Original Article

ISSN (O): 2347-338X; ISSN (P): 2347-3371

Mri Evaluation of Seizures: Study at a Tertiary Referral Center in Southern India

Ramakrishna Narra[1], **Anusha Putcha**[2], **Yeshwanty**[2], **Narmada Penumatcha**[3]

[1]Department of Neurology, Katuri Medical College, Guntur, Andhra Pradesh, India, [2]Department of Radiology, Katuri Medical College, Guntur, Andhra Pradesh, India, [3]DMRD, Katuri Medical College, Guntur, Andhra Pradesh, India.

Abstract

Background: Epilepsy is a chronic entity with recurrent episodes of seizures. Estimated prevalence of epilepsy is about 5 to 10 persons per 1000 population and the incidence is about 0.3 to 0.5%. magnetic resonance imaging(MRI) is the imaging modality of choice in the evaluation of seizures because of its high soft tissue contrast and its capability of multi planar imaging. MRI is useful in the localization of epileptogenic focus precisely and to demonstrate its relation with eloquent areas of brain. Thus it helps in guiding the neurosurgeon in planning a surgery in cases of medically refractory epilepsy. The current study is undertaken to study the causative factors and the MRI findings in patients presenting with seizures. **Subjects and Methods**: The main source of data for the study are the patients with clinically suspected seizures referred for MRI to the Department of Radiodiagnosis at Katuri Medical College and hospital, Chinakondrupadu, Guntur. 60 patients referred to the Department of Radiodiagnosis for a period of 24 months with clinical symptoms and signs of seizures and referred for MRI examination were studied. **Results**: Maximum number of patients were in the age group of 1-30 years (63%). Maximum number of patients presented with GTCS. MR abnormality was maximum seen in patients between the ages of 16 to 45 years. Out of 60 patients who presented with seizures, in 28 patients (47%) the study was normal. Cerebrovascular causes including infarct with gliosis and venous thrombosis were found to be the most common diagnosis on MR imaging in patients presenting with seizures since it was seen in 10 patients (16%). **Conclusion**: Accurate detection of the underlying cause in seizure is very important for planning appropriate management. MRI is highly sensitive and specific in finding the pathology which is responsible for seizures. In our study of 60 patients who clinically presented with seizures, infarct with gliosis, NCC, tuberculoma, atrophy, are the major etiological factors and others include venous thrombosis, developmental malformations, hypoxic ischemic injury, mesial temporal sclerosis, cavernoma, oligodendroglioma, meningioma and cerebral abscess. The commonest MR abnormality was cerebral infarct with gliosis. We conclude that MRI with seizure protocol plays a key role in the recognition of epileptogenic substrates and also for planning the management in patients with seizures and in predicting the prognosis.

Keywords: Magnetic resonance imaging, Magnetic resonance spectroscopy, Seizures, Tuberculoma, Cysticercosis

Corresponding Author: Ramakrishna Narra, Department of Neurology, Katuri Medical College, Guntur, Andhra Pradesh, India.

Received: 04 July 2021 **Revised: 19 September 2021** **Accepted: 28 September 2021** **Published: 24 December 2021**

Introduction

Seizure is a clinical manifestation of abnormal electrical discharge in the neurons of brain that causes altered neurological function. Epilepsy is defined as a chronic entity with recurrent episodes of seizures. Estimated prevalence of epilepsy is about 5 to 10 persons per 1000 population and the incidence is about 0.3 to 0.5%.[1] Epilepsy has a bimodal age distribution with predominance in children and elderly people compared to young adults.

Apart from clinical assessment, various investigations available for diagnosis of the etiology of seizures are skull x-ray, pneumocephalography, EEG, CSF analysis, CT and MRI.[2] MRI is the imaging modality of choice in the evaluation of seizures because of its high soft tissue contrast and its capability of multi planar imaging. MR imaging is useful in the localization of epileptogenic focus precisely and to demonstrate its relation with eloquent areas of brain. Thus it helps in guiding the neurosurgeon in planning a surgery in cases of medically refractory epilepsy.[3] The current study is undertaken to study the causative factors and the MRI findings in patients presenting with seizures.

Aims and Objectives

1. To study the spectrum of Magnetic Resonance Imaging findings in patients with seizures.
2. To identify the common structural abnormalities in the brain associated with seizures.

Subjects and Methods

Sample size – 60 patients referred to the Department of Radiodiagnosis with clinical symptoms and signs of seizures.

Study period – November 2016 to October 2018, for a period of 24 months.

Type of study – Descriptive cross sectional analysis study

Method of Collection of Data

- The main source of data for the study are the patients with clinically suspected seizures referred for MRI to the Department of Radiodiagnosis at Katuri medical college and hospital, Chinakondrupadu, Guntur.
- Informed consent is taken from all the patients or from guardian in case of pediatric patients prior to examination.
- Clinical history of each patient is recorded and MRI evaluation is done.
- A detailed proforma is filled up.
- All the patients underwent MRI scan of the brain and the data is collected and evaluated.

Inclusion Criteria

- All the patients who presented clinically with seizures and referred to the department of Radiodiagnosis.
- Patients of all age groups and both sexes are included in the study.

Exclusion Criteria

- Patients with history of insertion of metallic implants or placement of cardiac pacemakers and aneurysmal clips.
- Patients with history of claustrophobia.
- Patients with history of anxiety disorders who are reluctant to give consent.

Equipment used – 1.5 Tesla PHILIPS Achieva – 16 channel MRI scanner.

Technique:

- Sequences used: T1WI Axial, T2WI Axial, FLAIR Axial, T1WI Sagittal/ T2WI Coronal, Gradient echo sequence Axial, DWI Axial, T1WI FSPGR with or without contrast, MR Angiogram & MR Spectroscopy.
- When the study was negative with these sequences, additional sequences were done to evaluate hippocampus which includes T2WI Coronal, T2WI, FLAIR & T1WI Axial (sections parallel to the hippocampus orientation).

Results

Maximum number of patients were in the age group of 1-30 years (63%). Number of male patients were 34 (57%) and female patients were 26 (43%). Male predominance is noted with a sex ratio (M: F) of 1.3:1.

Out of 60 patients who presented with seizures, in 28 patients (47%) the study was normal. Cerebrovascular causes including infarct with gliosis and venous thrombosis was found to be the most common MR diagnosis in patients presenting with seizures as it was seen in 10 patients (16%). In one case with venous thrombosis, venous infarct was also seen.

ILLUSTRATIVE CASES

NEUROCYSTICEROSIS

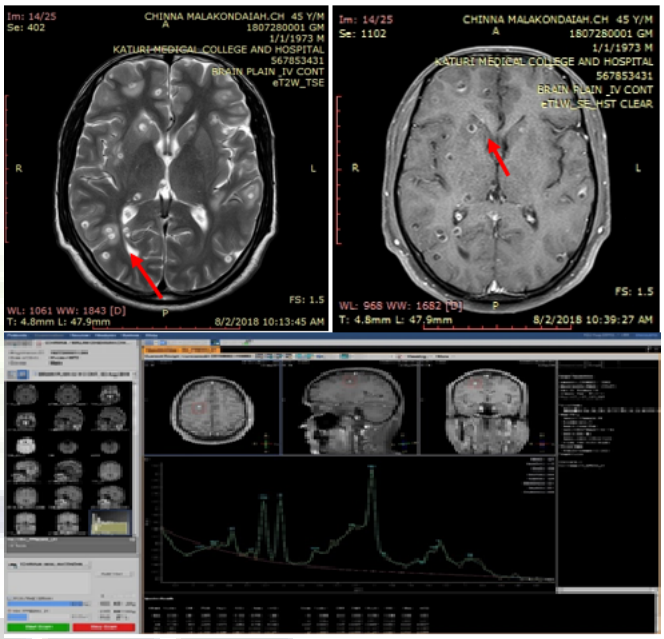

Figure 1: A - Axial T2 W MR image showing multiple hyperintense lesions with an eccentric mural nodule in bilateral cerebral hemispheres, few of them showing perilesional edema. B – Axial post contrast T1 image showing ring enhancement of the lesions (arrow). C- MR spectroscopy showing mild increase in choline and mild decrease in NAA and creatine.

FOCAL CORTICAL DYSPLASIA

OLIGODENDROGLIOMA

Discussion

Patients who present clinically with seizures will have a wide range of abnormalities on MR imaging based on the etiology. MRI is useful in planning the further management in seizures by effectively localizing the abnormality.

In our study 60 patients with clinical presentation of seizures were included in the study as per the inclusion criteria,

Table 1: Age and Sex Wise Distribution

Age in years	Male	Female	Total	Percentage
<1	1	1	2	3
1-15	11	3	14	23
16-30	13	11	24	40
31-45	6	4	10	17
46-60	1	3	4	7
>60	2	4	6	10
Total	34 (57%)	26 (43%)	60	100

Table 2: Distributionon the Basis of Clinical Diagnosis of Seizure.

Clinical diagnosis	No. of patients	Percentage
GTCS	48	80
Myoclonic seizures	3	5
Absence seizures	1	1.7
Simple partial seizures	2	3.3
Complex partial seizures	1	1.7
Temporal lobe seizures	2	3.3
Febrile seizures	1	1.7
Motor seizures	1	1.7
Neonatal seizures	1	

+Maximum number of patients presented with GTCS 48/60 (80%).

Table 3: Distributionof Patients on the Basis of Duration of Seizures

Duration of illness	No. of patients	Percentage
<1 month	2	3.34
1 – 3 months	41	68.33
>3 months	17	28.33

Majority of the patients 41/60 (68.33%) presented within one to three months of onset of seizure.

Table 4: Distributionof Patients on MR Diagnosis

MR diagnosis	No. of patients	Percentage
Normal study	28	47
Infarct with gliosis	8	13
NCC	4	7
Tuberculoma	4	7
Atrophy	3	5
Venous sinus thrombosis	2	3
Developmental malformations	2	3
Mesial temporal sclerosis	2	3
Hypoxic ischemic injury	2	3
Cavernoma	2	3
Oligodendroglioma	1	2
Meningioma	1	2
Cerebral abscess	1	2

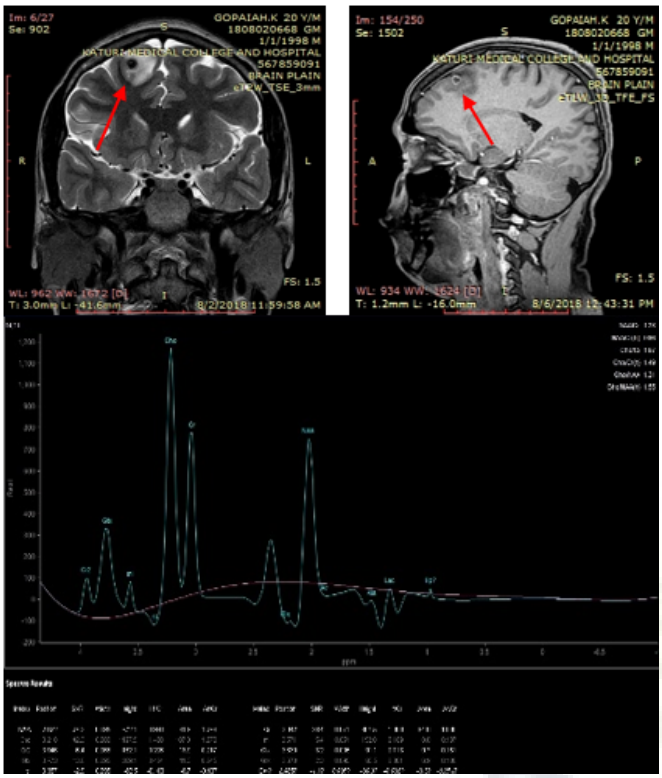

Figure 2: A- Coronal T2W MR image showing hypointense lesion (arrow) with peri lesional edema in right frontal lobe. B – Sagittal post contrast T1 image showing ring enhancement of the lesion (arrow). C- MR Spectroscopy showing decrease in NAA, increase in choline and Cho/Cr ratio - 1.49, favorable of tuberculoma.

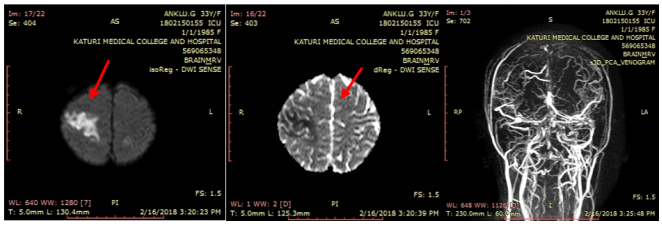

Figure 3: A & B – DWI and ADC map showing area of hyperintensity on DWI in right parietal lobe (arrow) with hypointense signal on ADC (arrow) indicating diffusion restriction, suggestive of infarct. C – MR Venogram showing absent flow in superior sagittal sinus and right transverse sinus, suggestive of thrombosis.

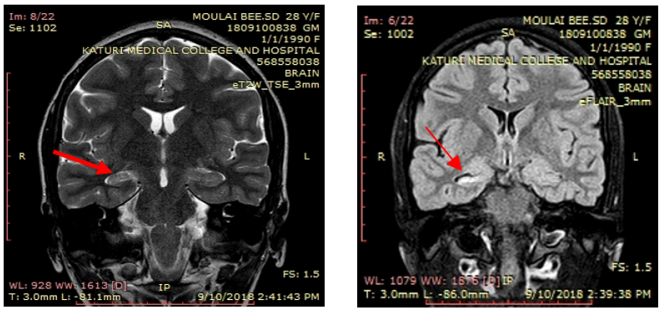

Figure 4: A & B – Coronal T2W & Coronal FLAIR images showing hyperintense signal, reduction of volume and loss of digitations in right hippocampus (arrows).

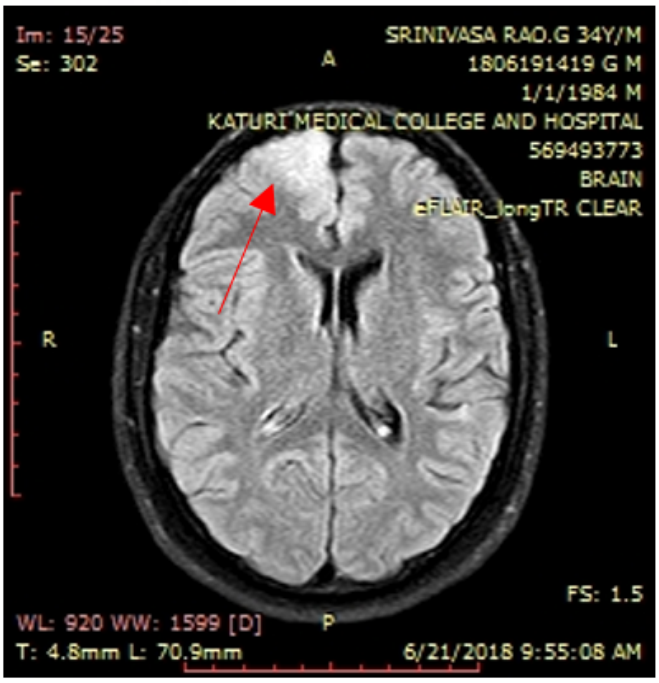

Figure 5: Axial FLAIR image showing focal cortical thickening and hyperintense signal in adjacent white matter in right frontal lobe (arrow).

exclusion criteria and the criteria of ILAE 1981. The clinical history of each patient was recorded and all of them underwent routine biochemical investigations as per the proforma and MRI scan with PHILIPS 1.5 T MRI scanner.

In our study the patients presented with duration of seizures ranging from few days to few months. GTCS was the most common clinical diagnosis accounting for 48 cases (80%).

Age and sex distribution

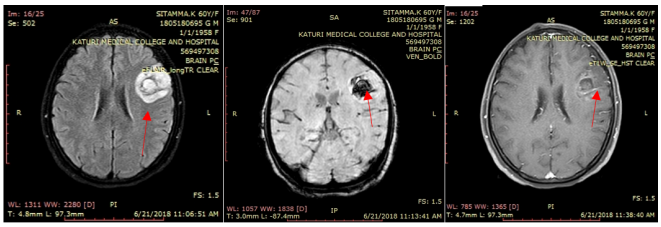

Figure 6: A – Axial FLAIR image showing well-defined cortical based intra-axial predominantly hyperintense lesion (arrow) with no perilesional edema. B - Gradient echo image showing hypointense signal (arrow) in the lesion. C – T1 post contrast image showing no significant enhancement (arrow).

The age of the patients in our study was ranging from neonate to 70 years with male predominance, males 34 (57%) and females 26 (43%).

MRI positivity

The MR imaging revealed abnormalities in 32 out of 60 patients (53%) which includes infarct with gliosis (13%), NCC (7%), tuberculoma (7%), atrophy (5%), venous thrombosis (3%), developmental malformations (3%), hypoxic ischemic injury (3%), mesial temporal sclerosis (3%), cavernoma (3%), oligodendroglioma (2%), meningioma (2%) and cerebral abscess (2%).

Cerebral infarcts with gliosis

Out of 60 patients 8 patients (13%) had cerebral infarction on MR imaging. Three patients revealed acute infarcts in fronto-parietal, parieto occipital lobes and in peri ventricular region diagnosed depending on the diffusion restriction, mild swelling with effacement of adjacent sulci. Four patients showed chronic infarcts with gliosis in left fronto parieto temporal and bilateral occipital lobes. Tiny ischemic lesions with hyperintense signal on T2W & FLAIR with no restriction of diffusion on DWI was noted in one patient in fronto parietal lobes.

In a study by Mc Gahan et al,[3] out of 638 patients with first-ever stroke 5% of the patients (31 patients) had early seizures. They also reported that hemorrhagic transformation in stroke is a predictive factor for early seizure.

Neurocysticercosis

Out of 60 patients, 4 patients (7%) had lesions with features of neurocysticercosis (NCC) on MR imaging. In all the 4 cases ring enhancing lesions were present in the cerebral hemispheres indicating parenchymal form of the disease. Lesions of NCC appear hypointense on T1W and hyperintense on T2W with perilesional edema for few lesions. The lesions show an eccentric mural nodule within the lesion. On MR Spectroscopy, choline peak is noted in all the 4 patients. Three patients had ring enhancing lesions with perilesional edema in fronto parietal lobes. One patient had multiple intra parenchymal ring enhancing lesions of different stages. Most of the lesions were found in the parietal lobe.

TR Velasco et al,[4] in their study of 512 patients with intractable epilepsy reported that isolated NCC was found in eight patients (1.56%).

Tushar B. Patil, et al,[5] in their study of 40 patients with probable diagnosis of NCC reported that 72% of patients had one lesion, 27% had multiple lesions and parietal lobe was the common site (4%) and their results were similar to our study.

Tuberculoma

Out of 60 patients, four patients were diagnosed as tuberculoma on MR imaging. The lesions were well defined, ring enhancing with thick wall and peri lesional edema. On MR Spectroscopy elevated lactate, lipid peak was seen in all the cases. Along with the appearances on MR imaging the supportive criteria taken into consideration while diagnosing a tuberculoma are past history of ATT usage, any history of contact and any evidence of tuberculosis in chest x-ray. All the four patients followed after treatment and remarkable resolution of the lesions were noted.

Naser UAMA et al,[6] in their study of 92 seizures cases with intracranial space occupying lesions reported that tuberculoma was found in 1.4% and 66.6% of them showed good response to medical treatment with significant improvement of the lesions within 6 weeks. Results of this study are in concordance with our study.

Cerebral atrophy

Three patients had features of cerebral atrophy. Two patients had diffuse cortical and subcortical atrophic changes in bilateral cerebral hemispheres. One patient who presented with temporal lobe epilepsy showed focal atrophic changes involving bilateral frontal and temporal lobes.

Ghayyur Khan et al,[7] in their study of MRI in 100 patients who presented with seizures, dementia and history of diabetes reported that cerebral atrophy was found in 47% males and 43% females and concluded that cerebral atrophy is a well-recognized late complication of diabetes. Similar results were found in our study in which 2 of the patients with cerebral atrophy were males, one patient was female and all the three patients had history of diabetes.

Venous sinus thrombosis

In our study two patients showed features of cerebral venous sinus thrombosis on MRI. One patient had superior sagittal sinus thrombosis. One patient showed superior sagittal sinus and right transverse sinus thrombosis with infarct in right fronto parietal lobe.In our study one patient presented with

history of oral contraceptive usage. Appropriate medical treatment was given and the patient showed significant clinical improvement. Gupta RK et al,[8] in their case report of a patient with history of continuous headache reported that the presence of superior sagittal sinus thrombosis with a small venous infarct was diagnosed using MR venogram study.

Developmental malformations

Two patients had features of developmental structural cortical malformations. One patient showed polymicrogyria in bilateral parietal lobes. One patient showed focal cortical dysplasia in right frontal lobe.

In a similar study by Jagruti P. Sanghvi et al,[9]of 76 patients with seizures reported that on MR imaging 9 patients showed focal cortical dysplasia and 3 patients had features of polymicrogyria.

Mesial temporal sclerosis

In the present study hippocampal sclerosis was noted in 2 patients. One patient had the features on right side whereas one patient had left hippocampal sclerosis. Hyperintense signal on FLAIR was noted in body and tail of hippocampus with relative loss of the hippocampal digitations and minimal reduction in volume of hippocampus in both the patients.

Bronen RA et al,[10] in their study of 31 patients with intractable epilepsy reported that out of 11 patients with cryptogenic temporal lobe epilepsy 9 patients had features of hippocampal sclerosis and the findings on MR imaging were unilateral hippocampal atrophy (commonly involving the body of hippocampus), hyperintense signal in the hippocampus on long TR scans, and atrophy of the temporal lobe and adjacent white matter.

Hypoxic ischemic injury

Two patients showed features of hypoxic ischemic injury. One patient showed T2W & FLAIR hyperintense foci in bilateral peri ventricular white matter. Another patient showed similar lesions in bilateral basal ganglia, brain stem and in peri ventricular white matter. Both the patients had eventful perinatal history.

L. Liauw et al,[11] studied 57 infants who were born after 35weeks or more gestational age, in which 23 patients were having perinatal hypoxic ischemic encephalopathy stage 2/3. They concluded that compared to the normal changes seen in myelination the hypoxic ischemic events can be concludes by comparing the signal intensity of posterolateral putamen versus posterior limb of internal capsule and corona radiate versus peri-Rolandic cortex on T1W images with a better predictive value.

Cavernoma

Two patients showed well defined non enhancing lesions with hemorrhagic signal intensities in the left temporal lobe in one patient and in right parietal lobe in another patient. On gradient echo images hypointense rim was noted in the lesions. Out of two patients diagnosed with cavernoma one patient was male and one patient was female. In both the patients the lesions were supratentorial in location.

Kayali Hakan et al,[12] in their study of 37 patients with cavernoma on MR imaging reported that 30 patients were males, 7 were females and 57% of the patients had lesions in supratentorial location. Results of this study are not in concordance with our study.

Oligodendroglioma

In the present study one patients showed features of an oligodendroglioma in left frontal lobe. The lesion appeared as a well-defined cortical based intra-axial heterogenous lesion predominantly hyperintense on T2W & FLAIR with no perilesional edema. On gradient echo images the lesion has hypointense signal. On contrast administration no perceptable enhancement was seen.

S. Fellah et al,[13] in their study of 50 patients with oligodendrogliomas and oligoastrocytomas reported that multimodal MR imaging (Diffusion,Perfusion and Spectroscopy) is more accurate in grading of these tumors when compared to conventional MRI.

Meningioma

In one patient who presented with seizures meningioma was noted in left sphenoid convexity. The lesion was seen as a well-defined extra axial dural based lesion with intense enhancement and dural tail at its margin in left sphenoid convexity.

Sultan Alshoabi et al,[14] in their study of 50 patients with meningioma of brain and spine reported that meningioma is more common in females above 40 years of age and most of the cases are convexity meningiomas in brain. The results of this study are similar to our study as the patient showing features of sphenoid convexity meningioma in our study is a 70-year-old female patient.

Cerebral abscess

In the present study cerebral abscess was noted in 1 patient in right parietal lobe. The lesion was seen as a well-defined space occupying lesion isointense to hypointense on T1W, hyperintense on T2W with peri lesional edema in right parietal lobe. Restriction of diffusion was noted on DWI. On contrast administration peripheral rim enhancement of the lesion was noted. On MR Spectroscopy elevated lactate, lipid peak was noted.

Fabiola W. Cartes-Zumelzu et al,[15] in their study of seven patients with pyogenic brain abscesses concluded that DWI is superior when compared to the routine conventional contrast enhanced MR imaging in the evaluation of success or failure of the drainage of an abscess.

Conclusion

Evaluation of a patient with clinical history of seizure disorder is a frequently encountered problem. MR imaging plays an significant role in the assessment of patient with seizures and to make an accurate diagnosis.

Accurate detection of the underlying cause in seizure is very important for planning appropriate management. MRI is highly sensitive and specific in the detection of pathology which is responsible for seizures. MRI has excellent soft tissue contrast, high spatial resolution, capability of multiplanar imaging and lack of ionizing radiation and these features make it an effective modality in the evaluation of patients with seizures.

In our study of 60 patients who clinically presented with seizures, infarct with gliosis (13%), NCC (7%), tuberculoma (7%), atrophy (5%), are the major etiological factors and others include venous thrombosis, developmental malformations, hypoxic ischemic injury, mesial temporal sclerosis, cavernoma, oligodendroglioma, meningioma and cerebral abscess. The most common MR abnormality was cerebral infarct with gliosis.

Hence we conclude that MRI with seizure protocol plays a major role in the detection of epileptogenic substrates and also in planning the management of patients with seizures and in predicting the prognosis.

References

1. Amudhan S, Gururaj G, Satishchandra P. Epilepsy in India I: Epidemiology and public health. Ann Indian Acad Neurol. 2015;18(3):263–277. Available from: https://dx.doi.org/10.4103/0972-2327.160093.
2. Goodridge D, Sd S. Epileptic seizures in a population of 6000 demography, diagnosis and classification and role of the hospital services. Br Med J. 1983;287(6393):641–688. Available from: https://doi.org/10.1136/bmj.287.6393.641.
3. Gahan JPM, Dublin AB, Hill RP. The evaluation of seizure disorders by computed tomography. J Neurosurg. 1979;50(3):328–360. Available from: https://doi.org/10.3171/jns.1979.50.3.0328.
4. Velasco TR, Zanello PA, Dalmagro CL, Araújo D, Santos AC, Bianchin MM, et al. Calcified cysticercotic lesions and intractable epilepsy: a cross sectional study of 512 patients. J Neurol Neurosurg Psychiatry. 2006;77(4):485–488. Available from: https://doi.org/10.1136/jnnp.2005.078675.
5. Patil TB, Paithnakar MM. Clinico-radiological profile and treatment outcomes in neurocysticercosis: A study of 40 patients. Ann Trop Med Public Health. 2010;3:58–63.
6. Abdul-Ghaffar NU, El-Sonbaty MR, Rahman NA. Intracranial tuberculoma in Kuwait. Int J Tubercu Lung Dis. 1998;2(5):413–421.
7. Khan G, Khan N, Aziz A. Detection of cerebral atrophy in type-II diabetes mellitus by MRI of brain. J Ayub Med Coll Abbottabad. 2010;22(2):67–70.
8. Gupta RK, Jamjoom AA, Devkota UP. Superior sagittal sinus thrombosis presenting as a continuous headache: A case report and review of the literature. Cases J. 2009;2:9361. Available from: https://doi.org/10.1186/1757-1626-2-9361.
9. Jagruti P, Sanghvi, Surekha B, Rajdhyaksha, Ursekar M. Spectrum of congenital CNS malformation in pediatric epilepsy. Indian Pediatrics. 2004;41(8):831–869.
10. Bronen RA, Cheung G, Charles JT, Kim JH, Spencer DD, Spencer SS. Imaging findings in hippocampal sclerosis: correlation with pathology. AJNR Am J Neuroradiol. 1991;12(5):933–973.
11. Liau L, W, Palm-Meinders IH, Van Der Grond J, Leijser LM, Cessie SL, et al. Differentiating Normal Myelination from Hypoxic-Ischemic Encephalopathy on T1-Weighted MR Images: A New Approach. AJNR Am J Neuroradiol. 2007;28(4):660–65.
12. Kayali H, Sirin S, Kahraman S, Oysul K, Solmaz I, Erde T. Intracranial cavernomas: Analysis of 37 cases and literature review. Neurol India. 2004;52(4):439–481.
13. Fellah S, Caudal D, Paula AMD, Dory-Lautrec P, Figarella-Branger D, Chinot O. Multimodal MR Imaging (Diffusion, Perfusion, and Spectroscopy): Is It Possible to Distinguish Oligodendroglial Tumor Grade and 1p/19q Codeletion in the Pretherapeutic Diagnosis? AJNR Am J Neuroradiol. 2013;34(7):1326–1359. Available from: https://doi.org/10.3174/ajnr.a3352.
14. Sultan A, Moawia G, Suliman S, Jumaa T, Fathelrehman A, Suzan. Evaluation of meningioma of the brain and spine with computerized tomography and magnetic resonance imaging. Am J Res Commun. 2015;3(5):236–281.
15. Cartes-Zumelzu FW, Stavrou I, Castillo M, Eisenhuber E, Knosp E, Thurnher MM. Diffusion-weighted imaging in the assessment of brain abscesses therapy. AJNR Am J Neuroradiol. 2004;25(8):1310–1327.

How to cite this article: Narra R, Putcha A, Y, Penumatcha N. Mri Evaluation of Seizures: Study at a Tertiary Referral Center in Southern India. Asian J. Med. Radiol. Res. 2021;9(2):20-26.

DOI: dx.doi.org/10.47009/ajmrr.2021.9.2.6

Source of Support: Nil, **Conflict of Interest:** None declared.