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Prevalence and Patterns of MRI Abnormalities in Seizure Patients at a Tertiary Care Center: A Cross-Sectional Study

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ABSTRACT

Introduction: Seizure is one of the most common neurological disorders, having multiple etiological factors. It has always been a challenging problem to identify the causes of seizures. MR (Magnetic Resonance) imaging is one of the important tools in the evaluation of patients with seizures. The objective of our study was to identify the common structural MR abnormalities in seizure patients and to study the prevalence of structural MR abnormalities according to age and sex.

Methods: This cross-sectional descriptive study of 109 patients with clinical impressions of seizure from various inpatient and outpatient departments of Tribhuvan University Teaching Hospital, Institute of Medicine (TUTH/IOM) over 11 months was conducted. Imaging protocols included T1/ T2/ FLAIR/ DWI-ADC axial, T1 sagittal, T2 coronal, T1 sagittal, FLAIR, T1 IR coronal oblique, T2* axial. Specially designed sequences such as T1W IR oblique coronal, SE FLAIR oblique coronal, and T2* GRE sequences were used.

Results: A total of 109 seizure patients, ranging in age from 7 months to 89 years, underwent MRI brain imaging. Epileptogenic MR abnormalities were observed in 50.5% of the patients, while no such abnormalities were found in 49.5% of the patients. Common structural abnormalities included infarcts, gliosis, and encephalomalacia changes (15.6%), sequelae of previous insults (8.2%), neurocysticercosis (7.3%), neoplasms (5.5%), developmental malformations (3.6%), mesial temporal sclerosis (2.7%), tuberous sclerosis (0.9%), hypothalamic hamartoma (0.9%), and others.

Conclusions: The spectrum of MR abnormalities in seizure patients includes infarcts and gliosis, cerebral infections, neoplasms, developmental malformations, and mesial temporal sclerosis.

Keywords: *Encephalomalacia; Gliosis; Neurocysticercosis; Neuroimaging; Seizure*

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INTRODUCTION

Seizures are a significant cause of morbidity and mortality. The majority of individuals with epilepsy live in low and middle-income countries, and the cause of the disease remains unknown in about 50% of cases. The prevalence of epilepsy in Nepal was found to be 7.3 per 1000 population. Treatment for seizure disorders involves the management of underlying conditions contributing to seizures and the suppression of recurrent seizures. Identifying the cause of seizures is crucial for treatment planning.[1,2,3,4]

Structural CNS lesions causing seizures can be identified through neuroimaging and treated accordingly. The use of dedicated seizure protocols in MRI significantly improves the chances of identifying the cause of seizures, leading to positive clinical impacts on patient management.[3]

The objective of our study was to estimate the prevalence of various MRI abnormalities in patients with seizures, identify structural abnormalities that may cause seizures, and investigate the prevalence in various age groups and sexes.

METHODS

This was a cross-sectional, descriptive study carried out in the Department of Radiology and Imaging in TUTH, IOM, after approval from the Institutional Review Committee (IRC) on September 9, 2020. This study was carried out from September 2020 to November 2021.

All seizure patients sent to the Department of Radiology and Imaging for MRI Head by treating physicians were included in the study, while those with contraindications to MRI were excluded.

Various studies have shown that the prevalence of seizures is around 5-10%. Taking the prevalence of the seizure to be 5%, the minimum sample size was calculated as 51. This study was carried out on 109 patients.[5]

Scanning was done in the supine-head first position using an 18-channel dedicated head coil (Birdcage). Sequences obtained were T1 FSE (fast spin echo), T2 FSE in the axial and sagittal plane, T2 FLAIR FSE in the axial and coronal oblique plane, and DWI-ADC in the axial plane. A T1W IR coronal image was also obtained. GRE T2* axial sequences were also obtained.

Relevant clinical details and MRI brain findings of each patient were obtained and entered in the datasheet. All relevant calculations and measurements were done using Microsoft Excel software.

RESULTS

The mean age of the patients was 30 years. Out of 109 patients, 67 (61%) were male, and 42 (39%) were female. The duration of seizures ranged from 10 days to 6 years, with 47% having a clinical history of more than or equal to 3 months and 43% having a clinical history of 1-3 months.

Approximately 50.5% (n=55) of patients had structural abnormalities known to cause seizures, while 49.5% (n=54) had no epileptogenic lesion (Table 1). Among these 54 patients without epileptogenic lesions, 49 showed no intracranial abnormalities, and five showed intracranial abnormalities not known to cause seizures. Infarcts, gliosis, and encephalomalacic changes (Figure 1) were the most common abnormalities, followed by sequelae of previous destructive brain insult, neurocysticercosis (Figure 2), mesial temporal sclerosis (Figure 3), and others. A few of the patients showed two or more findings, including multiple neurocysticercoses, chronic infarct with encephalomalacia, and an arachnoid cyst. Infarct was most common in old age (>60 years old), while neurocysticercosis, developmental malformation, and mesial temporal sclerosis were common in adolescents and young adults (16-30 years old) (Table 1).

The highest number of patients presented with generalized tonic-clonic seizures, with 46.3% showing positive MRI findings. All of the patients with focal motor seizures with impaired consciousness and gelastic seizures showed MR positivity, while only 50% of the patients with focal seizures and intact consciousness showed MR positivity.

Table 1: Distribution of patients on the basis of MRI abnormalities (n=55)

Abnormal MRI finding	< 1 yr	1-15 yrs	16-30 yrs	31-45 yrs	46-60 yrs	>60 yrs	Total	Percentage
Infarcts, gliosis and encephalomalacic changes	0	3	4	3	0	7	17	15.6
Sequelae of previous destructive brain insults	0	3	3	2	0	1	9	8.2
Neurocysticercosis	0	1	4	1	1	1	8	7.3
Neoplasms	0	0	2	3	1	0	6	5.5
Mesial temporal sclerosis	0	0	2	1	0	0	3	2.7
Developmental malformations	0	0	4	0	0	0	4	3.6
Tuberous sclerosis	0	1	0	0	0	0	1	0.9
Hypothalamic hamartoma	0	1	0	0	0	0	1	0.9
Others	0	3	1	1	0	1		5.5
Total	0	12	20	11	2	10	55	

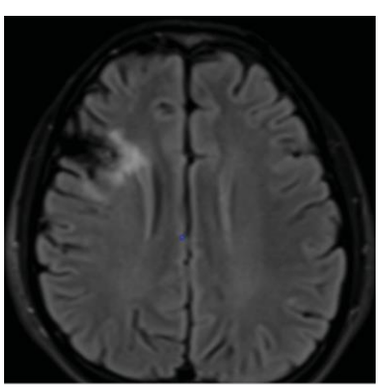

Figure 1: FLAIR axial section of the brain at supraventricular level showing focal gliosis and encephalomalacic changes in the right frontal lobe

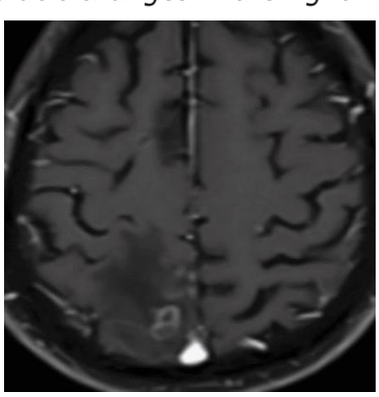

Figure 2: Post-contrast T1W image showing ring-enhancing lesion in the right parietal lobe with surrounding perilesional edema (a case of neurocysticercosis)

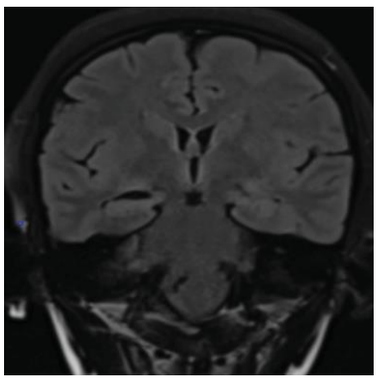

Figure 3: Coronal oblique FLAIR image showing a smaller right hippocampus with FLAIR high signal intensity and associated dilatation of the right choroidal fissure

DISCUSSION

Patients diagnosed with seizures can exhibit a wide range of pathological abnormalities, which can be identified and localized through MRI scans. This enables personalized treatment protocols for each patient. In a study involving 109 clinically diagnosed seizure cases, MRI brain imaging was performed using a dedicated seizure protocol. Additional examinations such as MRA, MRV, MRS, or contrast studies were conducted as needed.

In our study, approximately half of the patients (49.5%) had negative findings on MRI examinations, suggesting that structural abnormalities were not the cause of seizures in these cases. Similar rates of normal MRI findings were reported in other studies, such as 41% by Chabarwal et al., 40% by Hirani et al., and 47% by Narra et al. However, a lower proportion (30%) of patients had normal MRI findings in the study done by Kaur et al. Epileptogenic lesions were found in 50.5% of 109 patients in our study, the most common abnormalities being infarcts, gliosis, and encephalomalacia changes; followed by sequelae of previous brain insults, neurocysticercosis, neoplasms, mesial temporal sclerosis, and developmental malformations. Similar findings were reported in studies conducted by Chabarwal et al. and Sinha et al., which support the consistency of these results. Infarcts, gliosis, and encephalomalacia changes were more prevalent in patients over 60 years old. The study findings align with previous research done by Luhdorf et al., highlighting stroke as the most common cause of seizures in elderly patients. Neurocysticercosis was the only infectious cause of seizure in our study, seen in 7.3% of patients. Narra et al. also found neurocysticercosis in 7% of the patients. However, they also found tuberculoma (7%) and cerebral abscess (2%). A smaller sample size could be the cause of the non-inclusion of tuberculoma and cerebral abscess as the cause of seizure in our study, despite the relatively common prevalence comparable to neurocysticercosis. Developmental malformations were the cause of the seizure in only 3.5% of patients. Similar findings were seen in the study done by Narra et al (3%) and Singla et al. (3%).[6-12]

MRI has demonstrated its sensitivity and specificity in identifying the etiology of seizures, making it a crucial tool for accurate diagnosis and treatment selection. With its superior imaging capabilities, lack of ionizing radiation, and dedicated seizure protocols, MRI has become the investigation of choice for evaluating patients with seizures, except in emergencies. Still, around half of the patients didn't show structural abnormalities in conventional MRI sequences. Recent studies have shown promising results of Arterial Spin Labelling (ASL) in detecting the focus of seizure in otherwise structurally normal brain parenchyma in MRI. One of the limitations of our study is the non-inclusion of this sequence in our study. We also didn't compare the EEG findings with abnormalities in MRI, as the structural findings in MRI might not be the

corresponding epileptogenic focus. This is also one of the limitations of our study. The smaller sample size and single institutional study were also other limitations of this study.

CONCLUSION

MRI is the imaging modality of choice for the evaluation of seizure patients as it not only identifies the causes of seizure, but also localizes the origin of seizure and sometimes predicts the likelihood of recurrence. Structural abnormalities in MRI of brain may be seen in around half of the patients with seizure and with the most common abnormalities being the acquired abnormalities like infarcts, gliosis, and encephalomalacia changes.

CONFLICT OF INTEREST

None

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None

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