CHILDHOOD SEIZURES : IMPORTANCE OF ELECTROENCEPHALOGRAM AND NEUROIMAGING

Dissertation submitted in partial fulfillment of regulation for the award of M.D. Degree in Pediatric Medicine

(Branch VII)

THE TAMILNADU
Dr. M.G.R. Medical University

Chennai

March 2009

CHILDHOOD SEIZURES : IMPORTANCE OF ELECTROENCEPHALOGRAM AND NEUROIMAGING

Dissertation submitted in partial fulfillment of regulation for the award of M.D. Degree in Pediatric Medicine

(Branch VII)

THE TAMILNADU
Dr. M.G.R. Medical University
Chennai
March 2009

Coimbatore Medical College
Coimbatore - 641 014

CERTIFICATE

This is to certify that the dissertation entitled **CHILDHOOD SEIZURES: IMPORTANCE OF ELECTROENCEPHALOGRAM AND NEUROIMAGING** is a bonafide record of the work done by **Dr.S.SIVANANDAM,** under my guidance and supervision in the Department of Pediatrics during the period of his Post Graduate study at Coimbatore Medical College, Coimbatore for the degree of M.D (Branch VII) PEDIATRICS from 2007 to 2009.

Date :

Dr.K.ANURADHA M.D., D.C.H.,
Professor&Head of the Department,
Pediatrics
Coimbatore Medical College,
Coimbatore.

Date :

Prof.Dr.V.KUMARAN M.S.M.Ch.,
Dean
Coimbatore Medical College,
Coimbatore.

Coimbatore Medical College

COIMBATORE, TAMILNADU, INDIA - 641 014

(Affiliated to The T.N. Dr. MGR Medical University, Chennai)

ETHICS COMMITTEE

CERTIFICATE

Name of the Candidate : Dr. S. Sivanandam

Course : M.D (Paediatrics)

Period of Study : 2007 - 2009

College : Coimbatore Medical College

Dissertation Topic : Childhood Seizures - "Importance of Electroencephalogram and Neuroimaging"

The Ethics Committee, Coimbatore Medical College has decided to inform that your Dissertation is accepted / ~~Not accepted~~ and you are permitted / ~~Not Permitted~~ to proceed with the above Study.

Coimbatore - 14.

Date : 5.03.08

N. [illegible]

Secretary
Ethics Committee

DECLARATION

I, **Dr.S.Sivanandam**, solemnly declare that the dissertation titled **CHILDHOOD SEIZURES : IMPORTANCE OF ELECTROENCEPHALOGRAM AND NEUROIMAGING** has been prepared by me.

This is submitted to **The Tamilnadu Dr.M.G.R.Medical University**, Chennai in partial fulfillment of the requirements for the award of M.D., Degree Examination (PEDIATRICS) to be held in March 2009.

Place : Coimbatore

Date : **DR.S.SIVANANDAM**

SPECIAL ACKNOWLEDGEMENT

My sincere thanks to **Prof. Dr.k.Anuradha**., **M.D.D.C.H.,** Professor of Pediatrics, Coimbatore Medical College for allowing me to do this dissertation and utilize the institutional facilities.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to **Prof. Dr. K.Anuradha M.D., D.C.H.,** Professor of Pediatrics, for permitting me to undertake this study and for her guidance, invaluable help, encouragement and support throughout the study.

I am extremely thankful to **Prof. Dr. N. Anbalagan, M.D., D.C.H.,** professor of pediatrics for his guidance,, encouragement in doing this study.

I am extremely thankful to **Dr. K. Neelakandan, M.D., D.C.H., Dr.R.Narayanababu, M.D., D.C.H.,** Professors of Pediatrics , for there guidance in doing this study.

I am extremely thankful to **Dr.T.Theenathayalan kamalakkan, M.D., D.C.H., Dr.M.Senthilkumar, M.D.,** for there valuable suggestion and guidance in doing this work.

I sincerely thank our Professor of Neurology **Dr. K.Govindarajan MD., DM,** and Assistant professor **Dr. R. Ramakrishnan, MD.,DM** for there guidance and suggestion.

I sincerely thank all the children and their parents who have submitted themselves for this study without whom this study would not have been possible.

CONTENTS

INTRODUCTION

DEFINITION:

SEIZURE:

A Seizure or convulsion is a paroxysmal, time-limited change in motor activity and/or behaviour that results from abnormal electrical activity in the brain.

EPILEPSY:

Epilepsy is a condition in which seizures are triggered recurrently from within the brain.

PREVALENCE:

Seizures occur in 10% of children. For epidemiological classification purposes, epilepsy is considered to be present when two or more unprovoked seizures occur at an interval greater than 24 hours apart. The cumulative lifetime incidence of epilepsy is 3% and more than half of cases begin in childhood. However the annual prevalence of epilepsy is lower (0.5%-0.8%) because many children outgrow epilepsy.

Seizures may signal a potentially serious underlying systemic or CNS disorder that requires thorough investigation and management. For children with epilepsy, the prognosis is generally good, but 10-20% have persistent seizures refractory to drugs and those cases pose a diagnostic and management challenge.

ETIOLOGY:

The history can provide important information about the type of seizures. Aside from the description of the seizure pattern, the frequency, the time of day, precipitating factors, the alteration in the type of convulsive disorders, are important. A prolonged personality change or intellectual deterioration may suggest a degenerative disease of CNS whereas constitutional symptoms, including vomiting and failure to thrive, might indicate a primary metabolic disorder or a structural lesion. Space occupying lesions in the brain like neoplasm, brain abscess, tuberculoma, neurocysticercosis can cause seizures.

A description of the seizures along with the family history can provide clues to the presence of possible genetic epileptic syndromes.

Childhood seizure differs from adult seizure since the brain is a developing organ. The clinical picture is not static and the the pattern of fits may change with age, eg; infantile spasms can evolve into Lennox-Gastaut syndrome. In addition many types of seizures are restricted to childhood.

INTERNATIONAL CLASSIFICATION OF CHILDHOOD SEIZURES

I. PARTIAL SEIZURES

Simple partial (consciousness retained)

Motor

Sensory

Autonomic

Psychic

Complex partial (consciousness impaired)

Simple partial,followed by impaired consciousness

Consciousness impaired at onset

Partial seizures with secondary generalization

II. GENERALIZED SEIZURES

Absence seizures

Typical

Atypical

Generalized tonic clonic

Tonic

Clonic

Myoclonic

Atonic

Infantile spasms

III.UNCLASSIFIED SEIZURES

SIMPLE PARTIAL SEIZURES :

Motor activity is the most common symptom of SPS. The movements are characterized by asynchronous clonic or tonic movements, and they tend to involve the face, neck, and extremities. Versive seizures consisting of head turning and conjugate eye movements are particularly common in SPS. The average seizure persists for 10-20

sec. The distinguishing characteristic of SPS is that the patient remain conscious and may verbalise during the seizure. No postictal phenomenon follows the event.

COMPLEX PARTIAL SEIZURES:

A CPS may begin with a simple partial seizure with or without an aura, followed by impaired consciousness, conversely; the onset of the CPS may coincide with an altered state of consciousness. An aura consisting of vague unpleasant feelings, epigastric discomfort, or fear is present in approximately one third of children with SPS and CPS. The presence of an aura always indicates a focal onset of the seizure.

Automatisms are a common feature of CPS in infants and children, occurring in 50-75% of cases; the older the child the greater is the frequency of automatisms. They develop after a loss of consciousness and may persist into the postictal phase; they are not recalled by the child.

Spreading of the epileptiform discharge during CPS can result in secondary generalization with a tonic-clonic convulsion. The average duration of a CPS is 1-2 min, which is considerably longer than a SPS or an absence seizure.

ABSENCE SEIZURES:

Simple (typical) absence(petit mal) seizures are characterized by a sudden cessation of motor activity or speech with a blank facial expression and flickering of eyelids. These seizures, which are uncommon before age 5 years, are more prevalent in girls, are never associated with aura, rarely persist longer than 30 sec, and are not associated with a postictal state.

Hyperventilation for 3-4 min routinely produces an absence seizure. The EEG shows a typical 3/sec spike and generalized wave discharge. Complex(atypical) absence seizures have associated motor components consisting of myoclonic movement of the face, fingers, or extremities and,on occasion, loss of body tone. These seizures produce atypical EEG spike and wave discharges at 2-2.5/ sec.

GENERALIZED TONIC-CLONIC SEIZURES:

These seizures are common and may follow a partial seizure with a focal onset (secondary generalization) or occur de novo. They may be associated with an aura, suggesting a focal origin of the epileptiform discharge. It is important to inquire about the presence of an aura, because its presence and site of origin may indicate the area of pathology. Patients suddenly lose consciousness and , in some cases, emit a shrill, piercing cry, Their eyes roll back, their entire body musculature undergoes tonic contractions, and they rapidly become cyanotic in association with apnoea. The clonic phase of the seizure is heralded by rhythmic clonic contractions alternating with relaxation of all muscle groups. The clonic phase slows towards the end of the seizure,

which usually persists for a few minutes, and patients often sigh as the seizure comes to an abrupt stop. During the seizure children may bite their tongue, but rarely vomit. Loss of sphincter control,particularly the bladder, is common during a generalized tonic clonic seizure. The postictal phase is often associated with vomiting and an intense bifrontal headache.

MYOCLONIC EPILEPSIES OF CHILDHOOD:

This disorder is characterized by repetitive seizures consisting of brief, often symmetric muscular contractions with loss of body tone and falling or slumping forward, which has a tendency to cause injuries to the face and mouth. Myoclonic epilepsies include a heterogenous group of conditions with multiple causes and variable outcomes. Atleast five different subgroupings can be identified; these represent a broad spectrum of myoclonic epilepsies in the pediatric population.

TYPES OF MYOCLONIC EPILEPSIES:

- Benign myoclonus of Infancy
- Typical myoclonic epilepsy of early childhood
- Complex myoclonic eplilepsies
- Juvenile myoclonic eplilepsy
- Progressive myoclonic epilepsies

INFANTILE SPASMS:

Infantile spasms usually begin between the ages of 4 and 8 months and are characterized by brief symmetrical contractions of the neck, trunk, and extremities.

There are atleast three types of infantile spasms;flexor, extensor, and mixed.

Infantile spasm are typically classified into two groups: Cryptogenic and symptomatic. A child with cryptogenic infantile spasms has an uneventful pregnancy and birth history as well as normal developmental mile stones before the onset of seizures. The neurologic examination and the CT and MRI scans of the head are normal, and there are no associated risk factors. Approximately 10-20% of the infantile spasms are classified as cryptogenic, and the remainder are classified as symptomatic. Symptomatic infantile spasms are related directly to several prenatal,perinatal and post natal factors.

LANDAU – KLEFFNER SYNDROME

This is a rare condition of unknown cause. It is more common in boys and has a mean onset of 5 1/2 years. LKS is charecterised by loss of language skills in a previously normal child. Atleast 70% have an associated seizure disorder. Hearing is normal, but behavioral problems, including irritability and poor attention span, are particularly common. The seizures are of several types, including focal or generalized tonic – clonic, atypical absence, partial complex and occasionally myoclonic. High amplitude spike and wave discharges predominate and tend to be bitemporal, but they can be multifocal or generalized. CT and MRI studies typically yield normal results, and Positron emission tomography (PET) scan have demonstrated either unilateral or bilateral hypo or hyper metabolism.

MECHANISM OF SEIZURES

Although precise mechanisms of seizures are unknown, several physiologic factors are responsible for the development of a seizure. To initiate a seizure, there must be a group of neurons that are capable of generating a significant burst discharge and a GABAnergic inhibitory system. Seizure discharge transmission ultimately depends on excitatory glutamatergic synapses. Evidence suggests that excitatory amino acid neurotransmitters (glutamate, aspartate) may have a role in producing neuronal excitation by acting on specific cell receptors.

Seizures may arise from areas of neuronal death, and these regions of the brain may promote development of novel hyperexcitable synapses that can cause seizures. For example, lesions in the temporal lobe (including slow-growing gliomas, hamartomas, gliosis, and arteriovenous malformations) cause seizures, and when the abnormal tissue is removed surgically, the seizures are likely to cease. Further, convulsions may be produced in experimental animals by the phenomenon of kindling. In this repeated subconvulsive stimulation of the brain (e.g., amygdala) ultimately leads to a generalized convulsion. Kindling may be responsible for the development of epilepsy in humans after an injury to the brain. In humans, it has been proposed that recurrent seizure activity from an abnormal temporal lobe may produce seizures in the contralateral normal temporal lobe by transmission of the stimulus via the corpus callosum.

Seizures are more common in infants and in immature experimental animals.

Certain seizures in the pediatric population are age specific (e.g., infantile spasms); this observation suggests that the underdeveloped brain is more susceptible to specific seizures than is the brain of an older child or adult. Genetic factors account for at least 20% of all cases of epilepsy. Using linkage analyses, the chromosomal location of several familial epilepsies has been identified, including benign neonatal convulsions (20q and 8q), juvenile myoclonic epilepsy (6p), and progressive myoclonic epilepsy (21q22.3). The genetic defect of benign familial neonatal convulsions has been characterized by the identification of submicroscopic deletion of chromosome 20q 13.3. Furthermore, the substantia nigra has an integral role in the development of generalized seizures. Electrographic seizure activity spreads within the substantia nigra, causing an increase in uptake of 2-deoxyglucose in adult animals, but there is little or no metabolic activity within the substantia nigra when immature animals have a convulsion. It has been proposed that the functional immaturity of the substantia nigra may have a role in the increased seizure susceptibility of the immature brain. Additionally, the GABA sensitive substantia nigra pars reticulata neurons play a part in preventing seizures. It is likely that substantia nigra outflow tracts modulate and regulate seizure[1].

INVESTIGATIONS:

Most children with seizure disorders require no investigations other than EEG and structural brain imaging. Laboratory testing of serum electrolytes, toxicology screening, urine and serum metabolic testing should be chosen based on individual clinical circumstances rather than on a routine basis.In a child with a first non febrile

seizure,lumbar puncture is of limited value and should be used primarily when there is primary concern about possible meningitis, encephalitis, sepsis, subarachnoid hemorrhage or a demyelinating disorder. An EEG is recommended as part of the neruodiagnostic evaluation of the child with an apparent first unprovoked seizure[1]

ROLE OF EEG IN EPILEPSY

Electroencephalography is a continuous recording of electrical activity between reference electrodes placed on the scalp[1]

EEG is used

To help establish the likely diagnosis of epilepsy[2]

To help establish the type of epilepsy[2]

To help identify possible precipitants to epileptic seizures[2]

To investigate the cause of cognitive decline[2]

To help localize the onset of focal seizure[2]

To help predict the likelihood of recurrence after an initial seizure[2]

To monitor treatment including the time of drug withdrawal[2]

Most Electroencephalograms are recorded between seizures (interictal recording)

Interictal EEG is usually recorded for 10-60min[2]

EEG tracing is analyzed in terms of background activity and paroxysmal activity[2]

Background rhythms include various physiological rhythms like

1. Delta waves – 1 to 3/ sec (occur in very deep sleep, infancy)

2. Theta waves – 4 to 7 / sec (occur in temporal and parietal regions in children

normally)

3. Alpha – 8 to 12 / sec (occur in normal adults when in awake with eyes closed and quiet, recorded in occipital region)

4. Beta – 13 to 20 / sec (occur during mental activity and tension, recorded from parietal and frontal regions) [1]

Background rhythms are slower in children and become faster with maturity. As an older child passed from alert to drowsy to light sleep and then to deep sleep, a drop out in the alpha rhythm occurs followed by progressive slowing[2]

High voltage slow and sharp waves (K complexes) and sleep spindles (regular 12 – 14/sec waves) confined to the central regions occur during sleep in normal EEG[2]

Paroxysmal activity stand out from the background. Abnormal paroxysmal activity can be epileptiform or non- epileptiform abnormalities. They are abrupt and short lived giving rise to spikes and sharp waves. Interictal spikes and waves are often followed by slow waves constituting spikes and wave complexes[2]

Demonstration of paroxysmal discharges on EEG during a clinical seizure is diagnostic of epilepsy. Interictal EEG is normal in 40% of patients.[1] Also 2.2 to 3.5% of normal children have epileptiform abnormalities[2]. Patients who are taking an anticonvulsants and who are scheduled for a routine EEG should not have the medication decreased or discontinued before the study because status epilepticus could result[1]

Certain EEG abnormalities are activated by maneuvers like sleep following partial

sleep deprivation[2] or drug induced sedation, hyperventilation and photic stimulation.

Sleep (especially light sleep) is a powerful activator of many EEG abnormalities and if an awake recording is unhelpful it is usually worth obtaining a sleep recording. This can be achieved using natural sleep, following partial sleep deprivation or by drug induced sedation. When sleep is induced by drugs it should be remembered that these may influence the EEG beyond causing sleep. Benzodiazepine and barbiturates often cause excessive fast activity and suppress many EEG abnormalities : They are therefore best avoided.

Hyperventilation which should be included in the protocol for standard EEG recordings, is of particular use in investigating subjects with idiopathic generalized epilepsies in whom it frequently activates generalized spike-wave discharges.

Photic stimulation should also routinely be applied during standard EEG recordings. Photoparoxysmal responses are epileptiform abnormalities in which spike and/or spike-wave discharges are produced by intermittent photic stimulation. They are usually generalized but can be confined to the occipital regions. Generalized photoconvulsive responds are most often seen in subjects with idiopathic generalized epilepsies but occur in a variety of other epilepsies and rarely in normal children. Occipital photoconvulsive responses are occasionally seen in subjects with occipital lobe seizures.

EEG FINDINGS IN SPECIFIC CONDITIONS

Generalized seizure – Usually has generalized epileptiform discharges.

Focal seizures – Usually has focal epileptiform discharges.

Epileptic encephalopathies – Generalized background abnormalities.

Myoclonic epilepsy – Bursts of poly spikes.

Absence seizure – 3 per second spike and wave discharge precipitated by hyperventilation.

Hypsarrhythmia – High voltage generalized chaotic slow waves.

Benign epilepsy of childhood – Centro temporal spike.

Subacute sclerosing panencephalitis – Periodic epileptiform discharges recurring at similar intervals throughout the record.

Herpes encephalitis – Periodic lateralized slow waves or high voltage complexes.

Brain tumors, Inflammatory granulomas, infarcts and abscesses – Focal background slowing, reduction in amplitude and loss of physiological rhythm.

Static or progressive encephalopathy – diffuse slowing attenuation of the background EEG.[2]

ICTAL EEG

During routine EEG recording it is rare to record a seizure. Ictal records require prolonged recording for 24 hours or more and even then are only likely to be obtained if seizures are frequent. They are two types – Ambulatory cassette EEG and Video EEG recording. Prolonged recordings are useful to ;

-Help decide if paroxysmal clinical events are epileptic.

-Localize the onset of focal seizures.This is usually done as a part of presurgical workup in refractory epilepsy and requires video telemetry rather than a cassette recording.

-Establish the frequency of seizures and interictal epileptiform discharges.This may be useful if a child with epilepsy is performing less well at school than expected and it is considered that this might reflect under recognized seizure activity.

Occasionally children with epilepsy show a stagnation or decline in their cognitive performance. The EEG can be useful in investigating the possible role of epileptiform activity in causing this. In some children, especially those with idiopathic generalized epilepsies, frequent interictal and subtle ictal discharges are responsible and can be detected on prolonged EEG recordings, preferably with simultaneous video recording. In others, electrical status during slow wave sleep may be responsible for cognitive problems and this possibility should be investigated by a sleep recording. Finally, some children with apparent cognitive decline are in non-convulsive status epilepticus.This is usually obvious on a standard EEG.

NEUROIMAGING

For majority of children with seizure disorders, MRI is the only brain imaging method of importance. Main role of CT brain is to detect fractures, detect fresh blood and to exclude space occupying lesion, but in whom MRI would require a general anesthetic and CT is readily available.[2] MRI enables the following brain conditions associated with epilepsy to be detected.[2]

1. Brain malformations and maldevelopments

2. Vascular disorders such as arteriovenous malformations

3. Areas of sclerosis and gliosis associated with old infarcts, hypoxic ischemic insults and infection

4. Tumors

Most brain malformations and maldevelopments comprise normal brain tissue arranged abnormally and are best detected with T1 weighted images. Foreign tissue including tumors and gliotic tissue is usually best detected with T2 weighted images[2]. Contrast agent gadolinium is rarely helpful and is not indicated as a routine. However, it can be helpful in conditions associated with breakdown in the blood-brain barrier such as tumors and vascular malformations[2] Detection of mesial temporal sclerosis, the pathological substrate underlying mesial temporal lobe epilepsy is usually not detected with standard T1 and T2 weighted axial images. The important features are decreased volume (atrophy) and increased signal on T2 weighted and FLAIR (Fluid attenuated inversion recovery) sequences in the hippocampus and / or amygdala. Its detection requires thin heavily T1 weighted and T2 weighted coronal images taken orthogonal to the long axis of the temporal lobe[2]

INDICATIONS FOR NEUROIMAGING[2]

1. All children with focal epilepsies expect those with a pattern of epilepsy which corresponds clinically and on EEG with the syndrome of benign epilepsy of childhood.

2. If there are interictal neurological signs

3. If seizure do not come under complete control after the first line antiepileptic drug. Children with features of one of the idiopathic generalized epilepsies do not require neuroimaging provided they respond as expected to appropriate medication.

REVIEW OF LITERATURE

Hussain jageer et al.,[3] did a study of cranial computed tomography in partial motor seizures in Jawaharlal Institute of Postgraduate Medical Education and Research including 150 children with partial seizures, 71 males and 79 females. Computed tomography was done for all of them. Computed tomography was abnormal in 102 (68%) of children. Majority of children (75) had Single ring enhancing lesion in the parietal lobe (65), frontal lobe (7), occipital lobe (1), temporal lobe (1) and cerebellum (1). Single non-enhancing lesion (Calcified dots) was the next common anomaly and was found in 15 patients. They were localized to the parietal lobe(10), frontal lobe (4) occipital lobe (1). Multiple calcified lesions were found in 4 patients and multiple ring enhancing lesions were present in only one patient.

Aldenkamp Ap et al.[4] has done a prospective, standardized, nonrandomized and open clinical comparative study in Netherlands to compare the acute cognitive effects of short non convulsive seizures with the effects of interictal epileptiform electroencephalographic (EEG) discharges in children. Eligible patients were included when they had (a) unclear seizures and fluctuations in cognitive performance and (b) frequent epileptiform EEG discharges in a recent EEG. All children were assessed with EEG/video (Brainlab) simultaneously with computerized neuropsychological testing (FePsy) assessing motor speed / alertness, metal speed/attention, and memory function. Eleven patients with short nonconvulsive seizures during cognitive testing were included

and compared with 11 matched patients with interictal epileptiform EEG discharges during cognitive testing but without seizures. Patients included in both groups were reconfirmed diagnosis of epilepsy. Cognitive performance for both groups was compared. Statistical analysis showed significant correlations between the number of seizures (during cognitive testing) , impaired alertness and between the duration of ictal period and memory impairment. Interictal epileptiform EEG discharges do not have an additional independent effect on cognitive function. The results demonstrate the accumulating cognitive effect of seizures and illustrate that frequent seizures even when these are short in duration and with subtle symptomatology, can have a substantial impact on daily life and can lead to state-dependent learning impairment. Alertness and short-term memory appeared to be the functions that are most vulnerable for the acute effects seizures.

Shlome Shinnar et al[5] examined the EEG findings of 347 children with first unprovoked seizure. EEG were available in 321 (93%) and 135 (42%) had an abnormal EEG. EEG abnormalities included focal spikes (n=77), generalized spike and wave discharges (n=28), slowing (n=43), and nonspecific abnormalities (n=7). Abnormal EEGs were more common in children with remote symptomatic seizures (60%) than in those with idiopathic seizures (38%) ($p<0.003$), more common in partial seizures (56%) than in generalized seizures (35%) ($p<0.001$), and more common in children aged > 3years (52%) than in younger children (12%) ($p<0.001$). Fifty - nine (40%) of the 148 patients with both awake and asleep tracing had abnormal EEGs. Of 50 such EEGs with

epileptiform abnormalities, 15 (30%) demonstrated the abnormality either only while awake (n=8) or only while asleep (n=7). Of 17 patients with EEG slowing, 8 showed slowing only in the awake tracing and 9 showed slowing in both the awake and asleep tracing. Children with even a single unprovoked seizure have a high incidence of EEG abnormalities. Obtaining a combined awake and sleep EEG significantly increases the yield of EEG abnormalities. In children with an idiopathic first seizure, EEG abnormalities are associated with an increased risk of seizure recurrence.

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. The mean age of patients with partial seizure was 3.02 +/- 3.04 and mean age of patients with generalized seizure was 3.99 +/- 4.36. Abnormal EEG was found in 73% of them with partial seizures and 76.9% of them with generalized seizures. CT scan was abnormal in 50% of patients with partial seizures and 34.6% of patients with generalized seizure. With increasing abnormalities in EEG, chance of finding some abnormality in CT scan also increases.

Valente KD et al.,[7] has done a study in Brazil. The aim of the study was to assess the benefits and limitations of V.EEG monitoring in children. They analysed 39 children classified according to clinical complaints: doubts about epilepsy classification in 23 (group I); differential diagnosis with nonepileptic events in 8 (group II): and differential diagnosis between cognitive decline and subtle seizures in 8 (group III). Clinical episodes were recorded in 37 patients (94%). In group I, seizure type was reclassified in

11 patients and epileptic syndrome in 9 patients. In 2 patients a previously unnoticed seizure type was recorded. In group II, four patients presented with epileptic seizures. In group III nonconvulsive status was detected in 5 patients. Video electroencephalographic monitoring enabled major modification of therapeutic approach in 21 patients and guided new neuroimaging studies in 10 patients and the study was concluded as, In patients with frequent seizures, short video electroencephalographic monitoring allows proper classification of epileptic syndromes and diagnosis of nonepileptic seizure promoting introduction of appropriate treatment with a relatively low cost.

Zajac A et al.[8] has done a study to assess clinical value of electroencephalography and videoelectroencephalography in diagnosis of partial epilepsy in children including 140 children 70 boys and 70 girls aged 2 months to 17 pediatric years with partial epilepsy hospitalized between 1998 and 2004 in department of pediatric neurology , jagiellonian University, Krakow, 38 of the children were older than 5 years, with mean age 8 years and 4 months. The mean time of epilepsy course was 2 years and 4 months. More than 50% of children suffered from complex partial seizures. Statistical correlation of EEG results and pregnancy and birth period factors, results of neurlological and psychological examination was performed. All children underwent MRI and 15 HMRS neuroimaging as well . All children underwent EEG examination and 55 children underwent video EEG recording for 60 minutes. Sleep recordings in 40 children, awake EEG in 93 children and both type recordings in 8 children were performed.

Stroboscope, hyperventilation and sleep deprivation stimulation tests were used. All EEG recordings were assessed by 2 physicians with the EEG license and final result was a mean of their assessment. student-t test, mann- Whitney and bilateral fisher test were in statistical analysis. The results were EEG pattern was abnormal in 139/140 children and video EEG in all 55 children . In the vast majority of the patients with partial epilepsy focal EEG changes were recorded (in 111 /140) with a significant prevalence of unilateral changes observed in 48/111 patients. 34 children had focal EEG changes with one- site prevalence and 27/140 children had focal EEG changes in both hemispheres without any prevalence. Generalised EEG changes were revealed in 16/140 children. Hyperventialation revealed in 8 children paroxysmal bioelectric activity and in 43 enhanced abnormal EEG pattern. In all children with normal MRI imaging EEG/video EEG methods revealed changes significant for localization of seizures onset and origin and study was concluded as EEG patterns in children with partial epilepsy were dominated by localized and lateralized changes. EEG was crucial for localization of bioelectric foci especially in children with normal MRI. Focal EEG changes were significantly more often in children with hippocampal sclerosis. Interms of localization HMRS were more compatible with EEG than with MRI findings. HMRS examination is strongly indicated especially in children with EEG localized discharges and with normal brain MRI .

Shinnar S et al[9] did a study including 411 children with a first afebrile seizure. Imaging studies were performed in 218 (53%). 159 computed tomography and 59

magnetic resonance imagings were done. Two children had brain tumor, two had neurocysticercosis. 45 (21%) of 218 imaging studies were abnormal . The most common abnormalities were focal encephalomalacia (n=16) and cerebral dysgenesis (n=11). The fraction of abnormal imaging was similar in both generalized and partial seizure groups. Six children had errors of cerebral migration on MRI and study was concluded as Neuroimaging should be considered in any child with a first seizure who does not have an idiopathic form of epilepsy.

Annie. T. Berg et al[10]. did a community based study including 613 patients, 1 month to 15 year age group. Of the 613 children 488 (79.6%) had imaging , 388 (63.3%) magnetic resonance imaging and 197 (132.1%) computerized tomography scan and 97 (15.8%) both . Etiologically relevant abnormalities were seen in 62 (12.7 of those imaged). Fourteen of these children had otherwise completely normal presentation and histories. Abnormalities included tuberous sclerosis (N=4), tumors (N= 2), an arteriovenous malformation, later diagnosed as tumor, cavernous hemangioma, cerebral malformation (N=3) and other abnormalities (N=3). Thirteen of the 14 had partial seizures and 12 had focal electroencephalographic findings (EEG). Only 1 had neither and the study was concluded as In the children with newly diagnosed epilepsy, neuroimaging reveals a small but significant number of serious abnormalities not previously suspected. Most of these children had partial seizure or focal EEG abnormalities. Neuroimaging should be considered during the evaluation of newly diagnosed epilepsy, especially for those with neurological deficits or partial

seizures or focal EEG abnormalities that are not part of an idiopathic localization related epilepsy syndrome.

Kumar et al[11]. has done a study in Lucknow including 162 children aged 1 month to 12 years. Ten clinical features viz seizure type , age at onset, number of seizures, duation of epilepsy, family /antecedent history, mental / neurological deficit, abnormal EEG and evidence of tuberculosis were recorded. Univariate analysis taking 1. CT abnormality/no abnormality and 2.Ring/ disc enhancing lesion/ no such lesion on CT as outcomes. An abnormal CT scan was found in 79 (49%) patients. There were two high yield groups 1. Younger children with neurological / mental deficits 2. Older children without deficits. The commonest CT abnormality was a ring/disc like enhancing lesion seen in 32 patients. Higher age at onset (>4 years), absence of mental / neurological deficits, generalized tonic- clonic type of seizures and fewer episodes at presentation were significant associated with this finding.

Misra S et al [12] has done a study to study the Neuroimaging finding in children with seizure disorders and comparison of CT scan cranium and MRI brain as diagnostic modalities. A total of 96 children aged 3 months to 12 years presenting with seizure disorder were included . The cranial CT scan was abnormal in 70% of the cases of seizure disorder. The incidence of CT scan abnormality was higher in focal seizures as compared to generalized seizures (78% vs 65%) Ring/ Disc enhancing lesion is the most common abnormality (54%) followed by brain atrophy (12%) .The cases in which both CT scan and MRI could be performed, 4 cases (21%) had normal

CT scan but MRI revealed abnormalities in those case. The study was concluded as Ring/ Disc enhancing lesion is the most common abnormality (54%) found in children with seizure disorder followed by brain atrophy. MRI is better than CT scan as the diagnostic modality but the cost factor limits its use.

Murthy JM et al[13] has done a study on etiological spectrum of 558 children (< 16 years) with partial seizures seen in a university hospital in south India, was analysed using syndromic classification proposed by the International League Against Epilepsy (ILAE). Partial seizures accounted for 57 per cent of childhood epilepsies. Idiopathic localization-related epilepsies accounted for 3 per cent, symptomatic localization-related epilepsies for 48 per cent and cryptogenic localization-related epilepsies for 49 per cent. Single CT enhancing lesion (SCTEL; solitary cysticercal granuloma), single small cerebral calcific CT lesion (SSCCCTL), and multiple small cerebral calcific CT lesions together accounted for 51 per cent of patients categorized under symptomatic localization-related epilepsies. Of the 138 patients with these CT lesions, only four patients with SCTEL had focal signs to suggest symptomatic etiology and in the remaining the putative etiology was established only after CT scan was obtained. A CT scan was carried out in 247 children with localization-related epilepsies with no obvious causation, and the proportion of CT scans showing one of these three etiologies was 0.54 [95 per cent confidence intervals (CI), 49-60]. The observations suggest that in India a child with partial seizures with no obvious causation has a high probability of harboring one of these three lesions. In these patients, a CT scan should be the initial structural

imaging investigation and will be cost effective

Gulati P et al[14] did a study including 170 children of chronic seizures with strong clinical suspicion of an underlying intracranial lesion as its cause were studied by Magnetic Resonance Imaging (MRI). Maximum number of patients were between 6-12 years, males outnumbering females. Structural abnormalities were seen in 158 of the 170 patients. The study revealed tuberculoma as the commonest lesion in this series (n = 64) followed by cysticercosis (n = 27). Three patients were seen to have glioma. An interesting finding was disappearing lesion in 6 children. MRI proved to be an excellent modality in demonstrating and characterising the intracranial lesion.

STUDY JUSTIFICATION

Seizure is one of the common manifestation of various diseases in children. Though there are lot of investigations, EEG and Neuroimaging (CT/MRI) are the main modalities to investigate children presenting with seizure of varied etiology.

EEG is used in syndromic classification of seizures as well as nonconvulsive seizure activity as a cause of cognitive decline.

Neuro imaging (CT / MRI) is used to identify various causes like neurocysticercosis, tuberculoma, space occupying lesions, neuronal migration disorders, etc.

Though there are various studies have been done regarding the correlates of EEG and neuroimaging for children presenting with seizures, there are conflicting results which provoke us to do a study to determine the correlates of EEG and Neuroimaging in our center.

AIM OF THE STUDY

1. To asses the role of EEG and Neuroimaging (CT / MRI) in patients with seizure disorder and to make out any correlation between these two investigations.

2. To study the clinical profile of childhood seizures in the age group of one year to twelve years.

SUBJECTS AND METHODS

Study Design	:	Descriptive Study
Study place	:	Coimbatore Medical College and Hospital, Coimbatore.
Study period	:	From June 2007 to September 2008
Study population	:	Children presenting with history of seizures.
Sample size	:	100 Children
Inclusion criteria	:	Children presenting with first episode of unprovoked afebrile seizures in the age group of one to twelve years.
Exclusion criteria	:	1. Febrile seizure 2.Post traumatic seizures 3. Toxins 4. Drug overdose 5. Metabolic seizure 6. Seizures in developmentally abnormal children

Maneuver:

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). The examination findings are recorded. EEG recording, CT scan / MRI scan are done and findings in them are recorded.

OBSERVATION

Datas were colleted and analyzed statistically. To compare the mean values student t-test used and to compare the categorical variables chi – square test was used.

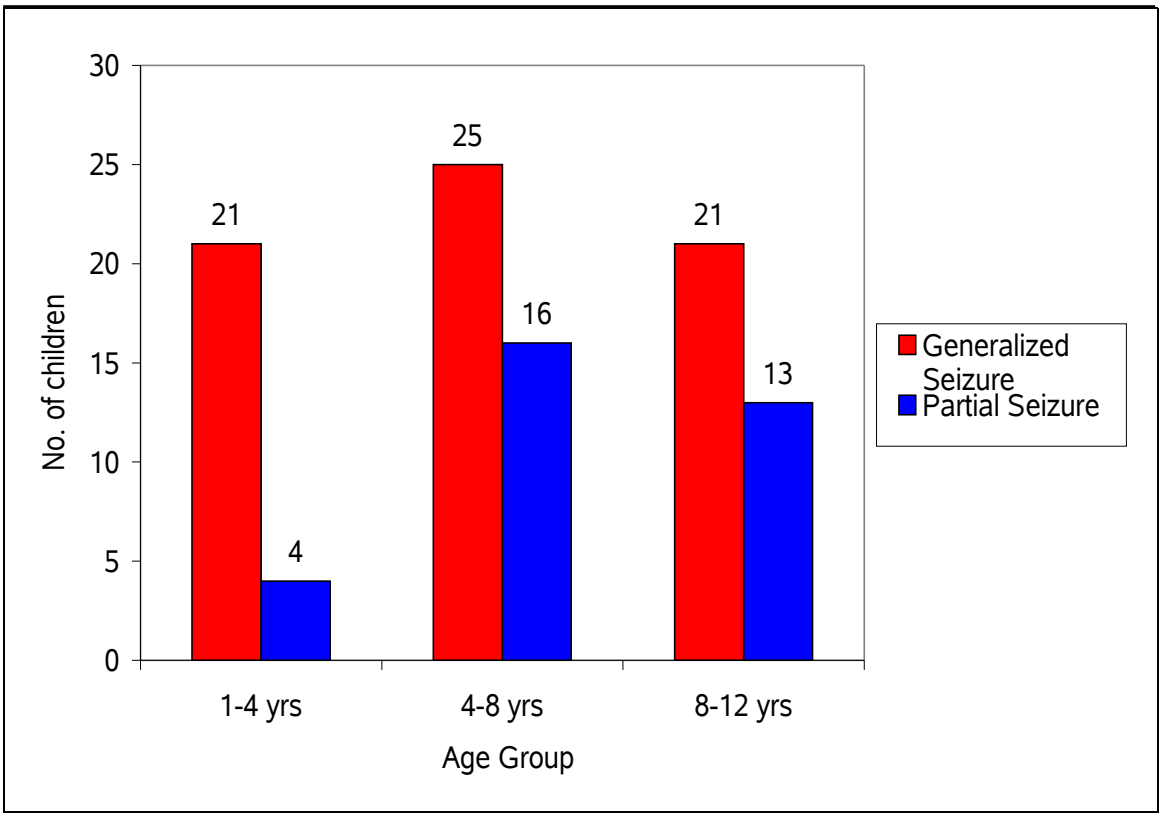
P value < 0.05 was considered significant.

AGE DISTRIBUTION

Age Group (in years)	Generalized Seizure			Partial Seizure		
	n (67)	Mean age (95% confidence interval)	S.D	n (33)	Mean age (95% confidence interval)	S.D
1 – 4 years	21	2.4119	1.01260	4	2.5000	1.22474
4 – 8 years	25	6.4500	1.24164	16	7.0938	0.93486
8 – 12 years	21	11.1429	1.01419	13	10.7692	1.09193
Total	67	6.6552	3.65183	33	7.9848	2.88174

The mean age group at which generalized seizure occur is 6.65 years and that of partial seizure is 7.48 years. Majority of the children presents in the age group of 4-8 years. In our study partial seizure occur more frequently in children beyond four years of age where as generalized seizure is all most evenly distributed throughout the study.

AGE DISTRIBUTION



SEX DISTRIBUTION

Sex	Generalized seizure	Partial Seizure	Total
Male	38 (56.7%)	13(39.4%)	51
Female	29(43.3%)	20(60.6%)	49
Total	67	33	100

The overall male : Female ratio is 1.04:1.

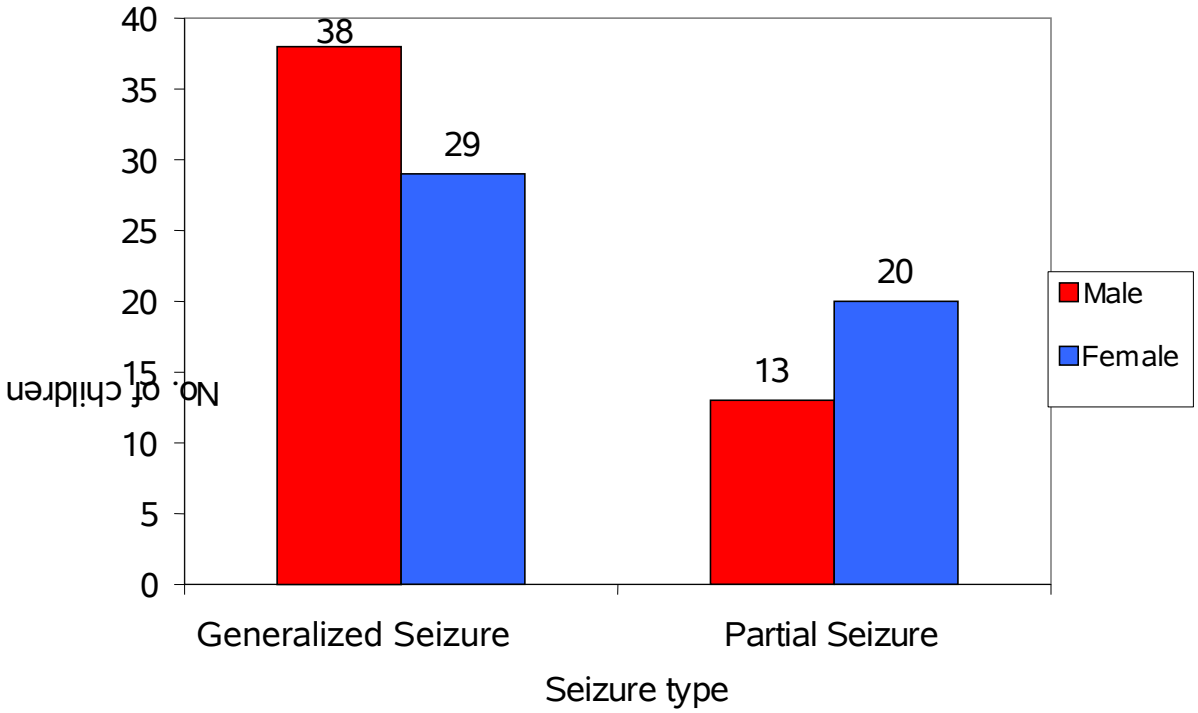
Male : Female ratio in generalized seizure group is 1.31:1.

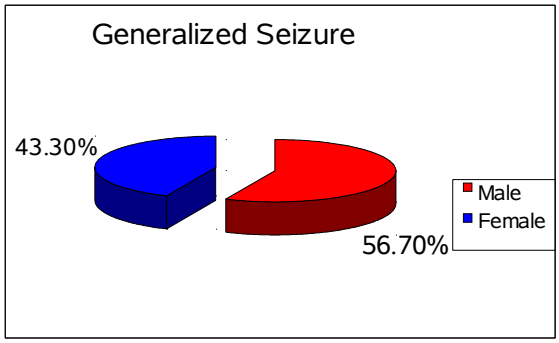
Male : Female ratio in generalized seizure group is 0.65:1.

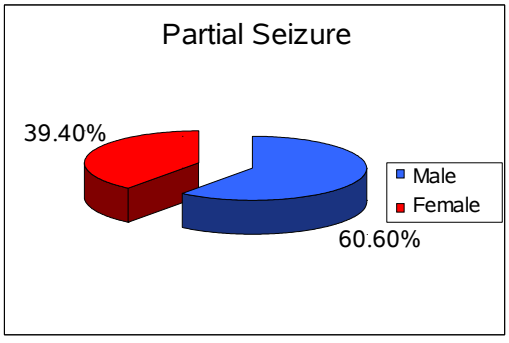
The difference observed is not statistically significant.

($p = 0.103$)

SEX DISTRIBUTION





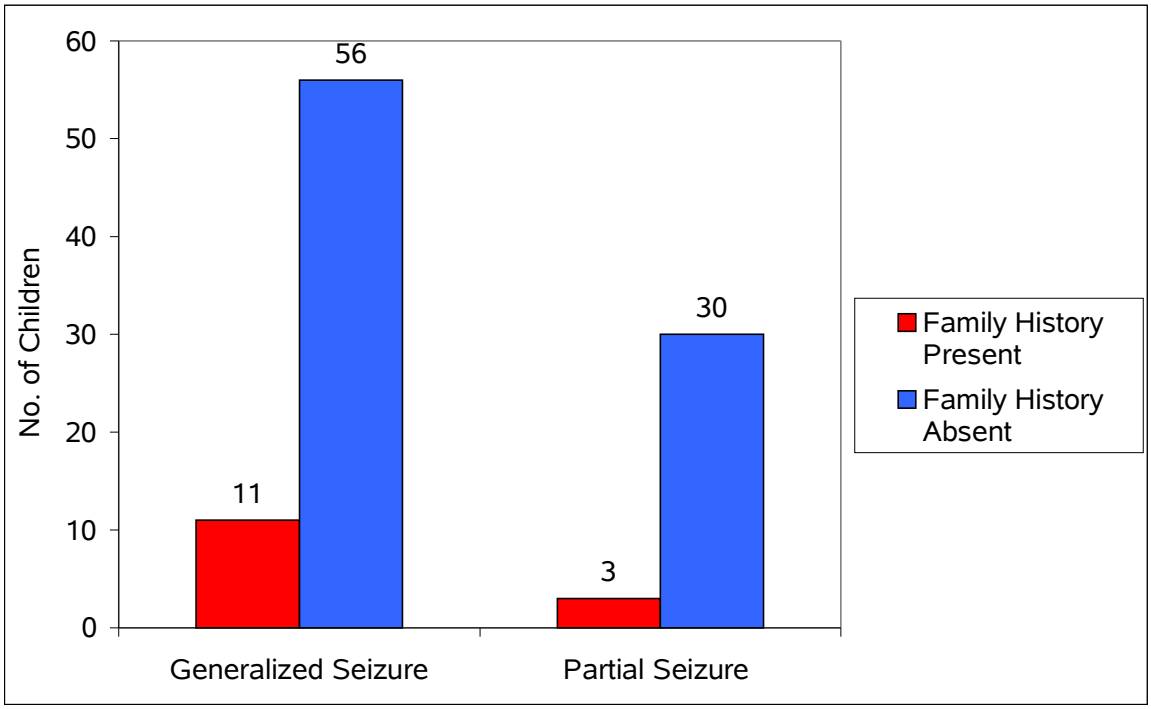


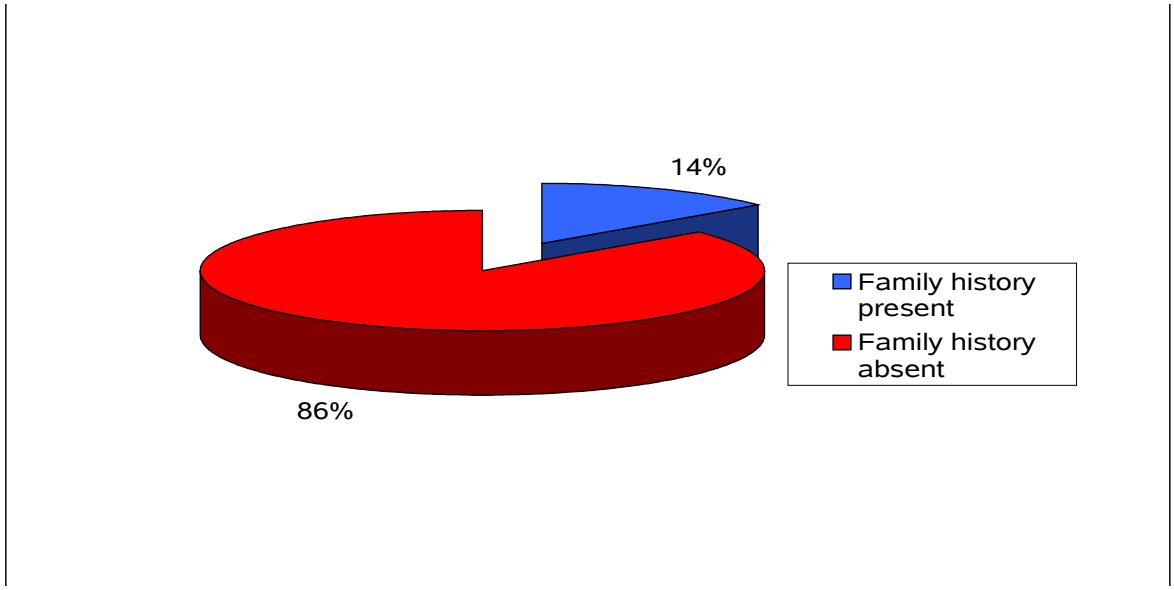
FAMILY HISTORY OF SEIZURE

Seizure type	Family history		Total
	Present	Absent	
Generalized Seizure	11(16.4%)	56(83.6%)	67
Partial Seizure	3 (9.1%)	30(90.9%)	33
Total	14(14%)	86(86%)	100

Only 14% of children has family history of seizure. Only 16.4% of children with generalized seizure had the family history of seizure. Only 4.1% 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).

FAMILY HISTORY OF SEIZURE





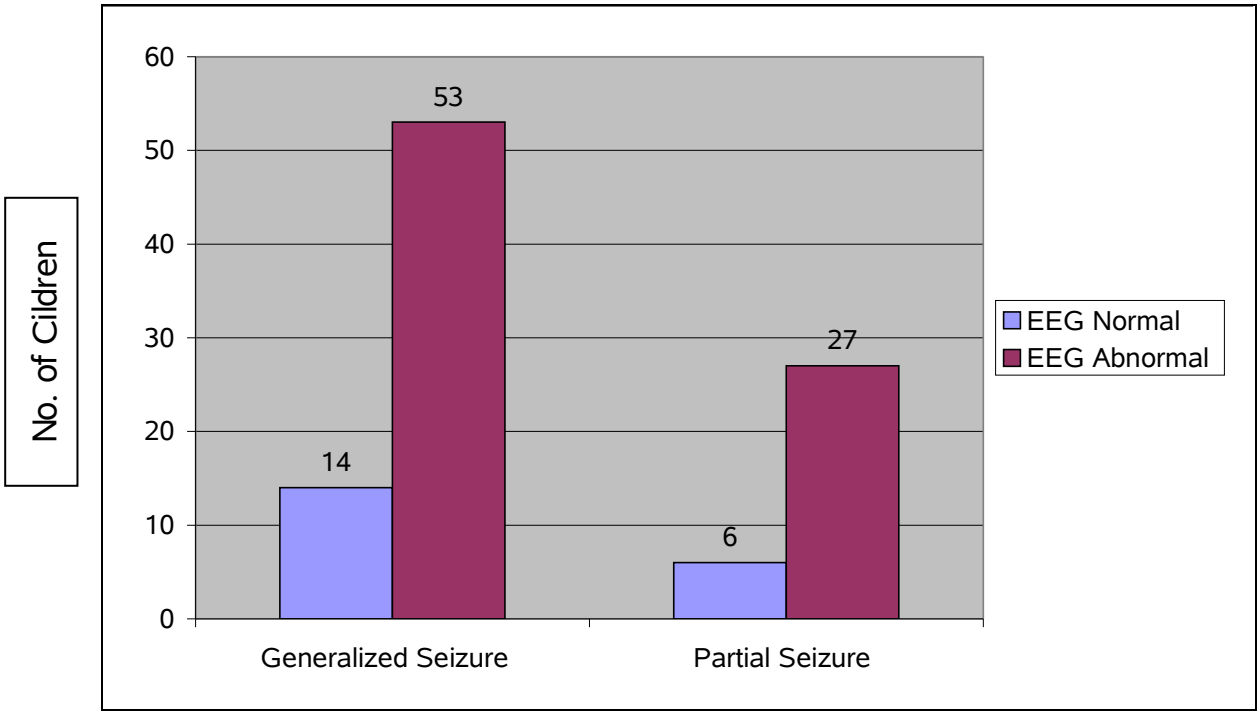
ELECTROENCEPHALOGRAM FINDINGS

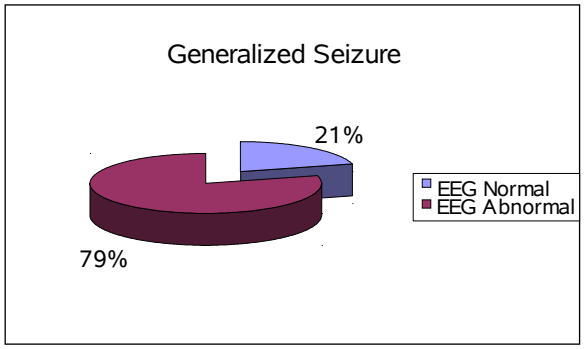
Seizure type	EEG normal	EEG abnormal	Total
Generalized Seizure	14(20.9%)	53(79.1%)	67
Partial Seizure	6 (18.2%)	27(81.8%)	33
Total	20(20%)	80(80%)	100

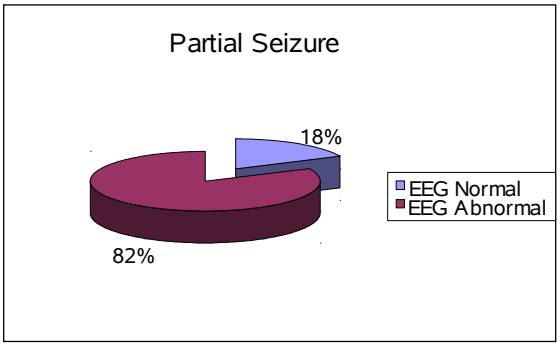
Among 100 children included in the study 80(80%), had EEG abnormality. 53(79.1%) children with generalized seizure had EEG abnormality 27(81.8%) children with partial seizure had EEG abnormality.

Applying chi square test of significance, there is no statistically significant difference in the incidence of EEG abnormality between generalized and partial seizure groups of children ($p = 0.75$).

ELECTROENCEPHALOGRAM FINDINGS







ELECTROENCEPHALOGRAM FINDINGS

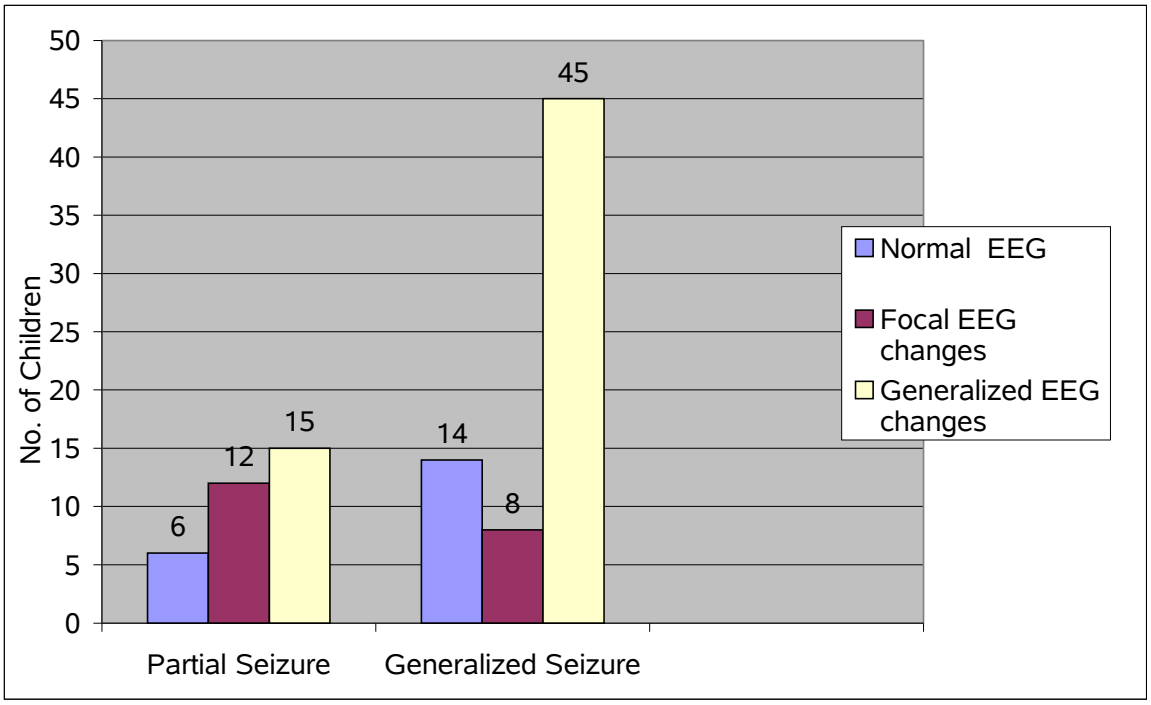
Seizure type	Normal EEG	Generalized EEG changes	Focal EEG changes	Total
Generalized Seizure	14(20.9%)	45(67.2%)	8(11.9%)	67%
Partial Seizure	6(18.2%)	15(45.5%)	12(36.4%)	33%
Total	20(20%)	60(60%)	20(20%)	100

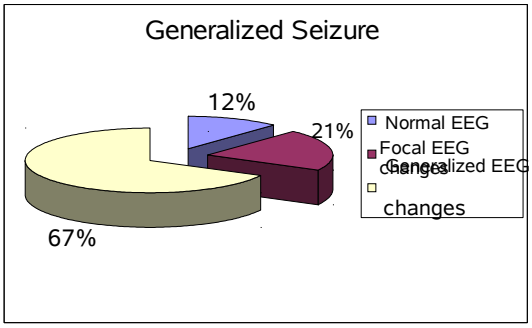
Among 100 children included in the study, 20(20%) had focal EEG changes, 60(60%) children had generalized EEG changes and 20(20%) had normal EEG findings. 8(11.9%) children with generalized seizure had focal EEG changes, 45(67.2%) had generalized EEG changes and 14(20.9%) had normal EEG.

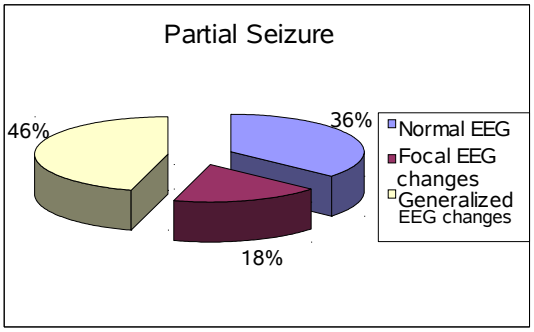
12(36.4%) children with partial seizure had focal EEG changes, 15 (45.5%) children had generalized EEG changes and 6(18.2%) had normal EEG.

Applying chi-square test of significance there is significantly high incidence of focal EEG changes in partial seizure group compared to generalized seizure group ($p=0.015$).

ELECTROENCEPHALOGRAM FINDINGS







NEUROIMAGING FINDINGS

Seizure type	Normal Neuroimaging	Abnormal Neuroimaging	Total
Generalized Seizure	56(83.6%)	11(16.4%)	67
Partial Seizure	18(54.5%)	15(45.5%)	33
Total	74(74%)	26(26%)	100

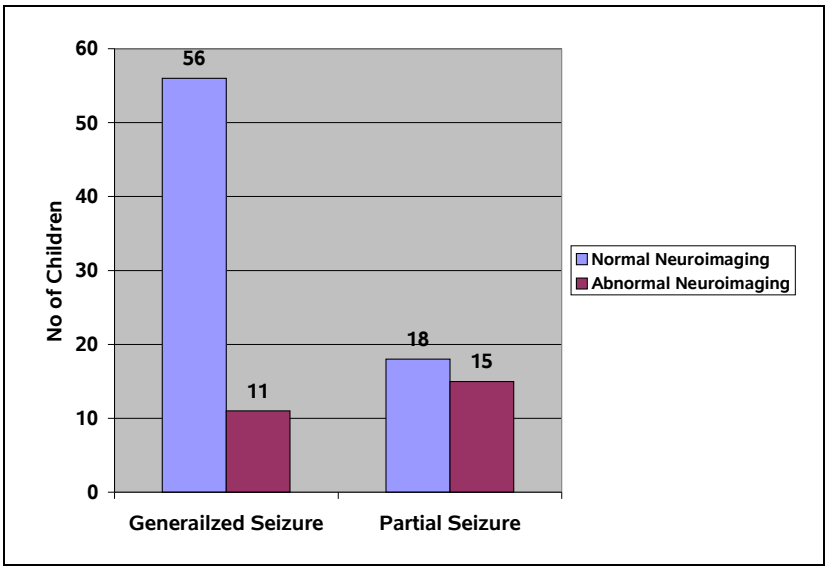
Among 100 children included in the study, 74(74%) had normal Neuroimaging and 26(26%) had findings in the Neuro imaging.

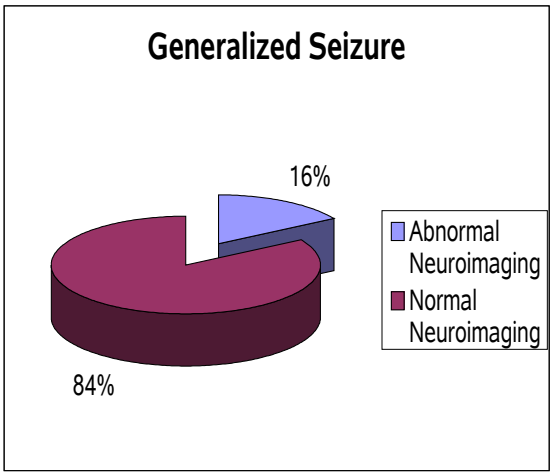
56(83.6%) children with generalized seizure had normal neuro imaging and 11(16.4%) had abnormal findings in Neuroimaging.

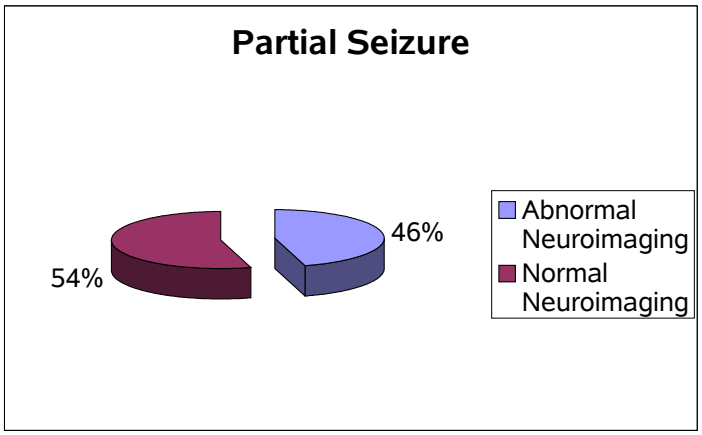
18(54.5%) children with partial seizure had normal neuroimaging, 15(45.5%) had abnormal findings in Neuroimaging.

Apply chi-square test of significance there is significant difference in the incidence of abnormal neuroimaging findings in partial seizure than generalized seizure ($p = 0.002$).

NEUROIMAGING FINDINGS




Generalized Seizure
16%
84%
Abnormal Neuroimaging
Normal Neuroimaging


Partial Seizure
46%
54%
Abnormal Neuroimaging
Normal Neuroimaging

NEUROIMAGING FINDINGS

Neuroimaging Findings	Generalized Seizure	Partial Seizure
1.Normal Neuroimaging	56(83.6%)	18(54.5%)
2.Abnormal Neuroimaging	11(16.4%)	15(55.5%)
Abnormal myelination	1(1.5%)	0(0%)
Ring enhancing lesion - Neurocysticercosis	2(3.0%)	6(18.2%)
Ring enhancing lesion - Tuberculoma	0(0%)	4(12.1%)
Calcification	0(0%)	2(6.1%)
Cortical dysplasia	2(3.0%)	2(6.1%)
Craniopharyngioma	1(1.5%)	0(0%)
High parietal atrophic changes	1(1.5%)	0(0%)
Hippocampal sclerosis	0(0%)	1(3.0%)
Midline dysgenesis	1(1.5%)	0(0%)
Mild prominence of subarachnoid space	1(1.5%)	0(0%)
Periventricular leukomalacia	1(1.5%)	0(0%)
Prominent cisterna magna	1(1.5%)	0(0%)

Of the 100 children studied, abnormal neuroimaging is noted in 26% of children. The abnormality is more common in partial seizures than in generalized seizures. The ring enhancing lesion presents mostly as partial seizures, the neurocysticercosis exceeds tuberculoma in our study.

NEUROIMAGING ABNORMALITIES IN PATIENTS WITH NORMAL AND ABNORMAL EEG

Type of seizure	Focal EEG changes		Generalized EEG Changes		Normal EEG	
	Neuroimaging		Neuroimaging		Neuroimaging	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
Generalized seizure	5(62.5%)	3(37.5%)	38(84.4%)	7(15.6%)	13(92.9%)	1(7.1%)
Partial seizure	2(16.7%)	10(83.3%)	12(80%)	3(20%)	4(66.7%)	2(33.3%)
Total	20		60		20	

Among patients with partial seizure with focal EEG changes, 16.7% had normal Neuroimaging and 83.3% had abnormal Neuroimaging findings.

Among patients with generalized seizure with focal EEG changes, 62.5% had normal Neuroimaging and 37.5% had abnormal Neuroimaging findings.

NEUROIMAGING ABNORMALITIES IN PATIENTS WITH NORMAL AND ABNORMAL EEG

	Normal EEG		Abnormal EEG	
	Generalized seizure	Partial seizure	Generalized seizure	Partial seizure
Normal Neuroimaging	13(92.7%)	4(66.7%)	43(81.1%)	14(51.9%)
Abnormal Neuroimaging	1(7.1%)	2(33.3%)	10(18.9%)	13(48.17%)
Total	14	6	53	27

Among children with Generalized seizure with abnormal EEG, 18.9% had abnormal Neuroimaging findings.

Among children with partial seizure with abnormal EEG, 48.17% had abnormal Neuroimaging findings.

DISCUSSION

The study is conducted to assess the role of Electroencephalogram and Neuroimaging in patients with partial or generalized seizures and to make out any correlation between the two investigation, if possible.

Of the 100 children studied 67(67%) of children presents with generalized seizures and 33(33%) of children presents with partial seizures. In our study generalized seizures predominates, which correlates with many previous studies [15,16, 17]. This observation in our study is comparable with Simi Misra et al[12].

The mean age of generalized seizure in our study is 6.65 years and mean age of children with partial seizure is 7.98 years. This observation in our study is comparable with Zajac A et al[8] and Ramesh Baheti et al[6].

Male : Female ratio in our study population is 1.04 : 1. Male : Female ratio in generalized seizure is 1.31 : 1 and 0.65 : 1 in partial seizure. The difference was not statistically significant in our study. This observation is comparable to that observed by Ramesh Baheti at al[6]. In our study males are more affected than females. This is similar to that observed by Redda Tekle – Haimanot et al[15]. Female were observed to have higher prevalence than males in study by Gallito G et al[18].

Family history is present in 14% of children. There is no significant difference in the presence of family history between generalized and partial seizure groups in our study. Redda Tekle – Haimanot et al[15] observed family history in 22%.

Overall electroencephalogram findings is abnormal in 80(80.0%) of all children included in our study. 79% had abnormal electroencephalogram findings in generalized seizures and 81.8% in partial seizure group in our study. Ramesh Baheti et al[6] observed 76.9% of children had abnormal EEG in generalized seizure group and 73.0% of children had abnormal EEG in partial seizure group.

Kurupath Radhakrishnan et al[17] observed EEG abnormality in 83.6% of children studied and were generalized in 74% of children. Luiz Eduardo Betting et al[19] observed 33% of children with idiopathic generalized seizure having EEG abnormality. In study done by Shlomo shinnar et al[5] 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.

There is high incidence of EEG abnormality in partial seizure group. This observation is comparable to study done by Zajak et al[8]. 13.3%(7) of children with generalized seizure had focal EEG abnormalities in our study. This finding may be due to focal onset seizure with fast secondary generalization.

Overall 74 (74.0%) had normal neuroimaging and 26(26.0%) had abnormal neuroimaging in our study. 16.4% children with generalized seizure had abnormal finding neuroimaging. 55.5% children with partial seizure had abnormal finding in neuroimaging. In our study neurocysticercosis was observed as the commonest abnormality in partial seizure group, follwed by tuberculosis. In a study done by Ramesh baheti et al,[6] 50% of children with partial seizure and 35% of children generalized

seizure had abnormal CT findings. Hussain Jagar et al[3] observed abnormal CT findings in 68% of children with partial seizure. Shinnar s et al[9] observed 21% of children had abnormality, focal encephalomalacia and cerebral disgenesis as the most common abnormality. Annie T Berg et al[10] observed abnormality in 12.7% of those imaged. Simi Misra et al[12] observed CT Brain was abnormal in 75% of children with seizure disorder, ring enhancing lesion as the commonest abnormality(54%) followed brain atrophy. Ring enhancing lesion is the commonest abnormality observed in many studies[3,11,13,18,19].

There is statistically significant difference in the occurrence of Neuroimaging abnormality in partial seizure than generalized seizure groups in our study. Neuroimaging abnormality is more common in partial seizure group. This is similar to that observed by Annie T Berg et al[10].

Most of the children with Neurocysticercosis presented as partial seizure in our study. Macro T et al[20] observed neurocysticercosis as the primary etiology of symptomatic epilepsy in 62% of cases.

In case of generalized seizure with normal EEG, 7.1% had abnormal Neuroimaging where as in generalized seizure with abnormal EEG findings, 18.9% had abnormal Neuroimaging. In case of partial seizure with normal EEG, 33.3% had abnormal Neuroimaging where as in partial seizure with abnormal EEG findings, 48.1% had abnormal Neuroimaging findings in our study. Hence in partial seizure when Electroencephalogram is abnormal, the chance of finding abnormality in neuroimaging is higher where as in generalized seizure there is no correlation between these two

investigation. This is similar to that observed by Ramesh Baheti et al[6]. In case of generalized seizure with focal Electroencephalogram abnormality, 37.5%(3) had abnormal neuroimaging findings. Where as partial seizure with focal EEG abnormality, 83.3%(15) had abnormal Neuroimaging findings. In case of generalized seizure with generalized EEG abnormality, 15.6%(7) had abnormal Neuroimaging findings where as in partial seizure with generalized EEG abnormality, 20%(3) had abnormal Neuroimaging findings. In case of generalized seizure with normal EEG, 7.1%(1) had abnormal neuroimaging findings. In case of partial seizure with normal EEG, 33.3% (2) had abnormal Neuroimaging findings.

SUMMARY AND CONCLUSION

80% of children included in our study had abnormal interictal EEG among which 11.9% of EEG shared focal abnormalities in generalized seizures. Hence EEG is useful not only to diagnose seizures but also to classify them.

In case of partial seizure with abnormal EEG there is a high incidence of Neuroimaging abnormality.

There is high correlation between focal EEG changes and Neuroimaging abnormality in partial seizure than in generalized seizure.

16.4% of children with generalized seizures had abnormal neuroimaging. Hence neuroimaging is of immense value even in generalized seizures.

12% of children had neuroimaging features of ring enhancing lesion (Neurocysticercosis and Tuberculoma). Hence Neuroimaging is essential for comprehensive management of children with epilepsy.

EEG and Neuroimaging are mandatory in evaluating children with first episode of afebrile seizure.

BIBLIOGRAPHY

1 .Nelson textbook of pediatrics 18th edition. Behrman, Kliegman, Jenson. E1sevier publication. Page 2457-2470.

2. Forfar and Arneil's textbook of pediatrics. Sixth edition.Neil Mclntosh,Peter Helms, Rosalind Smyth. Churchill Livingstone publishers.Page 919-950

3.Hussain Jageer, Srinivasan S, Serane V Tiroumourougane, Mahadevan S, Elangovan S, Bhuvaneswari V. Cranial computed tomography in partial motor seizures. 2004; 7 1(7) : 641-644.

4. Aldenkamp AP; Arends J; OverwegPlandsoen TC; van Bronswijk KC; Schyns-Soeterboek A; Linden I; Diepman L. Acute cognitive effects of nonconvulsive difficult-to-detect epileptic seizures and epileptiform electroencephalographic discharges. J Child Neurol. 2001 ; 16(2): 119-23.

5. Shlomo Shinnar, Harriet Kang,Annie T.Berg,Eli S,Golden sohn,W Allen Hauser, Solomon L. Moshé. EEG Abnormalities in Children with a First Unprovoked Seizure.Epilepsia May 1994 ;35(3): 471- 476.

6. Ramesh Baheti, BD Gupta, Rajesh Baheti. A study of CT and EEG findings in patients with generalized or partial seizures in Western Rajasthan JIACM 2003; 4(1): 25-9.

7.Valente KD; Freitas A; Fiore LA; Gronich G; NegrAo N. The diagnostic role of short duration outpatient .V-EEG monitoring in children. Pediatr Neurol. 2003; 28(4);285-91.

8. Zajac A; Kubik A; KaciA,,ski M. Assessment of EEG in children with partial epilepsy. Przegl Lek. 2006; 63(11):1181-90.

9.. Shinnar S, O Dell C, Mitnick R, Berg AT,Moshe SL. Neuroimaging abnormaliies in children with first unprovoked seizure. Epilepsy Res 2001 Mar; 43(3):261-9.

10. Anne T. Berg*, Francine M. Testa, Susan . R. Levy, and Shlomo Shinnar Neuroimaging in Children With Newly Diagnosed Epilepsy: A Community-Based Study pediatrics September 2000;106 (3): 527-532.

11. Kumar R; Navjivan S; Kohli N; Sharma B. Clinical correlates of CT abnormaity J in generalized childhood epilepsy in India. J Trop Pediatr. 1997; 43(4):199-203.

12. Simi Misra, Brija Kishore Das,Arvind kumar Srivastava, Neuroimaging Study in Children with Seizures. JNPS; 26(1): 13-16.

13.Murthy JM, Yangala R. Etiological spectrum of localization-related epilepsies in childhood and the need for CT scan in children with partial seizures with no obvious causation--a study from south India. J Trop Pediatr. 2000 Aug;46(4):202-6.

14.Gulati P, Jena A, Tripathi RP, Gupta AK. Magnetic resonance imaging in childhood epilepsy Indian Pediatr. 1991 Jul;28(7):761-5.

15. Redda Tekle-Haimanot, Lars Forsgren, Jan Ekstedt. Incidence of Epilepsy in Rural Central Ethiopia. Epilepsia,May 1997;38(5)541-546.

16. Carlo Di Bonaventura, Anna E. Vaudano, Marco Carni, Patrizia Pantano, Vater Nucciarelli, Girolamo Garreffa, Bruno Maraviglia, Massimiliano Prencipe, Luigi Bozzao, Mario Manfredi, Anna T. Giallonardo. EEG/fMRI Study of Ictal and Interictal

Epileptic Activity: Methodological Issues and Future Perspectives in Clinical Practice. Epilepsia December 2006;47(s5):521-58.

17. Kurupath Radhakrishnan, Erik K. St. Louis, Judith A. Johnson, Robyn1 L. McClelland, Barbara F. Westmoreland, Donald W. Klass.Pattern-sensitive Epi1esy: Electroclinical Characteristics, Natural History, and Delineation of the Epiletic Syndrome. Epilepsia January 2005;46(l):48-58.

18. Gallitto G; Serra S; La Spina P; Postorino P; LaganA A; Tripodi F; Gangem S; CalabrA[2] S; Savica R.; Di Perri R; Beghi E; Musolino R. Prevalence and characteristics of epilepsy in the Aeolian islands. Epilepsia. 2005; 46(11):1828-35.

19. Luiz Eduardo Betting, Susana Barreto Mory, Iscia Lopes-Cendes, Li M. Li, Marilisa M. Guerreiro, Carlos A. M. Guerreiro, Fernando Cendes. EEG Feature in Idiopathic Generalized Epilepsy: Clues to Diagnosis.Epilepsia March 2006;47(3):523-528.

20 . Marco T, Medina, Reyna M. Durón, Lisandro Martinez, Juan Ramón Osorio, Ana L. Estrada, Concepción Zuniga, Dora Cartagena, Julianne S. Collins, Kenton R. Holden . Prevalence, Incidence, and Etiology of Epilepsies in Rural Honduras: The Salamá Study. Epilepsia January 2005; 46(1): l24-131.

21. Nair, K. P. S.; Jayakumar, P. N. 1 ; Taly, A, B.; Arunodya, G. R.; Swamy, H.S.; Shanmugam, V. 2. CT in simple partial seizures in children: a clinical and computed tomography study. Acta Neurologica Scandinavica. April 1997;95(4): 197-200.

22. J.M.K. Murthy, Ravi Yangala, Mantha Srinivas et al. The Syndromic Classification of the International League Against Epilepsy: A Hospital-Based Study from South India.

Epilepsia Jan 1998; 39 (1): 48-54.

23. Rajshekhar V; Raghava MV; Prabhakaran V; Oommen A; Muliyil J. Active epilepsy as an index of burden of neurocysticercosis in Vellore district, India. Neurology. 2006; 67(12):2135-9.

24. S. M. Montano, MD, MPH, M. V. Villaran, MD, DTMPH, L. Ylquimiche, MDC, J. J. Figueroa, MD, S. Rodriguez, BS, C. T. Bautista, MS, A. E. Gonzalez, DVM, PID, V.C.W. Tsang, PhD, R. H. Gilman, MD, DTMH, H. H. Garcia, MD, PhD for the Cysticercosis Working Group in Peru. Neurocysticercosis Association between seizures, serology, and brain CT in rural Peru. Neurology 2005;65:229-233.

25. Del Brutto OH; SantibAA±ez R; Idrovo L; RodrA-guez S; DA-az-CalderA[3]n E; Navas C; Gilman RH; Cuesta F; Mosquera A; Gonzalez AE; Tsang VC; GarcA-a HH. Epilepsy and neurocysticercosis in Atahualpa: a door-to-door survey in rural coastal Ecuador. Epilepsia. 2005; 46(4):583-7.

26. Samuel Ong,* David A. Talan,* Gregory J.Moran,* William Mower,* Michael Newdow,* Victor C.W.Tsang,* Robert W.Pinner. Neurocysticercosis in Radiographically Imaged Seizure Patients in U.S.Emergencey Departments. CDC. June 2002;8(6):608-613.

ANNEXURE

PROFORMA

CHILDHOOD SEIZURES:IMPORTANCE OF ELECTROENCEPHALOGRAM AND NEUROIMAGING

Name : Age : Sex :

Address:- Date :

HISTORY

1.SEIZURE

Age of Onset

Aura

Prodrome

Single Episode

Multiple Episode

SEMIOLOGY : Tonic / Tonic – Clonic/ Myoclonic / Absence/ Focal/

- Automatisms
- Autonomic
- Postictal : Confusion / Headache / Vomiting / Weakness / Cranial Nerves
- Fever / Headache / Vomiting / Blurring of Vision

Birth History : Neonatal insult

Developmental History :

Family History :

Drug History :

Environmental :

ON EXAMINATION :

Neurocutaneous Markers

Dysmorphic Facies

Hyperventilation.

CNS EXAMINATION :

Focal Deficit

Fundus

Cranial Nerves

Motor

Cerebellar Sign's

Evidence of Raised ICT

SEIZURE CLASSIFICATION (ILAE) :

PARTIAL SIMPLE

COMPLEX

GENERALISED

OTHERS –

INVESTIGATION :

CT BRAIN PLAIN

CONTRAST

MRI B. urea

EEG B. Sugar

X ray Skull Electrolytes-Sodium

CSF Analysis S. Calcium

X ray chest Mantoux

ABBREVIATIONS

CPS	-	Complex Partial Seizure
CT	-	Computed tomography
CNS	-	Central Nervous System
EEG	-	Electroencephalogram
GABA	-	Gama Amino Butyric Acid
HMRS	-	Proton Magnetic Resonance Spectroscopy
ILAE	-	International League Against Epilepsy
LKS	-	Landau kleffner syndrome
MRI	-	Magnetic Resonance Imaging
NCC	-	Neurocysticercosis
PET	-	Positron Emission Tomography
SPECT	-	Single Photon Emission Computed Tomography
SPS	-	Simple Partial Seizure
V – EEG	-	Video Electroencephalogram