CLINICAL INVESTIGATION

Electroencephalographic profile of children attending a neurophysiology centre in Lagos, Nigeria

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Abstract

Background: Electroencephalography (EEG) is an important diagnostic tool for the evaluation of neurological disorders. There is a paucity of information about EEG recordings in Nigerian children. This study, therefore, aimed to describe the pattern and prevalence of EEG abnormalities among children referred for EEG assessment at a neurophysiology centre in Lagos, Nigeria.

Methods: This was a prospective study carried out at a neurophysiology centre, Lagos, Nigeria. Consecutive 200 patients referred for EEG at a neurophysiology centre between 1st October, 2015-30th April 2016 were recruited into the study. Information was obtained on demographic, clinical presentation and EEG recordings.

Results: The age of children ranges from 1-192 months with a median age of 42 (IQR 25-88) months. There were 128 males (64%) and 62 females (36%). Commonest clinical indications for making EEG request were seizure disorder (55%), cerebral palsy (24.5%) and afebrile seizure (6.5%). EEG recording was abnormal in 161 (80.5%) children. There was a significantly high prevalence of abnormal epileptiform discharges in all cases with the exception of children with febrile seizures (p=0.002). The commonest abnormal epileptiform discharges were focal (70.2%). Others werea generalized epileptiform activity (24.8%) and slow and diffuse waves suggestive of encephalopathies (5%). Ten (2%) children from the study population were diagnosed with absence seizure, Lennox-Gaustaut, and infantile spasm

Conclusion: Secondary causes of seizure are an important contributor to seizure disorders in Nigerian children. The EEG is useful in the detection and classification of seizure types.

Keywords: Electroencephalography • seizure, children • Nigeria

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Introduction

Seizure disorder results from the abnormal or excessive discharge of cerebral neurons which manifest in the form of motor, sensory, autonomic or psychic symptoms with or without loss of consciousness [1,2]. A seizure is a universal problem involving all ages, races, social classes, and nations [1,2]. However, the prevalence of seizure disorder is higher in low and middle-income countries particularly those in sub-Saharan Africa and Latin America [1-3]. According to a recent report by the World Health Organization, approximately 50 million people worldwide have a seizure with nearly 80% of these people living in low- and middle-income countries [4].

Although the diagnosis of seizure disorder is largely based on clinical manifestation, the evaluation of patients with suspected seizures requires the use of diagnostic tools such as electroencephalography and neuroimaging. This allows accurate diagnosis and proper treatment to be given thereby reducing morbidity and mortality in children with a seizure disorder.

The electroencephalogram (EEG) is a simple device which records the electrical activity of the brain through the use of an electronic device [5,6]. It is a valuable tool for assessing patients having seizures and other neurological conditions. It supports the diagnosis of seizure type in the presence of suggestive clinical features and in the classification of seizures. It is also useful to monitor prognosis, predict recurrence risk as well as the risk of relapse after drug withdrawal. The advent of digital EEG has allowed ease of application, manipulation of this device, quality, and interpretation of recordings especially in low technological settings [6].

In Nigeria, various hospital-based studies have shown that seizure is the commonest childhood neurological disorders with the prevalence rate ranging from 26.3%-60% [7-9]. Despite this high prevalence of seizure disorder among Nigerian children, there are few centres with facilities for electroencephalography. In addition, most of these existing centres are run by adult neurologists and psychiatrists. There is the paucity of information on the use and profile of recordings of EEG in routine child neurology practice in Nigeria. It is important that the profile of EEG recordings of Nigerian children be ascertained. Therefore, the aim of this study is to determine the pattern and prevalence of EEG abnormalities and the relationship between clinical indications and electroencephalographic diagnosis among children referred for EEG assessment at a neurophysiology centre in Lagos, Nigeria.

Methods

This was a prospective study of children seen over a period of six months (1st Oct 2015-30th April 2016) at the Electrophysiology Services Limited, Ikeja, Lagos, Nigeria. The centre has one trained electrophysiologist, 2 Medical officers and five nurses. The children were referred from various public and private medical facilities in Lagos and neighboring cities. They were being investigated for various neurological conditions, primary of which was a possible seizure disorder. All consecutive 200 children seen during the study were enrolled in the study.

Every child presenting at the center was interviewed by the medical officer on duty using a specifically designed proforma to obtain information from the parent/caregiver. Information was obtained on demography, clinical history, physical findings, and EEG recordings.

Cooperative children were assessed for EEG in the awake state while children who were unlikely to co-operate were sedated. Sedation consisted of the use of intramuscular paraldehyde approximated at 1ml per year of life at a maximum of 5 mls. Children who did not sleep an hour after the injection of paraldehyde were given a repeat dose at half of the initial dose given. Failed sedation after this resulted in abortion of the procedure to another day when sleep deprivation and sedation were then attempted. For the recording, most children were evaluated lying supine on the bed while a few were recorded sitting on the caregivers' laps or strapped to the back. A digital EEG machine-EB Neuro B.E. Light 32 channel, made in Italy was used to capture all recordings.

Appropriately placed 5 mm cup electrodes-using the Ten 20 EEG paste were attached to the appropriate anatomic sites on the scalp of the children using the 10-20 electrode placement system. A total of 23 electrodes were attached to each child, to include the pre-auricular and the midline Z electrodes. The recording was done using the longitudinal bipolar (double banana) montage. Post record formatting using other montages was also done. Average recording time was 15 minutes when awake, but up to 30 minutes should sleep occur. Hyperventilation and photic stimulation were done as activation procedures when considered appropriate.

The EEG was recorded by trained electrophysiologist and interpreted by a pediatric neurologist. EEG recording was considered abnormal when slow waves, sharp waves, spikes, spike-wave complexes or any epileptiform discharges were noted in the tracings. Those with abnormal EEG recordings were further classified into either focal or generalized or epilepsy syndromes depending on the findings on EEG tracing.

Statistical Analysis

Data were entered into Microsoft office excel and exported to statistical package SPSS for Windows version 21 for data analysis. Descriptive statistics were done on variables of interest. Categorical variables were compared using the chi-square test. A value of $p<0.05$ was considered statistically significant.

Results

A total of 200 children were studied. The age ranges from 1-192 months with a median age of 42 (IQR 25-88) months There were 128 males (64%) and 62 females (36%) giving male: female ratio of 1.8:1. Table 1 shows the frequency of occurrence of the clinical cases referred for electroencephalographic assessment. The clinical cases were significantly associated with age groups (p=0.001). Among children aged less than 60 months, seizure (34.2%), cerebral palsy (32.5%) and febrile seizure (10.3%) were the commonest reasons for making a request for EEG. For children aged 60-120 months, the commonest clinical cases were a seizure (59.2%) and cerebral palsy (20.4%) while for children aged greater than 120 months, the commonest clinical cases were a seizure (67.6%) and previous central nervous system infections (29.4%).

One hundred and twenty eight (64%) children had EEG recorded in a sedated state while 72 (36%) were recorded awake. Waveforms were mostly rhythmic (99%), symmetric (98.5%), and of a moderate voltage (93.5%). Only 3 (1.5%) children had an asymmetric recording. The EEG was abnormal in 161 children (80.5%).

Table 2 shows the relationship between clinical cases and the outcome of EEG recordings. There was statistically significantly (p=0.002) higher frequency of detecting abnormal EEG recording in all cases with the exception of febrile convulsion.

Figure 1 shows the frequency of the different pattern of abnormal EEG recording. Focal epileptiform activity was present in 113 (70.2%) children, generalized epileptiform activity was noted in 40 (24.8%) children while encephalopathy (focal or diffuse) was present in 8 (5.0%) children.

Figure 2 shows the distribution of EEG diagnosis

Table 1. Frequency of clinical cases referred for EEG according to age groups

Clinical cases	Total (n=200)	Age groups (months)		
		<60 (n=117)	60-120 (n=49)	>120 (n=34)
Seizure	92 (46.0)	40 (34.2)	29 (59.2)	23 (67.6)
Seizure with comorbidity	18 (9.0)	9 (7.7)	5 (10.2)	4 (11.8)
Febrile seizure	13 (6.5)	12 (10.3)	1 (2.0)	0 (0.0)
Cerebral palsy	49 (24.5)	38 (32.5)	10 (20.4)	1 (2.9)
Birth asphyxia with hypoxic ischemic encephalopathy	4 (2.0)	4 (3.4)	0 (0.0)	0 (0.0)
Meningitis/Encephalitis	10 (5.0)	5 (4.3)	1 (2.0)	10 (29.4)
Miscellaneous	14 (7.0)	9 (7.7)	3 (6.1)	14 (41.2)
$\chi2=32.7$; p=0.001				

Table 2. Relationship between clinical cases and electro-diagnosis

Clinical cases	Electroencephalography		
	Total (n=200)	Abnormal (n=161)	Normal (n=39)
Seizure	92 (46.0)	79 (49.1)	13 (33.3)
Seizure with comorbidity	18 (9.0)	16 (9.9)	2 (5.1)
Febrile seizure	13 (6.5)	5 (3.1)	8 (20.5)
Cerebral palsy	49 (24.5)	36 (22.4)	13 (33.3)
Birth asphyxia with hypoxic ischaemic encephalopathy	4 (2.0)	3 (1.9)	1 (2.6)
Meningitis/Encephalitis	10 (5.0)	10 (6.2)	0 (0.0)
Miscellaneous	14 (7.0)	12 (7.5)	2 (5.1)
$\chi2=21.4$; p=0.002			

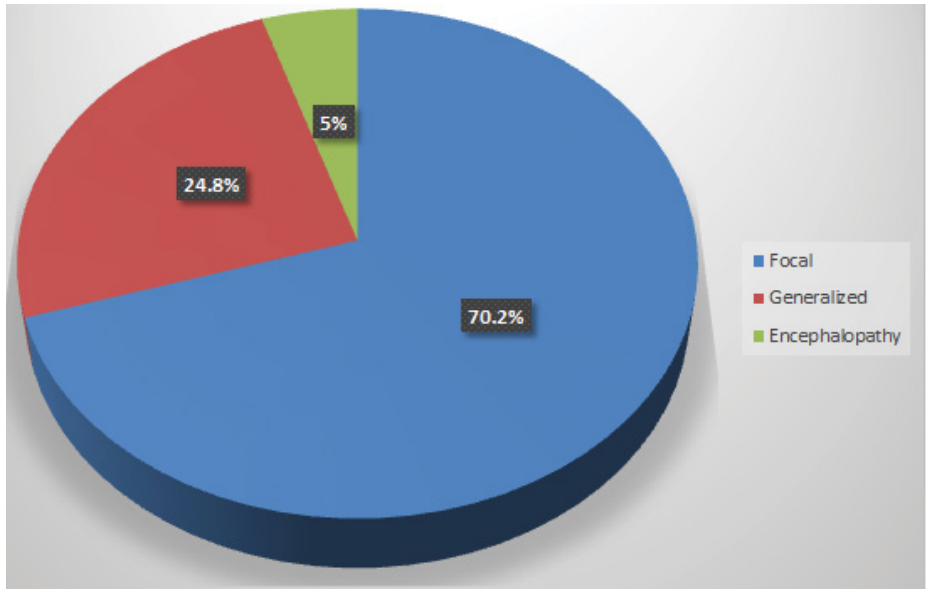

Figure 1: Pattern and frequency of abnormal electroencephalogram.

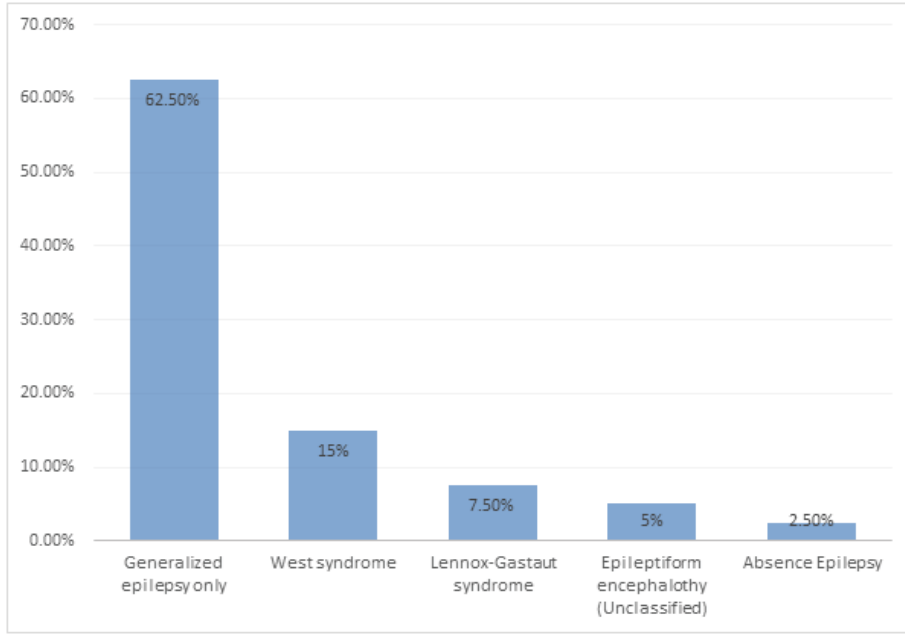

Figure 2: Electroencephalographic diagnosis in children with generalized seizure.

in children with generalized seizures. Out of 40 children with generalized seizure, 25 (62.5%) children had generalized seizures only, 6 (15%) children had West syndrome, 3 (7.5%) children had Lennox-Gastaut, 2 (5%) children had unclassified epileptic encephalopathy and a child (2.5%) had absence seizure.

Discussion and Conclusion

This study described the clinical indications for EEG, the pattern and distribution of electrodiagnosis and the relationship between clinical diagnosis and electro-diagnosis in Nigerian children. In this study, the majority of the children were aged less than 60 months and there were a higher proportion of male subjects. This is in agreement with the pattern reported in several studies showing greater prevalence in the young childhood population and preponderance of seizure disorder among males [10-12]. In developing countries, children who are an under-five year old are

at risk of several health burdens such as infections and perinatal asphyxia. Many of these conditions can affect brain function and present with a seizure disorder. The reason for the higher prevalence of seizure in males is not clearly known. However, it is suggested that some genetic epilepsy syndromes are more common in males. It may also be due to the abandonment of females and seeking medical help for male children due to a cultural preference for male children in certain communities [12].

The commonest reason for EEG request was a provisional diagnosis of epilepsy. This was demonstrated in this study with more than half (55%) of the requests due to epilepsy. This prevalence will be higher if children referred for fainting spells and other unusual body movements are included. Other reasons for making EEG request were neurological conditions such as cerebral palsy, febrile convulsion, severe birth asphyxia, and central nervous system infection. It should be noted that about a quarter of the children referred for EEG assessment in this study had cerebral palsy. This was higher than 1.6% reported for children from Nepal [13]. This is reflective of the level of obstetrics and perinatal care expected to prevent morbidity and mortality. Good perinatal care including detection of high-risk pregnancies, control of high blood pressure and infectious diseases during pregnancy and supervised delivery can prevent brain damage that may lead to epilepsy in the developing baby.

In our study, EEG recording was abnormal in 80.5% of cases. This is similar to 94% obtained in Ibadan, Nigeria [14] but higher than 56.5% from Nepal [13], 61% from Wellington, New Zealand [10] and 72% from Rochester, USA [15] This regional differences in yield of EEG epileptiform abnormalities may be related to the different clinical indications for utilizing EEG. There was a significantly higher chance of obtaining abnormal EEG recording in all clinical cases with the exception of febrile seizure. In children with febrile seizure, EEG recording was abnormal in 38.5% which was similar to 31% reported for children from Seol, Korea [16] This is in contrast to the findings in Iran where 69.4% of children with febrile seizure had abnormal EEG recordings [17] Several studies have shown that abnormal EEG in children with febrile seizure, in particular, focal epileptiform discharges, is a risk factor for subsequent epilepsy [18,19] This may justify the request for EEG assessment in children with complex febrile seizure by physicians in most parts of the world. However, in a Cochrane review study, there was no evidence to support or refute the use of EEG and the timing of its use after febrile seizures in children [20].

Focal epilepsy was the commonest seizure type in this study. This finding runs contrary to the general assumption of generalized epilepsy being commonest in children [21] Considering that about two-thirds of all the focal epilepsies became secondarily generalized [22], it is not unsurprising that a natural assumption of a generalized seizure is often what is presented clinically. The originating focal etiology is often best identified by carrying out an electroencephalogram assessment.

The EEG as shown in this study can also be used to determine the exact type of seizure disorder. This was noted in 10 (2%) children from the study population diagnosed with absence seizure, Lennox-Gaustaut, and infantile spasm. Epileptic encephalopathies are a subpopulation of epilepsies which result in significant brain dysfunction. Early diagnosis and appropriate management have been found to positively improve their outcome. This study showed that epileptic encephalopathies accounted for 2% of the generalized seizures and 5% of children with a seizure disorder. This suggests that epileptic encephalopathies are an important occurrence in Nigerian children and attention needs to be paid to their presence in children with seizure disorders.

In conclusion, the electroencephalogram remains a valuable tool for investigation of seizures in Nigerian children. It helps with the recognition of presence, classification of seizure type and diagnosis of epilepsies in children. This allows for the appropriate choice of antiepileptic drug and prognostication of the epilepsies.

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Nil.

Conflicts of Interest

There are no conflicts of interest.

Executive summary

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