ORIGINAL RESEARCH ARTICLE

Role of Magnetic Resonance Imaging in the Evaluation of Partial Seizures

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A B S T R A C T

Introduction: It is important to identify the neuroimaging features that are associated with status epilepticus. Advances in technology to localize focal epileptogenic substrates, especially that of high-resolution structural imaging with magnetic resonance imaging (MRI), have substantially improved the success of surgical treatment. The present study evaluates the efficacy of magnetic resonance imaging in the evaluation of patients with Partial Seizures.

Material and Methods: The present study was conducted among 50 patients with history of partial seizures. All patients underwent magnetic resonance imaging. The epileptogenic substrates were identified on the basis of the signal intensities and morphological abnormalities seen on magnetic resonance imaging. Data was collected through both interview and observation. The statistical test that was used is chi square with p value <0.05 considered as significant value.

Results: In our study, mesial temporal sclerosis was the most common abnormality identified in 30% of the study group, followed by gliosis seen in 27% of the seizure patients. Among patients with complex partial seizures, 22 patients had lesions detected in magnetic resonance imaging. The diagnostic yield in the partial seizure group is 73%.

Conclusion: Magnetic resonance imaging along with clinical history and electroencephaography should be used in the initial assessment of patients who are considered surgical candidates, since the presence of focal and, in particular, medial temporal lobe pathology increases the chances of progression to successful surgical treatment.

Keywords: Partial Seizures**;** MRI; Seizures

INTRODUCTION

Seizures may occur in up to 10% of the population, whereas Partial Seizures is a chronic disease characterized by recurrent seizures that may affect 2% of the population. Advances in technology to localize focal epileptogenic substrates, especially that of high-resolution structural imaging with magnetic resonance imaging (MRI), have substantially improved the success of surgical treatment.[1]

During status epilepticus, neuroimaging may be used to exclude other neurologic conditions. Therefore, it is important to identify the neuroimaging features that are associated with status epilepticus. In addition, MRI characteristics may provide insight into the pathophysiologic changes during status epilepticus.[2] Jabbari B et al[3] investigated the yield of magnetic resonance imaging in patients with partial complex seizures and the study indicated that magnetic resonance imaging is more informative than CT in complex partial Partial Seizures. Bergen D et al[4] conducted a study among patients with medically intractable Partial Seizures, showed that magnetic resonance imaging allows clear discrimination between tumors and non-neoplastic lesions in patients coming to surgery for intractable Partial Seizures.

The present study evaluates the efficacy of magnetic resonance imaging in the evaluation of patients with Partial Seizures.

MATERIAL AND METHODS

The present prospective observational purposive study was conducted among 50 patients who reported to Department of Radiodiagnosis, S.D.M. Hospital, Jaipur with history of partial seizures from April'2010 to April'2011, irrespective of age, sex and location. All patients underwent magnetic resonance imaging. Imaging was done with 1.5 Tesla Magnetic Resonance Imaging equipment from GE-HDXT and 3.0 Tesla Magnetic Resonance Imaging equipment from PHILIPS. The epileptogenic substrates were identified on the basis of the signal intensities and morphological abnormalities seen on magnetic resonance imaging.

STATISTICAL ANALYSIS

Data was collected through both interview and observation. Tools that were used are observation check list and interview schedule. Data analysis was done with the help of distribution of cases on the basis of age, sex, clinical presentation, type of partial seizure, epileptogenic substrates, MRI findings and correlation of EEG and MRI findings. The statistical test that was used is chi square with p value <0.05 considered as significant value.

RESULTS

The present study was conducted in a study population of 50 patients, who presented with history of partial seizures and underwent magnetic resonance imaging. Out of the 50 patients, the majority of patients belonged to the first two decades, the percentage being 28% in the first decade and

26% in the second decade. In our study, the majority were male patients (60%). Patients with simple partial seizures constituted 40% of the study group. Patients with complex partial seizures constituted 60% of the study group.

Epileptogenic substrate	No. of patients	Percentage Distribution
Mesial temporal sclerosis	9	30%
Gliosis	8	27%
Infectious etiology	6	20%
Tumours	4	13%
Malformations of cortical development	2	7%
Vascular malformation	1	3%
Total	30	

Table-1: Epileptogenic substrates

MRI features	Complex partial seizure group	Simple partial seizure group
MRI with findings	22	8
Normal MRI	8	12
Total	30	20
p value	0.03	

Table-2: Findings in patients with partial and generalized seizures

EEG and MRI correlation	No. of patients	Percentage distribution
Non- lateralizing	9	53%
Concordant	4	23%
Multifocal	3	18%
Discordant	1	6%
Total	17	

Table-3: Correlation of EEG and MRI findings in patients with partial seizure

Distribution	No. of patients	Percentage distribution
Hippocampal sclerosis (medial temporal lobe)	9	30.00%
Extrahippocampal lesions	21	70.00%
Total	30	

Table-4: Distribution of epileptogenic substrates

In our study, mesial temporal sclerosis was the most common abnormality identified in 30% of the study group, followed by gliosis seen in 27% of the seizure patients (table 1). MRI was normal in 20 patients while abnormalities were identified in 30 patients of the study group.

Among patients with complex partial seizures, 22 patients had lesions detected in magnetic resonance imaging (table 2). The diagnostic yield in the partial seizure group is 73%. Most of the electroencephalographic data was concordant in patients with mesial temporal sclerosis (table 3).

In the total study group, 30% of patients had evidence of hippocampal sclerosis (table 4).

Table 5 shows etiological classification of partial seizures according to epileptic substrates. Gliosis due to cerebrovascular causes was seen in most of the patients in our study. Neurocysticercosis was seen more frequently than tuberculosis as the infectious etiology in the study group. Glioma was seen more commonly in adults. In children, dysembryoblastic neuroepithelial tumor was more common. Subependymal heterotopia was identified in 1 patient and cortical dysplasia in 1 patient of the study group.

DISCUSSION

Magnetic resonance imaging has become indispensable in the diagnostic work-up of Partial Seizures patients, who present with recurrent seizures, which is amenable to both medical and surgical treatment.

About 15-30% of patients with partial seizures are refractory to pharmacotherapy[5-7] which mandates the need to evaluate these patients with imaging studies to identify possible structural abnormalities which may be responsible for seizures. Identification of a structural substrate on magnetic resonance imaging, guides further management, as the chance of being considered for surgical treatment is greatly enhanced when a structural abnormality is found on magnetic resonance imaging.[8-10] Approximately, 60% of patients become seizure-free after surgery, the seizure-free surgical outcome being 67% for hippocampal sclerosis, 75% for neoplasms, 58% for cortical dysplasia.[11] The magnetic resonance imaging features of patients presenting with recurrent partial seizures, who underwent Partial Seizures protocol imaging, as the detection rate of abnormality is high with Partial Seizures

Epileptogenic substrate	Etiology	No. of patients	Percentage Distribution	Total no. of patients
Gliosis	Stroke	4	50.00%	8
	Hypoxic insult	2	25.00%	
	Post – infectious	1	12.50%	
	Post- traumatic	1	12.50%	
Infectious etiology	Tuberculosis	2	33.00%	6
	Neurocysticercosis	4	67.00%	
Tumours	Glioma	2	50.00%	4
	DNET	1	25.00%	
	Metastasis	1	25.00%	
Malformations of cortical development	Subependymal heterotopias	1	50.00%	2
	Cortical dysplasia	1	50.00%	

Table-5: Etiological classification of various Epileptogenic substrates associated with partial seizure

protocol imaging.[12] Our study included fifty Partial Seizures patients who underwent Partial Seizures protocol magnetic resonance imaging. Out of the 50 patients, the majority of patients belonged to the first two decades, the percentage being 28% in the first decade and 26% in the second decade. Bronen et al,[13] has categorized the cause of Partial Seizures by the age of seizure onset, in which majority are in the first two decades, similar to our study. About 30(60%) were males and 20(40%) were female patients. Our study included 20 patients with simple partial seizures and 30 patients with complex partial seizures.

The epileptogenic substrates which includes hippocampal sclerosis, gliosis, infections, tumours, developmental anomalies and vascular malformations were identified on the basis of the magnetic resonance imaging features typical for each of these lesions. Hippocampal sclerosis was diagnosed based on the principal findings of volume loss and abnormal signal in the hippocampus[14,15] with identification of loss of hippocampal architecture on inversion recovery sequence.[16] In the present study, hippocampal sclerosis was identified in 9(30%) patients. Similar results were shown by Lefkopoulos et al[17] in their study of 120 patients with refractory seizures. Minor findings such as atrophy of the ipsilateral fornix and mammilary body, ipsilateral dilatation of the temporal horns were also identified in our patients. Associated involvement of the anterior temporal cortex was seen in one of the patients. This is significant because seizure-free surgical outcome is significantly better in isolated hippocampal atrophy.[18]

One of the patient who had history of focal seizures with normal volumetry of bilateral hippocampi underwent magnetic resonance spectroscopy which revealed decreased N-acetyl aspartate/ choline ratio and N-acetyl aspartate/ creatinine + choline ratio in the head of hippocampus which signify neuronal loss and/or metabolic dysfunction, findings suggestive of early mesial temporal sclerosis.[19] Majority of patients with hippocampal sclerosis were in their second and third decades with few cases seen in the first decade, similar to the study done by Bronen.[20]

Dual pathology was not identified in our patients with mesial temporal sclerosis. In our study, gliotic changes which occur as a consequence of infarction, trauma, infection was the second most common lesion, identified in 8(27%) of the patients. In magnetic resonance imaging, gliotic areas follow cerebrospinal fluid signal intensity on all pulse sequences. Hui et al[21] in their study of 100 patients with intractable Partial Seizures had found gliosis in 30% of patients, being the second most common finding next to hippocampal sclerosis, similar to our study.

Partial seizures as a consequence of a focal lesion due to infectious etiology was seen in 6(20%) of patients included in the study. About 4(66%) patients had evidence of neurocysticercosis, which appears as hypo to slightly hyperintense lesion on T1 W image and as hyperintense lesion on T2 W image, with ring enhancement and enhancing eccentric scolex on post contrast images. Among them, 2(33%) had tuberculoma diagnosed on the basis of hypo- to –isointense lesion on T1 W image and hypointense to variable intensity lesion with surrounding edema on T2 W image, showing ring enhancement on post contrast images. Rajashekhar V[22] has reported increased frequency of neurocysticercosis than tuberculoma in our country in patients with seizures. In our study also, we found neurocysticercosis to be more common than tuberculoma.

In our study, among the 30 patients with positive magnetic resonance imaging, tumors were identified as the focal epileptogenic substrate in 4(13%) of the patients. Magnetic resonance has nearly 100% sensitivity for identifying neoplastic lesions.[23] Out of these 4 patients, 2(50%) had low grade glioma showing variable/irregular contrast enhancement.

Dysembryoblastic neuroepithelial tumours was seen in 1(25%) of the children who presented with focal seizures and they were found in the temporal lobe.[19] Ganglio-glial tumours were more common in children while astrocytomas are more common in adults who present with seizures.[24]

Malformations of cortical development were identified in 2(7%) patients of the study group in their first decade, with subependymal heterotopia detected in 1(50%), cortical dysplasia in 1(50%) patients. Hypothelamic hamartoma, Lissencephaly, pachygyria/ polymicrogyria, cortical dysplasia and tuberous sclerosis were other leison which was not identified in our study. Vascular malformations most commonly presenting with seizures include cavernous angioma. In our study, only one patient with cavernous angioma presenting with focal seizure was identified. Medial temporal lobe pathology was identified in 30% of patients and extra-hippocampal lesions in the rest 70%.

The electroencephalography data was non-lateralising in 9, concordant in 4, multifocal in 3, and discordant in 1 patients. Concordance was seen in most patients with mesial temporal sclerosis. A study by Hui et al[21] on patients with refractory partial seizures has shown similar results. Electroencephalography tells us that a seizure focus is present in the brain. It can also localize the focus as well as help to classify the seizures. However, it cannot characterize the underlying structural abnormality which may be responsible for seizure in patients with partial Partial Seizures.

The most common lesion identified in patients with intractable Partial Seizures being hippocampal sclerosis followed by gliosis.[21] The localization of seizure focus can be made by clinical symptoms, electroencephalography, computed tomography, magnetic resonance imaging, functional magnetic resonance imaging, SPECT, and PET studies. No single modality among these can definitively identify the seizure focus, especially those who are planned for Partial Seizures surgery, and hence a combination of these should be used.[8]

Functional magnetic resonance imaging, SPECT and PET also help to localize the seizure focus. They are complementary to magnetic resonance imaging.[20] However, their availability restricts their routine usage, though they can be used in patients with abnormal magnetic resonance imaging with non-localising electroencephalography or discordant clinical semiology and/or electroencephalography findings and/ or electroencephalography findings, multifocal magnetic resonance imaging (tuberous sclerosis), normal magnetic resonance imaging with abnormal electroencephalography.[12]

Colosimo C et al[25] confirmed the superiority of MRI over

CT, relative to the parameters considered, i.e. histology and the assessment of tumor spread. In the clinical suspicion of brain tumors of the posterior cranial fossa in children, MRI if available should be the examination of choice if the patient's clinical status does not prevent its use. CT should be used only in emergency cases (acute intracranial hypertension) to identify hydrocephalus and intratumoral hemorrhages. Unenhanced CT also yields useful pieces of information for lesion "histology" and may be used to integrate MR findings in selected cases.

From the present study, we found that magnetic resonance imaging along with clinical history and electroencephaography should be used in the initial assessment of patients who are considered surgical candidates, since the presence of focal and, in particular, medial temporal lobe pathology increases the chances of progression to successful surgical treatment.

CONCLUSION

Magnetic resonance imaging with its superior soft tissue contrast, multiplanar imaging capability, lack of beam hardening artifact is more sensitive in picking up subtle cortical abnormalities, hippocampal lesions as well as characterizing lesions such as different types of tumours, infections with its advanced applications.

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