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Neuro radio logic diagnostic evaluation of partial seizure in children's

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ABSTRACT

Background: Seizures are characterized by abnormally excessive or synchronized neuronal activity in the brain. The purpose of the current study is to study etiology of partial seizure. To identify significant role of neuroimaging & EEG.

Materials and Methods: A cross sectional study involving a total 100 patients are recruited between 2-12 years. All the children aged 2 year to 12 years of age with partial seizures will undergo neuro imaging, plain and contrast (contrast where indicated).

Results: Out of 100 childrens 68% of the partial seizures in the age group 2 to 12 years occurred in younger children of 2-6 Years, while only 32% of the seizures occurred in 6 – 12 years of age group.. Among them, 75% of the cases revealed an identifiable cause in the CT brain and 63% of the cases showed abnormal EEG. Among the 75% with abnormal CT brain, 58 cases are identified as Neuroinfections, neurocysticercosis in 32 cases, Tuberculoma in 26 cases, 5 cases had infarct, 4 had Calcifications, 3 had Hydrocephalus, 2 had subdural effusion, 2 had AV malformations, 1 had brain tumour.

Conclusion; Thus, partial seizures are the most prevalent neurological disorder in children, having a significant social and economic impact on developing country.. Frequently, even relatively benign, episodic spells are mistaken as seizures and even treated as such. Therefore, proper diagnosis and therapy should be emphasized more.

1. Introduction

As per international league against epilepsy {ILAE 1989} all epilepsy cases are classified into two categories: - Partial seizures and Generalized seizures [commission on classification and terminology of ILAE 1989].[1]

Partial seizures account for about 40% of childhood seizures. Partial seizures may be classified as simple or complex. Consciousness is maintained in simple partial seizures whereas impaired in complex partial seizures (CPS). CPS could have a simple partial onset followed by impaired consciousness with automatisms or with impairment of consciousness at onset with automatisms. Idiopathic epilepsy can be identified by considering the age, functional development level of child, clinical features of seizures and interictal EEG (Electroencephalography). If clinical features and EEG findings are not consistent with known idiopathic disorder MRI (Magnetic Resonance Imaging) scanning is indicated to delineate the etiology.

The incidence of epilepsy has been reported to range from 0.8 to 1.1% (Agarwal et al 1998) and approximately 50% of all cases of epilepsy start in childhood.[1] 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

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adults with refractory epilepsy where malformations of cortical development have been implicated in about 25% of such cases.

Localization related epilepsy is set 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 CPS.

A seizure is a transient occurrence of signs and or symptoms resulting from abnormal excessive (or) synchronous neuronal activity in the brain.

The international classification of epilepsy (ILAE) seizures divides focal seizures into two large categories.

1. Focal seizures without impairment of consciousness (simple partial – old term).
2. Focal seizures with impairment of consciousness also called focal dyscognitive seizures (CPS – old term).
3. Simple and complex partial seizures can each occur in isolation. One can temporarily lead to other (usually simple to complex) or each can progress into secondary generalized seizures (Tonic, Clonic, Atonic or most often Tonic – Clonic).

1.1. Focal seizures without impairment of consciousness

These can take the form of sensory seizures (Auras) or brief motor seizures. Brief motor seizures are the most common.

Often there is a Jacksonian march from face to arm to leg, adverse head and eye movements to the contralateral side.

Post ictal Todd paralysis that can last min (or) hours (or) sometimes longer.

1.2. Focal seizures with impairment of consciousness

These seizures usually last for 2 min and are often preceded by an Aura such as rising abdominal feeling, Deja vu, Deja vecu, a sense of fear, complex visual hallucinations, micropsia (or) macropsia (temporal lobe) generalized difficulty to characterize sensations (frontal lobe), focal sensations (parietal lobe) (or) simple visual experiences (occipital lobe) subsequent manifestations consist of decreased responsiveness, staring looking around seemingly purposelessly and automatisms.

Automatisms are automatic semi purposeful movements of mouth (oral, alimentary such as chewing) or of the extremities (manual such as manipulating the sheets) leg automatisms like shuffling, walking others consist of altered consciousness with at contralateral motor usually clonic manifestations. After the seizure, the patient can have post ictal automatisms, sleepless and or other transient focal deficits, such as weakness (Todd's paralysis) or aphasia.

1.3. Secondary generalized seizures

Secondary generalized seizures can start with a generalized clinical phenomenon (from rapid spread of discharge from the initial focus) as a simple (or) complex partial seizures with subsequent clinical generalization. There is often adverse eye and head deviation to the side contralateral to the side of seizure focus, followed by generalized tonic-clonic (or) tonic – clonic activity.

EEG in patients with focal (or) partial seizures usually shows focal spikes (or) sharp waves in the lobe where seizure originates. A sleep deprived EEG with recording during sleep increases the diagnostic yield. Approximately 15% of children initially have normal EEG because discharges are relatively frequent (or) the focus is deep. If repeating the test does not detect paroxysmal findings then longer readings in the laboratory done are using ambulatory EEG (or) even impatient 24 hours video EEG monitoring may be helpful.

Brain imaging is critical in patients with focal seizures. In general MRI is preferable to CT, which misses subtle but occasionally potentially clinically significant lesions. MRI can show pathology such as changes as a result of previous strokes (or) hypoxic injury, malformations, medial temporal sclerosis, arterio-venous malformations, inflammatory pathologies (or) tumors.

1.4. Incidence and prevalence

1. Focal seizures account for 40% of childhood seizures.[2]
2. CT abnormalities are seen in 50-70% of cases of simple partial seizures. CT abnormalities are less frequently seen in complex partial seizures.
3. CT brain most often detects a hypodense lesion on plain scan with ring (or) disc like enhancement on contrast scan.

1.5. Computed tomography (CT) scanning

CT scans are created using a series of x-rays, which are a form of radiation on the electromagnetic spectrum. The scanner exits X-rays towards the patient from a variety of angles and the detectors in the scanner measure the difference between the X-rays that are absorbed by the body, and X-rays that are transmitted through the body. This is called attenuation.

The amount of attenuation is determined by the density of the imaged tissue, and they are individually assigned a Hounsfield unit or CT number.

High density tissue (such as bone) absorbs the radiation to a greater degree and a reduced amount is detected by the scanner on the opposite side of the body.

Low density tissue (such as the lungs), absorbs the radiation to a lesser degree, and there is a greater signal detected by the scanner.

The three dimensional data is viewable on a two dimensional monitor by acquiring projections from different angles and through a process known as reconstruction contrast imaging.

Depending on the structure being imaged, CT Scans can be used with and/or without contrast. The introduction of an intravenous radio fluorescent contract into the bold stream can be used for a variety of diagnostic purposes.

1.6. Interpretation

Tissues with a high Hounsfield score have a high attenuation coefficient and so appear white.

Media	**Hounsfield value**
Air	-1000
Fat	-70
Water	0
Blood	70
Bone	1000

Children with partial motor seizures have high probability of abnormal CT brain findings especially neuro infections which are potentially treatable. Therefore CT brain should be carried out 50% partial seizures show normal CT scan, remaining 50% of partial seizures show following etiology.

Abnormal ct scan	**13 (50%)**
a) Cerebral edema	-
b) Tuberculoma	1 (3.8%)
c) Calcification	6 (23.07)
d) Cerebral atrophy	2 (7.6%)
e) Hydrocephalus	-
f) Subdural effusion	2 (7.6%)
g) Hypodense hypoplasia	1 (3.8%)
h) Hypoplasia of thalamus	1 (3.8%)
i) Infarction of basal ganglion	1 (3.8%)
J) Neurocysticercosis	1 (3.8%)

1.7. MRI (Magnetic resonance imaging)

1. Alignment of the protons in the body with the large magnetic field of the MRI scanner. After a few seconds in the scanner the protons in the patient are aligned with the magnetic field.
2. A radio frequency (RF) pulse is used to tip the protons out of alignment with the scanner's magnetic field.
3. Once out of alignment the magnetic moment of the hydrogen protons can be measured as they rotate past measurement coils (loops of wire) including an electrical current.
4. The protons are pulled back into alignment with the main magnetic field decreasing the measurable signal. The rate at which this occurs determines the T1 properties of a tissue. If the protons in a tissue return to alignment faster than all other tissues then this tissue will be brightest on a T1-weighted scan.
5. While rotating the protons gradually become out of phase with one another decreasing the measurable signal. The rate at which this dephasing occurs determines the T2 properties of a tissue. If the protons in a tissue remain in phase with one another longer than all other tissue.
6. A proton density (PD) scan minimizes both T1 and T2 contrast to produce an image in which brightness is determined by the number of protons in a voxel.

1.8. EEG (Electro encephalogram)

Electroencephalogram (EEG) is an Electrophysiological monitoring method to record electrical activity of the brain. It is typically noninvasive, with the electrodes placed along the scalp, although invasive electrodes are sometimes used such as in electrocorticography. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. In clinical contexts EEG refers to the recording of the brain's spontaneous electrical activity over a period of time, as recorded from multiple electrodes placed on the scalp. Diagnostic applications generally focus either on event related potentials or on the spectral content of EEG. The former investigates potential fluctuations time locked to an event like stimulus onset or button press. The latter analyses the type of neural oscillations (popularly called "brain waves") that can be observed in EEG signals in the frequency domain.

1.9. Etiology of partial seizures

1. Idiopathic (normal CT scan)
2. Ring enhancing lesions
   (a) Neuro cysticercosis
   (b) Tuberculoma
   (c) Cortical infarct
3. Brain tumor
4. Gliosis
5. Calcification
6. Cerebral atrophy
7. Hydrocephalus
8. Subdural effusion
9. Encephalomalacia
10. Porencephalic cyst
11. Hypoplasia of thalamus
12. Infarction of Basal ganglion
13. Benign epilepsy syndromes with focal seizures
14. Severe epilepsy syndromes with focal seizures

1) A study named "Role of EEG and CT Scan in partial seizures in children" by Role of EEG and CT scan in partial seizures in children (Neeraj Jain) and Vibha Mangal

at Himalayan Institute of Medical Sciences, Jolly Grant, Dehradun, and India.[1] A prospective study over a 5 year period between January 2004, December 2009, in the department of pediatrics HIHT, Ritikesh city 172 children with partial seizures defined a per ILAE. All these children had 2 or more than 2 attacks of unprovoked partial seizures.

Children with neonatal convulsions, febrile convulsions and acute CNS infections were excluded. Both old and new patients attending the clinic were included. All patients were clinically examined and underwent one interictal EEG and CT scan after clinical evaluation and were diagnosed.

2. Aims and Objectives

1. To study etiology of partial seizure.
2. To identify significant role of neuroimaging & EEG.

3. Materials and Methods

3.1. Source of data

All children admitted in neurology ward of Kamineni Academy of Medical Sciences aged 2 Year to 12 Years of age with features of partial seizures.

3.2. Method of collection of data

All the children aged 2 year to 12 years of age with partial seizures will undergo neuro imaging, plain and contrast (contrast where indicated).

3.3. Inclusion criteria

All children with partial seizures aged 2 years to 12 years with available consent.

3.4. Exclusion criteria

1. All children with developmental delay, cerebral palsy and mental retardation.
2. All children with seizures following head injury, neurocutaneous syndromes.

3.5. Study design

Hospital based cross sectional study.

3.6. Sample size

100 Cases.

3.7. Duration of study

1 Year.

3.8. Study population

A consecutive 158 children of 2-12 years of age who presented to the emergency department (ED) of pediatrics with features of partial seizures during the study period were included in the present study. Ethical clearance has been obtained from Kamineni Academy of Medical Sciences.

3.9. Methodology

During the study period, a total of 158 young children between 2 to 12 years of age were brought consecutively to the Kamineni Academy of Medical Sciences for the complaints of partial seizures. After applying exclusion criteria, 100 children fulfilled the inclusion criteria and were taken as group study. In these children, a complete history was taken upon hospitalization, initial management was done to stabilize the child and then a physical examination was performed by the duty resident in charge giving special attention to following factors: age, gender, type of seizure, any secondary generalization, side of the seizure, associated aura and automatisms, post ictal Todd's palsy, signs of raised intracranial pressure such as headache, vomiting, visual disturbances, cranial nerve palsies. Abnormal fundus examination.

In collaboration with Biochemistry, Pathology, microbiology and Radiology, laboratory and neuro imaging studies including Complete Blood Picture (CBP), Random Blood Sugar, Mantoux, Chest X-Ray, Renal function tests, Liver function tests, Cerebrospinal fluid analysis, Erythrocyte Sedimentation Rate (ESR), EEG (Electroencephalogram), Computerized Tomography of Brain, were done in all the patients. Due to lack of affordability of many patients, MRI brain was done only in few patients whose CT brain did not reveal any etiology.

3.10. Details of the procedure

3.10.1. EEG

EEG was done using 24-channel RMS machine.

It took about 15-30 minutes to record the EEG in children.

In younger children only photic stimulation is done. Older children, hyperventilation sleep recording was also done.

The neurologist interprets EEG recordings.

None of the patient in study group had video EEG recording.

4. Observations and Results

EEG & CT brain was done in all the 100 cases, but MRI was done only in 10 cases, due to the unaffordability of most of the patients. MRI brain was reserved only for those cases whose CT brain & EEG did not reveal any etiology.

4.1. Abnormal clinical findings

Of the children who presented with partial seizures, abnormal clinical findings were found on examination in

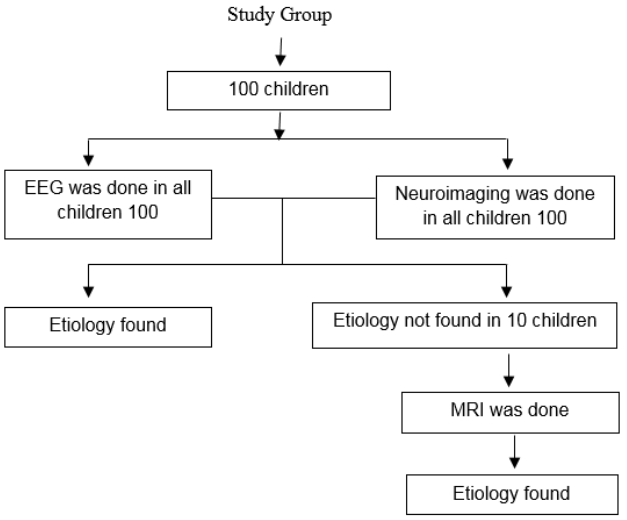

Fig. 1:

Table 1: Age distribution of partial seizures in the study group

Age	2 – 6 Years	6-12 Years
No. of children with partial seizures	68	32

Table 2: Sex distribution of partial seizures in the study group

Sex	Female	Male
No. of children with partial seizures	37	63

Table 3: Types of seizure

Type of seizure	Simple partial seizures	Complex partial seizures	Partial seizure with secondary generalization
No. of children	13	66	21

Table 4: Side of the Focal Seizure

Side of the focal seizure	Right side	Left side
No. of children	54	46

few children. They include Todd's paralysis (post ictal paralysis of the involved limbs), meningeal sings (Kernig's sign, Brudzinskis sign and nuchal rigidity), cranial nerve palsies, and abnormal fundus (papilloedema scolex)

Table 5: Number of children withabnormal clinical findings

S.No	Abnormal clinical findings	No. of children
1	Todd's palsy	13
2	Meningeal signs	4
3	Cranial nerve palsies	1
4	Abnormal fundus	6

When observed the neuroinfections that is Neurocysticercosis and Tuberculoma contributed 58% of the total cases with partial seizures i.e., 77% of the total abnormal CT brain, Hence neuroinfections are the most important causes of partial seizures noticed in our study.

Table 6: Number of childrennormal & abnormal EEG, CT

Findings	No. of Patients EEG	No. of Patients CT
Normal	37	25
Abnormal	63	75

Table 7: Age wise distribution ofabnormal EEG, CT

Age	Abnormal EEG	CT
2-6 Years	44(69.8%)	51(68%)
6-12 Years	19(30.1%)	24(32%)

Table 8: CT and EEG correlations

Findings	Abnormal EEG	Normal EEG
Abnormal CT brain	60 (80%)	15 (20%)
Normal CT brain	3(5%)	22(59%)

Table 9: CT brain abnormalities detected in the children with partial seizures:

S.No.	Abnormality	Percentage
1	Neurocysticercosis	32
2	Tuberculoma	26
3	Infarct	5
4	Arterio-venous malformation	2
5	Brain tumor	1
6	Calcifications	4
7	Subdural effusion	2
8	Hydrocephalus	3

Table 10: Abnormal EEG & CT Brain among neuro infections and other groups

Etiology	Both abnormal EEG & abnormal CT brain	Only abnormal CT brain
Neuroinfections	50	8
Others	10	7

Chi Square $x^2 = 6.16$
P = 0.013 (Significant)
P Value < 0 05 is significant

Hence neuroinfections are the most identified cause of partial seizures with abnormal EEG and CT brain in our study contributing to 58% of the cases with statistical significance with 'p' value of 0.013.

Of the 25 children with normal CT brain, MRI was done in 10 children whose parents were affordable. MRI brain was normal in these 10 children.

5. Discussion

Partial seizures / focal seizures are a common emergency among the pediatric emergencies. Partial seizures in

children represent a large percentage of epilepsy requiring an accurate diagnosis for appropriate management. CT scan of brain can effectively and easily diagnose and quantify cerebro-organic disturbance.

Abnormal findings on CT scan of brain gives an idea about the degree of cerebral involvement. EEG is also useful in classifying the seizure, on etiology, guiding the clinical management as well as provides evidence of localization when surgery is planned. Though MRI is the preferred imaging technique, accessibility and affordability of imaging modality is often a major determinant wherein CT scan is more widely available and affordable technique. CT scan involves radiation exposure, while MRI involves the risk of sedation in most infants. The International League against Epilepsy (ILAE) guidelines for neuroimaging studies suggest that a CT can be the diagnostic imaging of choice in patients with epilepsy if an MRI is not available[3]

In number of studies in developing countries, it was shown that in children with localisation related epilepsy when scanned, the prevalence of structural abnormalities was high. More than half of all scans were abnormal.[1,2,4,5] Several studies of patients with focal epilepsy studied by CT have been reported in the Western literature. None of these have described the ring (or) disc enhancing hypodense lesion, though the rate of positive findings is similar to ours. In contrast to this observation, most of the studies in India revealed that neuroinfections were the commonest cause.[5–10]

Hence to attain at a conclusion, this study was conducted to study the etiology of partial seizures and the significant role of radio neuroimaging in identifying these causes. Most of the causes of partial seizures are structural abnormalities which could be corrected either medically (or) surgically which reveals the importance of the study undertaken in the Department of neurology Kamineni Academy of Medical Sciences.

During the study Period, a total of 158 children were brought to the Pediatric Department of this institution. These children, 100 cases were included in the study, considering the age group between 2 to 12 years and excluding developmental delay, mental retardation, cerebral palsy and head injury. Among them, 75% of the cases revealed an identifiable cause in the CT brain and 63% of the cases showed abnormal EEG. Among the 75% with abnormal CT brain, 58 cases are identified as Neuroinfections, neurocysticercosis in 32 cases, Tuberculoma in twenty six cases, five cases had infarct, four had Calcifications, three had Hydrocephalus, two had subdural effusion, two had AV malformations, one had brain tumour.

Incidence of overall abnormal neuroimaging (75%) was similar to those study of Role of EEG and CT scan in partial seizures in children(Neeraj Jain)& Vibha Mangal study[1] named "Role of EEG and CT Scan in partial seizures in children" (70%), Clinco-diagnostic and therapeutic relevance of computed tomography scan of brain in children with partial seizures -Nehal H. Patel[4] (68%), A study of CT and EEG findings in patients with Generalized or Partial seizures in Western Rajasthan, Ramesh Baheti[5] (50%), Focal Epilepsy in India with special reference to lesions showing ring or disc like enhancement on contrast CT -RS Wadia[8] (68%), Abnormal EEG in our study is seen in 63% of patients which was similar to those of Neeraj Jain[1] (73%), Severe idiopathic generalized epilepsy of infancy. Neuropediatric-, Doose et al[11] (81%), A study of CT and EEG findings in patients with Generalized or Partial seizures in Western Rajasthan -Ramesh Baheti (73%).[5]

Among the abnormal neuroimaging, ring enhancing lesion were the most common cause. Ring enhancing lesion is defined as peripheral thin rim of enhancement with central hypo density and disc enhancing lesion is defined as uniform enhancing lesion in entirety. Radiologists' opinions is obtained in all cases. Differentiating solitary small cysticercosis granulomas and Tuberculoma in patients with epilepsy (Vedantham Rajasekhar)'s criteria[2] for Neurocysticercosis is utilized.

Table 11: Percentage of abnormal EEG among various studies

S.No.	studies	Abnormal EEG
1	Role of EEG and CT Scan in partial seizures in children, Neeraj Jain[1]	73%
2	A study of CT and EEG findings in patients with Generalized or Partial seizures in Western Rajasthan, Ramesh Baheti[5]	73%
3	Etiological spectrum of symptomatic localization related epilepsies, a study from south India JMK Murthy[6]	73%
4	Magnetic resonance imaging in childhood intractable partial epilepsies. Pathologic correlations Kuzniecky[7]	84%
5	Focal Epilepsy in India with special reference to lesions showing ring or disc like enhancement on contrast CT RS. Wadia[8]	50%
6	Neuroradiologicdiagnostic evaluation of partial seizure in children Present Study	63%

Percentage of children with abnormal EEG and abnormal CT Brain in partial seizures in different study groups

Of the total 100 cases in our study aged between 2 to 12 years, 68 children belonged to the age between 2 – 6 years, 32 children belonged to the age between 6 – 12 years, the ratio being 2.1: 1. Among these males were 63, females were 37, the ratio being 1.7: 1. Showing a higher male

Table 12: Percentage of abnormal CT brain among various studies

S.No	studies	Abnormal CT brain
1	Role of EEG and CT Scan in partial seizures in children ,Neeraj Jain [1]	62%
2	Clinco-diagnostic and therapeutic relevance of computed tomography scan of brain in children with partial seizures Nehal H. Patel [4]	78%
3	A study of CT and EEG findings in patients with Generalized or Partial seizures in Western Rajasthan ,Ramesh Baheti [5]	50%
4	Focal Epilepsy in India with special reference to lesions showing ring or disc like enhancement on contrast CT, RS. Wadia [8]	68%
5	Etiological spectrum of symptomatic localization related epilepsies, a study from south India ,JMK Murthy [6]	67.5%
6	CT in simple partial seizures in children: a clinical and computed tomography study ,K.P.S. Nair [12]	59.09%
7	Focal electroencephalographic abnormalities and computerized tomography findings in children with seizures J. Gibbs [13]	26%
8	Neuroradiologicdiagnostic evaluation of partial seizure in childrens Present Study	75%

Table 13: Percentage of neurocysticercosis, neurotuberculomas among neuroinfections various group

S.No	Study Name	Neurocysticercosis %	Neurotuberculoma %
1	Role of EEG and CT scan in partial seizures in children Neeraj Jain [1]	28	21
2	Differentiating solitary small cysticercous granulomas and Tuberculomas in patients with epilepsy ,Vedantam Rajasekhar [14]	80	20
3	Clinco-diagnostic and therapeutic relevance of computed tomography scan of brain in children with partial seizures, Nehal H. Patel [4]	9.6	38
4	Etiological spectrum of symptomatic localization related epilepsies, a study from south India, JMK. Murthy [6]	40	10
5	Focal Epilepsy in India with special reference to lesions showing ring or disc like enhancement on contrast CT RS. Wadia [8]	9	16.6
6	Neuroradiologicdiagnostic evaluation of partial seizure in childrens Present Study	32	26

predominance and the significant age group is between 2 – 6 years (or) less than 6 Years.

This study also sought to identify the underlying causes of partial seizures in all 100 children. Neuroinfections (58%) among the 100 were the most common etiology, they constituted (77%) of the abnormal CT brain. Among these, neurocysticercosis had the highest incidence (32%), followed by Neurotuberculoma (26%). Infarct was seen in (5%), calcifications (4%). Hydrocephalus (3%), Arterio venous (AV) malformations (2%), subdural effusion (2%), Brain tumor (1%). These observations were compared with those in other studies.

The present study showed similar results to that of Role of EEG and CT scan in partial seizures in children (Neeraj Jain) study.

The side of the seizure were considered in the study. Right sided seizures were (54%) when compared to left sided seizures (46%) the ratio being 1.17: 1, which is of no importance, detecting lesions almost equally on both sides.

Of the 100 children with partial seizures, complex partial seizures constituted the largest group (66%) ie. focal seizures loss associated with loss of consciousness, establishing the most common type of partial seizures. This was followed by partial seizures with secondary generalisation (21%) which shows that the high frequency waves from a focal lesion can spread to the cerebral hemispheres in a relatively more children causing secondary generalised seizure. The least common among these is the simple partial seizures (13%) which shows that most of the partial seizures are associated with loss of consciousness. These findings are similar to the study of Neeraj jain.

Both the studies showed that complex partial seizures are the most common type of partial seizures.

This study compares the incidence of neuroinfections in different parts of the world. When the studies conducted in India are compared with those of the Western countries, India and other developing countries showed more incidence of neuroinfections as the cause of partial seizures. The probable cause for this incidence may be

Table 14: Comparision of the type of seizures:

S.No.	studies	Complex partial seizure	Partial seizures with secondary generalisation
1	Role of EEG and CT scan in partial seizures in children Neeraj Jain [1]	55%	22.67%
2	Neuroradiologicdiagnostic evaluation of partial seizure in childrens Present Study	66%	21%

due to the poor economy, poor hygiene, and overcrowding, poor education. Hence the management of a case of partial seizures is entirely different in the developing countries, when compared to developed countries.

Table 15: Comparision of incidence of neuroinfections in different countries

S.No	studies	Neuroinfections %	Others %
1	Role of EEG and CT scan in partial seizures in children(Neeraj Jain)(India) [1]	88	12
2	Neuroimaging of children with partial seizures. (Kramer) [9]	5	95
3	Neuroradiology diagnostic evaluation of partial seizure in childrens Present Study	77	23

Hence the percentage of neuroinfections as the cause of partial seizures is 70 to 80% in developing countries due to the poor socioeconomic status and high rates of illiteracy with overcrowding as the probable etiology.

When the statistical significance is taken into consideration, neuroinfections which contributed to 77% of the total abnormal CT brains were detected by both EEG and CT brain in 50 cases (83%), only CT brain in 8 cases (13.7%), when the abnormal radio neuroimaging was compared in both the groups that is neuroinfections and others the X^2 is 6.16 and the 'p' value is 0.013 which is significant. A 'p' value of < 0.05 is considered significant.

Abnormal clinical findings are found in many children after examining the children in the general ward. Those findings in this study were found in 24% of the children the most common abnormal clinical finding being Todd's palsy which is weakness of the limbs involved in the seizure activity following the seizure. This finding was seen in 13 children which lasted for few hours to few days. Todd's palsy constituted 54% of the total abnormal clinical findings. The weakness improved spontaneously in all children.

Meningeal signs namely Kernig's Sign, Brudzinskis sign and nuchal rigidity are seen in 4 children (16.6%) of the total abnormal clinical findings. Meningeal signs are due to irritation of the nerve roots in the cervical spine. Meningeal signs are seen in meningitis which could be viral, bacterial, and fungal. Hence meningitis especially in younger children could produce partial seizures. Lumbar puncture was done in all the children with meningeal signs due to suspicion of meningitis. CSF findings revealed leukocytosis in most of the cases with meningitis. The CT brain in these cases showed subdural effusion, infarct, and hydrocephalus as the probable etiology for partial seizures. EEG could detect most of the focal seizures.

Abnormal fundus examination was seen in 6 cases constituting (25%) of the total abnormal clinical findings. The abnormal fundus included intrafundal scolex in 2 children with neurocysticercosis. The other 4 children had papilloedema probably to intracranial space occupying lesions such as brain tumor (or) raised intracranial pressure due to mass effects of Tuberculoma (or) chronic hydrocephalus which occurred due to meningitis or other causes.

Cranial nerve palsies were seen in 1 child (4%) of the children which was a child with meningitis. The observed cranial nerve palsy was 6^{th} nerve (abduscens nerve) which is the most common nerve to be involved in raised intracranial tension.

Abnormal clinical examination provides a clue to the etiology of partial seizures, hence every child with partial seizures should be examined for focal deficits, meningeal signs. Those children with abnormal clinical findings had also more incidence of abnormal CT and EEG findings revealing their importance. All the children with abnormal clinical findings had abnormal CT brain (100%).

Role of EEG and CT scan in partial seizures in children (Neeraj Jain and Vibha Mangal)[1] who studied the role of EEG and CT scan in partial seizures in children took 172 children in their study group. In them 112 (65.11%) were male, 60 (34.88%) were females. The age of patients ranged between 6 months and 12 years. 69.8% of children (120/172) had their first episode of seizure before the age of six years when compared to 68% of the children between 2 – 6 years in the present study group.

Intracranial lesions were detected in 107 out of 172 (62%) when compared to 75% in the present study. The most commonly observed lesions on CT scan of head were ring enhancing lesions which were multiple in 06 children and single in 54 children. Of these 60 patients, 22 were diagnosed as Tuberculoma (36.6%) when compared to 26 in our study (37.1%) using radiological criteria and supportive evidence of tuberculosis elsewhere. 35 were treated as

neurocysticercosis (NCC) immunological tests for NCC and follow-up. CT scan were not done due to economic constraints as in our study.

Partial seizures is the most common neurological disease of the childhood, which causes great impact on the social as well as economic aspect of the underdeveloped countries. Numerous relatively benign, episodic spells often are misdiagnosed and even treated as seizures. Therefore correct diagnosis and appropriate treatment should be more important.

CT findings observed in the study of Neeraj Jain [1] and the present study is as follows:

Table 16: CT scan lesions compared with study of Neeraj Jain [1]

S.No	CT scan lesions	Role of EEG and CT scan in partial seizures in children(Neeraj Jain)%	Neuro radiologic dia-gnostic evaluation of partial seizure in childrens Present Study %
1	Neuroinfections	55.46	58
2	Cortical infarct	11.21	5
3	Hydrocephalus	9.34	3
4	Calcifications	4	4
5	Brain tumor	1.86	1
6	Subdural effusion	2	1.86

Clinco-diagnostic and therapeutic relevance of computed tomography scan of brain in children with partial seizures, Nehal H. Patel [4] studied a total of 50 children and showed that CT brain was normal in 16 children (32%) and was abnormal in 34 children (68%). 20 children (~ 60% of abnormal scan) had potentially correctable lesion: Tuberculoma (n=13), neurocysticercosis (n=3), and brain abscess (n=4). Five children had changes representing static pathology that did not influence patient management. The clinical features correlated with CT findings in 78% children. Routine investigations like complete hemogram with Erythrocyte. Sedimentation rate (ESR), basic renal and liver function tests, Mantoux test and X-ray chest, were carried out in all patients as in the present study. Cerebrospinal Fluid (CSF) analysis by doing a lumbar puncture and /or (EEG) examination was carried out whenever clinically indicated. CT brain was done in all the patients. The Mantoux test was positive (>10mm) in 13 (26%) children and the findings suggestive of Tuberculomas on chest X-ray were present in 12 (24%) of cases. Of the 22 children with clinical suspicion, 17 had abnormal CSF findings. It was seen that there is a higher incidence of normal CT scan of brain (50-75%) in studies from the developed countries, when compared from India (37-76%). It was concluded that children with partial seizures have high probability of having abnormal findings on CT scan of brain, especially, neuroinfections which are potentially treatable. Therefore, CT scan brain should be carried out in all children with partial motor seizures especially, in developing countries.

Etiological spectrum of symptomatic localization related epilepsies, a study from south India, JMK Murthy studied [6] a total 991 cases of partial seizures. The various CT lesions in his study are as follows:

Table 17: CT scan lesions compared with study of JMK Murthy. [6]

S.No.	CT scan lesions	Etiological spectrum of symptomatic localization related epilepsies, a study from south India (JMK Murthy)	Neuroradiologic-diagnostic evaluation of partial seizure in children Present Study
1	Neuroinfections	43	58
2	Vascular	25	5
3	Tumors	4	1

Both the studies reveal that neuroinfections are the most common etiology of CT abnormalities in partial seizures. He stated that infections of the CNS are much more prevalent in the tropical countries and form important risk factor for epilepsy. Neurocysticercosis is a growing problem in tropical countries and increasingly recognized as a leading cause of epilepsy. Histological studies suggest that SCTEL (Single CT enhancing Lesion) represents dying cysticerci that will spontaneously resolve as the result of the host response. Tuberculoma was the pathology of 21% of histologically verified intracranial space occupying lesions when compared to 26% in our study. More than 60% of patients with intracranial Tuberculoma may have seizures. In India tuberculosis of the Central Nervous system is the most common type of chronic infection of CNS. Seizures occur as a late sequel in 10% of patients with neurotuberculosis and often with signs of focal CNS involvement.

Focal Epilepsy in India with special reference to lesions showing ring or disc like enhancement on contrast CT RS Wadia [8] who conducted the study in 150 consecutive cases of simple partial epilepsy showed that significant CT abnormalities were seen in 68%. The commonest lesion noted in his study was a hypodense lesion on unenhanced scan with a ring (or) disc enhancement on contrast scan and surrounding hypo density.

CT findings in focal epilepsy in his study and present study are as follows:

When both the studies are compared, Ring enhancing lesions particularly neuro-infections were the predominant group. He also showed the comparision of no. of cases whose etiology was identified before and after the CT scan era.

Table 18: Showing focal epilepsy, before and after availability of CT

S.No	Etiology	CT Scan	Prescan
1	No cause detected	32%	75%
2	Tumors	9.5%	7%
3	Vascular	16.5%	6%
4	Focal calcification	3.3%	0%
5	Tuberculoma	1.3%	2%
6	Focal ring (or) Disc	26%	0%

The above comparision showed that CT brain showed a revolution in the diagnosis of etiology of focal epilepsy. The ring enhancing lesions detected in the prescan era was 0% when compared to 26% in the CT scan era. Hence Focal Epilepsy in India with special reference to lesions showing ring or disc like enhancement on contrast CT RS Wadia and the present study conclude that CT brain is a must in the diagnosis and also in the management of partial seizures. Tuberculomas in his study, were also subjected to histology. Anti-tuberculous treatment was given in these cases. They were rescanned 1-2 months after the initial scan and seen that the lesions had regressed but not disappeared, implying that the regression of these lesions is a gradual and relatively slow process. The children in the present study were also started on Anti tuberculous treatment and steroids, but the repeat scan was not done due to short duration of the study.

Clinical application of neuroimaging in epilepsy, UC Weismann[15] in his study also stated that abnormalities were detected in more than half of all patients with localization related epilepsy but the etiology for the focal lesions differed in his study compared to the present study. In his study which was done in western countries, the primary etiologies were vascular, tumors, compared to neuroinfections in the present study, showing that etiologies of the focal seizures are different in different parts of the world but underlined the importance of optimal neuroimaging for these patients as most of the cases were treatable and were identified only on neuroimaging. In his study, he stated that MRI was superior to other imaging modalities, but MRI was not done in our study due to a no. of limitations. Moreover, plain CT and contrast enhanced CT were highly sufficient in our study which could identify 75% of the focal seizures and the treatment was initiated.

CT in simple partial seizures in children: a clinical and computed tomography study (K.P.S Nair)[12] stated in his study that Therapeutic relevance of computerized tomography (CT) in children with simple partial seizures in developed countries is reported to be remarkably low (1-2%) but the picture is entirely different in developing countries like India. He aimed at evaluating the significance of CT in the management of SPS in children and to determine the difference in clinical features of children with and without focal brain lesions in CT. In his study, focal structural lesions were present in (59.09%) of children when compared to 75% in the present study.

Neuroinfections (or) their sequel were responsible for 44.94% of the cases.

Table 19: showing the percentage of abnormal neuroimaging in focal seizures in developing countries like India.

S.No	Neuroimaging	CT in simple partial seizures in children: a clinical and computed tomography study(K.P.S Nair)	Neuroradiologi-cdiagnostic evaluation of partial seizure in children's present study
1	Total % of abnormal CT	59.09%	75%
2	Neuro infections	44.94%	58%

He concluded that CT study in children with simple partial seizures in developing countries has significant therapeutic relevance. It is not possible to clinically differentiate children with focal lesions from those without focal lesions in CT.

A study of CT and EEG findings in patients with generalized (or) partial seizures in Western Rajasthan, Ramesh Baheti[5] who conducted his study to assess the role of EEG and CT scan in patients with partial seizures observed that 73% of the children had an abnormal EEG compared to 63% in the present study. Abnormal CT brain was seen in 50% of the patients compared to 75% in the present study. His observation was also similar to that observed in clinical pattern of newly diagnosed seizures in Saudi Arabia. A prospective study of 262 children by Al-Suleiman et al[16] and severe idiopathic generalized epilepsy of infancy. Neuropediatric, (Doose et al)[11] who reported abnormal EEG in 81% of patients with partial seizures. He also established a correlation between abnormal EEG and abnormal CT brain. 57.8% of the abnormal CT brain has abnormal EEG in his study, compared to 80% in the present study.

Table 20: Showing the percentage of abnormal EEG among the children with abnormal CT brains.

Neuroimaging	A study of CT and EEG findings in patients with generalised (or) partial seizures in Western Rajasthan Ramesh Baheti	Neuroradiologic-diagnostic evaluation of partial seizure in children's Present study
% abnormal EEG among abnormal CT brains	57.8%	80%

The concluded that every case of partial seizures must be evaluated with EEG as well as CT scan as there are nearly

50% chances of finding some structural cerebral lesion, and also because EEG is a useful to screen out patients with seizure disorders and it may have some predictive value in determining co-existing CT abnormalities. He also stated that, CT scan may have both therapeutic and prognostic significance in partial seizures.

In the study named "Ring or Disc-like Enhancing Lesions in Partial Epilepsy in India" by Rashmi Kumar, Archana Kumar, *Neera Kohli, **M. C. Pant, Y. C. Govil, and B. Sharma.[10]

Management of refractory complex partial seizures (David M Treiman)[17] in this study showed that most of the complex partial seizures are manageable either by medical treatment (or) by surgery. He stated that the goal of management of refractory complex partial seizures is to make the patient completely seizure free and be achieved by the choice of the optimal antiepileptic drug (AED) (or) a combination of drugs, the use of strategies to maximize the effectiveness of the drug treatment, or by surgical removal of the seizure focus. In refractory partial seizures, surgical intervention has to be a consideration in the management which include resection of the seizure focus, multiple subpial transection, and destruction of the seizure focus by gamma knife.

From the above discussion, it is shown that there are a number of strategies that can improve control of partial seizures, both AEDs and Surgical, hence detection of the appropriate etiology by EEG and CT brain saves a number of children with partial seizures from significant morbidity and mortality. In the present study, CT brain and EEG were done in all the 100 cases, contrast was used whenever needed. Diagnosis of the etiology in partial seizures became very important as most of the lesions are treatable. Neurocysticercosis was managed by oral albendazole and steroids. Albendazole should be given for 7 days for single lesion and 28 days for multiple lesions (or) subarachnoid disease. Premedication with prednisone (or) dexamethasone before the first dose of ant parasitic drug is necessary.

Tuberculomas were treated medically with corticosteroids and ATT for 9-12 months. Brain abscess was managed with IV antibiotics for 6 weeks. Subdural effusion was treated by aspiration through the open fontanel. Hydrocephalus was treated with acetazolamide and furosemide and surgically by ventriculoperitoneal shunt. Cerebral edema was managed by osmotic diuretics like mannitol and hypertonic saline. Surgical decompression was not necessary. The child with brain tumor was operated and the tumor removed and was kept on chemotherapy.

Differentiating solitary small cysticercous granulomas and Tuberculomas in patients with epilepsy (Vedantham Rajasekhar)[14] in his study of 31 patients with histologically proven small solitary cysticercous granulomas and Tuberculomas highlighted important distinguishing features in the neuroimaging of the two lesions. Evidence of raised ICP, progressive neurological deficit was seen more in Tuberculomas (33%) when compared to (0%) in Neurocysticercosis. The size of lesion was > 2 cms in Tuberculomas in (100%) of cases where < 2 cm in neurocysticercosis in (100%) of cases. The lesion shape was irregular in Tuberculomas in (83.3%) whereas most of the cases of neurocysticercosis are regular in shape (80%). As the treatment modalities are entirely different for both the conditions, these differences provide a light for the proper management. These differences were used in the present study for distinguishing neuro Tuberculoma from neurocysticercosis.

Hence from the various studies, it is shown that CT brain and EEG play a very important role in the identification and management of partial seizures. All the children were started on antiepileptics and the specific management for each condition was given.

The present study recommends to also use MRI brain in more no. of cases to study the role of MRI brain in partial seizures as it was not done in most of the cases due to unaffordability.

6. Conclusion

In conclusion, it was found that, neuroinfections are the most common cause of partial seizures in developing countries in the tropical areas like India due to poor economy, poor Hygiene, overcrowding, poor education .ILAE recommended the use of CT brain as the diagnostic tool whenever MRI is unavailable (or) unaffordable and provides an equivalent diagnostic aid as of MRI. The conclusion/answer to research question is to understand the significant role of neuroimaging and EEG. In any child presenting to the emergency department with partial seizures to know the etiology as most of the causes are treatable either medically (or) surgically.

7. Conflicts of Interest

None.

8. Source of Funding

None.

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