

A comparative study of EEG findings among subjects in seizure-remission and patients with epilepsy in a resource constrained west African psychiatric hospital.

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Abstract

Background: Epilepsy is one of the commonest chronic neurological disorders, most especially in developing countries of the World. Again, electroencephalography (EEG) is an important investigation in epileptology and more so in monitoring seizure remission. Thus, in a resource constrained country like Nigeria, our study aimed to determine the epileptiform activities using routine EEG recordings on subjects in seizure remission compared to those subjects with active seizures.

Methods: In our study, and following ethical approval, standard EEG recording was carried out on convenient samples of equal number (131) of subjects with active seizure and those in seizure remission using the “Neurofax” Electroencephalography, EEG-1200 (R) machine. The EEG machine was used to carry out an awake 22-channel EEG scalp recording on each subject.

Results: Among subjects with active seizures, the mean duration of seizure was 2.80 ± 2.44 years, with range of 0.5 to 12.0 years. For subjects in seizure remission (SSR), the mean duration of remission was 2.41 ± 1.03 years, with range of 1 to 5 years. Out of the 131 subjects with seizure, 37 (28.3%) had normal EEG recording; and 94 (71.7%) had abnormal EEG recordings with various forms of epileptiform activities. On the other hand, of the 131 subjects in seizure remission (SSR), nearly half, 62 (47.3%) had normal EEG recording and 69 (52.7%) had abnormal (epileptiform activities) recording. The difference in these EEG findings between the two study groups was significant with $F=19.29$, $p=0.00^*$; $t=-2.22$, $p=0.028^*$; and 95% Confidence Interval, $CI=-0.70$ to -0.40 .

Conclusion: In addition to clinical evaluation, routine EEG recording can be used to monitor seizure remission in resource constrained countries such as Nigeria.

Keywords: EEG Findings, Epilepsy, Seizure-remission, Resource-constrained, Nigeria.

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Une étude comparative des résultats de l'EEG chez les sujets en crises-rémission et les patients épileptiques dans un hôpital psychiatrique ouest-africain à ressources contraintes

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Résumé

Contexte général de l'étude : L'épilepsie est l'un des troubles neurologiques chroniques les plus courants, plus particulièrement dans les pays en développement du monde. Encore une fois, l'électroencéphalographie (EEG) est une investigation importante en épileptologie et plus encore dans le suivi de la rémission des crises. Ainsi, dans un pays aux ressources limitées comme le Nigéria, notre étude visait à déterminer les activités épileptiformes à l'aide d'enregistrements EEG de routine sur des sujets en rémission de crises par rapport à ceux avec des crises actives.

Méthode de l'étude : Dans notre étude, et après approbation éthique, un enregistrement EEG standard a été effectué sur des échantillons pratiques d'un nombre égal (131) de sujets présentant des crises actives et de sujets en rémission de crises à l'aide de l'électroencéphalographie "Neurofax", machine EEG-1200 (R). La machine EEG a été utilisée pour effectuer un enregistrement EEG éveillé du cuir chevelu à 22 canaux sur chaque sujet.

Résultat de l'étude: Parmi les sujets ayant des crises actives, la durée moyenne des crises était de $2,80 \pm 2,44$ ans, avec une plage de 0,5 à 12,0 ans. Pour les sujets en rémission des crises (SSR), la durée moyenne de rémission était de $2,41 \pm 1,03$ ans, avec une fourchette de 1 à 5 ans. Sur les 131 sujets présentant des crises, 37 (28,3 %) avaient un enregistrement EEG normal ; et 94 (71,7%) avaient des enregistrements EEG anormaux avec diverses formes d'activités épileptiformes. D'autre part, sur les 131 sujets en rémission des crises (SSR), près de la moitié, 62 (47,3%) avaient un enregistrement EEG normal et 69 (52,7%) avaient un enregistrement anormal (activités épileptiformes). La différence dans ces résultats EEG entre les deux groupes d'étude était significative avec $F = 19,29$, $p = 0,00$ * ; $t = -2,22$, $p = 0,028$ * ; et intervalle de confiance à 95 %, $IC = -0,70$ à $-0,40$.

Conclusion : En plus de l'évaluation clinique, l'enregistrement EEG de routine peut être utilisé pour surveiller la rémission des crises dans les pays à ressources limitées comme le Nigéria.

Mots-clés : résultats EEG, épilepsie, crise d'épilepsie, ressources limitées, Nigéria

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INTRODUCTION

Epilepsy is described as a person having at least two unprovoked seizure episodes greater than 24 hours apart; or as one unprovoked seizure and a probability of further seizures similar to the general occurrence risk after two unprovoked seizures (1). The definition of epilepsy includes evidence of electroencephalographic (EEG) compliments or a significant symptomatic aetiology on Magnetic Resonance Imaging (MRI) of the brain (1, 2). While the diagnosis of epilepsy is largely clinical, based on good history taking and accurate physical and neurological examination, electroencephalography (EEG) is an important supplementary diagnostic tool to classify the type of epilepsy and monitor remission to treatment; and it remains one of the most commonly used investigative tool in the evaluation of people with epilepsy (3,4,5).

For most patients with seizures, the standard 30-minutes EEG recordings are routinely carried out most especially in developing countries such as Nigeria with dearth of EEG recording facilities (6). The limitation of this standard recording is failure to show epileptiform activities in the EEG of some clinically diagnosed seizure cases (7).

A very important aim in the management of epilepsy is to achieve seizure control; and for decades now seizure control is defined as seizure remission for 1 year (5). Aside from clinical evaluation, EEG recording is also an important investigation used to monitor and evaluate seizure remission (8, 9, 10). Furthermore, studies have also shown some factors as predictors of seizure recurrence during or after antiepileptic drug (AED) discontinuation. Such factors include using multiple AEDs, focal epilepsy, multiple types of seizure and increased EEG epileptiform abnormalities (11, 12).

Among these factors, only EEG epileptiform activities can be monitored preferably using long term EEG recording (LTM EEG) which includes ambulatory EEG (aEEG) and video EEG (vEEG). These LTM EEG modalities are more sensitive to detect epileptiform activities, they have higher sensitivity and lower false negative rates to detect such abnormalities when compared with regular routine EEG recording (13). However, in a resource constrained setting such as Nigeria, LTM EEG techniques of aEEG and vEEG are not available, but only routine EEG recordings. Thus, the objective of this study was to determine the epileptiform activities using routine EEG recordings on subjects in seizure remission

compared to those subjects with active seizures in a foremost West African Psychiatric hospital.

MATERIALS AND METHODS

Study Setting

The study was carried out in the Electroencephalography (EEG) unit of the Federal Neuropsychiatric Hospital (FNPH), Yaba, Lagos. The hospital is one of the foremost psychiatric facilities in Nigeria with over 500 beds for in-patients and a number of out-patient clinics to take care of psychiatrically ill patients from Lagos metropolis, referrals from surrounding states and neighbouring West African countries such as Benin Republic.

Subjects

Subjects included those referred for EEG recordings from within the hospital and those from other health facilities. Using convenient sampling, two groups of subjects were selected for study over a five-year period (January 2016 to December 2020). One group included subjects in seizure-remission for a minimum of one year; and the other group included subjects with active seizures, that is seizure duration of at least 6 months.

Ethical approval to carry out the study was obtained from the Research and Ethics Committee of the hospital (FNPH, Yaba) and consent was obtained from each participant.

Instruments and Procedure

- Socio-demographic and Clinical Proforma: This was used to obtain socio-demographic information such as age and sex. Clinical information obtained for the subjects with active seizures included clinical description of the seizure and seizure duration; and for those in remission and duration of remission.
- Electroencephalography (EEG) machine: The “Neurofax Electroencephalography, EEG-1200 (R) was used in this study (14).

The EEG machine was used to carry out an awake 22-channel EEG scalp recording on each subject. The setting was in a silent room in the EEG unit of the hospital (FNPH, Yaba); devoid of noise and environmental distractions. The recording was over 45-60 minutes with 5 minutes activation of hyperventilation. Furthermore, errors were ensured to be reduced to the barest minimum by eliminating sources of artefacts as much as possible. The EEG tracings were interpreted by two Consultant Neuropsychiatrists who had training in Electroencephalography, and

with twelve to sixteen years' experience in EEG interpretation.

RESULTS

Socio-demographic Variables (Table I)

One hundred and thirty-one (131) subjects were studied in each group: those with active seizures and those in seizure-remission, giving a total of two hundred and sixty-two (262) subjects. The two groups were age and sex matched. Thus, there was equal sex distribution of 86 (65.6%) males and 45 (34.4%) females in each group.

The mean age of subjects with seizure was 11.41 ± 9.40 years and age range of 2 to 80 years. The highest age groups were 0 to 10 years (55.7%) and 11 to 20 years (38.9%). For patients in seizure remission, the mean age was 11.37 ± 9.61 years and age range of 2 to 53 years. The highest age groups were also 0 to 10 years (53.4%) and 11 to 20 years (41.2%).

Clinical Variables

- Subjects with active seizures: The mean duration of seizure was 2.80 ± 2.44 years, with range of 0.5 to 12.0 years.
- Subjects in seizure remission (SSR): The mean duration of seizure remission was 2.41 ± 1.03 years, with range of 1 to 5 years.

EEG Findings

- Subjects with active seizures (Table II)

Out of the 131 subjects with seizure, 37 (28.3%) had normal EEG recording; and 94 (71.7%) had abnormal EEG recordings with various forms of epileptiform activities of spikes/polyspikes, sharp waves and spikes/polyspikes-and-slow wave complexes.

Localization of EEG abnormalities: Twenty-two (16.8%) had focal (Frontal, Temporal, Fronto-temporal and Fronto-centro-temporal) abnormal epileptiform activities. Focal with secondary generalization, 9 (6.9%) and Bursts epileptiform activities, 63 (48.1%).

Lateralization of EEG abnormalities: Six (4.5%) had right sided localization of their epileptiform activities, 7 (5.3%) bilateral, 9 (6.9%) each for left sided as well as focal with secondary generalization respectively, and 63 (48.1%) were burst epileptiform activities.
- Subjects in seizure remission (Table II): Out of 131 subjects in seizure remission (SSR), nearly half, 62 (47.3%) had normal EEG recording and 69 (52.7%) had abnormal

(epileptiform activities).

Localization of EEG abnormalities: Eighteen (13.8%) had focal epileptiform recordings over the Frontal, Temporal, Fronto-temporal and Fronto-centro-temporal recordings. Six (4.6%) had focal epileptiform activities with secondary generalization; and 45 (34.4%) had burst epileptiform activities.

Lateralization of epileptiform activities: Burst activities were found in 45 (34.4%) subjects, followed by bilateral lateralization, 10 (7.5%) and the least, 2 (1.5%) were left sites.

Inter-relationship between EEG abnormalities and Socio-demographic Variables (Table III)

- Subjects with active seizures: Age group had significant relationship with EEG abnormalities; that is younger age groups were more likely to have EEG abnormalities, with chi-square of 27.88 and $p=0.001$. Similarly, localization and lateralization also had significant relationships with EEG abnormalities at $p=0.001$ (Table III).
- Subjects in Seizure Remission (SSR): The EEG abnormalities had significant relationships with age groups, localization and lateralization as follows:
 - EEG abnormalities v. Age groups: $X^2=19.0, p=0.002$
 - EEG abnormalities v. Localization: $X^2=132, p=0.001$
 - EEG abnormalities v. Lateralization: $X^2=131, p=0.001$

Comparative Analysis of EEG Abnormalities Between Subjects with Active Seizure and those in Seizure Remission

More subjects with active seizure had EEG abnormalities of epileptiform activities, 94 (71.7%), compared with seizure-free subjects, 69 (52.7%). Consequently, nearly twice the percentage of subjects in seizure remission has normal EEG tracing compared to subjects with active seizures (47.3% v. 28.3%). The difference in these EEG findings was significant with $F=19.29, p=0.00^*$; $t=-2.22, p=0.028^*$; and 95% Confidence Interval, $CI=-0.70$ to -0.40 (Table IV).

DISCUSSION

In our study, subjects in both groups were predominantly children and adolescents; and this is in line with the fact that epilepsy is still majorly found in children and young adults in sub-Saharan Africa (15). Till date, the diagnosis of

epilepsy is mainly clinical from the witness account of the seizure episodes; while electroencephalography (EEG) remains the most important investigation to authenticate the diagnosis, classify the type of epilepsy, localize the seizure focus and guide prognosis (16).

In our study, 71.7% of subjects with epilepsy (SWE) had abnormal recordings of epileptiform activities in their EEG tracings. This is in line with previous studies where 29-56% of SWE have abnormal epileptiform activities in their initial routine EEG tracings; with yield increasing to more than 80% in subsequent recordings (16,17,18). Furthermore, in the diagnostic investigation of epilepsy, abnormal and epileptiform waves while the patient is having a seizure, that is ictal EEG recording and interictal epileptiform discharges are affirmed to be the most important findings that are consistent with accurate diagnosis of epilepsy (10,19). Comparatively, only 52.7% of subjects in seizure remission (SSR) had epileptiform activities in their EEG recordings.

Age is the only socio-demographic variable that is significantly related to EEG abnormalities in our study (Table III); that is epileptiform activities were more in the EEG tracings of the younger age groups in both study groups. This is similar to findings from previous studies that subject's age at onset of seizure and time of EEG recording is related to presence or absence of epileptiform activities in the EEG tracings (20).

Comparison between EEG findings among SWE and SSR groups.

EEG, most especially using the long-term monitoring (LTM) method has been found to be useful to monitor patients on antiepileptic drugs (AEDs), subjects in seizure-remission and prediction of seizure relapses (21,22). In our study, carried out in a resource-constrained setting in Nigeria where LTM EEG techniques are unavailable, we could only carry out regular 45-minute EEG recordings, although with the limitation of lower epileptiform yield, to monitor subjects in seizure remission (SSR) and compared with recordings on subjects with epilepsy (SWE), that is with active seizures. Sixty-nine (52.7%) of SSR compared to 71.7% of SWE had epileptiform discharges in their EEG tracings, and this difference was significant with $F=19.29$ and $p<0.01$. Thus, despite its limitation of possible lower epileptiform yield (23), regular or routine EEG recordings can be used to monitor seizure remission in resource constrained settings

like ours.

findings have shown that aside from the clinical history of seizure remission in patients on AEDs, the predictive value of EEG had been shown to be far better than the clinical monitoring, that is EEG is much useful for long-term monitoring of seizure remission (11,12,13). Furthermore, previous studies have also shown that abnormal EEG, in this case, epileptiform activity is indicative of cortical hyperexcitability; and in subjects with a history of seizures such as our subjects in seizure-remission, the presence of epileptiform activity in them is useful in prognostication and prediction of possible seizure recurrence during AEDs withdrawal and/or period of seizure remission (25,26,27)

CONCLUSION

In conclusion, and despite its limitations, routine EEG recording in conjunction with clinical evaluation can be used to monitor seizure-remission among subjects being treated for epilepsy in resource-constrained developing countries such as Nigeria.

Conflict of interest: None.

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Table I: Subjects' socio-demographic variables

Variable	Subjects' Groups			
	Active Seizure		Seizure-Free	
	N	%	N	%
SEX				
Male	86	65.6	86	65.6
Female	45	34.4	45	34.4
<i>Total</i>	131	100.0	131	100.0
AGE GROUPS (YEARS)				
0-10	73	55.7	70	53.4
11-20	51	38.9	54	41.2
21-30	02	1.5	03	2.3
31-40	02	1.5	01	0.8
41-50	01	0.8	01	0.8
=51	02	1.5	02	1.5
TOTAL	131	100.0	131	100.0

Table II: Electroencephalographic (EEG) findings on subjects

Variable	Subjects' Group			
	Active Seizure		Seizure-Free	
	N	%	N	%
<i>EEG FINDINGS</i>				
Normal EEG	37	28.3	62	47.3
Abnormal EEG (Epileptiform Activities, EAs).	94	71.7	69	52.7
<i>Total</i>	131	100	131	100
LOCALIZATION OF EAs				
Bursts	63	48.1	45	34.4
Focal (Frontal, Temporal, F-T)	22	16.8	18	13.8
Focal with sec. Generalization	9	6.9	6	4.6
LATERALIZATION OF EAs				
Bursts	63	48.1	45	34.4
Bilateral	7	5.3	10	7.5
Focal with Sec. Generalization	9	6.9	7	5.3
Right Sided	9	6.9	5	3.8
Left Sided	6	4.5	2	1.5

Table III: Inter-relationship between EEG findings and socio-demographic/clinical variables

Variables	Subjects with Active Seizure			Subjects in Seizure Remission		
	X2	df	p	X2	df	p
Age Group	27.88	5	0.00*	19.00a	5	0.00*
Sex	0.84a	1	0.77	0.72a	1	0.46
Seizure Duration	2.37a	4	0.67	-	-	-
Duration of Seizure Remission	-	-	-	4.31a	4	0.37
Localization of EEG Abnormalities	131a	7	0.00*	131a	6	0.00*
Lateralization of EEG Abnormalities	131a	5	0.00*	131a	5	0.00*