 ILAE position papers on the operational classification of seizure types and on the classification of the epilepsies introduced a multilevel framework based on seizure type, epilepsy type, and aetiology [10,11]. A central pillar of this aetiological scheme is structural epilepsy, in which neuroimaging, particularly magnetic resonance imaging (MRI), identifies a lesion considered to be the substrate of seizures [11,12].

Computed tomography (CT) reliably detects gross structural lesions, intracranial haemorrhage and calcified granulomas, but its sensitivity for the subtle epileptogenic substrates that account for a substantial fraction of refractory focal epilepsy is limited [12,13]. MRI provides multiplanar imaging with superior soft-tissue contrast and is markedly more sensitive for cortical dysplasia, hippocampal sclerosis, low-grade neoplasms, cavernomas and other vascular malformations [12-14]. However, standard "general-indication" brain MRI protocols miss a meaningful proportion of these lesions, particularly subtle hippocampal and cortical abnormalities that lie close to the limits of conventional spatial resolution [13,14]. Dedicated epilepsy protocols, incorporating high-resolution sequences acquired perpendicular to the long axis of the hippocampus and three-dimensional volumetric imaging, substantially increase lesion detection. The ILAE Neuroimaging Task Force has endorsed the Harmonised Neuroimaging of Epilepsy Structural Sequences (HARNESS-MRI) framework as the minimum standard for adults and children with newly diagnosed epilepsy [15]. Comparative studies have shown that switching from a standard protocol to a dedicated epilepsy protocol roughly doubles lesion-detection rates [16,17], and 3-Tesla imaging adds further yield in selected patients [18,19].

The aetiological spectrum of seizure disorders in LMICs differs from that in high-income countries. Endemic neuroinfections, particularly neurocysticercosis (NCC) and tuberculoma, account for a sizeable proportion of new-onset seizures across much of South Asia, sub-Saharan Africa, and Latin America [20,21]. Perinatal injury, post-infectious gliosis, and vascular causes dominate paediatric and older adult cohorts, respectively [3,5]. Within India, considerable inter-regional variation exists in causal patterns owing to differences in infection burden, nutritional status, perinatal care, road traffic injury patterns, and access to specialised health services [5,6]. Consequently, region-specific imaging data are essential for accurate diagnosis, rational therapy, and informed health-systems planning.

A further consideration in the LMIC setting is the relative availability and complementarity of diagnostic modalities. Electroencephalography (EEG) and MRI are complementary rather than interchangeable: EEG provides functional, time-resolved information about ictal and interictal abnormalities, whereas MRI defines the structural substrate that may underlie those electrophysiological events [10,15]. In many tertiary settings in India, EEG is more readily and cheaply available than MRI, yet without structural imaging the diagnostic workup is incomplete in any patient with new-onset seizures, particularly children; adults presenting after the age of 20 years; and those with focal features, abnormal neurological examination, or refractory seizures [10,11,15]. Where dedicated epilepsy MRI is unavailable, presumptive labelling of seizures as "idiopathic" or "cryptogenic" can both delay aetiological diagnosis and obscure surgically remediable disease, with downstream effects on prognosis, quality of life, and healthcare utilisation [5,6,13]. These considerations make the question of whether dedicated MRI is feasible and informative in routine Indian tertiary practice a clinically and operationally important one.

Rajasthan is a large North-western Indian state with a substantial rural population, distinct environmental exposures, and well-recognised barriers to timely neurological care [5]. To our knowledge, the contemporary spectrum of MRI brain findings in patients with seizure disorders from this region has not been systematically described in a centre using a dedicated epilepsy protocol. Such data are needed to refine the diagnostic approach to new-onset seizures in similar settings, to identify patients with surgically remediable epilepsies, and to inform regional public health strategies for seizure prevention and care.

The present study was therefore undertaken to describe the spectrum of MRI brain abnormalities, their anatomical distribution, and their influence on clinical management among consecutive patients with clinically diagnosed seizure disorders presenting to a tertiary care centre in Rajasthan. A secondary objective was to compare the diagnostic yield of conventional MRI with that of a dedicated epilepsy-protocol MRI in the same cohort.

Materials And Methods

Study design and setting

A hospital-based, cross-sectional observational study was conducted in the Department of Radiodiagnosis and Imaging at a tertiary care centre in Rajasthan over an 18-month period (10 May 2024 to 10 November 2025). The study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies [22]. The study was approved by the Institutional Ethics Committee (approval no.: AIMS/Ananta IEC/2024/213; date of approval: 01 May 2024) and conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all adult participants and from the parents or legal guardians of paediatric participants.

Participants

Ninety consecutive patients of any age and either sex with a clinically diagnosed seizure disorder, referred from outpatient, inpatient, or emergency settings for MRI brain evaluation, were prospectively enrolled. Patients were eligible for inclusion if they had a clinical diagnosis of seizure disorder made by the treating physician or neurologist, had been referred for MRI brain evaluation, and provided written informed consent. Patients were excluded if they had an absolute contraindication to MRI (such as a cardiac pacemaker, cochlear implant, ferromagnetic intracranial clip, or other incompatible metallic implant), if severe claustrophobia precluded completion of the examination, or if they were aged less than three months. Seizure disorder was defined operationally as a transient occurrence of signs and/or symptoms resulting from abnormal excessive or synchronous neuronal activity, diagnosed clinically by the treating unit, in accordance with the 2017 ILAE operational classification [10].

Sample size

In the absence of a validated regional reference for MRI yield in this population, a convenience sample of 90 consecutive eligible patients was enrolled over the 18-month study period. This sample size is broadly comparable to published Indian seizure-imaging descriptive series (reported range 60-120 patients) and yields a 95% confidence interval of approximately ±10 percentage points around an expected MRI-positivity rate of 70%, which is adequate precision for the descriptive aims of this study.

Clinical assessment

Trained study personnel recorded patient demographics (age and sex), seizure semiology (generalised, focal, or focal with secondary generalisation), duration of illness (<1 year, 1-5 years, or >5 years), seizure frequency (daily, weekly, monthly, or rare), perinatal complications, developmental delay, and family history of seizures. Seizure type was classified by the referring neurologist using the 2017 ILAE operational classification scheme [10].

MRI protocol

All examinations were performed on a 1.5-Tesla Siemens MAGNETOM Aera scanner (Siemens Healthineers, Erlangen, Germany) using a dedicated epilepsy protocol aligned with the HARNESS-MRI framework recommended by the ILAE Neuroimaging Task Force [15,16]. The protocol comprised two-dimensional (2D) sequences throughout, including: axial T1-weighted imaging (slice thickness 5 mm, TR/TE 500/15 ms); axial T2-weighted imaging (slice thickness 5 mm, TR/TE 4500/90 ms); axial 2D fluid-attenuated inversion recovery (FLAIR; slice thickness 5 mm, TR/TE/TI 9000/90/2500 ms); axial diffusion-weighted imaging (DWI; b-values 0 and 1000 s/mm^2); and high-resolution coronal T2-weighted images acquired perpendicular to the long axis of the hippocampus (slice thickness 3 mm, TR/TE 4500/90 ms). For paediatric patients aged less than 16 years, the protocol was adapted in accordance with ILAE paediatric neuroimaging recommendations [15], including sedation where clinically necessary and adjustment of slice thickness to account for smaller brain volume. Intravenous gadolinium-based contrast agent (Gadopentetate dimeglumine, Magnevist, Bayer AG, Leverkusen, Germany) was administered when clinically indicated, principally for suspected infective or neoplastic aetiology.

Image analysis

Images were independently interpreted by two consultant neuroradiologists blinded to one another's reports. Lesions were classified by aetiology as infective (tuberculoma, NCC, or post-infectious gliosis), neoplastic, vascular (infarct, cavernoma, or arteriovenous malformation), developmental (cortical dysplasia or congenital malformation), degenerative, or metabolic. Anatomical location was recorded by the lobe (frontal, temporal, parietal, or occipital), cerebellum, basal ganglia, or thalamus. Discrepancies between readers were resolved through consensus. To gauge the incremental yield of the dedicated protocol, abnormalities visible on conventional axial T1, T2, and FLAIR sequences alone were compared with those identified after the addition of high-resolution coronal hippocampal sequences and contrast-enhanced imaging.

Outcome measures

The primary outcome was the prevalence and aetiological distribution of MRI abnormalities in the cohort. Secondary outcomes were lesion distribution by seizure type and duration of illness, anatomical distribution, and management changes prompted by MRI findings (initiation of targeted medical therapy,

recommendation for surgical intervention, adjustment of antiepileptic drug regimen, or no change).

Statistical analysis

Continuous variables are summarised as mean ± standard deviation and median with interquartile range; categorical variables as frequencies and percentages. No inferential statistics were applied, in keeping with the descriptive design. Analyses were performed using EaseMyResearch Software (Clinomed Ease My Research Technology LLP, Jodhpur, India).

Results

Demographic and clinical characteristics

Demographic and clinical characteristics of the 90 enrolled patients are summarised in Table *1*. The cohort showed a wide age range with peak representation in the 21-40-year band (29 patients; 32.22%), male preponderance (62 patients; 68.89%), and clear predominance of generalised seizures (74 patients; 82.22%) of recent onset (70 patients; 77.78% with illness duration <1 year).

Characteristic	Value
Age	
Mean ± SD (years)	27.07 ± 22.46
Median (IQR)	23.00 (7.25-39.75)
<1 year, n (%)	20 (22.22)
1-10 years, n (%)	5 (5.56)
11-20 years, n (%)	15 (16.67)
21-40 years, n (%)	29 (32.22)
41-60 years, n (%)	10 (11.11)
>60 years, n (%)	11 (12.22)
Sex, n (%)	
Male	62 (68.89)
Female	28 (31.11)
Seizure type, n (%)	
Generalised	74 (82.22)
Focal	5 (5.56)
Focal with secondary generalisation	11 (12.22)
Duration of illness, n (%)	
<1 year	70 (77.78)
1-5 years	15 (16.67)
>5 years	5 (5.56)
Frequency of seizures, n (%)	
Daily	10 (11.11)
Weekly	7 (7.78)
Monthly	23 (25.56)
Rare	50 (55.56)
Other clinical features, n (%)	
Family history of seizures	0 (0.00)
Perinatal complications	9 (10.00)
Developmental delay	11 (12.22)
Contrast administration, n (%)	
Gadolinium contrast used	24 (26.67)
No contrast	66 (73.33)

TABLE 1: Demographic and clinical characteristics of the study population (n = 90).

Spectrum of MRI findings

Any structural or signal abnormality was identified on MRI in 64 of 90 patients (71.11%); aetiologically relevant findings were present in 56 of 90 patients (62.22%), and 34 patients (37.78%) had normal or non-aetiological scans (including eight patients with transient peri-ictal or post-ictal signal changes). The

difference between the 64 patients with any MRI abnormality and the 56 patients with aetiologically relevant findings is accounted for by these eight patients who showed only transient peri-ictal or post-ictal signal changes. These were classified as non-aetiological because they represent reversible post-seizure phenomena rather than fixed structural epileptogenic substrates. The frequency of named MRI findings is presented in Table 2. Mesial temporal sclerosis (MTS) and intracranial tumours were the most common specific aetiological findings (eight patients each; 8.89%), followed by peri-ictal or post-ictal signal changes (eight patients; 8.89%), vascular lesions and congenital malformations (seven patients each; 7.78%), encephalitis (five patients; 5.56%), and metabolic or degenerative lesions (four patients; 4.44%). Infective aetiologies - tuberculoma, NCC, post-infectious gliosis, and porencephalic cyst - each accounted for three patients (3.33%). As patients may have more than one MRI finding, table entries represent findings rather than patients.

MRI finding	n (%)
Normal/non-aetiological findings*	34 (37.78)
Mesial temporal sclerosis	8 (8.89)
Tumours	8 (8.89)
Peri-ictal/post-ictal signal changes	8 (8.89)
Vascular lesions	7 (7.78)
Congenital malformations	7 (7.78)
Encephalitis	5 (5.56)
Metabolic/degenerative lesions	4 (4.44)
Toxic encephalopathy	4 (4.44)
Post-infectious gliosis	3 (3.33)
Tuberculoma	3 (3.33)
Neurocysticercosis	3 (3.33)
Porencephalic cyst	3 (3.33)
Cortical dysplasia	1 (1.11)
Others†	13 (14.44)

TABLE 2: Distribution of magnetic resonance imaging findings in patients with seizure disorders (n = 90).

* indicates eight patients with peri-ictal/post-ictal changes only. † indicates white matter changes, nonspecific atrophy, and miscellaneous lesions.

Lesion distribution by seizure type and duration of illness

The distribution of MRI lesions stratified by seizure type is shown in Table 3. MTS was identified exclusively in patients with focal seizures with secondary generalisation (8 of 11 patients; 72.73%), consistent with the well-established association between hippocampal sclerosis and focal temporal-lobe epilepsy with secondary spread [22]. Tumours (eight patients; 10.81% of the generalised group), congenital malformations (seven patients; 9.46%), and encephalitis (five patients; 6.76%) were seen predominantly in the generalised group, reflecting the overall preponderance of that seizure type in the cohort. Toxic encephalopathy showed an unusual focal predominance (two of five cases in the focal group; 40.00%). Post-infectious gliosis and peri-ictal or post-ictal changes were distributed across all phenotypes. Percentages in Table 3 are calculated within each seizure-type group; patients may have more than one finding.

MRI finding	<1 year (n = 70), n (%)	1-5 years (n = 15), n (%)	>5 years (n = 5), n (%)
Normal/non-aetiological	22 (31.43)	3 (20.00)	1 (20.00)
Cortical dysplasia	1 (1.43)	0	0
Mesial temporal sclerosis	7 (10.00)	1 (6.67)	0
Post-infectious gliosis	2 (2.86)	1 (6.67)	0
Tuberculoma	2 (2.86)	1 (6.67)	0
Neurocysticercosis	0	1 (6.67)	2 (40.00)
Tumours	3 (4.29)	4 (26.67)	1 (20.00)
Vascular lesions	7 (10.00)	0	0
Congenital malformations	6 (8.57)	1 (6.67)	0
Metabolic/degenerative lesions	2 (2.86)	2 (13.33)	0
Toxic encephalopathy	4 (5.71)	0	0
Peri-ictal/post-ictal signal changes	6 (8.57)	1 (6.67)	1 (20.00)
Porencephalic cyst	3 (4.29)	0	0
Encephalitis	4 (5.71)	1 (6.67)	0
Others*	21 (30.00)	3 (20.00)	0

TABLE 3: Magnetic resonance imaging findings stratified by seizure type (n = 90).

Percentages are calculated within each seizure-type group (generalised n = 74, focal n = 5, focal with secondary generalisation n = 11). Patients may have more than one finding. * indicates white matter changes, nonspecific atrophy, and miscellaneous lesions.

When findings were stratified by duration of illness (Table *4*), most cases of MTS (seven patients; 7.78%), vascular lesions (seven patients; 7.78%), and congenital malformations (six patients; 6.67%) were detected in patients with a seizure history of less than one year, as were the majority of encephalitis (four patients; 4.44%) and toxic encephalopathy (four patients; 4.44%) cases. Tumours showed a trend towards longer illness duration, with the greatest count in the one- to five-year group (four patients; 4.44%) compared with shorter (<1 year: three patients) and longer (>5 years: one patient) intervals. NCC was confined to patients with illness duration of one year or more (1-5 years: one patient; >5 years: two patients), consistent with the chronic granulomatous evolution of cysticercal lesions [21].

MRI finding	<1 year (n = 70), n (%)	1-5 years (n = 15), n (%)	>5 years (n = 5), n (%)
Normal/non-aetiological	22 (24.44)	3 (3.33)	1 (1.11)
Cortical dysplasia	1 (1.11)	0	0
Mesial temporal sclerosis	7 (7.78)	1 (1.11)	0
Post-infectious gliosis	2 (2.22)	1 (1.11)	0
Tuberculoma	2 (2.22)	1 (1.11)	0
Neurocysticercosis	0	1 (1.11)	2 (2.22)
Tumours	3 (3.33)	4 (4.44)	1 (1.11)
Vascular lesions	7 (7.78)	0	0
Congenital malformations	6 (6.67)	1 (1.11)	0
Metabolic/degenerative lesions	2 (2.22)	2 (2.22)	0
Toxic encephalopathy	4 (4.44)	0	0
Peri-ictal/post-ictal signal changes	6 (6.67)	1 (1.11)	1 (1.11)
Porencephalic cyst	3 (3.33)	0	0
Encephalitis	4 (4.44)	1 (1.11)	0
Others*	21 (23.33)	3 (3.33)	0

TABLE 4: Magnetic resonance imaging findings stratified by duration of illness.

Percentages are calculated against the total number of patients in each duration group (<1 year, n = 70; 1-5 years, n = 15; >5 years, n = 5). Patients may have more than one finding. * indicates white matter changes, nonspecific atrophy, and miscellaneous lesions.

Anatomical distribution of lesions

The anatomical distribution of detected lesions is summarised in Table 5. The parietal lobe was the most frequent site of pathology (22 lesions; 34.38% of 64 abnormal scans), followed by the temporal and frontal lobes in equal proportion (15 each; 23.44%). Cerebellar involvement was noted in five patients (7.81%), basal ganglia in five patients (7.81%), and thalamus in four patients (6.25%). Percentages are calculated against the 64 patients with any MRI abnormality; patients may have involvement of more than one anatomical region.

Brain region	n (%)
Parietal lobe	22 (34.38)
Temporal lobe	15 (23.44)
Frontal lobe	15 (23.44)
Occipital lobe	11 (17.19)
Cerebellum	5 (7.81)
Basal ganglia	5 (7.81)
Thalamus	4 (6.25)

TABLE 5: Anatomical distribution of magnetic resonance imaging lesions (n = 64 patients with abnormal scans).

Percentages exceed 100% as patients may have more than one region involved.

Impact of MRI on clinical management

The influence of MRI findings on clinical management is shown in Table 6. Overall, MRI prompted a change in management in 48 of 90 patients (53.33%). Targeted medical therapy - comprising antitubercular therapy (ATT), anti-helminthic treatment, and oncology referral - was initiated in 37 patients (41.11%), while surgical lesionectomy was recommended in five patients (5.56%), principally for MTS and resectable neoplasms. The antiepileptic drug regimen was adjusted in six patients (6.67%), and 42 patients (46.67%) had no change in management.

Management category	n (%)
Targeted medical therapy initiated (ATT, anti-helminthic therapy, or oncology referral)	37 (41.11)
Antiepileptic drug regimen adjusted	6 (6.67)
Surgical intervention recommended	5 (5.56)
No change in management	42 (46.67)
Total patients with management change	48 (53.33)

TABLE 6: Impact of magnetic resonance imaging findings on clinical management (n = 90).

ATT: antitubercular therapy

Comparative yield of conventional and dedicated MRI

Of the 64 patients with abnormal imaging, conventional sequences (axial T1, T2, and FLAIR) identified an abnormality in 34 patients, whereas the addition of dedicated epilepsy-protocol sequences - comprising high-resolution coronal hippocampal sequences and contrast-enhanced imaging - disclosed lesions in a further 30 patients who had been negative on standard imaging, an 88% relative increase in detection within this cohort. It is important to note that conventional sequences were sufficient for detecting gross lesions such as large tumours and vascular malformations; the incremental gain from dedicated sequences was concentrated in subtle pathologies, principally MTS and cortical dysplasia, which are at the limits of conventional spatial resolution.

Discussion

This study describes the contemporary MRI spectrum of seizure disorders in 90 consecutive patients evaluated at a tertiary care centre in Rajasthan, a region for which such data have been sparse. Three principal observations emerge. First, dedicated epilepsy-protocol MRI demonstrated a structural abnormality in over 70% of patients. Second, the aetiological mix mirrored international patterns while retaining a regionally relevant infective contribution. Third, imaging directly altered management decisions in the majority of cases.

Diagnostic yield of MRI

The 71.11% lesion-detection rate observed in our cohort (64 of 90 patients) is consistent with contemporary international literature when dedicated epilepsy protocols are used. The ILAE Neuroimaging Task Force consensus and prospective implementations of the HARNESS-MRI sequence package report yields ranging from approximately 60% to 80% in unselected adult and paediatric epilepsy populations, with substantially lower yields when non-dedicated imaging is performed [15,16]. The study of von Oertzen et al. remains instructive: standard MRI was non-diagnostic in roughly half of patients with refractory focal epilepsy in whom a dedicated protocol subsequently revealed a lesion [17]. In our cohort, conventional sequences identified abnormalities in 34 patients, whereas the addition of high-resolution coronal hippocampal imaging revealed lesions in a further 30 patients - an 88% relative increase in detection. It is important to note that conventional sequences were adequate for detecting gross lesions such as large tumours and vascular malformations; the incremental gain from dedicated coronal hippocampal sequences was concentrated in subtle pathologies, principally MTS and cortical dysplasia, which are at the limits of conventional spatial resolution.

Aetiological spectrum

MTS and intracranial neoplasms were the commonest specific findings in our cohort (eight patients each; 8.89%). The prominence of MTS is in keeping with both Western and Asian series, in which it is the single most common pathology in surgical epilepsy and a leading MRI substrate of medically intractable focal epilepsy [23,24]. Recent histopathological data from the European Epilepsy Brain Bank have confirmed that

hippocampal sclerosis remains the most frequent diagnosis in adult surgical specimens, accounting for approximately one-third of cases [25]. Vascular and congenital lesions, each present in seven patients (7.78%), are likewise consistent with global aetiological surveys [12].

The combined contribution of NCC and tuberculoma (six patients; 6.66%) is notable. NCC is the leading parasitic cause of acquired epilepsy worldwide and remains endemic across much of India [20,21]. The relatively modest infective contribution in our cohort may reflect improved sanitation and public health measures and the urban referral catchment of a tertiary centre, though this explanation remains speculative and cannot be confirmed from the present data. Nevertheless, the persistence of these aetiologies underscores the continued need to interpret MRI in the context of regional epidemiology and to maintain a low threshold for contrast-enhanced imaging where infection or granulomatous disease is plausible [20,26]. The intermediate-duration peak of NCC detection in our cohort (Table *4*) is consistent with the natural history of cysticercus evolution [21].

Tumour-related seizures merit specific comment. In our cohort, tumours were over-represented in patients with longer duration of illness (Table *4*), consistent with the established association between low-grade gliomas and chronic drug-resistant focal epilepsy [14,25]. This temporal pattern reinforces the principle that recurrent or refractory seizures may warrant repeat dedicated MRI to exclude a slow-growing structural substrate [14,15].

Anatomical distribution

Parietal-lobe predominance (22 patients; 34.38%) was somewhat unexpected, as temporal-lobe pathology typically predominates in epilepsy series, especially those drawn from surgical cohorts [22,23]. Several explanations are possible. Our series included a broad mix of vascular and developmental lesions whose distribution is not preferentially temporal [12,26]. In a modest sample, anatomical proportions are also sensitive to chance variation. Additionally, a clinical-pathway effect may operate wherein patients with classic temporal-lobe semiology are triaged earlier toward specialist epilepsy units. The temporal and frontal lobes were equally represented (15 patients each; 23.44%), in line with previous reports outside dedicated epilepsy-surgery cohorts [12,22].

Lesion-seizure-type relationships

MTS was exclusively associated with focal seizures with secondary generalisation (8 of 11 patients; 72.73%), reflecting the well-known focal-onset biology of mesial temporal lobe epilepsy [23]. For other categories, the apparent concentration in the generalised group largely reflects the preponderance of that seizure type (74 of 90 patients; 82.22%) rather than a true biological predilection. Importantly, the detection of structural substrates in patients with clinically apparent generalised seizures has direct implications for practice: a substantial subset may represent focal seizures with rapid bilateral propagation in which the focal origin is clinically inapparent but radiologically detectable. Contemporary ILAE recommendations confirm that imaging should not be omitted on the basis of clinical seizure phenotype alone [10,11,15].

Impact of MRI on clinical management

MRI findings prompted a change in management in 48 of 90 patients (53.33%). Targeted medical therapy was the most frequent intervention (37 patients; 41.11%), reflecting the high yield for treatable infective and neoplastic substrates in this geography [20,21]. Surgical referral was recommended in five patients (5.56%), broadly aligned with the proportion harbouring potentially resectable substrates, principally MTS and circumscribed neoplasms [23,25]. Adjustment of antiepileptic drug regimens occurred in a further six patients (6.67%). These results are consistent with current consensus that MRI should form part of the initial diagnostic evaluation of patients with new-onset or unexplained seizures [15].

Practical implications

The diagnostic yield observed here, taken with current ILAE recommendations [15], supports building dedicated coronal hippocampal sequences into the default seizure protocol in centres with access to 1.5-Tesla imaging, rather than treating them as an optional add-on. This is an organisational rather than a hardware-driven change and does not require investment in higher-field platforms.

Comparison with earlier work

Compared with older Indian observational studies, largely conducted on lower-field magnets with non-dedicated protocols, our cohort shows a higher rate of MTS detection and a lower relative contribution of infective aetiology. This pattern, observed across several recent South Asian series, likely reflects technical advances in protocol design rather than a true epidemiological shift, though changes in regional infection burden may also have contributed - a hypothesis that would require population-level data to confirm.

Limitations

This study has several limitations. First, this is a single-centre descriptive study from one tertiary referral

hospital in Rajasthan; the findings may not be generalisable to primary or secondary care settings, rural facilities, or other regions. Second, the convenience sample of 90 patients limits statistical precision and precludes subgroup analyses with adequate power. Third, EEG data were not systematically available for all patients; a formal EEG-MRI concordance analysis was therefore not possible. Fourth, our comparison between conventional and dedicated epilepsy-protocol sequences was not pre-specified as a primary study outcome and is best regarded as descriptive rather than confirmatory. Fifth, histopathological confirmation of radiologically diagnosed lesions was available only for surgically managed patients. Sixth, follow-up imaging and longitudinal clinical outcome data were not collected. Finally, patient selection bias inherent to hospital-based tertiary referral cohorts cannot be excluded. Additionally, the use of a 1.5T scanner with 2D rather than 3D FLAIR sequences likely resulted in underdetection of subtle cortical dysplasia; 3T imaging with 3D FLAIR and phased-array coils would be expected to yield higher detection rates for this subtype [18,19].

Conclusions

In this single-centre cross-sectional cohort from Rajasthan, dedicated 1.5-T epilepsy-protocol MRI identified structural abnormalities in over 70% of patients with seizure disorders, with MTS, tumours, vascular, and congenital lesions as the leading substrates and a smaller contribution from NCC and tuberculoma. Imaging influenced subsequent management in most patients with abnormal scans. The findings support the feasibility of HARNESS-MRI-aligned dedicated protocols on widely available 1.5-T platforms in Indian tertiary practice. Larger multicentre studies with longitudinal follow-up, EEG-MRI correlation, and 3-T imaging where available are needed to refine regional epidemiology and to evaluate the effect of routine protocol implementation on downstream care. Future multicentre studies should incorporate systematic EEG-MRI correlation as a primary outcome measure, which would enable formal assessment of electroclinical concordance and further validate the management impact of dedicated epilepsy-protocol imaging in this region.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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