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Original Article

EEGS Findings Among Adults Sudanese Subjects Presented to the National Ribat University

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Abstract

Background: Epilepsy and seizure are one of the most common serious neurological disorders, and most patients either stop having seizures or less commonly die of them.
Methods: This retrospective cross-sectional study targeting adult Sudanese patients was conducted in the EEG units of the department of physiology, faculty of medicine, and the National Ribat University. Recordings were obtained from a digital EEG machine (Medtronic pl-EEG). The Statistical Package for Social Sciences (Windows version 15; SPSS) was used for statistical analysis. The study's main objective was to determine the percentage of abnormal EEGs in adult Sudanese epileptic patients who were referred to the Ribat EEG unit from March 2007 to September 2010.
Results: Nine hundred and fifty patients were included in this study, abnormal EEGs was seen in 54.7%, while it was normal was in 45.3%; primary generalized seizures constituted 45.5%, while focal onset seizures were collectively observed in 43.4%, other types of epilepsy counted for 11.2%.
Conclusion: This study showed that males were more affected than females, abnormal EEG was maximal in the age group16–30 years. Epileptiform seizure discharges decrease with age, generalized seizure discharges were dominated seizure.

Keywords: EEG, epilepsy, seizure

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1. Introduction

Epilepsy is a well-known chronic neurological disorder which is characterized by repeated unprovoked seizures. It is the second most common cause of mental health disability, particularly among young adults. [1,2]. These seizures are transient signs or symptoms due to abnormal, excessive, or synchronous neuronal activity in the brain. About 50 million people worldwide have epilepsy at any given time. Epilepsy is usually controlled, but not cured, with medication, although surgery may be considered in difficult cases. However, it is important to note that over 30% of people with epilepsy

do not have seizure control even with the best available medications. Not all epilepsy syndromes are lifelong, some forms are confined to particular stages of childhood. Epilepsy should not be understood as a single disorder, but rather as a group of syndromes with vastly divergent symptoms but all involving episodic abnormal electrical activity in the brain [1].Approximately 2 million persons in the United States have epilepsy, and 3% of the general population will have epilepsy at some time in their lives [4].In recent years, important advances have been made in the diagnosis and treatment of seizure disorders [5].However, understanding of the cellular and molecular mechanisms by which epilepsy develops, or epileptogenesis, is still incomplete [6].

1.1. Electroencephalography (EEG)

Electroencephalography (EEG) is the measurement of electrical activity produced by brain as recorded from electrode placed on the scalp. Scalp EEG measures the summed activity of post-synaptic currents. Although post-synaptic potentials generate the EEG signal, it is not possible for a scalp EEG to determine the activity within a single dendrite or neuron. Rather, a surface EEG reading is the summation of the synchronous activity of thousands of neurons that have similar spatial orientation, radial to the scalp. Scalp EEG activity oscillates at multiple frequencies having different characteristic spatial distributions associated with different states of brain functioning such as waking and sleeping. These oscillations represent synchronized activity over a network of neurons [7].

1.2. Normal EEG waves

Delta waves have a frequency of up to 3 Hz. They tend to be the highest in amplitude and the slowest waves. They are seen normally in adults in slow wave sleep. They are also seen normally in babies [8]. Theta waves have a frequency range of 4 to 7 Hz. They are seen normally in young children. They may be seen in drowsiness or arousal in older children and adults. Excess theta for age represents abnormal activity [8].Alpha waves have a frequency range of 8 to 12 Hz. Hans Berger named the first rhythmic EEG activity as the “alpha wave,” seen in the 8–12 Hz range in the posterior regions of the head on both sides, being higher in amplitude on the dominant side. It is brought out through relaxation and eye closure [9]. Beta waves have a frequency range of 12–30 Hz. They are seen usually on both sides in symmetrical distribution and are most evident

frontally. Low amplitude beta with multiple and varying frequencies is often associated with active, busy, or anxious thinking and active concentration [9].

2. Materials and Methods

2.1. Subjects

The study population included adult Sudanese patients referred to the EEG unit of the department of physiology, faculty of Medicine, National Ribat University from March 2007 to September 2010. The patients (aged 16 year or older) were referred from by general practitioners and neurologists, as well as the accidents and emergency departments.

2.2. Methodology

All patients underwent interictal EEG examination, with both wake and sleep tracings using digital EEG machine (Medtronic pl-EEG).

2.3. Montages of EEG recording

Bipolar montage was used. Each channel (i.e., waveform) represents the difference between two adjacent electrodes. The entire montage consists of a series of these channels. However, in referential montage, each channel represents the difference between a certain electrode and a designated reference electrode.

2.4. Stimulating methods

Different stimulation methods have been used. (i) Hyperventilation: Patients were asked to hyperventilate for about 3–5 min, this process stimulates the brain tissues already excited by the effect of hypocapnia and alkalosis. (ii) Photic stimulation: Repetitive flashes of light were delivered at different rate; the routine photic stimulation started with three flashes per second and ended with thirty flashes per second for 4 min. In the sleep recording, sleep was induced in adults by diazepam in a dose of 10–20 mg I.V. Chloral hydrate, which is less effective than diazepam, was used for children at a concentration of 20–40 mg/kg. The EEG recording was performed by a neurophysiologist expertise

technician in the neurophysiology lab of the National Ribat University, and all reports were reviewed by the neurologist and neurophysiologist in the National Ribat University.

2.5. Exclusion criteria

Patients below the age of 16 years and psychotic patients were excluded from this study.

3. Results

3.1. Gender distribution among patients with abnormal EEGs

This retrospective study included a total of 950 (473 male and 477 female) adult Sudanese patients referred to the EEG unit of the department of physiology, faculty of medicine, University of Ribat. Our study showed that 54.7% of the study population had abnormal EEGs, while 45.3% had normal EEGs. The effect of gender on abnormal EEG revealed a considerable difference – 63.1% (328 male) versus 36.9% (192 female) (Tables 1 & 2).

Table 1: Age distribution among patients with abnormal EEGs in the total study group.

Age (yr)	Number of participants	Percentage
16–30	304	58.5
31–45	108	20.8
46–60	59	11.4
61–75	32	6
76–90	15	2.9
91–100	2	0.4
Total	520	100

Table 2: Sex distribution among patients with abnormal EEGs in the total study group.

Age (Male)	No. of Patients	Percentage	Age (Female)	No. of Patients	Percentage
16–35	230	70.2	16–35	128	66.7
36–55	55	16.7	36–55	33	17.2
56–75	35	10.7	56–75	22	11.5
76–100	8	2.4	76–100	9	4.6
Total	328	100	Total	192	100

3.2. Abnormal EEGs highly distributed between younger age patients within the total study group

Most abnormal EEGs were maximal in patients aged 16–30 years (58.5%) in the abnormal group (Table 1). This was true for both age groups. It was evident that there were no gender differences, and epileptiform discharges taper with age; still abnormal EEG tends to decrease with age in males (70.2%) as maximum percentage lie in the age group 16–35 years, compared to females (66.7%) (Table 2).

3.3. Distribution of presenting features in the total abnormal group

Patients were mainly referred by neurologists and general physicians as having or possibly having epilepsy. Hence, according to history and clinical notes of referral for EEG, convulsions (focal or/and generalized) mounted to 57.69%, loss of consciousness (LOC) 39.4%, headache 18.3.%, and head trauma 12.7% of the total number of study population with no significant difference between genders (Figure 1).

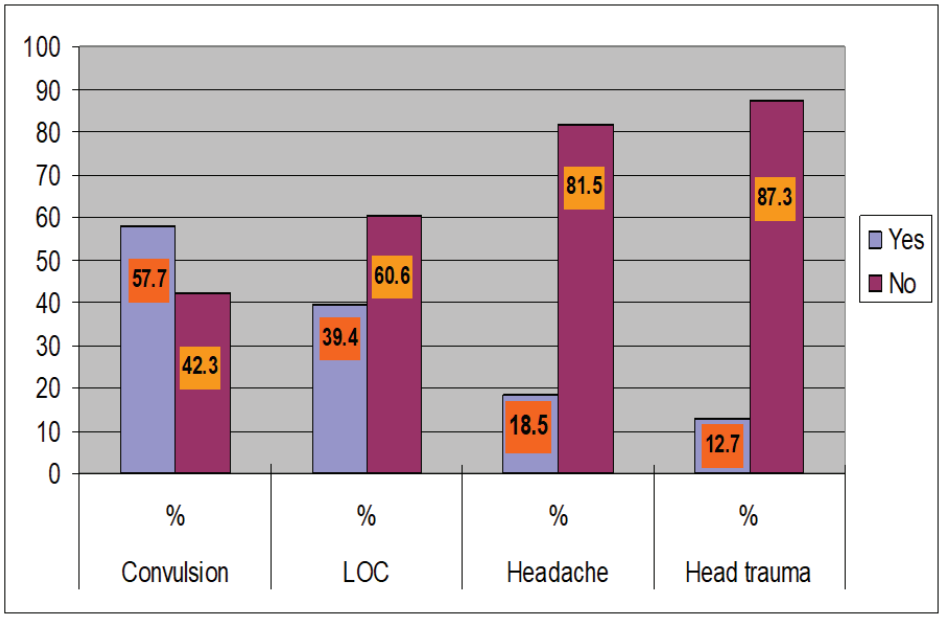

Figure 1: Distribution of presenting features in the total abnormal group.

3.4. The effect of sex on the presenting features in patient with abnormal EEGs

Out of the total abnormal EEGs, convulsion was distributed according to gender as follows: 60% (116) in female and 56.1% (184) in men, whereas, LOC was distributed as

39.6% (76) in female and 39.3% (129) in male. Headache was presented as 20.8% (40) in female and 17.1% (56) in male. Head trauma in females was 18.6% (28) and in males 11.6% (38).

Table 3: Percentage of presenting features in patient with abnormal EEGs.

(A) Male								
	Convulsion		**LOC**		**Headache**		**Head trauma**	
	Number of patients	**%**	**Number of patients**	**%**	**Number of patients**	**%**	**Number of patients**	**%**
Yes No	184 144	56.1 43.9	129 199	39.3 60.7	56 272	17.1 82.9	38 290	11.6 88.4
Total	328	100.0	328	100.0	328	100.0	328	100.0
(B) Female								
	Convulsion		**LOC**		**Headache**		**Head trauma**	
	Number of patients	**%**	**Number of patients**	**%**	**Number of patients**	**%**	**Number of patients**	**%**
Yes No	116 76	60.4 39.6	76 116	39.6 60.4	40 152	20.8 79.2	28 164	14.6 85.4
Total	192	100.0	192	100.0	192	100.0	192	100.0

3.5. Distribution of epileptiform discharges in the study population with abnormal EEGs

According to the types of epileptiform discharges encountered in the study group with abnormal EEGs, primary generalized epileptiform discharges come at the top of the list with a percentage of(45.5%, this was followed by partial epileptiform discharge; frontally initiated (18.8%), centrally initiated (11.3%), temporally initiated (8.3%), posterior or occipitally initiated (5%), frontal intermittent rhythmic delta activity (FIRDA) discharges (6.3%), myoclonic (2.5%), and others (2.3%) (Figure 2).

4. Discussion

Our results show that the percentage of abnormal EEGs in the study population was 54.7%. These findings are similar to those reported in Sudan and worldwide literature [10, 11]and were distributed as 63.1% and 36.9% in male and female, respectively, which matches with the findings of Ahmed *et al.* [12]. The less stigma associated with epilepsy in male could be the reason for higher male cases reported in hospitals [11].

Moreover, this study revealed that abnormal EEG distribution tends to decrease with age, 58.5% of abnormal EEGs occurred in patients aged between 16 and 30 years, however, this percentage was only 3.3% in the age group 76–100 years.

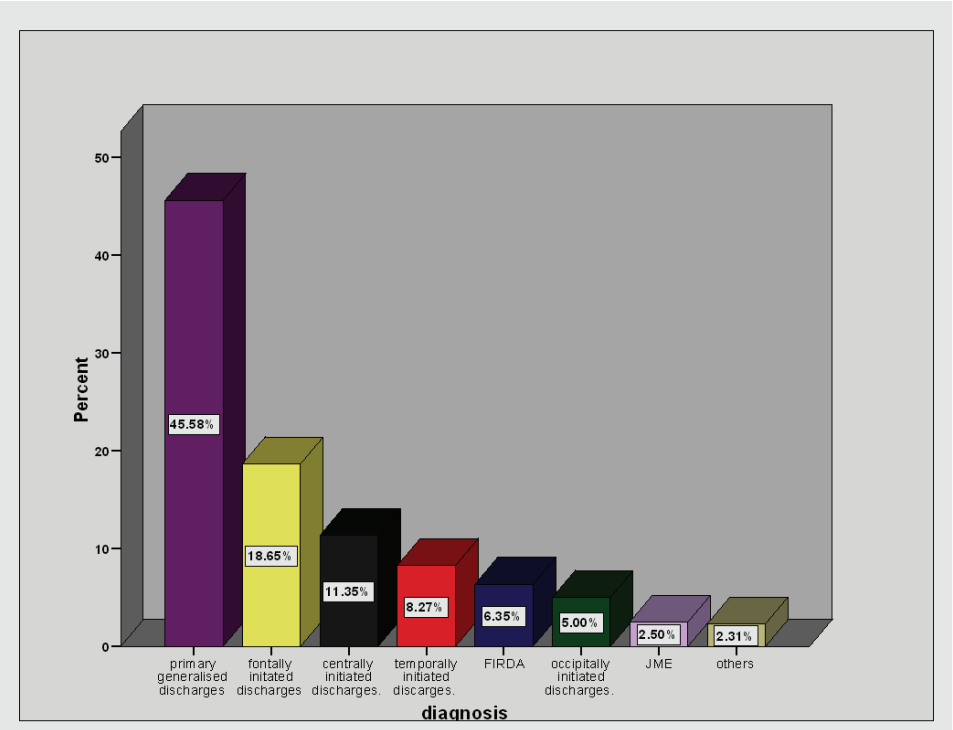

Figure 2: Distribution of epileptiform discharges in the study population with abnormal EEGs.

The study also showed that the epileptiform discharge subtyping was predominated by primary generalized epileptiform discharges (45.5%) followed by frontally (18.8%), centrally (11.3%), temporally (8.3%), FIRDA (6.3%), occipitally (5.0%) initiated epileptiform discharges, juvenile myoclonic epilepsy (JME) (2.5%), and others (2.3%).

In this study, subtyping of epileptic patients was based on clinical presentation and EEG findings. Primary generalized epileptiform discharges were found to be the most dominant disorder. It was 45.5% in the total study population, which is in accordance of Hussein *et al.* [13]with minimal gender difference – 43.3% in males versus 49.4% in females. They showed that primary generalized epileptiform discharges had an incidence of 39–59% of their cases. Partial epileptiform discharges were found to be 32–52%. While in this study, the partial epileptiform discharges collectively was seen in 43.4%, it was slightly less than Safranski *et al.*'s [14]focal onset epileptiform discharges (57.3%).

5. Conclusion

Finally, this study showed that males were more affected than females. The age group 16–30 years were more affected (58.5%). Epileptiform discharges decrease with age. Generalized epileptiform discharges were dominated (45%).

6. Recommendations

Since JME is misdiagnosed worldwide and as shown in this study, we recommend that full history must be taken by doctors, and a series of EEG recordings must be performed.

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Ethical Considerations

The data of this work has been taken from the EEG file records. The authors took the permission from the department of Physiology, Faculty of Medicine, National Ribat University.

Competing Interests

The authors declare that there is no conflict of interest in this work.

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