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A REVIEW OF ELECTROENCEPHALOGRAMS DONE AT THE KENYATTA NATIONAL HOSPITAL, NAIROBI
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A REVIEW OF ELECTROENCEPHALOGRAMS DONE AT THE KENYATTA NATIONAL HOSPITAL, NAIROBI

J. O. JOWI, Z. P. KIDIGA and M. G. GITAU

ABSTRACT

Background: **Electroencephalogram based studies done elsewhere suggest that epileptiform activity originates predominantly from the left cortical hemisphere. There is evidence that partial epilepsies (focal spike and wave epileptiform discharges on tracings) connotes focal; secondary structural cortical dysfunction. Studies seeking similar findings have not been done locally.**
Objective: **To review electroencephalograms (EEGs) done at Kenyatta National Hospital (KNH); looking for various types of epileptiform discharges and their cerebral cortex of origin.**
Design: **Retrospective observational study.**
Setting: **Kenyatta National Hospital, Nairobi, Kenya- from January 1986 to June 2004**
Results: **A total 10431 EEG records were reviewed. Ninety Eight percent of referrals for EEG evaluation was for clinical differential diagnosis of epilepsy. Abnormal EEGs comprised 32.2% of the study population. Epileptiform abnormalities (i.e. focal spike and wave, generalized spike and wave and 3Hz spike and wave) discharges accounted for 75.2% of all abnormal EEG waveform discharges. Of the epileptiform abnormalities, focal spike and wave discharges comprised 71%. Focal spike and wave discharge implies a possible secondary aetiology of epilepsy. The left cerebral hemisphere was the origin of 49.8% of focal spike and wave epileptiform EEG discharges. Multifocal loci in cerebral cortices (i.e. frontal, temporal and parietal) were the foci of origin of abnormal EEG waveforms in 69.9% of recordings.**
Conclusion: **Focal spike and wave epileptiform discharges, with attendant likely secondary aetiology of epilepsy is predominantly evident in this study. It contrasts findings from western literature. The left cerebral hemisphere is more epileptogenic as is noted in other studies.**

INTRODUCTION

The electroencephalogram (EEG) was developed in the 1920's and has since continued to play a pivotal role in evaluation and management of patients with epilepsy and epileptic syndromes (1). It can, however, effectively only be used to support a clinical diagnosis of epilepsy. Electroencephalograms are also used to assess the depth of anaesthesia, evaluate patients in intensive care unit and assess brain death (2, 3).

Focal epileptiform EEG activity has significant clinical connotation; presenting clinically as partial epilepsy. It may herald features of focal (secondary) cortical disorders. Partial ictal slowing of background frequencies is typical and may be lateralised or localised to a particular cerebral cortex (4, 5, 6).

Such secondary pathology, if identified, would shade light into the quality of perinatal and maternal health care standards.

Scalp EEG recording during partial seizures of mesial temporal lobe origin shows regional fronto-temporal ictal pattern in the hemisphere of onset in 50-80% of seizures. The number of patients with localising features in scalp EEG of extra temporal seizures is less than for temporal lobe onsets, 30% for frontal lobe seizures and less than 10% for parietal lobe seizures.

Less than 20% of occipital lobe seizures show regional localisation. Localisation of seizure activity onset is invaluable in epilepsy surgery. The yield of localisation is enhanced by placement of cortical surface and deep-seated (i.e. sphenoid) electrodes (7).

Periodic Lateralised Epileptiform Discharges (PLEDs) pattern is self-explanatory by its name. The complexes usually repeat at 1-2 seconds intervals and consist of spikes, polyspikes, or sharp waves followed by slow waves. Periodic Lateralized Epileptiform Discharges usually overlie an area of acute structural brain lesion such as herpes encephalitis or infarct (3, 8-10).

There are, however, pitfalls in the interpretation of EEGs. They may be insensitive, non-specific with artefactural and physiological waveforms that may resemble epileptiform discharges (spike and wave) (11). It is therefore very important to correlate clinical features with the EEG pattern observed.

Large population based studies show an incidence of 0.5-4% of normal persons with abnormal EEGs (1). Prevalence of epileptiform activity is higher in patients with cerebral tumour, cranial surgery, congenital birth injury, mental retardation and central nervous system infection amongst many disease conditions (1).

Routine, scalp, awake inter-ictal EEG recording is commonly done at Kenyatta National Hospital. The inter-ictal EEG recording may be normal in patients with epilepsy. Various techniques are applied to augment the yield of pick up of abnormality in the EEG recordings. These include hyperventilation, photic stimulation, sleep deprivation, continuous ambulatory EEG monitoring, video telemetry recording and implantation of EEG electrodes deep in specific areas of the brain.

Specific triggers in rare types of reflex epilepsies such as reading, gelastic, eating, photosensitive and musicogenic epilepsies have been applied (12, 13). Complementary techniques such as magneto-encephalography combined with magnetic resonance imaging and EEG analysis are now available but largely confined to specific research centers (14-16) These complementary techniques are still not available at The Kenyatta National Hospital.

Electroencephalogram based studies done elsewhere have suggested that epileptiform activity originates predominantly from the left cortical hemisphere. There is evidence that partial epilepsies (focal spike and wave epileptiform discharges on EEG tracings) connotes focal; secondary structural cortical dysfunction. Studies seeking similar findings have not been done locally.

A study was done at The Kenyatta National Hospital; EEG Unit (17) that looked at data in the period 1985-1987. It evaluated the reasons for referral of patients for EEG study, the positivity rate of the EEG tracings age and gender distribution.

Our study followed up on this (study period being January 1988 to June 2004) and had broader aims and objectives. We analysed data for various parameters ranging from age, gender, pattern of EEG tracings, cerebral hemisphere and cortex lobe of origin of the epileptiform EEG discharges.

MATERIALS AND METHODS

An 18 Channel Nihon-Kohden electroencephalograph machine was used in all the recordings. Common average referential and longitudinal and transverse bipolar montages were used in all examinations.

A total of 10,431 consecutive records of EEG reports over the study period were reviewed and analysed for various parameters ranging from age, gender, pattern of EEG tracings, cerebral hemisphere and cortex lobe of origin of the epileptiform EEG discharges. We looked at report data and tracings as on record. We studied some representative epileptiform EEG tracings which are shown in text. Like any retrospective study, the drawback here was that information obtained is dependent on recorded data. Proportions and frequencies were used to analyse data

RESULTS

A total of 10,431, EEG records were reviewed. There were 5,678 (54.4%) males and 4,550 (43.6%) females (M: F ratio 1.2:1) in the study population. In two hundred and three (1.9%) records, no indication of gender was noted.

Table 1
Age and gender distribution of the study population

Age Group (years)	Gender: Male	Female	Not Indicated	Total
0-4	1174	774	37	1985
5-9	806	514	29	1349
10-14	1005	857	38	1900
15-19	621	756	28	1405
20-24	501	438	19	958
25-29	332	290	18	640
30-34	274	189	11	474
35-39	192	137	3	332
40-44	160	117	3	280
45-49	85	77	1	163
50-54	57	59	2	118
55-59	53	43	2	98
60-64	40	26	2	68
65-69	27	25	1	53
70-74	19	36	1	56
75-79	16	8	0	24
80+	21	22	0	43
Not Indicated	295	182	8	485
Total	5678	4550	203	10431

The main referral base for EEG study was the Kenyatta National Hospital; 7643 (73.3%). The rest of the referrals came from health facilities as far as 400 kilometres away.

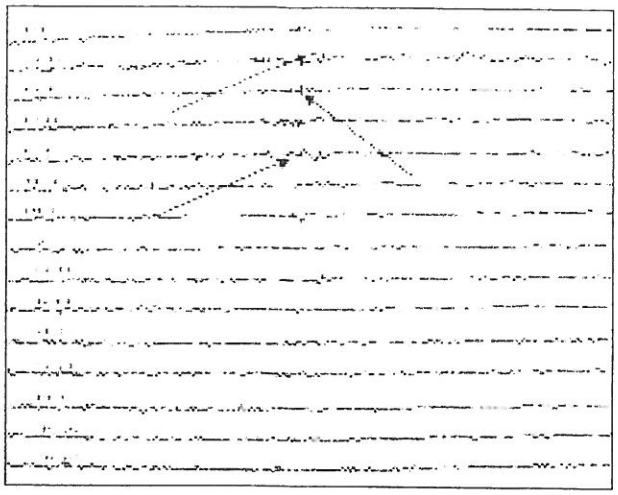
Hyperventilation augmentation technique was the commonest one carried out. It was done in 7098 (68%) of the cases. In 22% of the cases it was not carried out for various reasons such as cardiac disease, respiratory disease and in children. In 10% of the cases there was no indication as to whether hyperventilation was applied or not.

Standard Awake inter-ictal EEG recording was the commonest mode of examination, done in 83.1% of the cases. Sleep EEG recording was done in 15.3% of cases. In 1.6% of cases no indication was made as to whether the recording was a sleep recording or a wake one.

Of the 10,431 EEG records reviewed, 7068 (67.8%) were normal and 3363 (32.2%) were abnormal. Normal EEG tracings are usually destroyed after twelve months of storage. The abnormal EEG tracings/records were further analysed.

Table 2 shows the distribution pattern of the abnormal waveforms verses age group. Overall, epileptiform abnormalities (Focal Spike and Wake)(FSW) (Figure 1).

Figure 1
Focal Spike and Wave EEG (FSW) Complexes.



Generalised Spike and Wave (GSW) Figure 2 and 3Hz-spike and wave (3Hz) Figure 3 were more common (75.2%) as compared to other wave discharge abnormalities.

Table 2
Shows the distribution of abnormal EEG waveforms by age group

Age group (years)	FSW	NSSW	GSW	3Hz	Hyps	PLEDs	BS	ECS	SSp	Total
0-4	223	92	162	14	16	0	0	0	1	508
5-9	243	120	112	59	17	4	1	0	1	557
10-14	353	138	98	64	20	2	1	0	0	676
15-19	284	95	61	26	9	0	0	0	0	475
20-24	183	57	44	8	0	0	1	0	0	293
25-29	118	38	19	2	0	0	0	0	0	177
30-34	76	36	11	2	0	0	0	0	0	125
35-39	65	32	2	0	0	0	0	0	0	99
40-44	72	27	3	0	0	0	0	0	0	102
45-49	26	16	3	0	0	0	0	0	0	45
50-54	16	11	2	1	0	0	0	0	0	30
55-59	28	8	1	0	0	0	0	0	0	37
60-64	15	7	1	0	0	0	0	0	0	23
65-69	9	11	0	0	0	0	0	0	0	20
70-74	8	13	0	0	0	0	0	0	0	21
75-79	4	6	0	0	0	0	0	0	0	10
80+	9	4	1	0	0	0	0	0	0	14
Age not indicated	63	44	35	4	2	0	1	2	0	151
Total	1795	755	555	180	64	6	4	2	2	3363

FSW= Focal Spike and Wave, NSSW=Non Specific Slow Wave,GSW=Generalised Spike and Wave, 3Hz=3Hz-Spike and Wave, Hyps=Hypsarrthymias, PLEDs=Periodic Lateralized Epileptiform Discharges, BS=Burst Suppression,ECS=Electroconvulsive Silence and SSp=Sylvian Spikes

Figure 2
Generalised Spike and Wave (GSW) EEG tracings

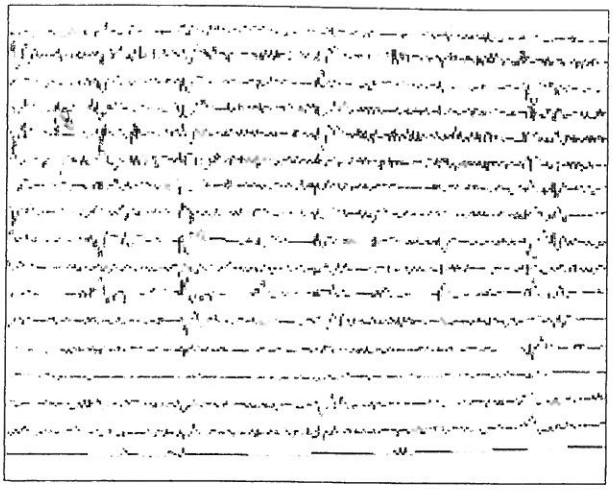
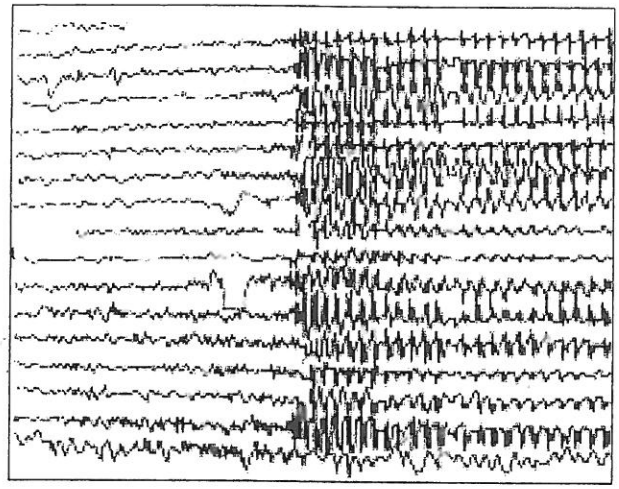


Figure 3
3Hz Spike and Wave (3Hz) EEG complexes



These other EEG waveform abnormalities included Non-Specific Slow Waves (NSSW), Periodic Lateralized Epileptiform Discharges(PLEDs), Burst Suppression(BS), Electroconvulsive Silence (ECS), Hypsarrthymias (Hyps) and Sylvian Spikes (SSp); all comprising 24.8% of the abnormal tracings.

The study showed that of the epileptiform abnormalities i.e. FSW+GSW+3Hz; Focal spike and wave discharge was the more common one comprising 71% of the group.

The FSW epileptiform abnormalities on EEG tracings originated from the left cerebral hemisphere in 49.8% and the right cerebral hemisphere in 40.3% (Table3).

Table 3
Cerebral hemisphere origin of the Focal Spike and Wave EEG discharges

Cerebral Hemisphere	Frequency	(%)
Left	894	49.8
Right	723	40.3
Bifrontal	26	1.4
Central	10	0.6
Not Indicated	142	7.9
Total	1795	100

Multifocal cerebral cortex (temporal/frontal/parietal) origin of focal spike and wave discharges was seen in 69.9% of tracings as compared to primarily occipital cortex in 3%, primarily central in 0.7% and primarily parietal cortex in 0.6% Table4.

Table 4
Cerebral cortical lobe of origin of the abnormal EEG waveforms

Cerebral Cortex Lobe	Frequency	(%)
Multifocal(frontal+ Temporal+Parietal)	1255	69.9
Primarily Occipital	54	3.0
Primarily Central	13	0.7
Primarily Parietal	10	0.6
Parietal/Occipital/Central	9	0.5
Not Indicated	454	25.4
Total	1795	100

Focal spike and wave epileptiform discharges was seen in 61% in age group 5-19 years.

DISCUSSION

Epilepsy is a common neurological disorder worldwide (18, 19). The electro-encephalogram is an invaluable tool in diagnosis and management of patients with epilepsy. It aids in diagnosis and classification of epileptic seizure types and syndromes (1).

This study reviewed 10,431 EEG reports done over a seventeen year period. About three quarters (73.3%) of referrals for EEG evaluation came from the hospital itself while the remaining were referrals from other public health institutions as far as 400 kilometers away in all corners of the republic. Male to female ratio was 1.2:1; favorably compares with the earlier study (17) of M: F ratio of 1.5:1.

Hyperventilation as an augmentation technique was used in 68% of the cases and only 15.3% had sleep EEG recording. Other techniques such as photic stimulation were hardly done; ambulatory EEG recording and Video-EEG Telemetry recording were not available.

About one third (32.2%) of the EEG recordings were abnormal. This compares to 36% in the earlier study (17). The study population predominantly comprised patients with clinical epilepsy as noted on the request forms; only 2% of the referrals for EEG were due to other diagnoses like stroke, post head injury headaches, suspected brain tumour, drug toxicities, encephalitis and coma in intensive care unit. In this study, as with the earlier study (17) epilepsy was found to be the commonest reason for referral for EEG. In the earlier study the highest positivity of EEG reporting was found to be for sub-acute sclerosing pan-encephalitis (17). Our study concentrated on the various forms of epileptiform discharges.

Of the abnormal EEG tracings, epileptiform abnormalities (focal spike and wave, generalised spike and wave and 3Hz spike and wave) were seen in 75.2% of cases. Focal spike and wave epileptiform discharges was seen in 61% in age group 5-19 years in this study. Focal spike and wave epileptiform discharges presumably signify secondary aetiology for the epilepsy (20). Studies from developed countries indicate that the age group 5-19 years significantly has primary generalised epilepsy (generalised spike and wave epileptiform discharges) (18, 19). Our finding is in contrast. This finding therefore raises fundamental questions about the etiology of aepilepsy in this age group. It would be important to look at issues like perinatal care, early childhood infections and infestations, malaria, meningitis, encephalitis, HIV/AIDS and head trauma as possible insults to the young brains with resultant secondary epilepsy.

The left hemisphere was significantly more epileptogenic, a finding confirmed by other studies (21-26). Occipital lobe is very rare as an origin of epileptogenic discharges (4). This study confirms the same. Further studies are needed to explain these findings.

In conclussion, the study shows that in those with epileptiform EEG discharges, focal spike and wave is the commonest finding. There is therefore need to do prospective clinical studies to evaluate the correlation between focal spike and wave epileptiform discharges, phenomenological presentation of seizures and seizure aetiologies. The left cerebral hemisphere is more epileptogenic. The occipital lobe is a rare origin of epileptogenic discharges.

We recommend that there is need for studies to explain why focal spike and wave discharges are more prevalent. There is need for studies to explain why the left hemisphere is more epileptogenic.

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