

Correlation between Clinical Seizure Type with Aetiology, Electroencephalogram and Neuroimaging in Infants and Children Aged 1 Month -14 Years

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Abstract:

Objective: To find out etiology, determine the frequency of abnormal EEG and neuroimaging in infants and children aged 1 months-14 years.

Methods: In this cross-sectional observational study, children between 1 month and 14 years of age admitted to Sriram Chandra Bhanj Medical College and Hospital, Cuttack complaining of seizures were observed from December 2020- December 2022.

Results: Out of 210 patients 137 had abnormal EEG, of whom only 42.5% also had abnormal CT scan and the majority 52.5% had normal CT. However out of 38 cases with normal EEG recording 28% had abnormal CT scan. There is a statistically significant relationship between EEG recording and CT scan findings ($p=0.045$).

Conclusion: Based on our findings we recommend EEG and Neuroimaging only in all children with abnormal history, clinical examinations, endemicity of tuberculosis and persistent altered sensorium or focal deficits following an epileptic fit.

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Introduction

Seizures are characterized as brief, involuntary changes in awareness, behavior, motor activity, sensation, or autonomic function that are brought on by an excessive rate and hyper-synchrony of discharges from a cluster of brain neurons. Epilepsy, febrile seizures, single seizures, seizures related to metabolic, viral, or other etiologies, as well as other conditions, are all often referred to as seizure disorders. One or more distinct seizures may occur as a symptom of epilepsy syndrome, which has a specified age of onset and prognosis.

McAbee et al [1] stated seizures are the most common neurological disorder with 4-10% of children suffering at least one seizure in the first 16 years of life. As per Vinning EP [2] incidence is higher in children younger than 3 years of age. Less than 1/3 of seizures in children are caused by epilepsy, cumulative lifetime incidence is 3% with more than half of cases begin in childhood. The prevalence is higher in developing countries such as Columbia, Ecuador, India, Nigeria, Panama, United republic of Tanzania and Venezuela in which prevalence of more than 10/1000 were reported [3, 4]. Reasons for higher incidence are related to higher risk of permanent brain damage like central nervous system infections, head trauma, perinatal

complications, and malnutrition [5, 6]. The prognosis of children with epilepsy is often favourable, but 10-20% experience chronic seizures resistant to treatment, making diagnosis and treatment more difficult.

A child with seizures should be evaluated using clinical examination, Electroencephalogram (EEG), Magnetic Resonance Imaging (MRI), and Computer Tomography scans (CT). In situations like cerebral hemorrhage, calcifications, and tumors where prompt diagnosis and treatment are needed CT is preferred. MRI scans are more sensitive than CT scans in situations like cortical abnormalities, dysgenesis, hippocampal sclerosis etc.

Murthy et al [7] carried out a study on 591 patients with generalized seizures and observed 53% of them had an identifiable etiology. Localisation of abnormalities in partial seizures varies from 28% to 80% association as found in different studies [8, 9].

This study was developed and carried out in response to the frequent hospitalization for seizure disorders and the diversity of opinions on etiology, EEG, and neuroimaging abnormalities. Additionally, this study is expected to broaden the scope to include the

detection of several deadly curable illnesses thereby reducing mortality and morbidity.

Aims and Objectives

- To find out etiology, determine the frequency of abnormal EEG and neuroimaging in infant and children aged 1 months-14 years.
- To draw a correlation between clinical seizure type with etiology, EEG and neuroimaging.

Materials and Methods

Study design: Cross-sectional observational study.

Subjects: Children between 1 month and 14 years of age admitted to Sriram Chandra Bhanj Medical College and Hospital, Cuttack complaining of seizures.

Duration: December 2020- December 2022.

Inclusion criteria- >1 month and < 14 years child with seizures with or without focal deficits.

Exclusion criteria: Neonatal seizures, Typical Febrile seizures, Post Traumatic seizures, Pseudoseizures

Sample size: Total 210 patients were recruited.

A detailed history, demographic data was taken, thorough clinical examination was done to elicit etiology than blood glucose was estimated for all patients by heel prick or finger prick as required using Accu check glucometer. Blood glucose less than 45 mg/dl was considered as hypoglycaemia and

treated accordingly. Routine blood tests like complete blood count (CBC), liver function tests (LFT), Renal function tests (RFT), Serum electrolytes, malaria parasite detection tests(slide & ICT), Widal, blood culture, urine culture, Scrub typhus etc were sent to rule out possible infections. Fundoscopy and Lumbar puncture test were done to rule out meningitis. All the patients were advised for EEG with proper handwashing and sedation prior to the investigation. Standard recording speed was 30 mm/ sec, calibrations 50 microvolts (deflection of 7 mm). The first 8 channels showed changes in the right hemisphere and the last 8 channels show changes in left hemisphere. Epileptiform activity was studied as spikes, polyspikes, sharp waves alone or in combination with waves, hysarrhythmias etc. CT scan (non-contrast) was done in all patients with a 3rd generation CT scan machine from SIEMENS. MRI was done using 1.5 Tesla magnet (GE).

Statistical Analysis

The collected data was entered into worksheets of Microsoft Office Excel Version 2013. Data was analyzed using descriptive statistics. Categorical variables were expressed as percentages, compared using Pearson's Chi Square test for Independence of Attributes/ Fisher's Exact Test as appropriate. SPSS version 22 has been used for analysis. P value less than 0.05 has been considered as significant.

Results

Table 1: Distribution of seizure frequency among various seizure subtypes

Seizure Type	Frequency	Percentage (%)
Generalised Seizures		
Generalised Atonic Seizure	14	6.7
Generalised Myoclonic Seizure	7	3.3
Generalized Tonic Seizure	11	5.2
Generalised Tonic Clonic Seizure	94	44.7
Infantile Spasms	2	1.0
Partial Seizures		
Simple Partial seizure	22	10.5
Complex Partial Seizure	55	26.1
Complex Febrile Seizures		
Complex Febrile Seizure	19	9.0
Undiagnosed	6	2.8
Total	210	100

Generalised tonic-clonic seizures which were a type of generalized seizures were the most common subtype of seizures (44.7%). Partial seizures were the second most common among which complex partial seizures (26.1%) were more common than simple febrile seizures(10.5%). Infantile spasms were the least common form (1%).

Table 2: Co-relation of EEG recording with CT scan

EEG	CT Scan						P Value
	Abnormal		Normal		Not Done		
	Count	%	Count	%	Count	%	
Abnormal	65	42.5	72	46.8	17	11.0	0.045
Normal	11	27.5	27	67.5	2	5.0	
Not Done	10	62.5	4	25.0	2	12.5	

Out of 210 patients 137 had abnormal EEG, of whom only 42.5% also had abnormal CT scan and majority 52.5% had normal CT. However, out of 38 cases with normal EEG recording 28% had abnormal CT scan. There is a statistically significant relationship between EEG recording and CT scan findings (p=0.045).

Table 3: Co-relation between EEG recording with MRI scan abnormality

EEG	MRI Scan						P Value
	Abnormal		Normal		Not Done		
	Count	%	Count	%	Count	%	
Abnormal	78	50.6	42	27.3	34	22.1	<0.001
Normal	14	35.0	3	7.5	23	57.5	
Not Done	13	81.3	3	18.8	0	0.0	

Out of 120 patients with abnormal EEG 65% also had abnormal MRI scan. And rest 17 patients with normal EEG recording 82% had abnormal MRI showing a statistical significant relationship (p<0.001) exists between EEG and MRI scan.

Table 4: Co-relation of MRI and CT

CT Scan	MRI Scan						P Value
	Abnormal		Normal		Not Done		
	Count	%	Count	%	Count	%	
Abnormal	85	98.8%	1	1.2	0	0.0	<0.001
Normal	10	9.7%	47	45.6	46	44.7	
Not Done	10	47.6%	0	0.0	11	52.4	

Total 86 patients had abnormal CT findings, of them 98.8% i.e. 85 patients also had abnormal MRI scan. 57 patients had normal CT but of them only 17% had abnormal MRI. (p<0.001)

Discussion

In the present study ,210 cases between 1 month and 14 years were evaluated. The most age group for seizures was 5- 10 years constituting up to 40%. generalized tonic clonic type of seizures were the most common variant which is similar to that found in the study conducted by Kapoor et al [10] constituting (58.3%) and Shawki et al (49.5%)[5]. However Berg et al found complex febrile seizures prevalence to be 10-15% in his study which was dissimilar our study with only 9%. This can be explained by the definitions that are taken as complex febrile seizures.

We found 50.9% patients with partial seizures and 88.3% with generalized seizures had abnormal EEG. This correlates well with the study conducted by Baheti et al [11]and Akhtar et al [12] in terms of percentage but a striking difference was found between the electrical activity noted in the above studies and our study. They showed sharp wave and spike Pattern in both generalized and partial seizure groups where we found sharp wave alone as the common pattern in partial seizure group. This difference may be due to varied opinion by different neurologist having experience in pediatric EEG.

Our study revealed 137 patients had abnormal EEG recording of whom 47% had abnormal CT scan, of 37 patients with normal EEG 28% had abnormal CT. this correlates well with Baheti et al [11] who observed 57.8% and 28.5% chance of finding

abnormal CT scan with abnormal and normal EEG respectively.

Out of 120 patients who had abnormal EEG recording, the majority 65% had abnormal MRI.. But 82% patients who had abnormal MRI findings had a normal EEG recording. This was due to high picking power of MRI with normal EEG recording.

A statistically significant association between CT scan and MRI scan as 98.8% patients had both abnormal CT and MRI scan. Whereas only 17% with normal CT Had abnormal MRI scan.

Conclusion

EEG is one of the basic test done for every seizure disorder patient and there is a strong correlation between the type of seizure seen and the presence of an EEG abnormality. Further there was a strong correlation between abnormal EEG and abnormal neuroimaging. Hence the need of neuroimaging tp be strongly considered in children having abnormal EEG, though the patients having normal EEG can be safely discharged without neuroimaging if follow up can be assured. MRI has advantage over CT scan in diagnosis of complex febrile seizure.

Aetiology can be suspected from the type of EEG abnormality and could be confirmed by neuroimaging in most of the cases of seizure disorder patients. Furthermore this knowledge will facilitate mass awareness amongst parents and public and multi-disciplinary diagnostic facilities, therapeutic rehabilitation and approaches.

Based on our findings we recommend EEG and Neuroimaging only in all children with abnormal history, clinical examinations, endemicity of

tuberculosis and persistent altered sensorium or focal deficits following an epileptic fit.

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