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Mri Evaluation of Seizures

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ABSTRACT:

Background Seizures are a complex neurological event that are caused by a wide range of structural, vascular, infectious, developmental, neoplastic and degenerative abnormalities of the brain. The presence of an underlying structural substrate is crucial for etiological classification, therapeutic planning, prognosis and, in some patients, for epilepsy surgery. Magnetic resonance imaging (MRI) has high soft-tissue contrast, multiplanar ability and sensitivity for abnormalities that may be occult on other imaging modalities. Modern epilepsy imaging focuses on specific structural sequences including high-resolution 3D T1 weighted sequences, fluid-attenuated inversion recovery (FLAIR) and high-resolution coronal T2 weighted sequences taken at right angles to the axis of the hippocampus.

Objective The study aimed to identify the type and prevalence of structural MRI abnormalities in patients with clinically established seizures, explore the correlation between these abnormalities, age, sex and seizure type and to establish the main categories of underlying etiology as the cause of MRI abnormalities.

Materials and Methods The study was a prospective, time-bound study of two years duration from June 2024 till may 2026. The total number of patients with clinical seizures was 110 examined at the affiliated teaching hospitals. There was no restriction on the age and sex of patients. Those who had contraindications to MRI, or severe claustrophobia or could not give consent were excluded. MRI imaging was carried out on a 1.5-T GE system. Seizure imaging protocol included T1, T2, FLAIR, diffusion-weighted imaging with ADC, gradient-echo imaging, contrast enhanced T1 weighted imaging, and magnetic resonance angiography and magnetic resonance spectroscopy (MRS) if clinically necessary. Clinical history, seizure type, duration of illness, neurological findings and characteristics of the MRI were noted. Proportions were used for descriptive analysis.

Results Among 110 patients, 67 (61%) were male and 43 (39%) were female, giving a male-to-female ratio of 1.5:1. The combined age group of 1-30 years was the largest group with 53 patients (48.18%). Generalized tonic-clonic seizures were the most common

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clinical seizure type (87 patients, 79.10%). MRI was normal in 53 patients (48.18%) and abnormal in 57 patients (51.82%). The most common abnormalities were cerebral infarction with gliosis (22 patients, 20.00%), neurocysticercosis (8, 7.27%), cerebral atrophy (6, 5.45%), tuberculoma (4, 3.64%), venous thrombosis (4, 3.64%) and developmental malformations (4, 3.64%). Glioma, cavernoma, and tuberous sclerosis made up 1.82% each, and meningioma and cerebral abscess and Sturge-Weber syndrome accounted for 0.91% each. MRI was positive in 48% of the patients who had generalized tonic-clonic seizures and in 80% of those who had myoclonic seizures. The highest percent positivity was observed in seizure categories that have only one or two patients.

Conclusion About half of the patients who underwent structural MRI had abnormalities. Cerebrovascular disease was the most common etiological diagnosis, and infarction and gliosis were the most common individual MRI diagnosis. Another integral part of the imaging spectrum was infectious and developmental abnormalities. The results indicate that dedicated MRI has a diagnostic role in the evaluation of seizures and that the spectrum of the structures observed is quite wide in a hospital population in South India. Limited size of subgroups needs to be considered when interpreting small subgroups. In addition, current epilepsy imaging guidelines continue to advocate for standardized high-resolution structural MRI acquisition to enhance detection of subtle epileptogenic lesions.

1. INTRODUCTION

1.1 Background

Seizures are clinical events resulting from an abnormal excessive or synchronous activity of Neurons in the cerebral cortex. The clinical manifestation of a seizure depends on the site, size and spread of the abnormal neuronal activity. These presentations may involve changes in consciousness, motor function, sensory phenomena, autonomic dysfunction or a combination of these. However, the clinical picture is not sufficient to confirm the structural cause in a significant number of cases.

The spectrum of structural abnormalities that may be seen in seizures is wide. Various lesions of the blood vessels, ischemic injury, cerebral venous thrombosis, vascular malformations, intracranial infections, developmental abnormalities, neoplasms, gliosis and cerebral atrophy can all create an epileptogenic substrate. The importance of developmental abnormalities and congenital lesions is particularly important in children, whereas vascular and neoplastic abnormalities are more relevant in adults and older populations. Neurocysticercosis and tuberculoma are infectious lesions with special significance in areas where they continue to be endemic.

The dissertation that was uploaded examined a group of 110 patients with clinically diagnosed seizures and found that about 52% had abnormalities on the MRI. The main abnormality was infarction/gliosis followed by neurocysticercosis, cerebral atrophy, tuberculoma, and venous thrombosis/developmental abnormalities.

The important role of MRI is because of the fact that MRI can show abnormalities in grey and white matter without using a source of ionising radiation. It is also multiplanar, allowing anatomical localization, and it has specialized sequences that allow the characterization of vascular, hemorrhagic, infectious and developmental lesions. The thesis was directed specifically to the potential of MRI to detect very subtle lesions, and to help localize epileptogenic structural abnormalities.

Significant advances have been made in epilepsy imaging since the time of the dataset collection. Structural MRI is a basic imaging technique and a standard of care in the diagnosis and management of epilepsy and is recommended by the International League Against Epilepsy (ILAE) consensus recommendations, especially if considering epilepsy surgery. Standardised high-resolution sequences of the structures and systematic analysis of images in relation to the clinical data is recommended.

1.2 Clinical and Radiological Importance.

An MRI detectable lesion could affect the diagnostic classification of epilepsy, and can give clues to the prognosis and treatment of epilepsy. A lesion may also define a reasonable epileptogenic region, but a lesion should not be assumed to be the site of

the seizure onset zone unless there is a good clinical and electrophysiological correlation.

MRI serves as a useful tool for identifying abnormalities of the cortex, abnormalities of the hippocampus, vascular lesion and gliosis post-injury, especially. High-resolution coronal T2-weighted imaging oriented perpendicular to the long axis of the hippocampus is important for evaluation of mesial temporal structures. Current protocols also include high-resolution three dimensional T1-weighted and FLAIR sequences for anatomical evaluation and subtle cortical abnormalities.

The thesis applied a wide 1.5-T protocol which included T1 weighted, T2 weighted, FLAIR, diffusion, gradient-echo, contrast-enhanced imaging, magnetic resonance angiography and magnetic resonance spectroscopy images as needed. Such a multimodal approach allowed the characterization of ischemic, hemorrhagic, vascular, infectious, developmental and neoplastic abnormalities.

1.3 Regional Importance

This study was done in Bellur , southern part of India, and patients were referred from various affiliated hospitals. The population is thus a spectrum of hospital-based samples and not a prevalence sample of the community. The prevalence of neurocysticercosis, tuberculoma and vascular abnormalities of the brain demonstrates the importance of the prevalent neurological diseases found in different regions in the differential diagnosis of seizures.

The results also highlight the need for age-specific interpretation. Patients ranged in age from infancy to old age and developmental malformations occurred mainly in younger patients, whereas infants, children and adults were included in the age range for infarction and atrophic changes.

2. REVIEW OF LITERATURE

2.1 MRI in Epilepsy

As a structural imaging technique, MRI has increasingly superseded previous methods, and has become the main imaging modality for providing detailed information about patients with epilepsy. The primary benefits of this are the high intrinsic soft-tissue contrast, multiplanar imaging and lack of ionizing radiation. The thesis states that MRI is especially beneficial for subtlest lesions, their location and their relation with neighboring structures.

The ILAE Neuroimaging Task Force then adopted structural MRI guidelines for epilepsy. The 2019 consensus report highlighted the variability of how MRI is acquired and interpreted across institutions, and recommended harmonised MRI structural imaging requirements, to enhance diagnostic performance.

The HARNESS-MRI approach combines high resolution, three-dimensional T1-weighted and FLAIR images with high resolution, two dimensional coronal T2-weighted images. The coronal sequence is oriented perpendicular to the long axis of the hippocampus for ease in assessing the architecture of the hippocampus.

2.2 Mesial Temporal Sclerosis

In proper context, mesial temporal sclerosis is referred to as hippocampal sclerosis, which is an important structural substrate of temporal lobe epilepsy. MRI abnormalities consist of hippocampal volume loss and increased T2/FLAIR signal and loss of normal internal hippocampal architecture. Coronal T2-weighted and FLAIR imaging are particularly useful to detect.

Volumetric MRI and MR spectroscopy are other methods discussed in the thesis. In some cases, quantitative assessment of the hippocampus is more sensitive than a purely visual assessment. Spectroscopy scans with lower ratios of N-acetylaspartate may signal poor metabolism or loss of neurons.

As mentioned in the extensive literature review, mesial temporal sclerosis is mentioned quite a lot, but was not mentioned as a diagnosis on MRI in the results of the final 110 patients. This is significant in the sense that a thorough literature survey does not mean that all the pathologies reviewed happened in the studied population.

2.3 Malformations of Cortical Development

Malformations of cortical development are important causes of epilepsy, especially in children and patients with drug-resistant epilepsy. They involve abnormalities of neuronal proliferation, migration and cortical organization such as focal cortical dysplasia, polymicrogyria, lissencephaly, heterotopia and hemimegalencephaly.

The thesis describes four developmental malformations, such as polymicrogyria, inferior vermian agenesis and lissencephaly.

Focal cortical dysplasia may be difficult to diagnose using imaging because of subtle cortical thickening, blurring of the grey-white matter interface, abnormal underlying white matter signal and abnormal sulcation. These features are explained in the literature review of the thesis.

Current systematic evidence still confirms the significance of using high-resolution MRI in the management of focal cortical dysplasia. A recent (2026) systematic review indicated that conventional 1.5 T/3 T protocols using 3D T1-weighted and FLAIR sequences are able to detect a large number of type II focal cortical dysplasias, but sensitivity is highly variable across lesion types and imaging protocols.

2.4 Vascular Abnormalities

Vascular abnormalities are an important cause of seizures due to the potential to cause epileptogenic tissue through damage to the cortex, gliosis and venous congestion.

In the present series, 22 patients were found to have infarction and gliosis, and 4 patients to have had venous thrombosis. Infarction associated with gliosis and venous thrombosis was grouped together and represented 26 cases (23.64%) in the present study population and were the most common diagnostic group found on MRI in the thesis.

Cases of venous thrombosis comprised superior sagittal sinus, transverse sinus and transverse-sigmoid sinus. Two patients developed hemorrhagic infarction and one patient had extension to a superficial cortical vein and focal gyral edema. Two cases were in the puerperium and one was related to oral contraceptive.

Gradient echo, susceptibility sensitive sequences are valuable in the work up of hemorrhagic lesions and vascular malformations, and MR venography is valuable in the evaluation of suspected cerebral venous sinus thrombosis.

2.5 Infectious Lesions

Eight patients (7.27%) were diagnosed with neurocysticercosis. The lesions were reported as being parenchymal, often with multiple lesions, and showed ring enhancement with varying associated edema. MRS was also used in the evaluation of these lesions.

In four patients, the diagnosis was made of tuberculoma. The lesions were well defined, rim-enhancing, with hyperintense lipid and lactate peaks on MRS, and with perilesional edema. In 3 patients, imaging was performed at follow-up, and there was marked resolution of the lesions.

A cerebral abscess occurred in one patient. Central to peripheral enhancement of the lesion was observed on MRI, and diffuse restriction and increased lactate and lipid peaks on MRS.

These observations illustrate the ability of MRI to distinguish and define multiple types of seizure-producing infectious process. For cases in which the qualitative anatomical data are not adequate, complementary information can be acquired from DWI, contrast-enhanced imaging, and MRS.

2.6 Neoplastic and Vascular Malformations

Low grade gliomas were seen in two patients. The lesions appeared hypointense on T1-weighted imaging, hyperintense on T2-weighted and FLAIR imaging, and had high choline peaks on MRS, and were not contrast-enhancing.

Two cavernomas were detected, and showed hyperintense signal on gradient echo imaging with a hypointense rim.

One patient presented with a frontal convexity meningioma which was enhancing with surrounding edema, mass effect and midline shift.

This is a good example of the wide differential diagnosis of structural epilepsy.

3. MATERIALS AND METHODS

3.1 Study Design and Setting

A time-limited clinical study (prospective) was carried out during two years, from april 2024

to may 2026. A total of 110 patients with clinical symptoms and signs of seizures were referred to the Department of Radio-Diagnosis and Imaging Sciences and underwent brain MRI.

The institutions that participated were adichunchanagiri institute of medical sciences.

3.2 Study Population

All patients were included based on clinical diagnosis of seizures. Cases were included irrespective of age and sex. The original thesis used the 1981 ILAE clinical classification of seizures.

All patients from the neonatal period to old age were studied allowing an evaluation of age distribution of MRI abnormalities.

3.3 Inclusion and Exclusion Criteria

On the basis of clinical data selected patients with seizures were included. Those with contraindications to MRI, such as pacemakers, metallic implants, and aneurysm clips were excluded. Those who had severe claustrophobia or anxiety that would not allow them to have MRI scans were also excluded, as were patients who were not able to give consent.

3.4 Clinical Assessment

A detailed clinical history was taken, such as duration of seizures, type of seizure, other illnesses associated with seizures. Neurological examination was done to rule out focal neurological deficits and other abnormalities. Biochemical investigations were carried out regularly and included hemoglobin, leukocyte counts, differential, urinalysis, blood urea, blood glucose, serum creatinine, serum calcium and liver function tests. Chest radiography and fundus examination were also done.

3.5 MRI Acquisition

All MRI scans were obtained with a GE 1.5-T machine. After routine MRI safety screening, patients were placed in a head coil in a supine position. The brain was scanned between the nasion and inion.

The protocol consisted of a T1 and a T2 weighted axial image, thin-slice axial oblique T1 and T2 weighted images, three dimensional T1-weighted MPRAGE or SPGR, axial and coronal FLAIR, thin-slice T2-weighted imaging, DWI and ADC maps, and gradient echo sequences. Where indicated, CE T1-weighted imaging, MRA and MRS were performed.

A statement of using gadobenate dimeglumine at 0.1 mg/kg stated when a contrast agent was indicated, especially in cases of suspected tumors, vascular malformations and neurocutaneous syndromes was used in the thesis.

3.6 MRI Interpretation

MRI results were documented by the presence and type of lesions. Lesion location, signal intensity, edema, hemorrhage, atrophy, infarction, mass effect, contrast enhancement, calcification, developmental abnormalities and hydrocephalus were included in the assessment.

3.7 Follow-up

Patients were followed until the end of treatment, a maximum of 6-months.

3.8 Statistical Analysis

The proportions were used in the statistical analysis of the original dissertation. The current research paper presentation thus does not incorporate any inferential results not reported in the source dataset, but continues to follow the descriptive statistical approach used in the original presentation.

4. RESULTS

4.1 Demographic Characteristics

There were 110 patients in the study. There were 67 males (61%) and 43 females (39%), giving a male-to-female ratio of 1.5:1. The age group with the highest number of patients was 1-15 years (28 patients, 25.45%) and then 16-30 years (25 patients, 22.73%). The study population was 48.18% in the age group 1–30 years.

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Table 1. Age and Sex Distribution of the Study Population

Age Group	Number of Patients	Percentage (%)
<1 year	19	17.27
1–15 years	28	25.45
16–30 years	25	22.73
31–45 years	17	15.45
46–60 years	11	10.00
>60 years	10	9.10
Total	110	100.00
Male	67	61.00
Female	43	39.00
Male : Female	1.5 : 1	—

The source thesis reports a male predominance and identifies 1–30 years as the most represented combined age range.

The source thesis states that there is a male predominance and that the combined range of ages 1-30 is the most represented.

4.2 Clinical Seizure Distribution

The most common clinical group was the generalized tonic-clonic type, which was seen in 87 patients (79.10%). A total of 10 patients (9.10%) had myoclonic seizures and four patients (3.64%) had simple partial seizures. The rest of the groups had low numbers of patients.

Table 2. Distribution of Patients According to Seizure Type

Seizure Type	Number	Percentage (%)
Generalized tonic-clonic seizure (GTCS)	87	79.10
Myoclonic	10	9.10
Absence	1	0.91
Simple partial	4	3.64
Complex partial	2	1.82

Temporal lobe	2	1.82
Febrile	1	0.91
Neonatal	1	0.91
Motor	1	0.91
Tonic	1	0.91
Total	110	100.00

4.3 Duration of Illness

Patients were presented after 1-3 months of illness. This comprised 69.09% of the patients and 30 patients (27.27%) had been ill for more than three months and four patients (3.64%) for less than a month.

Table 3. Distribution of Patients According to Duration of Seizures

Duration	Number	Percentage (%)
<1 month	4	3.64
1–3 months	76	69.09
>3 months	30	27.27
Total	110	100.00

4.4 MRI Findings

MRI revealed abnormalities in 57 of 110 patients (51.82%) and normal MRI examinations in 53 of 110 (48.18%) patients. Infarctions with gliosis were the most common single abnormality found (22 patients, 20%).

Table 4. MRI Diagnoses in the Study Population

MRI Diagnosis	Number	Percentage (%)
Normal MRI	53	48.18
Infarct with gliosis	22	20.00
Neurocysticercosis (NCC)	8	7.27
Atrophy	6	5.45
Tuberculoma	4	3.64

Venous thrombosis	4	3.64
Developmental malformations	4	3.64
Glioma	2	1.82
Cavernoma	2	1.82
Tuberous sclerosis	2	1.82
Meningioma	1	0.91
Cerebral abscess	1	0.91
Sturge-Weber syndrome	1	0.91
Total	110	100.00

Infarcation and atrophic changes were observed in two patients and infarction and venous thrombosis were seen in two patients. Infarction was combined with gliosis and venous thrombosis as the major cerebrovascular diagnoses in the dissertation (26 patients, 23.64%).

4.5 Overall MRI Abnormality Rate

Table 5. Overall MRI Abnormality Status

MRI Status	**Number**	**Percentage (%)**
Normal MRI	53	48.18
Abnormal MRI	57	51.82
Total	110	100.00

The original table shows 57 abnormal examinations and 52% is written as an observation about the abnormality.

4.6 MRI Abnormalities by Sex

Of the 57 cases with MRI abnormalities, 38 (67%) were males and 19 (33%) were females.

Table 6. Sex Distribution Among Patients with Abnormal MRI

Sex	**Number**	**Percentage (%)**
Male	38	67.00
Female	19	33.00
Total	57	100.00

The reported analysis provided a descriptive sense of proportions that cannot inform a statistical association between sex and MRI abnormality because none of the analyses performed tests for inferential results.

4.7 MRI Abnormalities by Age

The distribution of abnormalities varied according to age. All age groups were seen with infarctions involving gliosis, and neurocysticercosis was seen primarily among the age group of 1 to 45 years. An older age group of 31-45 years old had the highest frequency of venous thrombosis in the given data set. Developmental malformations were found in the younger age group (< 15 years).

Table 7. Age-wise Distribution of MRI Abnormalities

MRI Finding	<1 y	1–15 y	16–30 y	31–45 y	46–60 y	>60 y	Total
Infarct	5	3	1	1	4	8	22
NCC	0	2	3	2	1	0	8
Atrophy	3	1	1	0	0	1	6
Tuberculoma	0	1	3	0	0	0	4
Venous thrombosis	0	0	0	4	0	0	4
Developmental malformations	3	1	0	0	0	0	4
Glioma	0	1	0	0	0	1	2
Cavernoma	0	0	1	0	0	1	2
Tuberous sclerosis	0	1	1	0	0	0	2
Meningioma	0	0	0	1	0	0	1
Cerebral abscess	0	0	1	0	0	0	1
Sturge-Weber syndrome	0	1	0	0	0	0	1
Total abnormal cases represented	11	11	11	8	5	10	56*

The most abnormalities per patient as reported in the thesis were in the 1-30 years age group.

4.8 MRI Positivity According to Seizure Type

Of all the patients with generalized tonic-clonic seizures, 42 (48%) had MRI abnormalities. 8 of 10 patients (80%) had abnormalities in the myoclonic seizures. Both simple and complex partial seizures were equally positive 50% of the time. The reported data revealed 100% positive for the temporal lobe seizures, absence seizures and motor seizures.

Table 8. MRI Positivity According to Seizure Type

Seizure Type	Total Patients	MRI Abnormal	MRI Positivity (%)
GTCS	87	42	48
Myoclonic	10	8	80
Simple partial	4	2	50
Complex partial	2	1	50
Absence	1	1	100
Temporal lobe	2	2	100
Tonic	1	0	0
Motor	1	1	100
Neonatal	1	0	0
Febrile	1	0	0

The percentages shown in the "temporal-lobe," "absence" and "motor seizure" categories are based on only one and two patients each and are not considered reliable estimates of diagnostic yield.

4.9 Neurological Examination

There were 94 patients with normal neurological examination. Each five patients had global developmental delay and microcephaly; two patients had mental retardation and four patients had other neurological findings.

Table 9. Neurological Examination Findings

Neurological Finding	Number	Percentage (%)
Normal neurological examination	94	85.45
Global developmental delay	5	4.55
Microcephaly	5	4.55

Mental retardation	2	1.82
Other neurological findings	4	3.64
Total	110	100.00

5. RESULTS ANALYSIS

The main quantitative finding is that about half of the group had MRI abnormalities. A total of 57 of the 110 patients in the study showed that their MRI scans detected some structure problem, while 53 of the patients had no MRI scan abnormality detected.

The distribution of the abnormal findings suggests that the population of people with seizures in this study had a variety of underlying mechanisms. Cerebrovascular disease was the most prevalent category, 26 cases (with infarction and gliosis and venous thrombosis). Infarcations with gliosis predominated, indicating that acquired cortical and subcortical injury played an important role in this hospital population.

The third category was infectious pathology. The other types were neurocysticercosis (7.27%), tuberculoma (3.64%) and cerebral abscess (0.91%). All of these observations highlight the importance of intracranial infections in the regional population of seizures.

Four cases of developmental malformation, two cases of tuberous sclerosis and one case of Sturge-Weber syndrome were classified as developmental pathologies. The results support the known role that developmental abnormalities play as epileptogenic substrates but the study population is too small to make precise estimates of the prevalence by age.

Additionally, there is a clinical significance of normal MRI examinations in 48.18% of the patients. A normal structural MRI is no barrier to diagnosis of epilepsy or to the possibility of an epileptogenic abnormality. The possible reasons for the occurrence of MRI-negative epilepsy include lesions below the usual spatial resolution, selection of inadequate protocols, subtle abnormalities of the cortex, motion artefacts, lesions not having a clear structural correlate and inappropriate imaging orientation. The contemporary ILAE recommendations stress systematic assessment and optimized protocols, given the fact that certain epileptogenic lesions are difficult to visualize.

Generalized tonic-clonic seizure was the predominant clinical seizure distribution. This concentration prevents direct comparisons of seizure types. Only two patients had seizures involving the temporal lobes and were observed to have 100% MRI positivity, while only one patient had absence seizures and was observed to have 100% MRI positivity. As such, these percentages should not be interpreted as a general diagnostic probability.

6. DISCUSSION

6.1 Principal Findings

The most important result of the investigation was the identification of abnormalities in structural MRI in 57 of 110 patients (about 52% of the study population). This study showed that significant number of patients who have clinically diagnosed seizures actually have a structurally identifiable MRI abnormality.

The most important individual radiological finding is that of cerebral infarction with gliosis, which was observed in 22 patients. The study also contrasts with epilepsy populations with a higher proportion of drug-resistant focal epilepsy where hippocampal sclerosis and focal cortical dysplasia might account for a greater proportion of MRI-positive cases. The difference is probably due to the wide clinical inclusion criteria and hospital-based population in the dissertation.

Unlike other theses, the thesis encompassed patients of any age with seizures, not just patients with focal epilepsy or medically refractory epilepsy. This overall design enabled the identification of vascular (vasculopathy), infectious, developmental and neoplastic abnormalities.

The principles of MRI are compared with 6.2.

The results corroborate the basic concept that MRI is an important structural evaluation in the assessment of seizures. The merits of MRI were highlighted due to its high soft tissue contrast and multiplanar properties.

This has become a key principle confirmed by contemporary evidence. Structural MRI is recognized as an essential tool for diagnosis and management in epilepsy in the ILAE 2019 consensus recommendations, and these guidelines suggest how it should be acquired and interpreted.

Many of the elements of the original 1.5-T protocol are still relevant to current practice, such as high-resolution T1 imaging, FLAIR, coronal T2 imaging, diffusion, susceptibility-sensitive imaging and contrast imaging when clinically appropriate.

The current recommendations emphasize more the three-dimensional structural imaging harmonization. The HARNESS-MRI protocol consists of 1mm isotropic 3D T1-weighted and 3D FLAIR acquisition, and high-resolution coronal T2 acquisition perpendicular to the hippocampus.

6.3 Cerebrovascular Disease

The largest pathological group of the present data was the group of cerebrovascular abnormalities. Twenty-two patients developed infarction and gliosis and four patients developed venous thrombosis.

Acute, subacute and chronic abnormalities were present in the infarction cases. The thesis covers the following conditions: diffusion restriction in acute infarction, chronic gliotic changes, encephalomalacia and deep white matter ischemic lesions.

Seizures can occur in conjunction with acute cortical ischemia or chronic cortical scar. In a suitable clinical setting, the localization of previous infarction with gliosis offers an anatomical basis for the understanding of seizure generation.

The venous thrombosis results are also clinically significant. Four (2%) patients had cerebral venous sinus thrombosis, two of which were linked with hemorrhagic infarction. Clinical associations were identified in the study as being puerperium and oral contraceptive use.

The observations in these cases emphasize the need to include venous imaging in the assessment of selected cases, especially in those with headaches, papilledema, pregnancy-related causes, or when the distribution of the haemorrhagic infarction or papilloedema suggests a cerebral venous disease.

6.4 Neurocysticercosis

Neurocysticercosis was the second most common single abnormality noted in eight patients. The lesions were parenchymal and were often multiple, with rings enhancing and varying perilesional edema.

This is especially significant in the regional context. Seizures can be caused by parenchymal neurocysticercosis by inflammatory effects, perilesional edema, gliosis or chronic calcified or residual lesions. MRI can show the number, location, stage and the presence of edema in lesions.

MRS is included in the evaluation, providing further evidence for the multimodal nature of the original imaging protocol. The thesis reported choline peaks in the NCC cases.

6.5 Tuberculoma and cerebral Abscess

Tuberculomas were seen in four patients. Imaging showed rim enhancing lesions with perilesional edema and MRS revealed high lipid and lactate peaks. Of these, three patients who were followed with imaging showed significant resolution following therapy.

Diffusion restriction and MRS abnormalities were found in the single cerebral abscess. The findings help show the benefit of using conventional MRI, diffusion and spectroscopy to distinguish infectious and neoplastic/ring-enhancing lesions.

6.6 Developmental Abnormalities

Four of the patients had developmental malformations. Two had polymicrogyria, one had inferior vermian agenesis and one had lissencephaly.

This was mostly found in younger patients. The age distribution is consistent with clinical relevance of developmental neuroimaging in children and young people with early onset seizure presentations.

There is still a strong focus on the high-resolution aspect of MRI in contemporary imaging literature regarding these abnormalities. Systematic recent evidence suggests that both 3D T1 and FLAIR are important structural sequences to include in focal cortical dysplasia protocols, but there is variation in sensitivity, and subtle lesions need specialized imaging and interpretation.

The 2026 ILAE guidelines also recommend MRI in young children who have a first afebrile seizure or new onset epilepsy. In 753 infants with an MRI, the evidence review found abnormal scans in 58.2%, but there was some uncertainty due to the variability of results among studies.

This modern data further emphasizes the significance of the developmental abnormalities found in the original data set, and it also illustrates the evolution of paediatric epilepsy imaging.

6.7 Neoplastic Lesions

Among the space-occupying lesions two low-grade gliomas and one meningioma and one cerebral abscess were diagnosed. The low-grade gliomas showed T2/FLAIR hyperintensity, and mild mass effect and increased choline on MRS without contrast enhancement.

Large extra-axial lesion located in the frontal convexity was seen with contrast enhancement and perilesional edema and mass effect in the meningioma.

Tumors are uncommon, but this does not reduce their clinical significance since detection of an epileptogenic neoplasm can significantly impact clinical management. MRI can give information about the location of the lesion, how extensive it is, how the lesion is enhancing, and the relationship of the lesion to other adjacent structures.

6.8 MRI-Negative Patients

In 53 patients (48.18%), a normal MRI was documented. The proportion is clinically significant in the sense that a normal conventional structural exam does not exclude the presence of an epileptogenic process.

The current use of imaging in the treatment of epilepsy has shifted to standardized high-resolution scan protocols and expert review. The recommendations of ILAE are focused on the optimization of lesion detection and include the systematic interpretation and appropriate image acquisition.

For MRI-negative epilepsy, a correlation with seizure semiology, EEG, functional imaging and/or advanced MRI analysis may be needed. Multimodal neuroimaging techniques such as PET, SPECT, functional MRI (fMRI) and source imaging from EEG are also acknowledged in the role of pre-surgical evaluation in ILAE educational guidance.

The original dissertation did not systematically assess MRI-negative patients by use of modern multimodal techniques. It is therefore important to remember that the 48.18% proportion of N-MRIs should not be viewed as an accurate estimate of the prevalence of truly MRI-negative epilepsy, but as a result of a particular 1.5-T clinical population and protocol.

6.9 Clinical Seizure Type and MRI Findings

GTCS accounted for 79.1% of all cases and 42/87 GTCS patients had MRI abnormalities. 10 patients had 8 abnormal MRI examinations.

The apparent MRI positivity rates were high in the smaller seizure categories. The denominators were too small, however, to be used to make reliable estimates. For instance, there were only two patients in the temporal lobe seizure group, both of whom had abnormalities. One patient had an abnormal MRI and was classified as having an absence seizure.

Therefore, the findings can only be used to make the observations of the study population and do not provide statistically significant comparisons between seizure types. To see whether the semiology of seizures is an independent predictor of MRI abnormality would require a larger study.

6.10 Neurological Examination and MRI

The neurological examination was normal in most cases (94/110) patients were classified as neurologically normal.

The significance of this finding lies in the fact that structural MRI abnormalities could be seen despite the absence of focal deficits during routine neurological examination, highlighting the value of this technique for diagnosis. This means that the absence of focal neurological signs and symptoms does not rule out the presence of a structural defect.

The features associated with increased risk of abnormal MRI in infants seen during the 2026 ILAE evidence review were abnormal neurological examination, and the evidence was noted to be limited.

6.11 Relevance of 1.5-T MRI

All data were collected on a 1.5-T GE scanner. The system offered traditional and advanced MRI sequences that were adequate for the diagnosis of a wide variety of abnormalities.

3-T systems are often used for modern epilepsy imaging, especially when the patient has a subtle lesion or when presurgical evaluation is indicated. But, no matter the field strength, it is crucial that a standardized and properly oriented protocol exists. The 2019 consensus recommendations of the International League Against Epilepsy make protocol quality and protocol selection and systematic evaluation more important than relying on field strength.

The 52% abnormality rate thus represents the diagnostic success obtained with the initial 1.5-T protocol, but there are opportunities for further improvements in diagnostic sensitivity by higher resolution acquisition and post-processing according to current standards.

7. METHODOLOGICAL STRENGTHS AND LIMITATIONS

This prospective design is an important strength as patients were not selected from historic records, but instead were evaluated during the stipulated study period. A large age range and relatively full MRI protocol were also included as part of the study. Diffusion, susceptibility sensitive imaging, MRA and MRS enabled different pathological categories to be characterized.

The main methodological drawback is the lack of a formal calculation of sample size. The original methodology was to recruit at least 50 cases, which would depend on the availability of cases; it turned out that 110 cases were recruited.

The study was hospital-based and referral dependent. Hence the sample should not be considered to represent the entire population of people who suffer from seizures.

Another restriction is the descriptive statistical method. Proportions were the only figures reported. For this reason the study does not report p-values, confidence intervals, effect sizes or multivariable models.

Another limitation is the lack of formal interobserver analysis. The thesis does not contain separate interpretation of the MRI by more than one blinded radiologist or interobserver agreement measurements.

Systematic quantification of the relationship between MRI findings and EEG was also not performed. The information provided by the EEG is important for anatomical-electrophysiological correlation, especially in the case of patients with focal epilepsy.

Similarly, a quantitative outcome analysis was not developed in the objective related to postoperative outcome. Follow-up was done in a few patients but results are not reported in a structured postoperative cohort, in terms of seizure free rate, Engel, or statistical relationship between preoperative MRI and surgery. Thus, the postoperative goal was not thoroughly assessed with the available information.

Last, there were very few numbers of seizures for several categories. Therefore, percentages like the 100% MRI positivity of temporal-lobe seizures are not very statistically stable.

8. CONTEMPORARY IMPLICATIONS FOR EPILEPSY MRI

The data shows the diagnostic utility of a comprehensive 1.5-T MRI protocol in a hospital cohort. Modern epilepsy imaging offers a paradigm to build on this strategy.

Both consensus statements from ILAE 2019 call for the use of standardized structural imaging and systematic interpretation. The HARNESS-MRI approach involved both high resolution 3D T1-weighted and FLAIR sequences along with high

resolution coronal T2-weighted imaging of the hippocampi.

Advanced MRI techniques continue to be developed, as illustrated in recent literature. The diagnosis of focal cortical dysplasia is more difficult and challenging because subtle lesions may not be apparent on routine exams. A systematic review in 2026 found significant differences in sensitivity between MRI methods and highlighted the value of the high-resolution structural sequences.

Current ILAE evidence in favor of MRI after a first afebrile seizure and/or new-onset of epilepsy includes infants with developmental delay or perinatal complications, abnormal neurological examination, prolonged seizures, and/or focal EEG abnormalities.

These advances indicate that the historical data may serve as a good reference for assessing the MRI diagnostic yield longitudinally. Modernized 3-T standardized HARNESS-MRI, structured reporting, EEG correlation and inferential statistics may be able to establish if subtle epileptogenic abnormalities are found more often with improved acquisition and interpretation.

9. CONCLUSION

Overall, MRI of the brain showed a wide range of structural abnormalities in the 110 patients with clinically diagnosed seizures, who were evaluated prospectively. The number of patients in whom a normal MRI was performed was 53 (48.18%) while the number of patients who showed abnormalities was 57 (51.82%). The most common single abnormalities were cerebral infarction and gliosis (20% each). The next largest group consisted of neurocysticercosis, cerebral atrophy, tuberculoma, venous thrombosis and developmental malformations.

Cerebrovascular pathology was the most common group, comprising of 26 patients (23.64%) when combined with venous thrombosis. Infectious diseases were also a significant part of the spectrum of MRI – especially neurocysticercosis and tuberculoma. Developmental abnormalities were more prevalent in younger patients and vascular and atrophic abnormalities in a wider age range.

The most common clinical forms were generalized tonic-clonic (GTC) seizures. The prevalence of MRI abnormalities in patients with GTCS and myoclonic seizures was 48% and 80%, respectively. Apparent 100% positivity for the motor seizure and absence categories, and the temporal-lobe category, were extremely small numbers and should not be interpreted as population level estimates.

The study has set the diagnostic value of MRI in the evaluation of seizures in the hospital population of South India. The results show that the structural pathological changes associated with seizures are not monotypic, but rather represent vascular, infectious, developmental, neoplastic and atrophic phenomena. The high MRI abnormality rate, around 52%, is testament to the high diagnostic value of structural imaging with the given protocol over the study period.

The opportunities of the original method are offered by contemporary recommendations on epilepsy imaging, which support the use of regular high-resolution structural MRI, specific imaging of the hippocampus and systematic interpretation of the image and the clinical-electroencephalogram correlation.

A modern extension of this study should include formal sample size calculation, multicentre recruitment, standardisation of MRI protocols, EEG correlation, inferential statistical and interobserver assessment and structured follow-up. Such an approach would enable the evaluation of both abnormality frequency and predictors of MRI positivity in the clinic, as well as the prognostic value of individual MRI substrates.

BIBLIOGRAPHY

[1] Lucato LT, Guedes MS, Sato JR, Bacheschi LA, Machado LR, et al. The role of conventional MR imaging sequences in the evaluation of neurocysticercosis : Impact on characterization of the scolex and lesion burden. Am J Neuroradiol 2007 Sept;28:1501-04.

[2] Venkatramana R. Vattipally, and Richard A. Bronen. MR imaging of epilepsy: Strategies for successful interpretation. www.radiologic.theclinic.com Doi:10.1016/j.rcl.2005.09.001

[3] Wright NB. Imaging in epilepsy : a paediatric perspective. The Br J Radiol 2001 July; 74:575-589.

[4] Arora V, Mahajan DS, Sandhu PS, Singh JP, Chopra R. MRI in seizure disorder – A pictorial essay. www.ijri.org 2012 Sept;14.96.149.236.

[5] Laurens De Cocker, Felice D'Arco, Philippe Demaerel and Robin Smithuis. Role of MRI in epilepsy. The radiology Assistant 2013.

[6] Myint PK, Staufenberg EFA, Sabanathan K. Post stroke seizure and post stroke epilepsy. Postgrad Med J 2006 Sept; 82(971):568-572.

[7] Liu Rs, Lemieux L, Bell GS, Hammers A, Sisodiya SM, Bartlett PA, et al. Progressive neocortical damage in epilepsy. Ann Neurol 2003;53(3):312-324.

[8] Sachin Rastogi, Christopher Lee, Noriko Salamon. Neuroimaging in pediatric epilepsy : A multimodality approach. Radio Graphics 2008;28:1079-1095.

[9] Barkovich AJ, Kuzniecky RI, Jackson GD, et al. A developmental and genetic classification for malformations of cortical development. Neurology 2005;65(12): 1873-1887.

[10] Phuattwee Tang, et al. Annals academy of medicine Singapore. 2008 May;37:397-401.