

Evaluation of Non Febrile Seizure Disorder on MRI with Correlation with Seizure Type and EEG Records in Children.

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Abstract

Objectives: The aim of this retrospective study was to investigate the spectrum of abnormality on MRI, to correlate MRI findings with the seizure type and EEG findings wherever available in children presenting with non febrile seizure disorder.

Patients and Methods: A retrospective hospital based study was done of 271 children who underwent brain MRI for seizure disorder with exclusion of febrile conditions, recent trauma and metabolic conditions from the study. The MRI findings were interpreted independently and subsequently correlated with clinical history and EEG findings wherever available from patients' records.

Results: More than half of the patients (53%) were in the age group of 11-15 years. Generalised seizures were the most common seizure pattern in all age groups. Out of the 271 children included in the study, 106(39%) had abnormal cranial MRI scans. The most common abnormality detected on MRI was granulomatous lesion in 56 cases (33.3%), followed by periventricular leukomalacia/hypoxic ischemic encephalopathy in 12 cases (7.1%), focal gliotic and encephalomalacic changes in 9 cases (5.4%), congenital/developmental anomalies including leukodystrophies in 8 cases(4.8%), mesial temporal sclerosis in 5 cases(3%), hydrocephalous in 4 cases(2.4%), and demyelinating conditions in 3 cases(2%), while tumors (2 cases), cerebral atrophy (2 cases), vascular malformations (2 cases), non traumatic intracranial bleed (2 cases)and cerebral venous thrombosis (1 case) comprised the rest of the causes. Children with unclassified and partial seizures had high rate of abnormality detection on MRI, while those with primary generalized seizures had relatively lower rate of abnormality detection on MRI. Interictal awake scalp EEG findings were available in 100(37%) cases. There was moderate positive correlation between abnormality detection on EEG and MRI(Pearson correlation coefficient, $r=0.65$).

Conclusions: This study shows that CNS granulomatous pathology and hypoxic ischemic encephalopathy were the two most common abnormalities detected on MRI and primary generalized seizures were the most common presentation in children presenting with non febrile seizures.

Prior knowledge of seizure type and EEG records can be helpful factors in increasing diagnostic efficacy of MRI and avoiding unnecessary imaging.

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I. Introduction

Non febrile seizures occur in children of all ages and pose a clinical challenge in terms of cause, management and prognosis. In a study done by Van Den Berg et al (1), non febrile seizures in young children were more likely to be associated with male gender, low birth weight and congenital abnormalities of CNS compared to febrile seizures. Childhood afebrile seizures have been found to be recurrent and more likely associated with abnormalities on neuroimaging in various studies.(2,3,4)

An epileptic seizure is a paroxysmal alteration in neurologic function resulting from abnormal excess neuronal electrical activity. The pathophysiologic basis of seizures is loss of normal neuronal excitation and inhibition, resulting in a state of relative hyper excitability.(5) Seizures are classified into either generalized or partial, with partial seizures being further divided into those without loss of consciousness (simple) and those where consciousness is lost or impaired (complex). Epilepsy is a chronic condition characterised by recurrent seizures unprovoked by an acute systemic or neurologic insult, the term itself does not indicate a specific underlying pathology.(6)

The American Academy of Neurology guidelines for the evaluation of the first non febrile seizure in a child recommend a routine EEG for all children and urgent neuroimaging for children with postictal focal neurologic deficits. Strong consideration is recommended for nonurgent neuroimaging in certain clinical circumstances, including cognitive or motor impairment of uncertain etiology, unexplained abnormalities on

neurologic examination, abnormal EEGs not representing a benign syndrome, seizures of partial onset, or in children under the age of 1 year.(7)

The role of neuroimaging is to i) identification of pathology that require specific therapy and ii) assist formulation of syndrome based or aetiological diagnosis.(8) CT scan is used in emergency situations and also as a complement to MRI for example to identify calcified lesions. Being much more sensitive than computed tomography (CT), magnetic resonance imaging (MRI) is the technique of choice to identify an underlying cause in symptomatic epilepsy. However the sensitivity and diagnostic accuracy of MRI is in part determined by the technique of scanning and the experience of the interpreting radiologist with hence clinical data is mandatory to direct a proper investigation.(9,10)

This study was undertaken to evaluate non febrile seizure disorder on MRI in children with correlation with clinical seizure type and EEG records wherever available.

II. Materials and methods

This hospital based retrospective study was conducted in Department of Radiodiagnosis, of a tertiary care teaching hospital in Northern India, which included 271 children who underwent brain MRI for seizure disorder between June 2015 and May 2017 with exclusion of febrile conditions, recent trauma and metabolic conditions.

The MRI findings were interpreted independently and subsequently correlated with clinical history, microbiological and pathological investigations and interictal awake scalp EEG findings (available in 80 cases) from patients records.

MRI was performed on 1.5T GE SignaHde MRI scanner with the acquisition of the following sequences routinely: Axial T1 spin echo, Axial and Cor T2 fast spin echo, Axial T2Flair, Axial DWI SE-EPI (b=1000, all directions), Axial Gradient echo, Oblique Cor T2FLAIR and Cor 3D T1 spoiled gradient sequences. Additional thin section Fiesta C in desired plane and post gadolinium T1 sequences in axial/cor/sag planes where done wherever required.

III. Results

More than half of the patients (53%) were in the age group of 11-15 years. Generalised seizures were the most common seizure pattern in all age groups (Table 1).

Table 1: Type of seizure as per age of children

Age group	Number of patients	Seizure Type		
		Partial(%)	Generalised(%)	Unclassified(%)
0-5 years	60	11(18.3)	34(56.7)	15(25)
>5 years -11 years	67	18 (26.9)	44 (65.7)	5 (7.4)
>11years- 15 years	144	40 (27.8)	97 (67.3)	7 (4.9)
Total	271	69 (25.4)	175 (64.6)	27 (10)

Overall most common seizure type was generalized tonic-clonic (43.4% cases), followed by generalized tonic or clonic (14.3%), complex partial (11.9%), simple partial (11.3 %), partial seizures with secondary generalization (7%), atypical absence (4.8%) with rest of the seizure types comprising less than 10% of the cases.

Abnormality on MRI was noted in 106/271(39%)patients. Overall the most common abnormality detected on MRI was granulomatous lesion in 56 (52.8%) cases followed by hypoxic ischemic encephalopathy in 12 (11.3%) cases, focal gliotic and encephalomalacic changes in 9(8.5%) cases, congenital/developmental anomalies including leukodystrophies in 8(7.5%) cases, mesial temporal sclerosis in 5 (4.7%)cases , hydrocephalous in 4(3.8%) cases, and demyelinating conditions in 3(2.8%) cases, while tumors (2 cases), cerebral atrophy (2 cases), vascular malformations (2 cases),non traumatic intracranial bleed (2 cases)and cerebral venous thrombosis (1 case) comprised the rest of the causes.

In children upto five years of age most common abnormality noted on MRI were hypoxic ischemic encephalopathy and congenital/developmental anomalies, while in children older than five years of age, granulomatous lesions were the predominant pathology. (Table 2)

Table 2: Age group wise spectrum of abnormality detected on MRI

MRI Abnormality	Number of cases			
	0-5 years	>5-11 years	>11 -15 years	Total
Granuloma	3	19	34	56
Hypoxic ischemic encephalopathy (HIE)	6	4	2	12
Focal gliosis/encephalomalacia	1	2	6	9
Congenital/developmental anomaly (Inclleukodystrophy)	6	1	1	8
Mesial temporal sclerosis	0	0	5	5

Hydrocephalous	1	2	1	4
Intracranial tumor	0	1	1	2
Misc. (ICH, SSPE, PRES, Neuroglial cyst, Atrophy)	1	4	5	10

In partial seizure 43/69(62.3%) patients had abnormality on MRI, in case of generalised seizures 46/175 (26.3%) patients had abnormality on MRI while in patients with other seizure types (unclassified) 17/27 (63%) had abnormality on MRI. This difference was statistically significant (p value = 0.003).(Table 3) In this study, a correlation between EEG and MRI was made. MRI abnormality was seen in 106/271 (39%) of patients and EEG abnormality was seen in 52/100 (52%) of patients for which EEG records/reports were available. A total of 34 (70.3%) patients with normal EEG had normal MRI, while 38 (73%)patients with abnormal EEG had abnormal MR scans. There was moderate positive correlation between abnormality detection on EEG and MRI. (Pearson correlation coefficient r=0.65). According the seizure type EEG abnormality was highest (67%) in case of partial seizures while it was lowest in case of generalised seizures (44.6%). (Table 3)

Table 3: Distribution of abnormality on MRI and EEG as per seizure type

Seizure type	Number of cases	Abnormality on MRI (%)	Abnormal EEG/EEG records available (%)
Partial	69	43(62.3%)	20/30 (67%)
Generalised	175	46 (26.3%)	29/65 (44.6%)
Others/unclassified	27	17 (63%)	3/5 (60%)

IV. Discussion

In this study most of the patients were in the 11-15 years age group (53%) and generalised seizures were most common seizure type (64.6%) in the study group. These observations are in agreement with the studies by various authors who have found 10-30 years as the most common age group(11-15) and the range of patients with generalised seizures between 50–69%, while 31–50% had partial seizures.(14,16-18,22). However Chan et al (19) and Doescher et al (2) have found focal seizures more common than generalized seizures in children.

Two most common abnormalities detected on MRI were granulomatous lesion in 56(33.3%) cases and hypoxic ischemic encephalopathy in 12 (7.1%) cases.Likewise CNS infections/infestations, previous insult, and perinatal insult have been found to be most common etiologies associated with seizures in studies done by Mac et al (Asia)(20), Sebit et al (Africa)(21) and Senanayake et al.(22)

Children with unclassified and partial seizures had higher rate of abnormality detection on MRI compared to those presenting with primary generalized. This difference was statistically significant (p value= 0.003). Studies done by Rasool et al (23), Bachman et al(24) and Resta et al(25) have also found higher frequency of abnormal neuroimaging with partial seizures.

In our study according the seizure type EEG abnormality was highest (67%) in case of partial seizures while it was lowest in case of generalised seizures (44.6%).This is in partial agreement with study by Rasool et al (23) who found high rate of EEG abnormality in case of both partial and generalised seizures (approx.70%).

There was moderate positive correlation between abnormality detection on EEG and MRI. (Pearson correlation coefficient r=0.65). Statistically significant correlation between abnormal EEG and abnormality detection on MRI has been found in studies done by Rasool et al(India)(22), Doescher et al(US)(2), Berg et al(US)(26), and by us in our previous study(15).

V. Conclusion

This study shows that CNS granulomatous pathology andhypoxic ischemic encephalopathy were the two most common abnormalities detected on MRI and primary generalized seizures were the most common presentation in children presenting with non febrile seizures. Prior knowledge of seizure type and EEG records can be helpful factors in increasing diagnostic efficacy of MRI and avoiding unnecessary imaging.

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