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MAGNETIC RESONANCE IMAGING IN CHILDHOOD SEIZURES

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ABSTRACT

Aim and Objective: To evaluate the diagnostic efficacy of a standard MRI of the brain in identifying the epileptic foci in children with seizures.

Methods: This is a prospective observational study where a total of 100 children aged 1 to 12 years with seizures who underwent MRI imaging of brain during the study period were included. All patients will be evaluated clinically and then undergo an MRI of the brain performed using a 1.5 Tesla MRI scanner. MRI scan was done and findings are recorded. Datas were collected and analyzed statistically.

Results: Out of 100 children with seizures who were included in the study, 74% had GTCS type of seizure and 26% had focal (partial) type of seizure. Both GTCS and focal seizures were observed to be common among males (54.1% and 61.5% respectively). Overall 58 children (58%) had normal MRI findings and 42(42%) had abnormal MRI imaging. Out of 71 children with abnormal EEG, 53.5% had normal MRI and 46.5% had abnormal MRI findings. All the children who had abnormal findings in MRI invariably had abnormal EEG and this association was found to be statistically significant (p<0.001). Out of 42 children with abnormal MRI findings, Hypoxic Ischemic changes and periventricular leucomalacia [21.4% (n=9)] is the commonest abnormality followed by other white matter lesions that constituted about 19%. Other findings were infection associated changes (14.3%), congenital malformations (14.3%), atropic changes (14.3%), vascular lesions (7.1%), CSF disorders (4.8%), tumors (4.8%).

Conclusion: As majority of seizures has its onset in childhood, evaluation of various etiologies of seizures is mandatory. Magnetic resonance imaging (MRI) is the most important noninvasive imaging modality, and is mandated in the evaluation of children with epilepsy together with electroencephalography. Using 3T MRI and other applications like MR spectroscopy, functional MRI and diffusion weighted MRI in evaluation of seizure will help identifying the etiology of seizure exactly which is the limitation of our study.

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INTRODUCTION

Seizures constitute the most common neurological problem in children and the majority of epilepsy has its onset in childhood. Appropriate diagnosis and management of childhood epilepsy is essential to improve quality of life in these children. ⁽¹⁾ Approximately 4-10% of children experience at least 1 seizure (febrile or a febrile) in the 1st 16 yr of life. The cumulative lifetime incidence of epilepsy is 3%, and more than half of the cases start in childhood. The annual prevalence is 0.5-1. ⁽²⁾

Primary generalized epilepsy is considered to be genetic in etiology whereas most localization related epilepsy is presumed to be the result of a cerebral insult even though the insult cannot be determined in about half of all epileptic patients regardless of age. Recent development in imaging technology have reduced this figure in children and young

adults with refractory epilepsy where malformations of cortical development have been implicated in about twenty five percent of such cases. ⁽³⁾ Localization related epilepsy is said to be more common in developing countries. Imaging has led to identification of cause of complex partial seizures in more children which determines appropriate treatment (medical or surgical) in a given child with complex partial seizures. MRI is better than CT scan in diagnosing causes of localization related epilepsy. ⁽⁴⁾

MATERIALS AND METHODS

This is a hospital based prospective observational study done in children aged 1 to 12 years with seizures admitted in Rajah Muthiah Medical College & Hospital. **Inclusion Criteria:** All children aged 1 to 12 years with seizures who undergo MRI imaging of brain during the study period.

Exclusion Criteria

- Any previously diagnosed non central nervous system disorders liable to cause seizures (eg. Electrolyte abnormalities, hypocalcemia).
- Syncopal and hypoglycemic attacks, pseudo-seizures or drug induced seizures.
- Patients with known contraindications to MRI.
- Patients presenting with head injury.

All children who satisfied the inclusion criteria were included in the study after getting informed written consent from the parents. The data regarding their name, age, sex, address, type of seizures (according to international classification of epileptic seizures), past history of seizures, contact with tuberculosis, drug history, development history, family history are collected in a preformed proforma (annexure). All patients will be evaluated clinically and then undergo an MRI of the brain performed using a 1.5 Tesla MRI scanner (Magnetom Avanto TIM, 18 channel; Siemens, Erlangen, Germany). Routine spin echo T1, T2 and Inversion recovery sequences are followed by a T1 weighted high resolution magnetization prepared rapid gradient echo sequence (MPRAGE) and a high resolution inversion recovery (IR) sequence both obtained in an oblique coronal plane perpendicular to the hippocampus. MRI scan was done and findings are recorded. Datas were collected and analyzed statistically.

RESULTS

Table – 1 Age Distribution with Reference to Seizure Types

Type of Seizure	Age (in years)						Total
	1-3 yrs.		4-7 yrs.		8-12 yrs.		
	N	%	N	%	N	%	
GTCS	43	58.1	17	23	14	18.9	74
Partial	12	46.2	4	15.4	10	38.5	26
Total	55		21		24		100

Table – 2 Sex Distribution with Reference to Seizure Type

Type of Seizure	Sex				Total
	Male		Female		
	N	%	N	%	
GTCs	40	54.1	34	45.9	74
Partial	16	61.5	10	38.5	26
Total	56	56%	44	44%	100

Table – 3 Association of Neuro – Imaging Findings and Type of Seizure

Type of Seizure	Neuro-Imaging Findings				Total
	Normal		Abnormal		
	N	%	N	%	
GTCs	46	62.2	28	37.8	74
Partial	12	46.2	14	53.8	26
Total	58	58.0	42	42	100

Table – 4 Distribution of Neuro Imaging Abnormality

Final Diagnosis	N	%
HIE / PVL	9	21.4
Infection	6	14.3
Cong. Malformation	6	14.3
White Matter Disorders	8	19.0
CSF Disorder	2	4.8
Vascular Lesions	3	7.1
Atrophic Changes	6	14.3
Tumour	2	4.8
Total	42	100

Table – 5 The Association of MRI Vs EEG Findings

MRI Findings	EEG Findings				Total	
	Normal		Abnormal		N	%
	N	%	N	%		
Normal	14	100	38	53.50	52	61.18
Abnormal	0	0	33	46.50	33	38.82
Total	14	100	71	100	85	100

Chi-square Test

	Value	'P' value
Chi-square test	10.637	0.001

DISCUSSION

Out of 100 children with seizures who were included in the study, 74% had GTCS type of seizure and 26% had focal (partial) type of seizure. GTCS of both febrile and a febrile type were included. In study by Eriksson *et al* ⁽⁵⁾, 48% had generalized epilepsy and 45% had focal seizures. Another study by Simi Mizra ⁽⁶⁾ *et al* also had similar observation. Generalized seizures are more common followed by localization related seizures. Both GTCS and focal seizures were observed to be common among males (54.1% and 61.5% respectively) [Table.2] and in age group between 1-3 yrs (58.1% and 46.2% respectively) [Table.1]. However this difference was not statistically significant in our study. This observation is comparable to that observed by Ramesh Baheti *at al.* ⁽⁷⁾ Overall 58 children (58%) had normal MRI findings and 42(42%) had abnormal MRI imaging in our study. 53.8% of children with partial seizure had abnormal finding in MRI whereas only 37.8% children with generalized seizure had abnormal neuroimaging [Table.4]. This observation is comparable to previous studies done by Hirtz *et al*,⁽⁸⁾ and

Fariba khodapanahandeh and Homayon Hadizadeh.⁽⁹⁾ Neuro imaging abnormalities are more common with focal (partial) seizures. Electroencephalogram findings is abnormal in 71% of all children included in our study. 85.7% had abnormal electroencephalogram findings in GTCS group and 77.3% in partial seizure group [Table.5]. There is high incidence of EEG abnormality in GTCS group, however it is not statistically significant. Similar observation was made by Ramesh Baheti *et al* ⁽⁷⁾ where 76.9% of children had abnormal EEG in generalized seizure group and 73% of children in partial seizure group. In another study by Shlomo shinnar *et al* ⁽¹⁰⁾ EEG abnormality was observed in 42% of children. Abnormal EEG in 56% of children with partial seizure and 35% of children with generalized seizure and the difference was statistically significant.

Out of 71 children with abnormal EEG, 53.5% had normal MRI and 46.5% had abnormal MRI findings [table-8]. All the children who had abnormal findings in MRI invariably had abnormal EEG and this association was found to be statistically significant (p<0.001). Out of 42 children with abnormal MRI findings, 21.4% (n=9) had Hypoxic Ischemic changes and periventricular leucomalacia and is the commonest abnormality followed by other white matter lesions that constituted about 19%. Among these 9 children with HIE changes, 6 children had GTCS and 3 had partial seizures. Shinnar *s et al* ⁽¹¹⁾ observed abnormality in 21% of children with focal encephalomalacia and cerebral dysgenesis as the most common abnormality. In another study by Andrew J. Kalnin *et al*,⁽¹²⁾ out of 87 children with MRI abnormality, the most common abnormality was ventricular enlargement

(51%). Among children with white matter disorders (n=8), hypomyelination / delayed myelination was noted in four children, Metachromatic leukodystrophy (n=1), Canavan disease (n=1), Acute Demyelinating Encephalomyelitis (n=2). Lesions caused by various infections constituted 14.3% of abnormal MRI findings and includes Tuberculoma (n=1), Neurocysticercosis (n=1), focal cerebritis (n=1), B/L paracentral subdural empyema (n=1), Viral encephalitis (n=1), terminal zone myelitis (n=1). In a study by Rachna Chaurasia *et al.*⁽¹³⁾ most common cause of epilepsy was found to be CNS tuberculosis (Tuberculomas, 15.7% & TBM, 14.6%). Congenital malformations of brain constituted 14.3% (n=6) of brain abnormalities in MRI. This included Arnold Chiari Malformation type 1 (n=3), partial agenesis of corpus callosum with Dandy Walker malformation (n=1), Pachygyria (n=1), Heterotopia (n=1). Partial seizures was found to be predominant type in 66.7% of those who had congenital malformations and only 33.3% had GTCS [Table.7]. Gray matter lesions such as heterotopias and cortical dysplasia were seen in 12% of brain abnormality in the study by Andrew J. Kalnin *et al.*⁽¹²⁾.

Brain atrophic changes were observed in 14.3% (n=6) of children with MRI abnormality including diffuse atrophy (n=1), hemiatrophy (Dyke Davidoff Masson Syndrome, n=1), B/L temporal lobe atrophy (n=1), followed by gliosis (n=3). However leukomalacia/gliosis was found to be in 23% of children in a study done by Andrew J. Kalnin *et al.*⁽¹²⁾. Vascular causes including subdural hemorrhage (n=1) and other encephalomalacia in parietal lobe due to chronic infarct (n=2) were seen in 7.1% of total abnormality. Both CSF disorders including communicating hydrocephalus (n=1), cistern magnum (n=1) and tumor (Ganglioglioma, n=2) were found in 4.8% of children with MRI abnormality each.

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