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## Study on MRI evaluation of various etiologies of seizures

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**Abstract**---Introduction: Epilepsy describes a condition in which a person has unprovoked, recurrent seizures due to a chronic, underlying process. Several studies have estimated the prevalence of epilepsy ranging from 5-30 persons per 1000 population. Most of the patients suffering from epilepsy have good control on seizures with the use of antiepileptic medications, however most of the patients with intractable epilepsy have seizures that are focal and can be potentially treated. Objectives of our study: The objective of our study to find out the role of MRI in evaluating the aetiologies of seizures in subjects with seizure disorder. Methodology: We included a total of 150 subjects after taking voluntary consent from the study subjects based on inclusion and exclusion criteria. A detailed proforma was recorded which included subject's socio demographic data, medical history, personal history, past-history, family history and general physical examination, blood pressure measurement, systemic examination etc. The points noted were duration of illness, type of seizures, and any associated illness. Detailed clinical and neurological examination were done to find out any neurological deficit. Based on the history and examination, a clinic etiological diagnosis was made. Follow up of subjects were done until the completion of treatment (maximum 6 months). The procedure and the risk involved in contrast examination were briefly explained to the subjects. Results: A total of 150 subjects suffering from seizure disorder were included in the study based on inclusion and exclusion criteria. The age of the subjects ranged from more than one year to 78 years with male predominance of 102 (68%) and 48 (32%) females. MRI diagnosis revealed that 35.33% had normal, 17.33% had infarct with gliosis, 16.66 had infective granuloma, 1% had glioma, none had atrophy, 4.6% had developmental malformation, 4% had meningioma and 12% had

miscellaneous findings. Discussion and Conclusion: MRI is the investigation of choice in patients with seizure disorder. The sensitivity of MRI in detecting abnormalities in patients with seizure disorder is in part associated to the underlying pathologies and by the MRI techniques and experience of the interpreting physician. Accurate diagnosis of the cause of seizure is crucial for finding an effective treatment.

**Keywords**---magnetic resonance imaging, seizures, infarct, glioma, meningioma, gliosis.

## Introduction

A seizure (from the Latin “to take possession of”) is a paroxysmal event due to abnormal excessive or synchronous neuronal activity arising in the gray matter of the cerebral cortex of brain. Depending on the distribution of discharges, this abnormal brain activity can have various manifestations, ranging from dramatic convulsive activity to experiential phenomena not readily discernible by an observer. Epilepsy describes a condition in which a person has unprovoked, recurrent seizures due to a chronic, underlying process.<sup>1</sup> Several studies have estimated the prevalence of epilepsy ranging from 5-30 persons per 1000 population. Most of the patients suffering from epilepsy have good control on seizures with the use of antiepileptic medications, however most of the patients with intractable epilepsy have seizures that are focal and can be potentially treated.<sup>2-4</sup>

Seizures have been classified in several ways, according to their etiology, i.e., idiopathic (primary) or symptomatic (secondary); their site of origin; their clinical form (generalized or focal); their frequency (isolated, cyclic, or repetitive, or the closely spaced sequence of status epilepticus); or their electrophysiologic correlates.<sup>5</sup> Seizures are symptoms of abnormal brain function and due to a diverse etiology. Western studies have shown that about 4% of the population will have unprovoked seizure by the age of 80 and treatment may reduce the chance of a second one by as much as 50%.<sup>6</sup>

There are several neuro-radiological investigations available to diagnose and find out the etiology of seizures, these include x-ray of the skull, pneumocephalography, CSF examination, carotid angiography, EEG, CT scan and MRI scan. In this context, the revolutionary introduction of MRI for evaluation of seizures has been a great boon, both for the diagnosis of cerebral lesions as well as clinical management of patients with neurological disorders.<sup>7</sup> Magnetic resonance imaging is the preferred imaging tool for detecting the structural abnormalities that can result in seizure activity. The diagnosis of epilepsy with the help of MRI has made this diagnostic tool beyond compare to other investigations. Postoperative MR may detect reasons for failure such as inadequate resection and can monitor tumour recurrence on follow-up imaging, especially it is useful for prognosticating postoperative seizure control.<sup>2,4</sup>

Recently several studies have evaluated the role of MRI in the subjects with Seizures have found differences in the incidences of various aetiologies and small sample size. There are limited number of studies on this topic till date, hence we have taken up this study to evaluate various aetiologies in our population. Hence the present study was undertaken to identify and evaluate various aetiologies of causation of seizures using MRI scan in our population.

### **Objectives of the study**

The objective of our study to find out the role of MRI in evaluating the aetiologies of seizures in subjects with seizure disorder.

### **Materials and Methods**

Study area: The study will be conducted in the Department of Internal Medicine at Prasad Institute of Medical Sciences, Banthara, Lucknow, UP

Study Design: This is a prospective observational study conducted at Prasad Institute of Medical Sciences, Banthara, Lucknow, UP

Study population:

We included a total of 150 subjects presenting to various departments with seizure disorder.

### **Inclusion Criteria**

- Willing to give voluntary consent to participate in the study will only be included.
- Age above 1 year and below 80 years.

### **Exclusion criteria**

- Subjects less than one year
- Subjects who loose follow up
- Subjects not willing to give voluntary consent to participate in the study
- Pregnancy
- Lactation
- Contraindications to MRI

Study Period: This study was carried out from March 2021 to December 2021.

Sample Size: Sample size will be calculated using the formula

$$n = Z^2_{1-\alpha}P(1-P)/d^2$$

Where n = Required sample size

P = Prevalence of the cause

d = Precision

$$n = 95 \times 0.85 \times 0.15 / (0.6 \times 0.6) = 136$$

Taking 10 % dropouts into consideration we will take 150 patients.

## Data collection

We included a total of 150 subjects after taking voluntary consent from the study subjects based on inclusion and exclusion criteria. A detailed proforma was recorded which included subject's socio demographic data, medical history, personal history, past-history, family history and general physical examination, blood pressure measurement, systemic examination etc. The points noted were duration of illness, type of seizures, and any associated illness. Detailed clinical and neurological examination were done to find out any neurological deficit. Based on the history and examination, a clinic etiological diagnosis was made. Follow up of subjects were done until the completion of treatment (maximum 6 months). The procedure and the risk involved in contrast examination were briefly explained to the subjects.

A detailed history was taken and clinical examination was done. The points noted were duration of illness, type of seizures, any associated illness. Detailed clinical and neurological examination was done to find any neurological deficit. Based on the history and examination, a clinic etiological diagnosis was made.

- Follow-up of cases was done until the completion of treatment (Maximum 6 months).

The procedure was briefly explained to the patient including the risks of contrast examination. All patients were screened before entry into the MRI scanning room for ferromagnetic objects, cardiac pacemakers, and aneurysm clips, etc. Patients were examined in the supine position on the MRI machine after proper positioning and immobilization of the head was obtained. The head coil was used for the scan. Initial topogram of the head was obtained and sequences were planned according to the MRI seizure protocol. MRI protocol at 1.5T included the entire brain from nasion to inion, conventional routine 5 mm slice thickness, T1 and T2 axial sequences, 1.5mm slice thickness coronal oblique. T1 weighted MPRAGE or SPGR images; 1.5mm slice thickness will be acquired as a 3 dimensional (3D) volume, there by post processing and reformatting images into multiple planes. Protocol also included coronal and axial FLAIR sequences with 2-3mm slice thickness 1mm inter slice gap. A conventional thin slice, T2 weighted axial and coronal sequence were obtained. Gadolinium paramagnetic contrast agent was used in MRI. Contrast agent was used if a known tumour or vascular malformation. Dosage used as 0.1mg/kg wt. The scans were studied in detail on monitor and finally films were taken for permanent record

## Statistical Analysis

Statistical analysis of the data will be performed using the statistical package for social sciences for window SPSS Inc. Quantitative variables will be expressed in proportions and percentages.

## Results

A total of 150 subjects suffering from seizure disorder were included in the study based on inclusion and exclusion criteria. The age of the subjects ranged from more than one year to 78 years with male predominance of 102 (68%) and 48 (32%) females.

Table 1: Shows distribution of study subjects based on type of seizure (clinical diagnosis)		
Clinical diagnosis	Number	Percentage
GTCS	126	84
Simple partial seizures	11	7.3
Complex partial seizures	09	6
Myoclonic Seizures	5	3.33
Absence Seizures	4	2.66
Febrile Seizures	3	2
Motor Seizures	3	2

It is evident from the above table 1 that the most common clinical diagnosis is GTCS followed by simple partial, complex partial, myoclonic, absence, febrile and motor seizures.

Table 2: Shows distribution of study subjects based on MRI findings		
MRI diagnosis	Number	Percentage
Normal study	53	35.33
Infarct with gliosis	26	17.33
Infective granuloma	25	16.66
Glioma	15	1
Atrophy	0	0
Developmental malformation	7	4.6
Meningioma	6	4
Miscellaneous	18	12

It is evident from the table 2 that 35.33% had normal, 17.33% had infarct with gliosis, 16.66 had infective granuloma, 1% had glioma, none had atrophy, 4.6% had developmental malformation, 4% had meningioma and 12% had miscellaneous findings.

## Discussion

We included a total of 150 subjects with seizure disorder based on inclusion and exclusion criteria. The age of the subjects ranged from more than one year to 78 years with male predominance of 102 (68%) and 48 (32%) females. the most common clinical diagnosis is GTCS followed by simple partial, complex partial, myoclonic, absence, febrile and motor seizures. MRI findings revealed 35.33% had normal study, 17.33% had infarct with gliosis, 16.66 had infective granuloma, 1% had glioma, none had atrophy, 4.6% had developmental malformation, 4% had meningioma and 12% had miscellaneous findings.

had glioma, none had atrophy, 4.6% had developmental malformation, 4% had meningioma and 12% had miscellaneous findings.

Magnetic resonance imaging came into clinical practice in 1980s, it has been the preferred platform for evaluating diseases of the brain and spinal cord. Its advantages over computed tomography include superior contrast resolution, multiplanar imaging, absence of beam hardening artifacts and lack of ionizing radiation. These advantages result in better detection of small lesions, improved differentiation between gray and white matter structures and better visualization of hippocampus, all of which are critically important in epilepsy imaging.

In the year 2015, Kushwah Avadesh Pratap Singh et al. conducted a prospective study on “Role of MRI in evaluation of seizures” in which they included a total of 100 patients with clinical impression of seizures were examined by 1.5 Tesla magnetic resonance imaging and found that GTCS was the most common clinical diagnosis constituting (80%) cases followed by cerebral infarction with gliosis (16%), infections – NCC (7%) and tuberculoma (10%), cerebral atrophy (1%), developmental cortical malformations (2%), venous thrombosis (4%), low-grade glioma (9%), meningioma (3%). Thus, they concluded that the MRI is the investigation of choice in patients with seizure disorder. The sensitivity of MRI in detecting abnormalities in patients with seizure disorder is in part associated to the underlying pathologies and by the MRI techniques and experience of the interpreting physician. Accurate diagnosis of the cause of seizure is crucial for finding an effective treatment. With its high spatial resolution, excellent inherent soft tissue contrast, multiplanar imaging capability and lack of ionizing radiation, MR imaging has emerged as a versatile tool in the evaluation of patients with seizure disorder.

In the year 2017, Xu Zhao et al conducted a study on “Role of conventional magnetic resonance imaging in the screening of epilepsy with structural abnormalities: a pictorial essay. They concluded that the role of cMRI in the screening of epilepsy with structural abnormalities is very important. Due to the kinds of causes and large variety of presentation, the subtle precise characterization of these images is important for the correct diagnosis and management of these patients with epilepsy. The “MAGIC TVs” approach might be helpful in reducing false negative diagnosis and improving the diagnosis rate. “M” stands for mesial temporal sclerosis(MTS), “A” stands for atrophy/gliosis, “G” stands for hypothalamic hamartoma with gelastic seizures, “I” stands for infection, “C” stands for malformations of cortical development (MCDs), “T” stands for tumor, “V” stands for vascular malformations, “s” stands for Sturge-Weber syndrome (SWS).

In the year 2018, Shadab Maqsood et al. conducted a prospective observational study on “Role of Magnetic Resonance Imaging in Evaluation of Epilepsy”. They found that Majority of the patients were in the first two decades, the percentage of patients in the first decade being 29% and those in the second decade being 27%. Mesial temporal sclerosis was the most common abnormality identified in 29% of the study group. MRI was normal in 60 patients while abnormalities were identified in 90 patients of the study group. Among patients with partial seizures, 68 patients had lesions detected in magnetic resonance imaging. The diagnostic

yield in the partial seizure group was 68%. They concluded that the Magnetic resonance imaging should be considered in the initial evaluation of patients presenting with seizures, particularly with intractable partial seizures because of its high sensitivity for epileptogenic substrates, superior soft tissue contrast, multiplanar capability, lack of beam hardening artifact and lack of ionizing radiation.

In the year 2019, Swati Chabarwal et al. conducted a study on “Role of evaluation of seizure disorder in Southern Rajasthan. They included a total of 110 subjects referred from various outdoor/indoor departments with the history of seizure were included after fulfilling the inclusion criteria. They found that Out of 110 patients’ majority (41%) were normal, 20% had cerebral infarct with gliosis followed by NCC 7.2%, atrophy 5.45%, tuberculosis 11%, venous thrombosis 3.64%, developmental malformations 3.64%, glioma 1.82%, cavernoma 1.82%, tuberous sclerosis 1.82%, meningioma 0.91%, cerebral abscess 0.91% and Sturge-weber syndrome 0.91%. Most of the patients with cerebrovascular causes and male predominance 61.8%. They concluded that the spectrum of MRI findings related to vascular, developmental, infection and neoplasm was identified. MRI is noninvasive modality with no radiation hazard, excellent gray white matter resolution and multiplanar imaging capability. MRI helps in detection of subtle lesions responsible for seizures and the study also observed that MRI with appropriate imaging protocols add sensitivity and specificity in evaluation of seizures.

### **Conclusion**

MRI is the investigation of choice in patients with seizure disorder. The sensitivity of MRI in detecting abnormalities in patients with seizure disorder is in part associated to the underlying pathologies and by the MRI techniques and experience of the interpreting physician. Accurate diagnosis of the cause of seizure is crucial for finding an effective treatment. MR imaging is superior neuroimaging with no radiation exposure and could be the first investigation of choice in epileptic syndrome, acute cerebrovascular disease with seizure, developmental cortical malformations, and vascular malformations. Its ability in identifying subtle lesions, location, extent of the lesions and amount of findings are excellent.

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