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Original Research Paper

Radiology

TO IDENTIFY PATTERNS OF MRI IN PATIENTS WITH SEIZURES VISITING A TERTIARY CARE HOSPITAL IN BARABANKI DISTRICT OF UTTAR PRADESH.

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ABSTRACT

Introduction: Neuroimaging is increasingly vital in assessing patients with seizures and epilepsy, especially those with drug-resistant cases. Our aim here was to identify patterns of MRI in patients with seizures and to study the etiological factors of seizures according to age subgroups visiting a tertiary care hospital in Barabanki district, Uttar Pradesh. **Methods:** This Cross-sectional observational study was conducted in the Department of Radiodiagnosis, Hind Institute Of Medical Sciences, Barabanki, Uttar Pradesh. Patients of all age groups and both sexes who presented with seizures and were referred to the Department of Radiodiagnosis were included in the study. As needed, MRI (plain/ contrast) was done using PHILLIPS MRI 1.5 T machine with proper protocol. The collected data was tabulated and analyzed. P values of 0.05 were statistically significant. **Results:** MRI findings among the 83 cases showed that 30 (36.1%) had normal MRI results. Infarct with gliosis was observed in 13(15.6%) of cases, while neurocysticercosis (NCC) was found in 9 (10.8%). Tuberculoma was present in 8 (9.6%) of the patients, and atrophy was seen in 5 (5.7%). Neoplasms and cerebral abscesses each accounted for 3 (3.4%) of the cases. Venous thrombosis was observed in 2 (2.3%) of patients, and vascular malformations, developmental malformations, and tuberous sclerosis each appeared in 1 (1.1%) of cases. Additionally, hypoxic-ischemic encephalopathy (HIE) changes were noted in 3 (3.4%) of patients, and mesial temporal sclerosis was found in 4 (4.8%). **Conclusion:** This study showed the spectrum of brain abnormalities using Magnetic Resonance Imaging in patients with seizures which helped us to establish the cause of seizures in different age groups so that appropriate preventive and educational measures can be taken in the area.

KEYWORDS : MRI, neurocysticercosis, seizures, tuberculoma

INTRODUCTION:

A seizure, derived from the Latin word "sacire" meaning "to take possession of," is a sudden event caused by abnormal, excessive, or synchronized neuronal activity in the brain. Depending on where and how these discharges occur, this abnormal brain activity can lead to various manifestations, from convulsive movements to experiences that may not even be apparent to observers. "Epilepsy" refers to a condition where individuals experience recurrent seizures without an obvious provoking cause, often due to an ongoing neurological condition. It is estimated that between 2% and 5% of people worldwide will experience a seizure at least once in their lifetime[1].

Seizures can arise from a variety of underlying causes. In some instances, such as with primary generalized epilepsy syndromes that are genetically determined, there are no corresponding findings on neuroimaging. Seizures induced by temporary physiological imbalances, including febrile convulsions, hypoxia, hypoglycemia, or alcohol withdrawal, are typically diagnosed clinically without the need for imaging, as imaging is primarily used to rule out other potential diagnoses. Conversely, seizures can also occur as a manifestation of acute conditions that exhibit detectable tissue changes, such as cerebral venous thrombosis, posterior reversible encephalopathy syndrome, or infectious and autoimmune encephalitis, congenital structural abnormalities (e.g., cortical dysplasias, vascular malformations) or acquired structural lesions (e.g., tumors, infarctions, traumatic injuries).

An estimated 8-10% of people will experience a seizure at some point in their lives. Seizures are categorized as acute symptomatic, triggered by events like brain injury, drug withdrawal, or fever, or unprovoked, with no clear cause. They can be either focal or generalized [2].

For first-time seizures, an unenhanced CT (Computed Tomography) scan is often used initially to rule out life-threatening conditions. About 30% of these cases reveal epileptogenic lesions, commonly due to stroke, trauma, or tumors. Patients with such lesions are at a higher risk for recurring seizures and epilepsy [3]. Neuroimaging is an increasingly vital tool in assessing patients with seizures and epilepsy, especially those with drug-resistant cases. Up to 80% of these patients may have surgically treatable abnormalities, highlighting the essential role of radiologists in their multidisciplinary care[4].

With the growing application of MRI for patients with seizures, seizure-induced signal changes (SCM) have been observed more frequently [5,6]. Research utilizing Diffusion-Weighted Magnetic Resonance Imaging (MRI-DWI) has highlighted temporary focal hyperintensity on DWI and subsequent reductions in the apparent diffusion coefficient (ADC) during the postictal phase of seizures [7]. Although the exact pathophysiology behind SCM is not completely understood, it is believed that these changes arise from increased energy

metabolism, hyperperfusion, and cellular swelling associated with seizure activity [8,9]. DWI and perfusion MRI (PI) have been mainly applied in acute stroke, but may provide information in the peri-ictal phase in epileptic patients [7].

MATERIALS & METHODS:

This hospital based cross-sectional, descriptive study was conducted in the Department of Radiology of Hind Institute Of Medical Sciences, Barabanki, UP in 18 months. Patients of all age groups (≤1 to ≥60 Years) and both sexes who presented clinically with seizures and referred to the Department of Radiodiagnosis were included in the study. Patients with history of insertion of metallic implants or placement of cardiac pacemakers, aneurysmal clips, history of claustrophobia, anxiety disorders, and trauma/ traumatic haemorrhage were excluded [10].

Sample Size: 83

Calculated using the formula $n = Z^2 pq/d^2$

Informed consent was taken from all the patients or guardians of pediatric patients prior to examination. Detailed clinical history of each patient and neurological examination were also done to find any neurological deficit. Based on the history and examination, a clinic-etiological diagnosis was made. MRI evaluation was done. A detailed proforma was filled up, data was collected and evaluated.

Examination Technique:

Before entering the MRI scanning room, all patients were screened for ferromagnetic objects, cardiac pacemakers, and aneurysmal clips to ensure safety during the procedure. Patients were positioned in the supine position inside the MRI scanning room, with their heads immobilized for optimal imaging. The head coil was utilized for the scan. Initially, a topogram of the head was obtained to plan sequences according to the MRI seizure protocol. The MRI protocol at 1.5 Tesla covered the entire brain from nasion to inion. It included routine axial sequences with 5mm slice thickness for T1 and T2 weighted images. Additionally, coronal oblique sequences with 1.5mm slice thickness were acquired using T1 weighted MPRAGE or SPGR techniques to capture detailed three-dimensional (3D) volume data, facilitating post-processing and image reformatting into multiple planes. The protocol also incorporated coronal and axial FLAIR sequences with 2-3mm slice thickness and a 1mm interslice gap. A thin-slice T2 weighted axial and coronal sequence was performed as well. Gadobenate dimeglumine, a paramagnetic contrast agent in a dose of 0.1 mg/kg was administered during MRI scans. It was used in cases where vascular malformations or neurocutaneous syndromes were suspected or identified to enhance diagnostic accuracy. As a precautionary measure, resuscitation apparatus and emergency drugs were kept ready.

Equipment used: PHILLIPS MRI 1.5 T machine

Various details of MRI findings were studied as under:
Any lesion present, Site, Signal intensity, Surrounding edema, Any hemorrhage, Atrophy, Infarction, Mass effect, Contrast enhancing lesion, Calcification, Developmental malformations, Hydrocephalus were noted.

Statistical Analysis:

A pre-structured pre-tested proforma was used to collect the required information and were entered into MS Excel sheet. The results of observations of individual subjects were pooled and analyzed. SPSS software version 20.0 Chicago, Illinois, USA was used for analyzing data.

RESULTS

A total of 83 patients of all age groups coming up with seizures, 33 (39.8%) patients were under age group of 1-30 years followed by the age group of 31-60 years 26 (31.3%). The gender distribution showed slightly more in females 44 (53.0%) than males 39 (100.0%) across all age groups. The age group with the highest percentage of male patients was 1-30 years, it was 15 (38.5%), while females were 18 (40.9%).

The spectrum of MRI findings among the 83 cases showed that 30 (36.1%) had normal MRI results. Infarct with gliosis was observed in 13 (15.6%) of cases, while neurocysticercosis (NCC) was found in 9 (10.8%). Tuberculoma was present in 8 (9.6%) of the patients, and atrophy was seen in 5 (5.7%). Neoplasms and cerebral abscesses each accounted for 3 (3.4%) of the cases. Venous thrombosis was observed in 2 (2.3%) of patients, and vascular malformations, developmental malformations, and tuberous sclerosis each appeared in 1 (1.1%) of cases. Additionally, hypoxic-ischemic encephalopathy (HIE) changes were noted in 3 (3.4%) of patients, and mesial temporal sclerosis was found in 4 (4.5%) (Figure *1*).

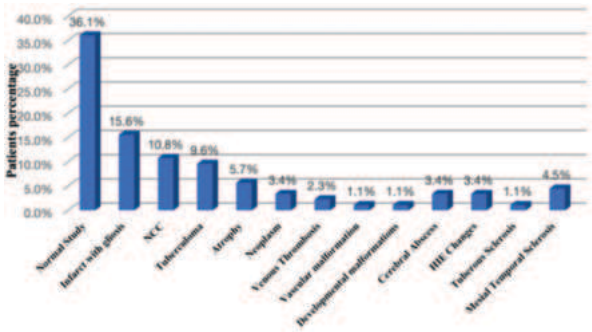

Figure 1: Spectrum Of Findings Using Magnetic Resonance Imaging

Table 1: Distribution Of Abnormalities In Various Age Groups

MRI Findings	<1 year	1-30 years	31-60 years	> 60 years	P Value
Normal Study	7 (77.8%)	11 (33.3%)	8 (30.8%)	4 (26.7%)	0.051
Infarct with gliosis	0 (0.0%)	4 (12.1%)	5 (19.2%)	4 (26.7%)	0.307
NCC	0 (0.0%)	5 (15.2%)	4 (15.4%)	0 (0.0%)	0.250
Tuberculoma	0 (0.0%)	4 (12.1%)	3 (11.5%)	1 (6.7%)	0.693
Atrophy	0 (0.0%)	0 (0.0%)	1 (3.8%)	4 (26.7%)	0.003
Neoplasm	0 (0.0%)	1 (3.0%)	1 (3.8%)	1 (6.7%)	0.855
Venous Thrombosis	0 (0.0%)	0 (0.0%)	1 (3.8%)	1 (6.7%)	0.490
Vascular malformation	0 (0.0%)	0 (0.0%)	1 (3.8%)	0 (0.0%)	0.528
Developmental malformations	1 (11.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.040
Cerebral Abscess	0 (0.0%)	2 (6.1%)	1 (3.8%)	0 (0.0%)	0.689
HIE Changes	1 (11.1%)	2 (6.1%)	0 (0.0%)	0 (0.0%)	0.314
Tuberous Sclerosis	0 (0.0%)	1 (3.0%)	0 (0.0%)	0 (0.0%)	0.674
Mesial Temporal Sclerosis	0 (0.0%)	3 (9.1%)	1 (3.8%)	0 (0.0%)	0.461
Total (n= 83)	9 (10.8%)	33 (39.8%)	26 (31.3%)	15 (18.1%)	

On age wise correlation of MRI findings, <1 year old children showed developmental malformations and HIE changes (1)11.1% each. In the 1-30 years age group, (11)33.3% had normal MRI results, (4)12.1% had infarct with gliosis or tuberculoma, and (5)15.2% had NCC. The 31-60 years age group had (8)30.8% normal results, (5)19.2% with infarct with gliosis, and (4)15.4% with NCC. Among patients over 60 years old, (4)26.7% had normal results, and there was a higher prevalence of infarct with gliosis (4)26.7% and atrophy (4)26.7%. The statistical significance was notable for atrophy (p=0.003) and developmental malformations (p=0.040), indicating significant age-related differences for these conditions (Table *1*).

DISCUSSION:

Our study found a significant proportion of patients had normal MRI results (77.8%), especially under 1 year of age. This indicates that many infants in this age group may not exhibit detectable abnormalities on MRI scans. However, when abnormalities are present, they can include a range of conditions such as infarct with gliosis, neurocysticercosis (NCC), tuberculoma, cerebral atrophy, neoplasms, venous thrombosis, vascular malformations, cerebral abscess, or mesial temporal sclerosis. Identifying and distinguishing these conditions on MRI scans is essential for accurate diagnosis and appropriate management of affected individuals.

Several reports have documented the peri-ictal MRI changes observed in patients experiencing status epilepticus (SE) and single seizures, irrespective of their history of chronic epilepsy. The majority of these studies have specifically focused on SE cases. In the absence of a magnetic resonance image lesion, the cingulate gyrus seizures were not easily localized as stated in Alkawadri R et al [11]. Research on SE patients has highlighted MRI findings including heightened signal intensity on T2-weighted images and DWI, along with gyral swelling and contrast enhancement of the gyri. Furthermore, the spatial distribution of seizure-induced signal changes (SCM) during complex partial SE (CPSE) has been a subject of investigation.

Duncan JS et al highlighted that the predominant localization of diffusion-weighted imaging (DWI) abnormalities during ictal activity in status epilepticus (SE) was observed in the hippocampus and the pulvinar region. The integration of DWI findings with EEG analysis provided valuable insights into the localization and propagation of seizures Brain imaging has a crucial role in the presurgical assessment of patients with epilepsy. Structural imaging reveals most cerebral lesions underlying focal epilepsy. Functional MRI can be used to identify areas of the cortex that are essential for language, motor function, and memory [12].

Comparing our findings to prior research, our study showed a higher prevalence of isolated NCC at 10.8%, contrasting significantly with the 1.56% reported in TR Velasco et al [13] involving 512 patients with intractable epilepsy. Additionally, our study identified a greater proportion of patients with multiple lesions compared to another study involving 40 patients with suspected NCC. Furthermore, our findings align with existing literature regarding the frequent involvement of the parietal lobe in NCC cases (Figure *2*).

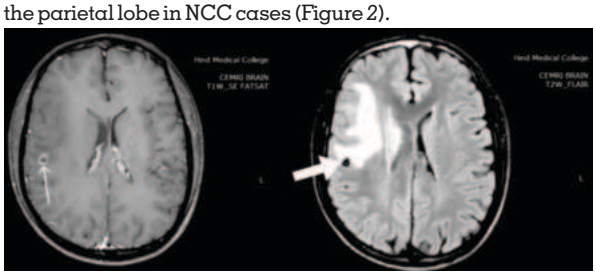

Figure 2: "MRI images showing Neurocysticercosis (NCC) in the colloid vesicular stage, characterized by edema and post-contrast ring enhancement due to the presence of a granulomatous response around the cyst

First arrow showing Ring Enhancing Lesion, and second one showing lesion along with peri-lesional edema.
Further, MRI demonstrated superior sensitivity in detecting non-calcified cerebral lesions associated with NCC, with a prevalence of 10.8% in our study compared to 9.6% reported previously. These outcomes underscore MRI's critical role in diagnosing and characterizing NCC lesions, particularly in regions where the disease is very commonly seen in population.

Naser Uama et al, [14] 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. The results of this study are in concordance with our study with 8 (9.6%) of the patients out of 83 presenting with tuberculoma (Figure *3*).

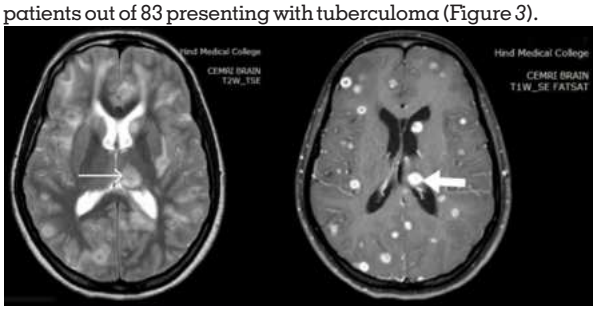

Figure 3: MRI images displaying multiple ring-enhancing lesions, suggestive of tuberculomas.

Furthermore, five patients in our study presented with features of cerebral atrophy, primarily involving bilateral frontal and temporal lobes, along with cerebellar atrophy. Ghayyur Khan et al, [15] 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.

In our study, MRI scans identified cerebral venous sinus thrombosis in 2 patients. Among them, one exhibited superior sagittal sinus thrombosis, and another presented with thrombosis in both the transverse and sigmoid sinuses.

Given that all thrombi were linked to infarcts, we categorized them together. Magnetic Resonance Venography (MRV) was performed on all patients. Gupta RK et al, [16] 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.

LIMITATIONS

This study has limitations. First, this was a cross sectional observational study conducted at a single rural hospital, which was one of the small hospitals in our city and the possibility of selection bias exists. Our patients comprised a group with more critical patients who were vulnerable in developing seizures including, acute symptomatic seizures.

Secondly, It was a small sample size based study. There was selection bias as only those patients referred to the institution's Radiology Department were enrolled in the study. Follow-up was not considered in the present study setting.

CONCLUSIONS

MRI remains the cornerstone in the evaluation of patients with seizure disorders. Its sensitivity in detecting abnormalities is

influenced by both the underlying pathologies and the expertise of the examiner. Precisely identifying the cause of seizures is essential for developing effective treatment plans. MRI offers significant benefits such as high spatial resolution, superior soft tissue contrast, the ability to image in multiple planes, and the lack of ionizing radiation, which makes it an invaluable tool in clinical settings. Our study, revealed a diverse spectrum of imaging findings and etiological factors. Infective granulomas (15.6%) and cerebral infarcts (10.8%) were the most common abnormalities detected. Less frequent findings included subdural hematomas, subarachnoid haemorrhages, acute disseminated encephalomyelitis, and encephalitis. Clinicians must remain vigilant about the diverse differential diagnoses of MRI-detected lesions in patients with seizures, encompassing both status epilepticus and single seizure events.

In conclusion, MRI remains the gold standard in neuroimaging for assessing seizures and epilepsy. Its pivotal role lies in providing accurate diagnoses, shaping personalized treatment approaches, and forecasting patient prognoses with precision. Hence, MRI patterns play a significant role in patients presenting with seizures with MRI seizure protocol to confirm or rule out any organic or developmental lesions.

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