

## **Original Research Paper**

Radiology

### MAGNETIC RESONANCE IMAGING IN EVALUATION OF PEDIATRIC EPILESPY

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#### OBJECTIVE ;

To study the spectrum of MRI findings in paediatric patients with epilepsy and to analyze the proportional distribution of various causes of epilepsy in paediatric patients.

**METHODS**; This prospective study was done in the Department of Radio diagnosis & KRSNAA diagnostic centre of Mahatma Gandhi Memorial Medical College & M. Y. Hospital, Indore, Madhya Pradesh, India, after getting approval by ISRB (Institutional Scientific Review Board). MRI was done in total 60 patients in age group of 1-18years who were cilinically presented with seizures. Contrast was given in patients with tumour, suspected vascular malformations, inflammation, and Infectious pathology.Paediatric patients with febrile seizures & trauma were excluded.

**RESULTS**; Majority of patients who presented with seizures belonged to the age group of 13-18 years (41.6 %). Most of the patients were males (56.7%). The proportion of patients presenting with generalized seizures (70%) were higher than those with partial seizures(25%). More than half of patients 39/60 (65.0%) presented within one to three months of onset of seizures. The MRI findings were normal in 28 patients (46.7%) and revealed spectrum of abnormalities in 32 (53.3%) cases . Infection was the most commonly identified substrate comprising appr 16.7%. The second most common substrate identified was Mesial temporal sclerosis(15%). This was followed by Gliosis, congenital malformations and tumours in that order. Among the infectious causes Neurocysticercosis (6.7%) was identified more commonly than tuberculosis(5%). In the congenital malformations group Nodular heterotopia, Focal cortical dysplasia, Schizencephaly and Pachygyria-,Lissencephaly were identified. Only one patient in the study group had a vascular malformation identified and that was found to be cavernous malformation. Glioma was seen more commonly in children. (3.3%)Conventional MR was 87.5 % accurate in diagnosing Infections. CE-MRI was 90% accurate in diagnosing Infections. CE-MRI is more specific (96.6%) in detecting tumors compared to conventional MRI(93.3%). Diagnostic accuracy of MRS in detecting infections was 100%, MRS was more specific (96.6%) in detecting tumors. The diagnostic yield from magnetic resonance imaging is high in patients with refractory seizures.

**CONCLUSION**; MRI plays a pivotal role in the workup of paediatric patients with epilepsy and MRS is a useful evaluation tool in addition to MRI for children undergoing imaging for the evaluation of seizures.

KEYWORDS	Pediatric epilepsy, spectrum of epilepsy
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#### INTRODUCTION

Seizure is a paroxysmal alteration in neurologic function resulting from abnormal excessive neuronal electrical activity.Epilepsy is defined as,at least two unprovoked seizures occurring >24 hours apart.One unprovoked seizure and probability of further seizures similar to the general recurrence risk (at least 60%) after two unprovoked seizures, occurring over the next 10 years.<sup>1</sup>

Epilepsy is a common disorder, sparing no age, race or ethnic background. The incidence of epilepsy is 1 % 2, making it a common neurological condition. It has lot of psycological, social and functional inabilities in affected children and their families.<sup>2</sup>

The role of MRI in epilepsy is to identify the epileptogenic focus, to depict the topographic relationships between epileptogenic focus and the eloquent regions of brain.<sup>3</sup>

MR spectroscopic imaging (MRSI) has become a valuable tool for quantifying metabolic abnormalities.<sup>5</sup>Therefore the study has been undertaken to analyse the spectrum of MRI findings in pediatricpatients with epilepsy and to find the proportional distribution of various causes.

#### METHODS

This prospective study was done in the Department of Radio diagnosis & KRSNAA diagnosticcentre of Mahatma Gandhi Memorial Medical College & M. Y. Hospital, Indore, MadhyaPradesh, India, after getting approval by ISRB (Institutional Scientific Review Board). MRI wasdone in total 60 patients in age group of 1-18years who were cilinically presented with seizures.Contrast was given in patients with tumour, suspected vascular malformations, inflammation, and Infectious pathology. MRI was performed in all patients according to a standardizedpaediatric seizure protocol with 5 mm thickness slices and 0.5 mm interslice gaps in the axial, coronal and sagittal plane with T1&T2-weighting, along with inversion recovery and diffusionweighted imaging (DWI) sequences. B values of 0 and 1000 sec/mm2 were used for DWI.An epilepsyprotocol MRI also includes coronal and axial fluid-attenuated inversion recovery (FLAIR)sequences with a 2- to 3-mm slice thickness and a 0- to 1-mm interslice gap.

#### RESULTS

MR DIAGNOSIS	NO. OF PATIENTS	PERCENTAGE
Normal study	28	46.7
Mesial temporal sclerosis	9	15.0
Congenital malformations	5	8.3
a) Focal cortical dysplasia	1	1.6
b) Schizencephaly	1	1.7
c) Nodular heterotopia.	1	1.6
d) Lissencephaly (pachygyri)	1	1.7
e) Cavernous malformation	1	1.7

Infections	10	16.7
a) Tuberculosis	3	5
b) Neurocysticercosis	4	6.7
c) Cerebral abscess	3	5
Gliosis	5	8.3
Tumours	3	5.0
a) Glioma	2	3.3
b) DNET	1	1.7

# TABLE 1: DISTRIBUTION OF PATIENTS BASED ON MRI DIAGNOSIS.

#### DISCUSSION

About 15-30% of patients with partial seizures are refractory to pharmacotherapy according to Arroyo et al6&Kwan P et al<sup>7</sup>, which mandates the need to evaluate these patients with imaging studies to identify possible structural abnormalities which may be responsible for seizures.

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 in the study conducted by Spencer SS et,al.

In our study 60 patients with clinical diagnosis of seizures were selected as per the criteria laid down by ILAE 1981.

Patients presented with seizures of varying duration ranging from few days to few months. GTCS was the most common clinical diagnosis constituting (70%) cases this was in concordance with the study by Das s k et al.<sup>8</sup>

In our study age range of patients was from 1 to 18 years with male predominance, male 34 (56.7%) and female 26 (43.3%).Maximum number of patients was in the age group of 13-18 years which consisted of 25 patients, accounting for ~41.6% of patients.

Bronen et al<sup>9</sup>, has categorized the cause of epilepsy by the age of seizure onset, in which majority are in the  $2^{nd}$  decade, similar to our study.

MR examination revealed positive findings in 32out of 60patients (53.3 %). This included 17 (53.5%) males and 15(46.5%) females. The various abnormalities include infections (16.7%), mesial temporal sclerosis(15%), gliosis (8.3%), congenital malformations (8.3%), tumours (5%) this was in concordance with study conducted by Chaurasia et al<sup>2</sup>

In our study among the 32 positive cases, congenital malformations were detected in 5 patients (8.3%). This included on e case of schizencephaly, on e case of lissencephalycomplex(pachygyria) [Fig 1], one case of focal cortical dysplasia[Fig2], one case of nodular heterotopia[Fig 3] and one case of cavernous malformation[Fig 4].

Schizencephaly was diagnosed based on csf cleft seen extending from ventricle to cortical surface.

Focal cortical thickening seen on both T1WI &T2WI with blurring of grey white matter junction seen on SPGR suggested Focal cortical dysplasia .

Nodular heterotopia showed nodular lesions of grey matter signal intensities in high parietal region on all sequences .

One patients revealed well defined focal non enhancing lesion showing hemorrhagic signal intensities in the sub cortical white matter of parietal lobe with complete hypointense rim and blooming seen on gradient echo sequence suggested cavernous malformation.

In the present study, hippocampal sclerosis[Fig 5] was identified in 9(15%) patients. Similar results were shown by Lefkopoulos et al<sup>10</sup>

in their study of 120 patients with refractory seizures.

Hippocampal sclerosis was diagnosed based on the principal findings of volume loss and hyperintense signal on T2WI & FLAIR in the hippocampus similar to study done by Cendes et al.<sup>13,</sup> Bronen et al <sup>14,</sup>Kuzniecky<sup>15</sup>, with identification of loss of hippocampal architecture on inversion recovery sequence JacksonGD<sup>61</sup> study showed abnormal hippocampal T2 relaxation times in the hippocampus ipsilateral to the site of seizure origin in 70% of patients and bilateral abnormalities were present in 29% of cases with hippocampal sclerosis.

In our study, gliotic changes which was identified in 5 (8.3%) of the patients. In magnetic resonance imaging, gliotic areas follow cerebrospinal fluid signal intensity on all pulse sequences similar to the study by Hui et al (2003)<sup>11</sup>

Infections constituted the most common cause in our study, accounting for 10 patients (16.7%), of which (60%) belonged to 13-18 year age group. This included 4 patients with neurocysticercosis [Fig 6] and 3patients with tuberculomas[Fig 7] and 3 patients with cerebral abscess [Fig 8].

TR Velasco et al, evaluated 512 patients of intractable epilepsy and concluded that isolated NCC was found in eight patients (1.56%).

All patients had parenchymal form of NCC, with multiple ring enhancing lesions in cerebral hemispheres. Lesions shows T1 hypointense and T2 hyper intense contents. Few lesions showed perilesional edema.

Most of lesions seen in parietal lobe and some show cystic signals with eccentric speck within the lesion. MRS showed choline peak in all lesions .

Three patients were diagnosed as having tuberculoma on MRI scan. The lesions were well defined, rim enhancing, conglomerate with thick wall of different size.which were hypointense on T1WI and hyperintense on T2WI. Ring enhancement seen on post contrast T1WI. The lesions showed perilesional edema on FLAIR and on MRS revealed elevated lactate, lipid peak.

Three patients diagnosed cerebral abscess. They showed evidence of space occupying lesion in right high parietal lobe with perilesional edema with high signal intensity on T2WI with peripheral hyperintensity on T1WI. The lesion showed rim enhancement on post contrast T1WI. Restriction noted on diffusion weighted images and MRS shows high AA's peak and Lip/Lac peak similar to the study done by Gupta et,al (2000).<sup>12</sup>

Of the thirty two cases with abnormal MRI, neoplastic etiology was detected in three cases accounting for 5% patients. This included two cases of glioma and one case of DNET[Fig 9], which were confirmed histologically.

The lesions were hypointense on T1WI and hyperintense on both T2WI and FLAIR sequences. Mild perilesional restriction with mild mass effect seen. MRS showed low choline in both cases and the lesions showed no contrast enhancement. The above features suggested low grade glioma.

The bubbly shaped lesion was hypointense on T1WI and hyperintense on T2WI and FLAIR sequences with mild perifocaledema. MRS showed elevated Lactate level and no enhancement seen on postcontrast T1WI suggested DNET.

Chaurasia et al (2013)  $^{2}$  analysed the magnetic resonance imaging of 271 paediatric patients with epilepsy, of which tumours constituted 2.1% of cases(n=4).

From our study, we found that magnetic resonance imaging along with clinical history, CE-MRI and MRS should be used in the 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.

Accurate diagnosis of the cause of epilepsy is important not only for the specific treatment and follow up but also for explaining the prognosis to the parents.

MR imaging is superior neuroimaging with no radiation exposure and could be the first investigation of choice in epileptic syndrome, Mesial temporal sclerosis with seizure, developmental cortical malformations, and vascular malformations.It's ability in identifying subtle lesions, location, extent of the lesions and amount of findings are excellent.

Metabolite ratios (MRS ) individually and in combination with CE-MRI can increase the sensitivity and PPV when compared with conventional MR imaging alone in determining Infections and tumors. MRS had the most superior diagnostic performance in predicting Infections and tumors.

#### CONCLUSION

Combining appropriate new imaging techniques has led to greater insights into the pathophysiology underlying symptomatic epilepsy and can contribute greatly to elucidating the basic mechanisms of the various forms of epileptic disorders.

In our study we found that Conventional MR was 87.5 % accurate in diagnosing Infections&CE-MRI was 90% accurate in diagnosing Infections.CE –MRI is more specific (96.6%) in detecting tumors compared to conventional MRI(93.3%).Diagnostic accuracy of MRS in detecting infections was 100%, MRS was more specific (96.6%) in detecting tumors compared to CE-MRI.Hence we conclude that MRI plays a pivotal role in the workup of paediatric patients with epilepsy and MRS is a useful evaluation tool in addition to MRI for children undergoing imaging for the evaluation of seizures.

#### Appendix

Fig 1 ; Sparse cortical sulci seen in axial  $\, T2WI$  , FLAIR  $\,$  and coronal  $\, T2WI$  .

#### Diagnosis ; Pachygyri (Lissencephaly).



Fig 2: The left parieto-occipital cortex shows focal area of thickened cortex with blurring of grey-white matter junction in T1WI (A) and abnormal increased signal in T2(B), (C) and FLAIR(D) consistent with dysplastic cortex.

Diagnosis; Focal cortical dysplasia









Fig3; Axial T1WI (A), T2WI(B), FLAIR (C) and coronal T2WI (D) images show nodular lesions of grey matter signal intensities seen in periventricular regions of bilateral parietal lobes.

B)

#### Diagnosis : Nodular heterotopia



Fig 4; Focal T1 isointense (A), T2 (B) / FLAIR (C) heterogeneous hyper intense lesion showing blooming on gradient image (D).

#### Diagnosis; Cavernous angioma







Fig 5: Coronal FLAIR (A), (B) and T2WI (C), (D). Marked asymmetry of hippocampus seen with atrophic left hippocampus. Left hippocampus demonstrates high signal on FLAIR. Features are consistent with MTS.

Diagnosis; Left mesial temporal sclerosis.



A)



B)



Fig 6; Well circumscribed cystic lesion with cental dot seen in right parietal lobe which is hyperintense on T2WI(A) and hypointense on T1WI (B) and FLAIR (C) with surrounding perifocal edema . lesion showed ring enhancement on postcontrast T1WI (D).

Diagnosis; Neurocysticercosis.



Fig 7; A fairly defined peripherally enhancing conglomerate T1 isointense (A), T2 hypo intense (B) lesion in the left fronto-parietal lobe with surrounding edema on FLAIR (C), showed lipid-lactate peak in MR spectroscopy.

Diagnosis; Tuberculoma.





B)

A)



C)

D)

Fig 8; Loculated thick walled cystic lesion measuring noted in right-temporo-parietal region. It is associated with significant surrounding edema .Content of this cystic lesion is hypointense in T1WI (A), hyperintense on T2WI(B). On DWI sequence, it is showing marked restricted diffusion (C).

#### Diagnosis; Cerebral abscess







D)

Fig 9; A well-defined cortical based non enhancing T1 hypo intense(A) and T2 (B)/FLAIR(C) hyperintenseintraxial mass in the right temporal lobe, showing a 'bubbly' appearance and no surrounding edema. No contrast enhancement on post contrast T1WI(D).

Diagnosis; Dysembryoplasticneuroepithelialtumour (DNET)





A)



D)

## C)

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