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TO STUDY THE SIGNIFICANCE OF EEG AND NEUROIMAGING AND ITS CORRELATION IN UNPROVOKED SEIZURES BETWEEN THE AGE GROUP BETWEEN 2 MONTHS TO 6 YEARS

Dr.M.Mallikarjuna[1], Dr. M.Uday[2], Dr.K.Aruna Jyothi[3], Dr. Maddi Prakash Kumar[4*]

[1]Associate Professor, Department of Pediatrics, Kurnool Medical College, Kurnool, AP.

[2]Post Graduate, Department of Pediatrics, Kurnool Medical College, Kurnool, AP.

[3]Associate Professor, Department of Pediatrics, Govt Medical College, Nandyal, AP.

[4]Associate Professor, Department of Pediatrics, Kurnool Medical College, Kurnool, AP.*

Corresponding Author: Dr. Maddi Prakash Kumar

Abstract

Introduction: Seizure of unknown etiology as well as one that occurs in relation to a preexisting brain lesion or progressive nervous system disorder. This differs from acute symptomatic seizure in which seizure is due to acute symptomatic illness or brain insult. The etiology of unprovoked seizures include epilepsy, tumor's, brain malformation. There is increased concern regarding early morbidity and sudden unexpected death due to congenital and acquired neurological deficits, noncompliance to antiepileptic drugs and status epilepticus and incidence of sudden unexpected deaths is 0.36 to 0.43 per1000 person years[1]. Relative risk of sudden un expected death is 7.7 times higher in patient with onset of epilepsy[2]. Mortality in children issignificantly higher than the general population.

Materials and methods: Hospital based Prospective observational study for a period of one and half year (January 2021 to August 2022) from date of approval of my thesis work by Institutional Scientific and Ethical Committee. The study has conducted in the Department of Pediatrics, Govt. General Hospital, Kurnool. The prevalence of unprovoked seizure was taken as 10%. The sample size was calculated using obtained prevalence as 90%, at 95% confidence interval with absolute precision of 10%. The minimum sample size is 36 cases by the following sampling method. But the convenience purpose 50 sample size was obtained.

Results: Seizures are more common in age group less than 1 year about 60%. This study includes generalized seizures are frequently occur less than 1 year about 61%. Partial seizures are frequently occurring in the age group less than 1 year about 53%. P value is 0.85 by Pearson chi square test which is statistically notsignificant. 94% of the children has normal development, 6% of the children has developmental delay. Children with developmental delay have seen in generalized seizures. P value is 1.0 by Pearson chi square test which is statistically notsignificant.

Conclusion: Higher incidence of neuroimaging abnormality is seen with partial seizures with abnormal Electroencephalogram. There is higher correlation between neuroimaging abnormality and focal Electroencephalogram changes in partial seizures when compared to generalized seizures. Electroencephalogram and Neuroimaging are strongly recommended in evaluating Children with afebrile seizures.

Key Words: Seizure, neuroimaging abnormality, unprovoked seizure, Electroencephalogram.

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INTRODUCTION

Seizure of unknown etiology as well as one that occurs in relation to a preexisting brain lesion or progressive nervous system disorder. This differs from acute symptomatic seizure in which seizure is due to acute symptomatic illness or brain insult. The etiology of unprovoked seizures include epilepsy, tumor's, brain malformation. There is increased concern regarding early morbidity and sudden unexpected death due to congenital and acquired neurological deficits, noncompliance to antiepileptic drugs and status epilepticus and incidence of sudden unexpected deaths is 0.36 to 0.43 per1000 person years[1]. Relative risk of sudden un expected death is 7.7 times higher in patient with onset of epilepsy[2]. Mortality in children is significantly higher than the general population.

Around 50 million people in world have epilepsy and nearly 80% from developing countries[3]. The prevalence rates were 6.99 from rural areas, 5.48 from urban area and 4.07 for active seizures per 1000 population[4]. There is differential distribution of epilepsy among various socio- demographic and economic groups with higher rates reported for the male gender, rural population and low socio-economic status.

The combination of seizure history, EEG, and neuro imaging allows the clinician for the accurate diagnosis and early management decisions regarding epileptic drug therapy and surgery and also facilitates patient counseling in the first episode of afebrile seizure. EEG can detect focal lesion's which are not visible with neuro imaging and show epileptic form findings that allow diagnosis of particular epilepsy syndromes and also useful to evaluate risk of seizure recurrence. MRI brain is the preferred method to avoid radiation exposure and is useful in identification of structural and functional causes of seizure.

As our institution is tertiary care Centre, most of the cases are referred and admitted in our institution are seizure cases. MRI brain and EEG are feasible in our institution. Hence this study helpful in early diagnosis and management and expedite referral for surgical consideration.

AIMS AND OBJECTIVES

Is MRI brain when used along with EEG aids in better diagnosis andidentifying the focus of seizures in children.

Primary objective:

To find out the sensitivity of MRI brain and EEG for the diagnosis of firstepisode of un provoked seizure when used in combination.

Secondary objective:

- Find out the incidence of un provoked seizures among pediatricadmissions
- Find out the burden of structural abnormalities compared to epilepsy.

MATERIALS AND METHODS

Study Design: Hospital based Prospective observational study.

Study Period: A period of one and half year (January 2021 to August 2022) from date of approval of my thesis work by InstitutionalScientific and Ethical Committee.

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Study Setting: The study has conducted in the Department of Pediatrics, Govt. General Hospital, Kurnool.

Study Subjects: Study population comprising of patients with unprovoked seizure who fulfill the below mentioned inclusion and exclusioncriteria.

Study Size: 50

The prevalence of unprovoked seizure was taken as 10%. The sample size was calculated using obtained prevalence as 90%, at 95% confidence interval with absolute precision of 10%. The minimum sample size is 36 cases by the following sampling method. But the convenience purpose 50 sample size was obtained.

Inclusion Criteria

- Age between 2months to 6 years
- Children with unprovoked afebrile seizures
- Epilepsy

Exclusion Criteria

- Seizures in neonatal period
- Acute symptomatic seizures
- Febrile seizures
- Post traumatic seizures
- Meningitis
- Encephalitis

INSTITUTIONAL ETHICS COMMITTEE APPROVAL: Obtained

STUDY METHODS:

Patients who are fulfilling the inclusion and exclusion criteria will be included the study. After taking informed written consent, History and physical examination will be done in all the patients according to prefixed proforma. All the patients will be subjected to various investigations like

- Complete blood count (CBC) by hematology cell counter.
- renal function test,
- liver function test,
- electrolytes,
- blood sugars

Should be carried out to exclude meningitis, hypoglycemia, Dyselectrolytemia Mainstay of investigations include1.EEG (Electroencephalogram) 2. Magnetic resonance imaging

Statistical analysis was carried out using the standard formula. Microsoft excel 2007 and SPSS (statistical package for social sciences) version 23 software was used for data entry and analysis. Chi square test is used to compare the categorial variable. $P< 0.05$ is take as significant.

RESULTS

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Table .1 AGE distribution

Age	Seizure type		Total
	Generalized Seizures	Partial	
<1 yr	22	8	30
>1yr	13	7	20
Total	35	15	50

Seizures are more common in age group less than 1 year about 60%. This study includes generalized seizures are frequently occur less than 1 year about 61%. Partial seizures are frequently occurring in the age group less than 1 year about 53%. P value is 0.85 by Pearson chi square test which is statistically notsignificant.

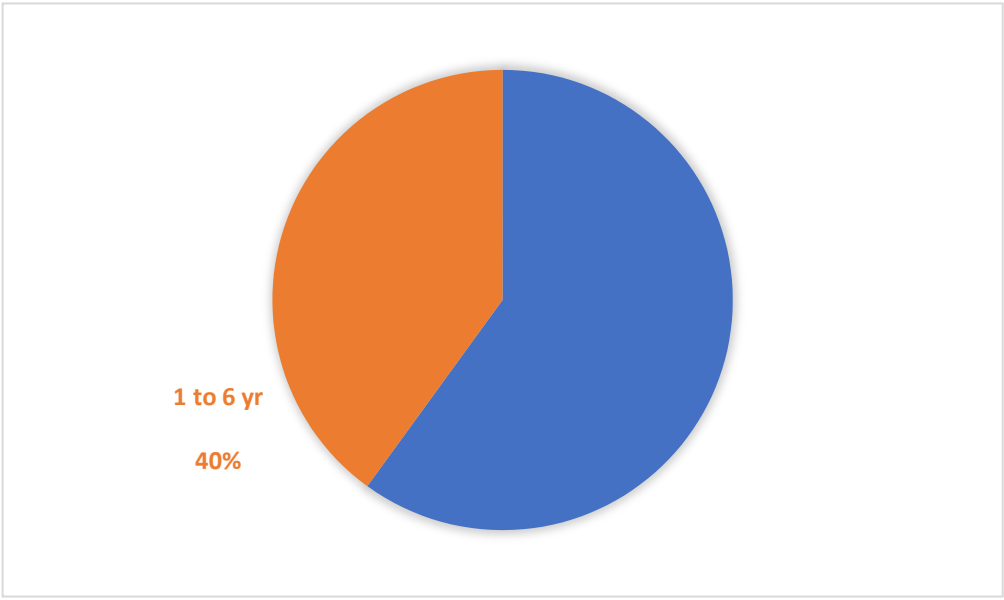

Chart .1 Age Distribution

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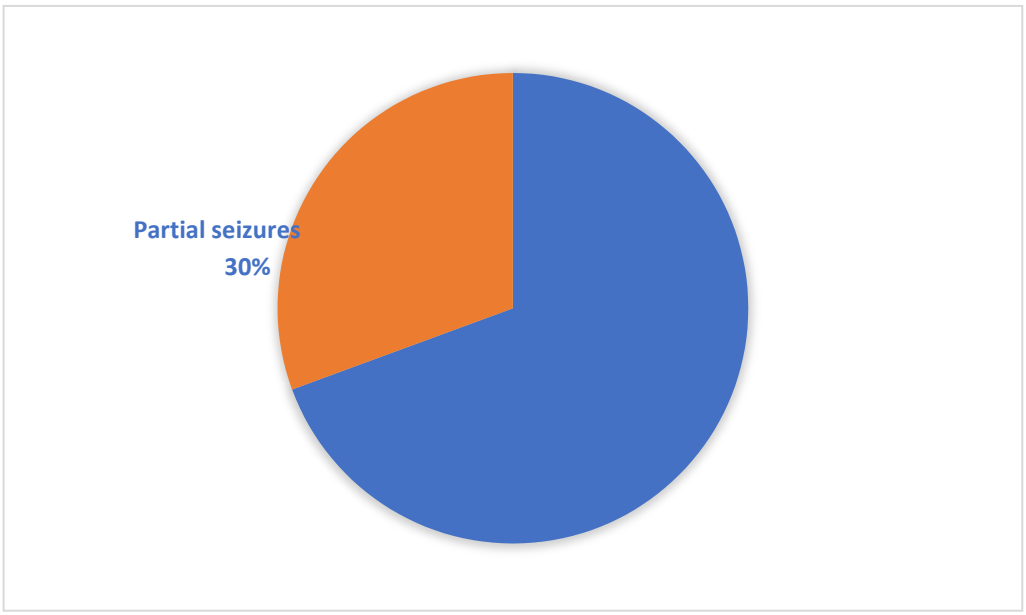

Chart 2. Types of Seizures

35 children with generalized seizures (70%) 15 children with partial seizures (30%).

Table.2 Sex Distribution

SEX	GENERALIZED SEIZURE	PARTIAL SEIZURE	TOTAL	PERCENTAGE
MALE	20	10	30	60 %
FEMALE	15	5	20	40%
TOTAL	35	15	50	100%

Generalized seizures are more frequently seen in male children -60%. Partial seizures are more frequently seen in male children-40%. In generalized seizures male to female ratio is 1.4: 1. In partial seizures male to female ratio is 2: 1. P value is 0.509 by Pearson chi square test which is statistically notsignificant.

Chart .3 Sex Distribution

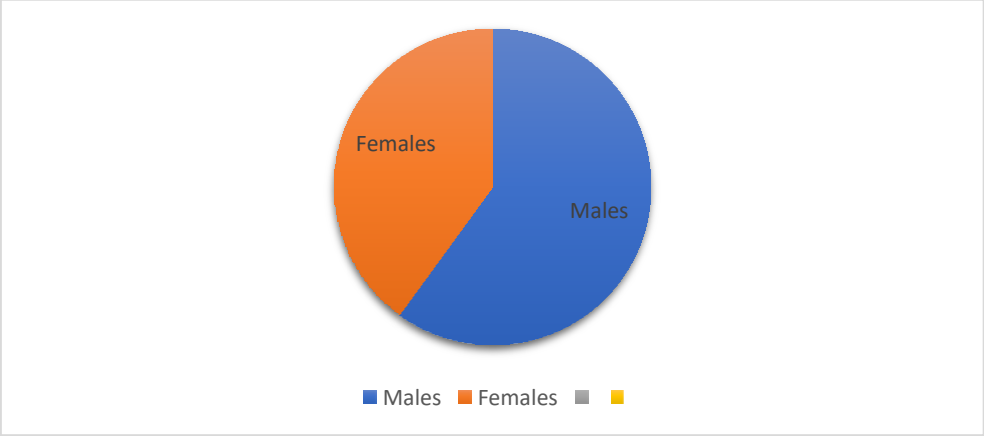

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Table.3 Development and Seizure Types

Development	Generalized seizures	Partial seizures	total
Delay	3	0	3
Normal	32	15	47
Total	35	15	50

94% of the children has normal development, 6% of the children has developmental delay. Children with developmental delay have seen in generalized seizures. P value is 1.0 by Pearson chi square test which is statistically notsignificant.

Chart 4. Development History

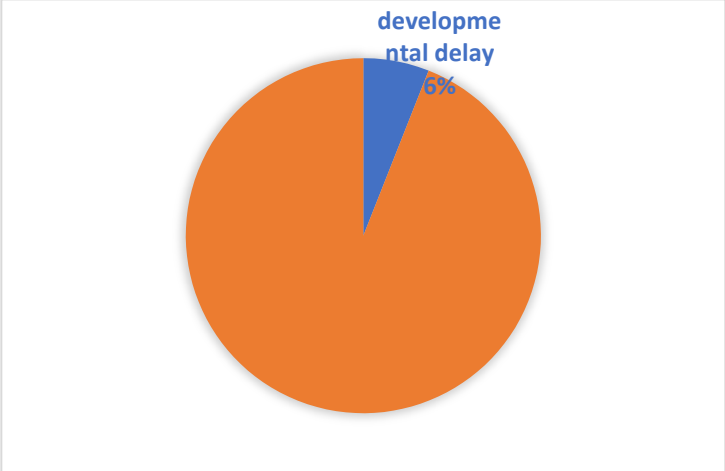

Chart.5: Seizure Types in Developmental Delay Children

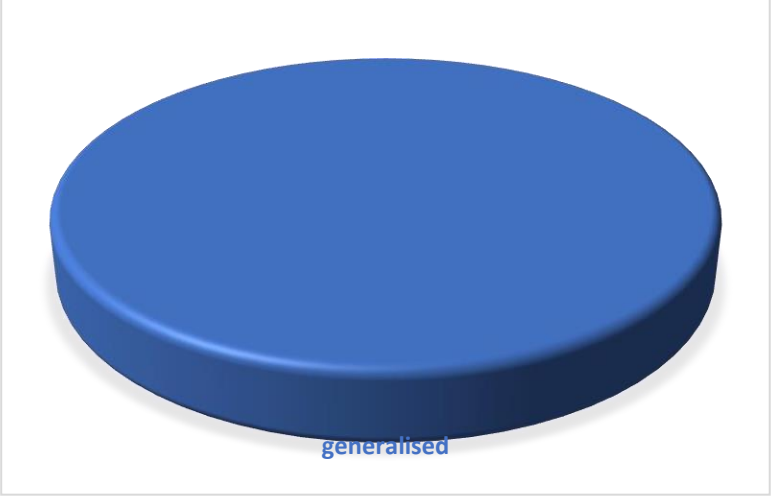

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Table No. 4 Family History of Seizure

Seizure type	Family history		Total
	Present	Absent	
Generalized seizure	5 (14.2%)	30 (85.7%)	35
Partial seizure	2 (13.3%)	13 (86.7%)	15
Total	7 (14%)	43 (86%)	50

Only 14% of children has family history of seizure. Only 14.2% of children with generalized seizure had the family history of seizure. Only 13.3% of children with partial seizure had the family history of seizure. By applying chi square test of significance, there is no significant difference in the family history in both generalized and partial seizure groups (P = 0.321).

Chart No. 6: Family History of Seizure

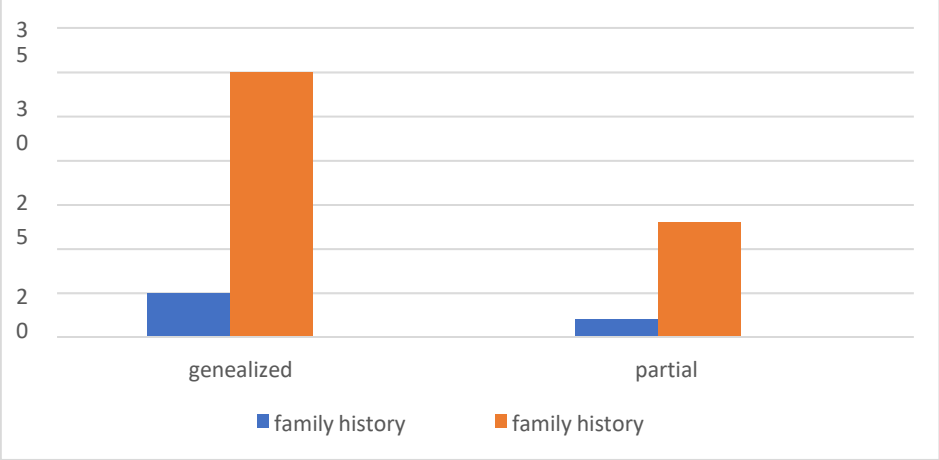

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Table 5. EEG Findings

SEIZURE TYPE	ABNORMAL	NORMAL	TOTAL
GENERALIZED	28		35
PARTIAL	13		15
TOTAL	41		50

Among the 50 children admitted with seizures in this study 82% had abnormality 68.2% among the generalized seizures had abnormality 86% among the partial seizures had EEG abnormality. P value is 0.43 by Pearson chi square test which is statistically not significant.

CHART .7 EEG FINDINGS

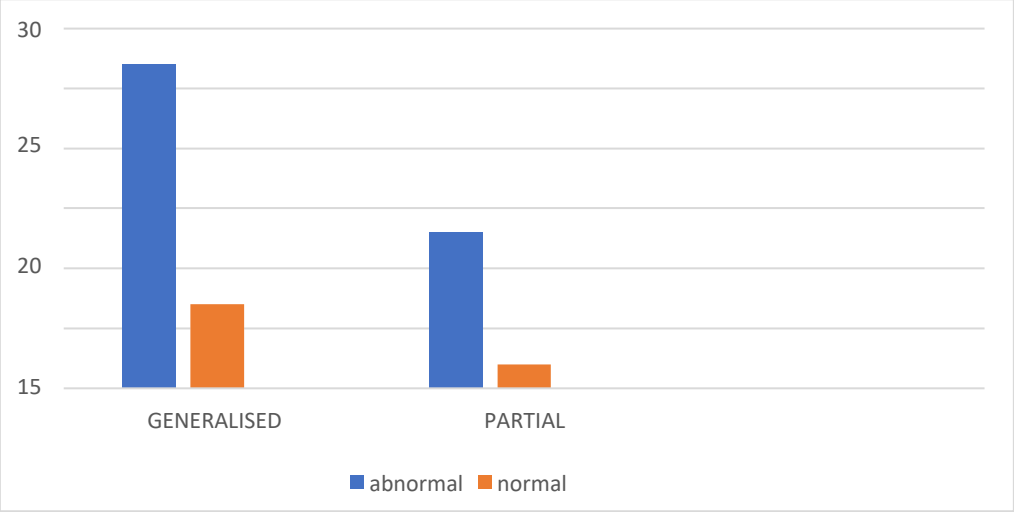

CHART. 8 EEG ABNORMALITY

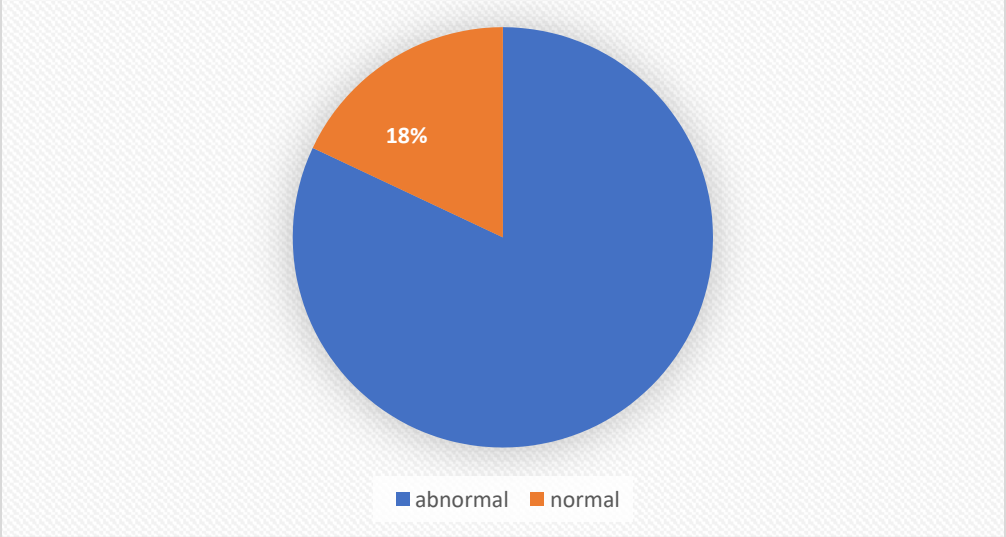

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Table .6 EEG Findings In Seizure Types

EEG	SEIZURE TYPES		TOTAL
	GENERALIZED	PARTIAL	
GENERALIZED SPIKE AND WAVE	27	4	31
FOCAL SPIKE ANDWAVE	0	9	9
HYPSARRHYTHMIC	1	0	1
NORMAL	7	2	9
TOTAL	35	15	50

Among the 50 children included in the study 18% had focal changes, 62% had generalized EEG changes and 18% children had normal EEG findings, Children with generalized seizures had 79.4% of generalized EEG activity and 20% had normal EEG findings. P value is 0.00 by Pearson chi square test and is statistically significant.

CHART .9 EEG FINDINGS IN SEIZURE TYPES

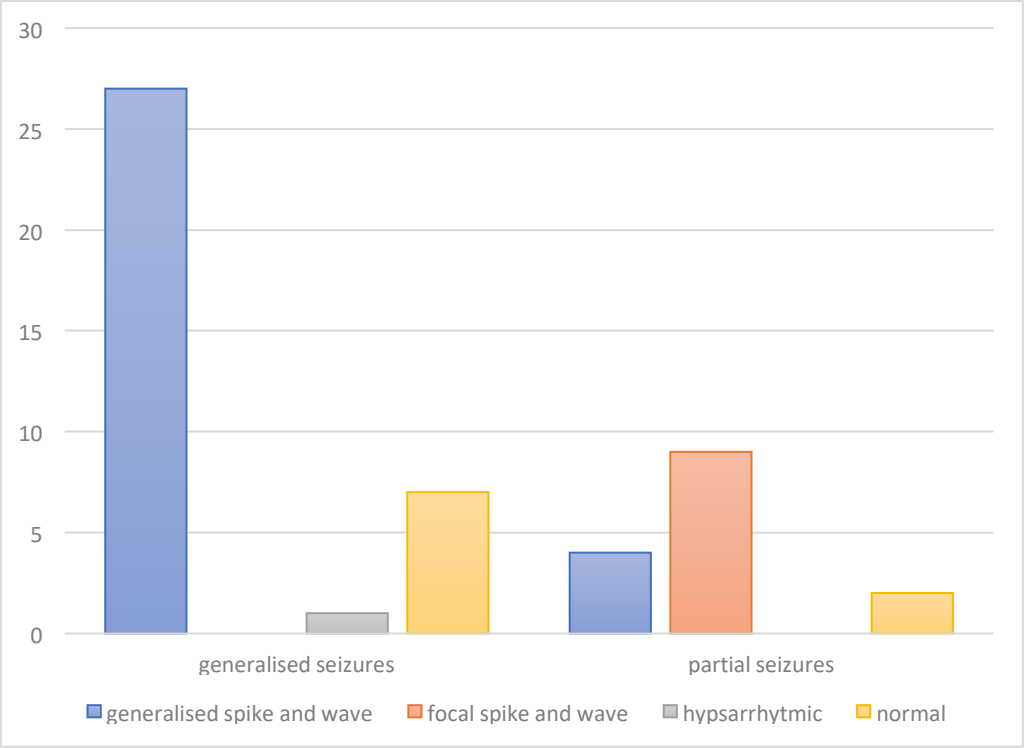

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Table 7: MRI Abormalities in Seizures

SEIZURES	NORMAL MRI	ABNORMAL MRI	TOTAL
GENERALIZED SEIZURES	26	9	35
PARTIAL SEIZURES	10	5	15
TOTAL	36	14	50

33.3 % patients with partial seizures have MRI abnormality. 26.4% children with generalized seizures have MRI abnormality. P values by Pearson chi-square test 0.809 which is statistically not significant There is high correlation between partial seizures and abnormal MRI brain.

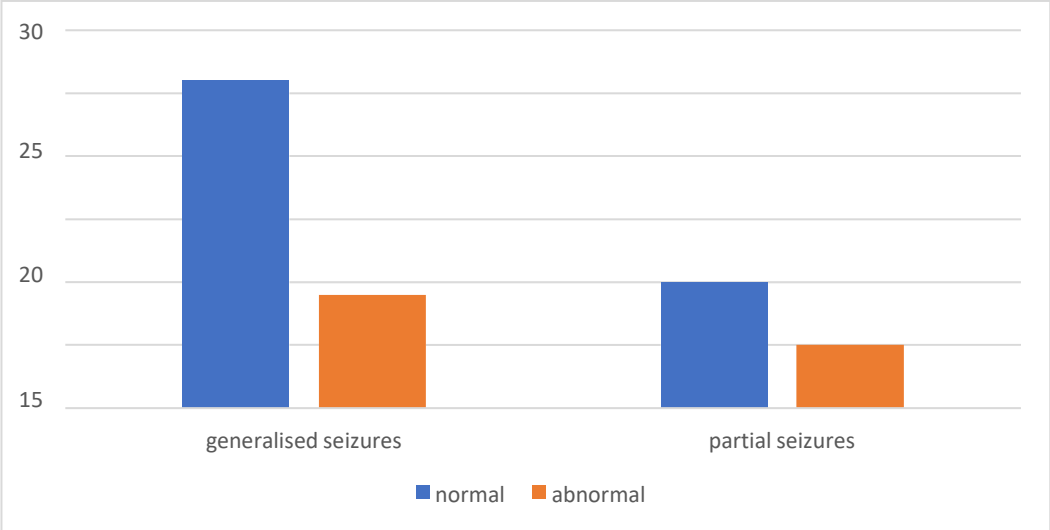

Chart. 10 MRI Brain in Seizures Types

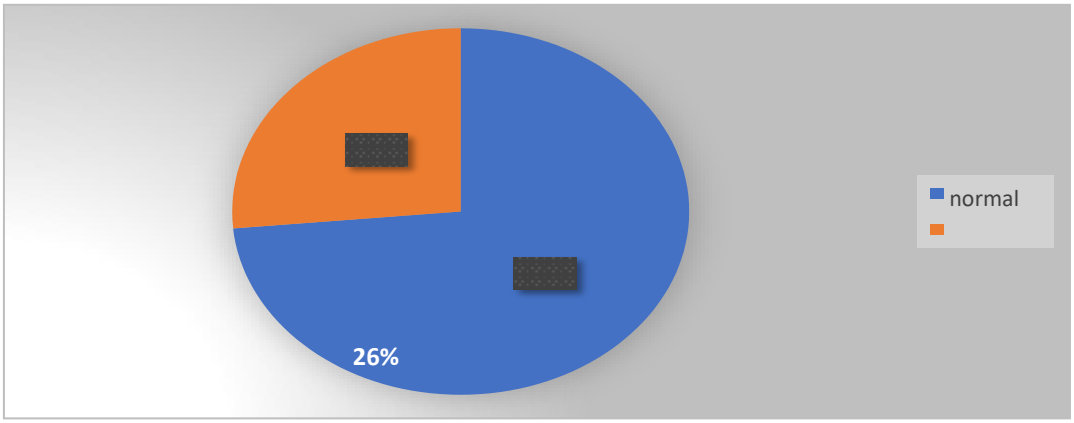

Chart No 11: MRI Brain in Generalized Seizure

74% of the generalized seizures have MRI normal. 26% of the generalized seizures have MRI brain abnormal.

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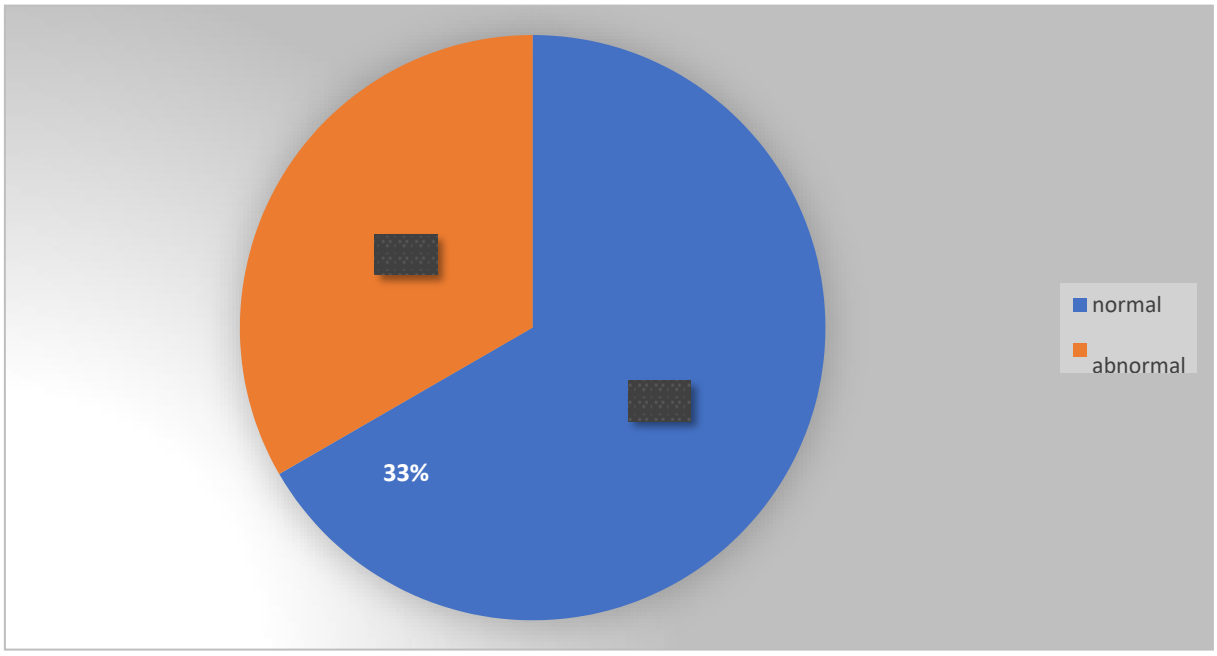
Chart No. 12 MRI Brain In Partial Seizures



67% of the partial seizures have MRI brain normal. 33% of the partial seizures have MRI brain abnormal.

Table .8. Various MRI Findings

MRI FINDING	PARTIAL SEIZURES	GENERALIZED SEIZURES
Normal findings	10	26
Abnormal findings	5	9
ICSOL	1	0
Cerebral atrophy	1	1
Corpus callosum agenesis	0	1
Unmyelination	0	1
Hydrocephalus	0	1
lissencephaly	0	1
Demyelinating in B/L coronal radiata	0	1
B/L basal ganglia necrotizing lesions	0	1
Hyperintensities	1	1
Focal cortical dysplasia	1	0

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Bulky left medial temporal lobe	1	0
leukodystrophy		1

Table. 9 MRI Abnormalities with Normal and Abnormal EEG

Types of seizures	Normal EEG		Generalizedspike and wave		Focal spikeand wave		hypsarrhythmia		total
	Normal MRI	Abnormal MRI	Normal MRI	Abnormal MRI	Normal MRI	Abnormal MRI	Normal MRI	Abnormal MRI	
Generalized seizures	4	2	21	7	0	0	1	0	35
Partial seizures	1	1	4	0	5	4	0	0	15
total	5	3	25	7	5	4	1	0	50

Patients with partial seizures with focal EEG changes, 55% had normal MRIbrain changes and 45% with abnormal MRI brain changes.

Table 10. MRI Brain Changes Comparision with EEG Changes

	Normal EEG		**Abnormal EEG**		**Total**
	Generalized seizures	**Partial seizures**	**Generalized seizures**	**Partial seizures**	
Normal MRI	4	1	22	9	36
Abnormal MRI	2	1	7	4	14
Total	6	2	29	13	50

Among children with generalized seizures with abnormal EEG, 25% had abnormal MRI brain. Among children with partial seizures with abnormal EEG, 30.7% had abnormal MRI brain changes. P value by Pearson chi square test is 0.602 which is statistically notsignificant.

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Chart No. 13 Normal EEG with MRI Brain Changes

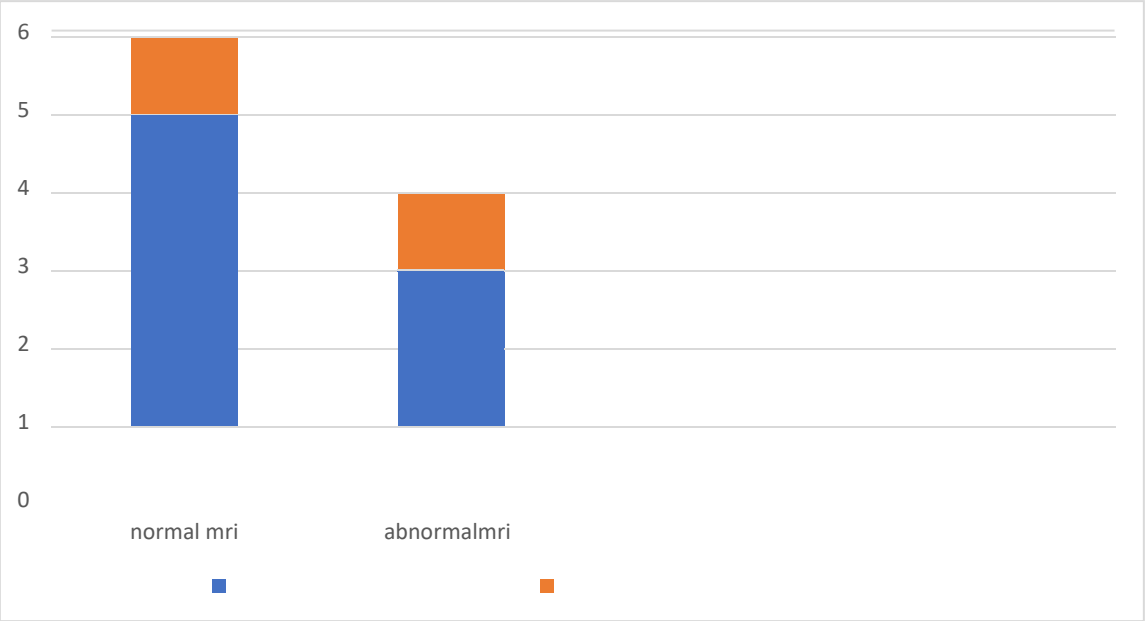
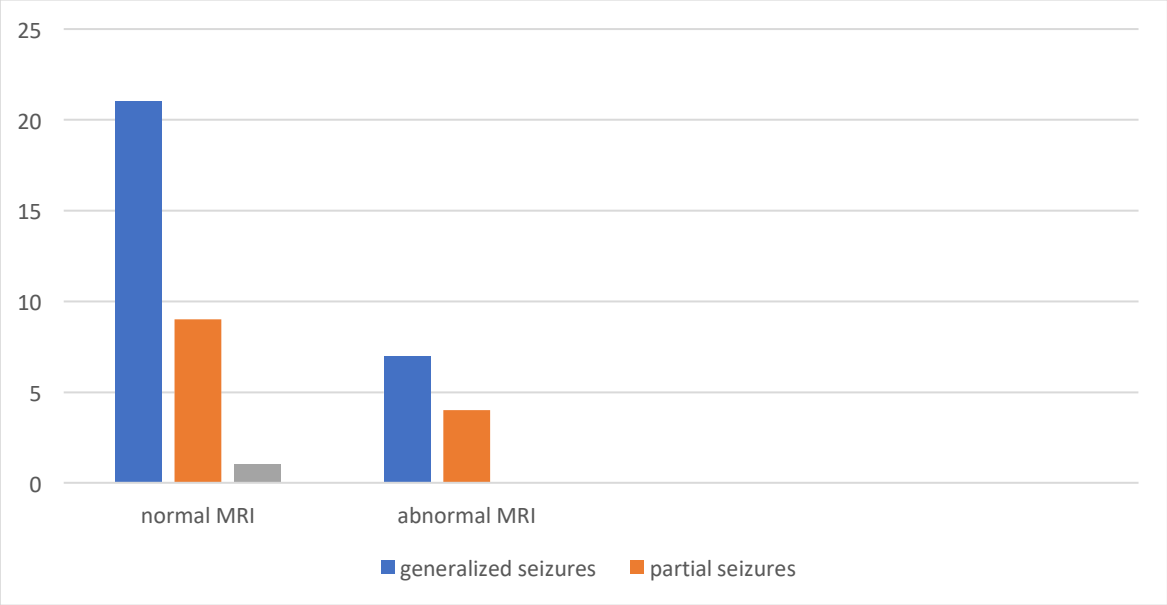


Chart No. 14 Abnormal EEG with MRI Brain Changes



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This is a hospital-based study to determine the incidence of children with first episode of afebrile seizure or newly diagnosed epilepsy in government general hospital, Kurnool. 50 children were included in this studywith an incidence of 6.7/1000 person years.

DISCUSSSION

A seizure or a convulsion is a sudden, paroxysmal, involuntary, time- limited alteration in behavior, motor activity, autonomic function, consciousness, or sensation that results from abnormal electrical activity in brain.

Seizures are the manifestation of abnormal hypersynchronous discharges of cortical neurons. About 10 % of children experience convulsion during the first five years.

Several times a child may present with condition that mimic seizures and misinterpreted as seizures. These include Breath holding Cough syncope, Narcolepsy, Night terror, Tics.

This study is to conduct to find out the sensitivity of MRI brain and EEG for the diagnosis of first episode of un provoked seizure when used in combination and to find out the incidence of un provoked seizures among pediatric admissions and find out the structural abnormalities compared to epilepsy.

EEG is a noninvasive, readily available and inexpensive investigation tool, helps in diagnosis of the event, identification of a specific syndrome, and prediction of long-term outcome. It also helps to differentiate a seizure from other events and predicts the risk for recurrence[17].
EEG done within 24 hours of the seizure is most likely to show background and epileptiform abnormalities.

MRI is the preferred method of imaging to avoid radiation exposure while providing more detailed diagnostic information
MRI (magnetic resonance imaging) is the diagnostic tool that identifies structural changes in the brain that may cause seizures or be associated with epilepsy.

After the first seizure, MRI can be used to identify any serious disorder that may have provoked the seizure, such as a brain tumor or arteriovenousmalformation (a blood vessel abnormality).

It can help determine the proper seizure type and syndrome.

Our study was conducted among 50 children in government general hospital, Kurnool admitted with seizures and found to had 35 children with generalized seizures (70%) 15 children with partial seizures (30%).

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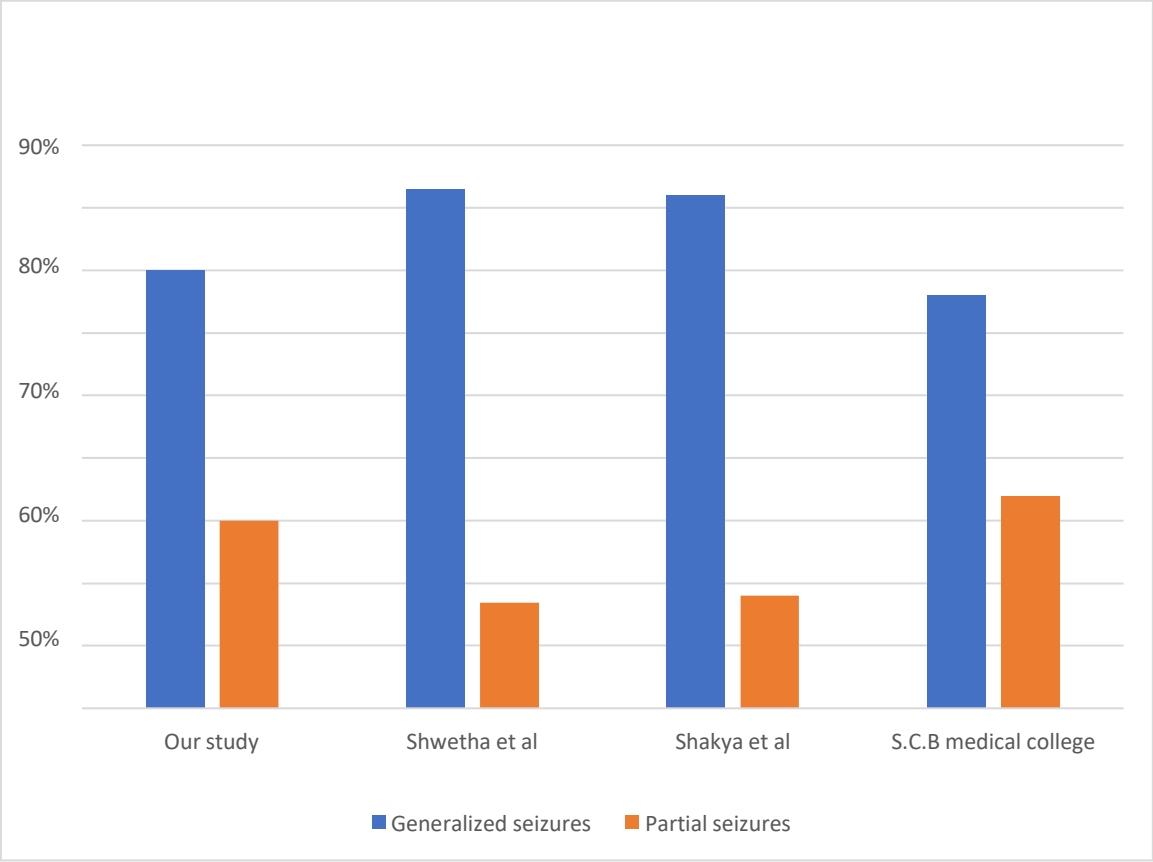
It is similar with study done in S.C.B medical college and hospital[21], Cuttackwith generalized seizures seen in 66% of children and partial seizures seenin 34%.

A study done by Das R, Mondal A, Islam MA, et al had generalized seizure was found in 27.5% children; followed by partial seizure in 26.2%; complex febrile seizure in 3.8%; and undetermined seizure in 1.2%. The difference may be due to age group criteria and sample size.

Table.11 Comparison of Seizures with Other Studies

S. No		Generalizedseizures	Partial seizures
1	Our study	70%	30%
2	Shwetha et al	83.1%	16.9%
3	Shakya et al	82%	18%
4	S.C.B medicalcollege study	66%	34%

Chart 15. This is the bar chart showing different studies with proportion ofgeneralized and partial seizures



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Age distribution: Our study was conducted among 50 children in government general hospital, kurnool admitted with unprovoked seizures between the age group 2 months to 6 years. A study done by Shwetha et al with first episode of unprovoked afebrileseizure between the age group 1 year to 15 years. Most of the children are less than 5 years.

A study done by Mohammed S, Elfeshawy in the scientific journal of Al-Azhar medical faculty, girls studied in children age group between 6months to 12 years, with most of the children are between 1 to 8 years.

A study done by Das R, Mondal A, Islam MA et al with first onset unprovoked seizure in the age group 6months to 12 years attending OPD and IPD in Burdwan medical college with most of the children are between the age group 6 years to 12 years.

A study done by Annie. T. Berg et al[22], a community-based study including 613 patients in the age group between 1 month to 15-year age group with most common age group was less than 10 years

A study done by Kumar et al[23,] in Lucknow including 162 children aged 1 month to 12 years with most common age group is more than 4 years.

Table.12 Age Distribution Comparison with OtherStudies

S.No	Study	Age group	Most common age group
1	Our study	2months - 6 years	Less than 1 year
2	Shwetha et al	1year - 15 years	Less than 5 years
3	MohammedS, Elfeshawy et al	6 months to 12 years	1year to 8 years
4	Das R, Mondal A, Islam MA et al	6 months to 12 years	6 years to 12 years
5	Annie. T. Berg et al	1 month to 15 years	Less than 10 years
6	Kumar et al	1 month to 12 years	More than 4 years

Generalized seizures are mostly seen in age < 1 year which is around 60%. Partial seizures are seen in less than < 1 year which is almost similarto age group > 1year. A study done by Gollapalli, Sidhartha Kiran, et al. shows maximumchildren with age group 3- 10 yrs.

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A study done by Shlome Shinnar et al in 347 children with most common age group of children are above 3 years.

Ramesh Baheti, et al., 6 did a study in western Rajasthan including 52 children with seizure disorder. 26 of them had partial seizures and the rest 26 of them had generalized seizures, with the most common age group is less than 1 year.

Gulati P et al[24] did a study including 170 children of seizures with maximum number of patients were between 6-12 years, males outnumbering females.

SEX distribution:

In our study, most of the children are male with the ratio of male to female is 1.5 **:**1, with 68% of the generalized seizures are seen in males andthe ratio of male to female in partial seizures is 2**:** 1. So, this study has mostlymales been affected.

This distribution almost similar to Gollapalli, Sidhartha Kiran, et al. withratio of male to female is 1.8 :1. A study done by Shwetha et al had ratio of male to female is 1.3 :1.A study done by Hussain Jageer et al varies with this study with male to female ratio 0.9 to 1. A study done by Zajac A et al studied in 140 children with male to female ratio is 1:1. A study done Gulati p et al[24], shows that male to female ratio is 1.4 :1.

Tabl.13: Sex Distribution Comparision with Other Studies

S. No	Study	Sex distribution
1	Gollapalli, Sidhartha Kiran, et al	1.8:1
2	Zajac A et al	1:1
3	Shwetha et al	1.3: 1
4	Hussain Jageer et al	0.9:1
5	Gulati p et al	1.4:1
6	Our study	1.5:1

Neuroimaging: Neuroimaging can also be useful adjunctive tool in evaluation of a firstepisode of afebrile seizure but its role in pediatric patients with first episode of unprovoked seizure is still a controversy. MRI is more sensitive than CT and is the modality of choice when indicated.

Meta analytic studies done have shown that neuroimaging abnormalities are found in 30 % of children. Emergency neuroimaging should be performed in a child with first afebrile seizure to look for intracranial pathologies needing immediate intervention.

In this study, brain atrophic changes were the most common neuroimaging abnormality. Other lesions include lissencephaly, ventriculomegaly, corpus callosum dysgenesis, demyelination, focal cortical dysplasia, leukodystrophy.

In our study MRI scan is done in children admitted with first episode of un provoked seizure and it shows

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28% of the children have MRI brain abnormalities. Among the children with generalized seizures shows abnormality of MRI brain in 26.4%. Children with partial seizures shows MRI abnormality in 33.4%.
This study shows MRI brain abnormality is more common in partial seizures than generalized seizures but there is no significant difference between MRI abnormalities between partial and generalized seizures.

According to the study done by Gollapalli, Sidhartha Kiran, et al, CT scan shows the most frequent abnormality was solitary tuberculoma .and most CT abnormalities are seen in partial seizures which is about 74%children. In generalized seizures CT scan abnormalities was seenaround 41% children.

A study done in S.C. B Medical college & Hospital, Cuttack. CT scan was found to be abnormal in 70.6% of patients with Focal Seizures & 24.2%patients of Generalized respectively. Most common abnormalities observed in Focal seizures group were ring/ disc lesions (33.3%), Whereas among patients with generalized seizures, the Commonest finding was cerebral atrophy (6%).

A study done by Hussain jageer[25] et al done computed tomography in children with first episode of afebrile seizures and scan abnormalities found in 68% of children. most of the children had single ring enhancing lesion.
Ramesh Baheti et al done CT scan and found 50% of the children with partial seizures and 34.6% of the children with generalized seizure have CTscan abnormalities.

According to study done by Das R, Mondal A, Islam MA, et al abnormal MRI was found in 75%of the children with first episode seizures, among them 40% children were of generalized seizure,27.5% of the children are partial seizures, followed by 5.6% and 1.9% cases of complex febrile seizure and undetermined seizure respectively. Among 40 patients who showed normal MRI findings, 11.3% cases were of generalized seizure, 6.2% children were of partial seizure followed by 5.6% of children and 1.9% children of complex febrile seizure and undetermined seizure respectively.

EEG

EEG is a useful electrophysiological investigation for evaluating a paroxysmal event in children. It measures the electro potential difference between two points on the scalp. It is a non-invasive tool that analyzes neuronal maturation and abnormal cortical excitability.

EEG helps in differentiating epileptic from non-epileptic clinical event and focal seizures from generalized seizure.

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In our study EEG was done 50 children of first episode of unprovoked seizures. Among them 82% children had EEG abnormality.79.2% of the generalized seizures and 86% of the partial seizures had EEG abnormalities.EEG had 18% had focal changes and 62% had generalized changes.

A study done by Gollapalli, Sidhartha Kiran, et al, shows Among the patients with abnormal EEG, features suggestive of generalized seizure disorder was present in 60.94%. One hemisphere slowing suggestive of underlying focus is present in 39.06%. EEG abnormalities were found in 50% of cases of generalized seizures and 74% of cases of partial seizures.

According to the S.C.B Medical college & Hospital, Cuttack, nearly 64.8% of patients with Focal seizures and 21.2% of generalized seizures were having abnormal EEG. Sharp wave and spikes or slow waves were themost common findings observed in both the seizure groups.

MRI AND EEG

In our study 50 children with first episode of un provoked seizures were subjected to MRI brain, EEG and correlation has been seen. Children with normal EEG and normal MRI is seen in 10 %. normal EEG and abnormal MRI is seen in 6% of children. children with abnormal EEG with normal MRI seen in 62 % of children and abnormal EEG with abnormal MRI is seen in 22% of children

A study done by Gollapalli, Sidhartha Kiran, et al. found both CT and EEG were abnormal in 21.82%. which was consistent with our study.

According to study in S.C.B Medical college & Hospital, Cuttack children with normal EEG, 11.7% patients with Focal seizure, and 60.6% patients with Generalized seizure were having normal CT scan, while among patients with abnormal EEG, 41% of patients with Focal seizure and 12% patients of generalized seizure were having abnormal CT scan.

A study done by Misra S et al found that cranial CT scan was abnormal in 70% of the cases of seizure disorder.

A study done by Ramesh Baheti, In case of generalized seizure with focal EEG abnormality, 37.5% had abnormal neuroimaging findings. Whereas partial seizure with focal EEG abnormality, 83.3% had abnormal neuroimaging findings. In case of generalized seizure with generalized EEG abnormality, 15.6% had abnormal Neuroimaging findings where as in partial seizure with generalized EEG abnormality, 20% had abnormal Neuroimaging findings. In case of generalized seizure with normal EEG, 7.1% had abnormal neuroimaging findings. In case of partial seizure with normal EEG, 33.3% had abnormal neuroimaging finding.

CONCLUSION

Higher incidence of neuroimaging abnormality is seen with partial seizures with abnormal Electroencephalogram. There is higher correlation between neuroimaging abnormality and focal Electroencephalogram changes in partial seizures when compared to generalized seizures.

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Electroencephalogram and Neuroimaging are strongly recommended in evaluating Children with afebrile seizures.

LIMITATIONS

- This study is done in a small group from one geographical area whichcannot be generalized
- Children less than 2 months and more than 6 years were not includedin this study.
- This study did not include long term follow up to neuro development outcome.

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