

## EEG Changes in Patients with Migraine

Majeed Salih Hamad \*, Nawfal M. Sheaheed \*\*,  
Sarmed Mohammad Abdulrasool \*\*\*, Akram M. Almahdawi \*\*\*\*

### ABSTRACT:

#### BACKGROUND :

migraine is a recurring syndrome of headache, nausea, vomiting, and/or other symptoms of neurological dysfunction in varying admixtures. Migraine, is one of the most common causes of headache, afflicts approximately 15% of women and 6% of men.

#### OBJECTIVE:

This study was designed to determine the EEG changes in a sample of migraineurs with their relation to its types.

#### PATIENTS AND METHODS:

This cross-sectional study was conducted in the department of neurology of Baghdad teaching hospital from December 2007 to February 2008. A total of 60 migraineurs were taken, aging (10-40) years, diagnosed according to International headache society (IHS) criteria. Patients with history of epilepsy, head injury, brain lesion and recurrent headaches not Compatible with IHS criteria were excluded from the study . EEG was performed, whenever possible, during headache and between attacks of headache.

#### RESULTS:

Sixty Iraqi patients with migraine were evaluated. Twenty patients (33.3%) were having migraine with aura (MWA) while 40 patients (66.7%) had migraine without aura (MWOA). Of the sixty studied patients 15 were having electroencephalographic finding. Among patients with MWA, 8 of them have abnormal EEG (40%), while in patients with MWOA, 7 of them have abnormal EEG (17.5%). Slow waves were found in 10 patients (52.64%), sharp waves in 8 (42.10%), and spikes in one patient (5.26%). It has been found that 9 patients (50%) have abnormality in occipital region, 6 of them (33.34%) in frontal region, and 3 of them (16.66%) in temporal region.

#### CONCLUSION:

EEG is not useful as a diagnostic tool for migraine, as the EEG changes found in migraine are not specific, they are infrequently associated, and there is no EEG difference between MWA and MWOA. So, clinical criteria are the only way for diagnosis of migraine.

**KEYWORDS:** migraine, headache, EEG

### INTRODUCTION:

Migraine is one of the most common causes of headache, afflicts approximately 15% of women and 6% of men.<sup>(1)</sup> The current state of knowledge suggests that a primary neuronal dysfunction leads to a sequence of changes intracranially and extracranially that account for migraine, including

the three phases of premonitory symptoms, aura, and headache.<sup>(2)</sup> The pathogenesis of migraine may be related to an imbalance in activity between brainstem nuclei regulating antinociception and vascular control.<sup>(3)</sup> A causal association between migraine aura and headache is supported by evidence that both are linked to the phenomenon known as cortical spreading depression (CSD) of Leao.<sup>(4)</sup> Slowing of back ground rhythm, both generalized<sup>(5,6)</sup> and focal<sup>(7-9)</sup> is described in children and adults during a migraine. Unilateral reduction of Alpha activity in migraine with visual aura in adult<sup>(10)</sup> and in children.<sup>(11)</sup> This disturbance of alpha asymmetry is observed within 3 days of attack. Also there is unilateral intermittent or bilateral delta activity during attacks of basilar and

\* Department of Neurology of Baghdad Teaching Hospital. neurologist at Rizqari Teaching Hospital, Erbil, Iraq.

\*\* Specialist Neurologist at Baghdad Teaching Hospital, Baghdad, Iraq.

\*\*\* Specialist Neurologist at Baghdad Teaching Hospital, Baghdad, Iraq.

\*\*\*\* Professor of Neurology, President of the Iraqi Board of Neurology, Consultant Neurologist at Baghdad Teaching Hospital.

hemiplegic migraines.<sup>(12,13)</sup> Spike or sharp wave discharges in temporal region have been described in some patients with classical migraine<sup>(14)</sup> and Sharp wave particularly in temporal region may be seen in hyperventilation.<sup>15</sup> Paroxysmal theta activity, a variant of the discrete spike is the appearance of episodes, lasting from a fraction of a second to several seconds, of rhythmic high-voltage activity at 4-6Hz.<sup>(15)</sup> Some studies which have been reviewed in the literature support the concept of central neuronal hyperexcitability as a pivotal physiological disturbance predisposing to migraine.<sup>(16)</sup> It has been suggested that the enigmatic epileptic-epileptoid characteristics of EEG in migraineurs could be an expression of the electrically hyperactive epileptic foci located mainly within the brain stem and generated by insufficient opioid inhibition of peptidergic neuron.<sup>(17)</sup> Migraine and epilepsy are both chronic disorders characterized by recurrent neurologic attacks variously accompanied by headache as well as by gastrointestinal, autonomic, and psychologic features. Migraine and epilepsy are linked by their symptom profiles, comorbidity, and treatment. The presence of one disorder increases the likelihood that the other is also present. In addition, a number of migraine syndromes can be confused with epilepsy. The diagnosis and treatment of each disorder must take into account the potential presence of the other.<sup>(18)</sup> There is about a 2.4 fold higher risk of migraine in patients and their relatives who have epilepsy compared with relatives who do not have epilepsy. There is therefore a strong association between migraine and epilepsy, which is independent of seizure type, etiology, age at onset or family history of epilepsy. It has been proposed that there is a state of underlying neuronal hyperexcitability that increases the risk of both disorders. Seizures may occur during attacks of migraine without aura, where the condition has sometimes been known as migrainalepsy. In other cases, seizures with visual symptoms analogous to, but quite different form, symptoms of the migraine aura may be accompanied or followed by headaches that are similar or identical to migraine. In typical patients, the clinical history usually allows the separation of migraine and epilepsy. The diagnosis of atypical migraine symptoms can be quite difficult, however, and a number of epileptic and nonepileptic syndromes may mimic migraine. In more complex cases, EEG and video-EEG monitoring are useful.<sup>(18)</sup>

### **AIM OF THE STUDY:**

To determine the EEG changes in migraine.

### **PATIENTS AND METHODS:**

This cross-sectional study was conducted in the department of neurology of Baghdad teaching hospital from December 2007 to February 2008. A total of 60 migraineurs were taken, ageing (10-40) years, diagnosed according to International headache society (IHS). Patients with history of epilepsy, head injury, brain lesion and recurrent headaches not compatible with IHS criteria were excluded from the study. Age, sex, family history and types of migraine were evaluated. All of the patients had been examined by a specialist neurologist. EEG was performed, whenever possible, during headache and between attacks of headache. Recording were performed by a 16 channel Micro med machine (Italian-2005). Each recording session lasted for a minimum of 30 minutes, with 3 minutes of hyperventilation (HV) and intermittent photic stimulation (IPS) with a flash frequency ranging from 10 - 30Hz. Regarding the abnormal discharges are distinctive waves or complexes distinguished from background activity, these include spike (duration 20-70 ms), sharp wave (duration 70-200 ms), and slow wave (duration more than 200 ms) occurring singly or in burst's.

### **RESULTS:**

During the period of the study, sixty Iraqi patients with migraine were evaluated. The migraineurs are categorized in (table 1) into patients with aura and those without aura. With 20 patients (33.3%) having migraine with aura, male: female ratio being 1:4. While 40 patients (66.7%) have migraine without aura, with 1:3.4 male: female ratio. Of the sixty studied patients, 15 were having electroencephalographic finding. (Table 2) compares EEG findings between patients with migraine with aura and migraine without aura. 12 of patients with MWA have normal EEG (60%), and 8 have abnormal EEG (40%). While 33 patients with MWOA have normal EEG (82.5%) and 7 have abnormal EEG (17.5%). EEG findings according to side of headache is illustrated in (table 3). Of the 18 patients with right side headache, four have bilateral EEG abnormality, and 14 have normal EEG. 23 patients have left side headache, one of them has left side EEG abnormality, one has right side EEG abnormality, one has bilateral EEG abnormality, and 20 have normal EEG. (Table 4) shows type and site of EEG findings according to side of headache in patients with abnormal EEG, of

those with right side headache, two patients have bifrontal slow waves, one has bioccipital sharp waves, and one has bioccipital sharp and slow waves. Of patients with left side headache, one has left occipital and temporal sharp and slow waves, one has right frontal slow waves, and one has bioccipital sharp waves. Of patients presenting with bilateral headache, three have bifrontal slow waves, two have bioccipital sharp and slow waves, one has bioccipital sharp waves, one has bioccipital and temporal spikes, and one has bilateral temporal and occipital sharp waves. Frequency of different types of EEG abnormality is shown in (table 5). Slow waves are found in 10 patients (52.64%), sharp waves in 8 (42.10%), and spikes in one patient (5.26%). Also frequency of site of EEG

abnormality is illustrated in (table 6). It has been found that 9 patients (50%) have abnormality in occipital region, 6 of them (33.34%) in frontal region, and 3 of them (16.66%) in temporal region. (Table 7) shows the relation between the type of migraine and the location of EEG Abnormalities (occipital, temporal, or frontal) the results is that most migraineurs have normal EEG findings. Those with abnormal finding are interpreted as: occipital EEG abnormality is more common in MWA, the frontal EEG abnormality is equally present in both types of migraine, temporal EEG abnormality is only present in MWOA. (Table 8) shows the relation between the type of migraine and the type of EEG abnormalities. Slow wave and sharp wave are seen more in MWA while spike is only present in MWOA.

**Table 1: sex distribution in migraine types.**

Type of migraine	Male	Female	M:F	Total	
				Number	%
MWA <sup>1</sup>	4	16	1:4	20	33.33
MWOA <sup>2</sup>	9	31	1:3,4	40	66.67

<sup>1</sup>MWA=migraine with aura, <sup>2</sup>MWOA=migraine without aura

**Table 2: EEG findings in different types of migraine.**

Type of migraine	Normal EEG		Abnormal EEG	
	No.	%	No.	%
MWA(20)	12	60	8	40
MWOA(40)	33	82.5	7	17.5

**Table 3: EEG findings according to side of headache.**

Side of migraine	Side of EEG abnormality			Normal EEG	Total	
	Rt.	Lt.	Bilateral		No.	%
Rt.*	0	0	4	14	18	30
Lt.*	1	1	1	20	23	38.33
Bilateral	0	0	8	11	19	31.67

\*Rt. = right, Lt. = left.

**Table 4: Relationship between side of headache and type and side of EEG abnormality.**

Side of migraine	Type and side of EEG abnormality	No. of patients
Rt. Sided headache	SWBF <sup>1</sup>	2
	SHWBO <sup>2</sup>	1
	SHWBO, SWBO <sup>3</sup>	1
Lt. sided headache	SHWLTO <sup>4</sup> , SWLTO <sup>5</sup>	1
	SWRF <sup>6</sup>	1
	SHWBO	1
Bilateral headache	SWBF	3
	SHWBO,SWBO	2
	SHWBO	1
	SPBOT <sup>7</sup>	1
	SHWBT <sup>8</sup> ,SHWBO	1

<sup>1</sup>SWBF=slow wave bifrontal, <sup>2</sup>sharp wave bioccipital, <sup>3</sup>slow wave bioccipital, <sup>4</sup>sharp wave Lt. temporoccipital, <sup>5</sup>slow wave Lt. temporoccipital, <sup>6</sup>slow wave rt. Frontal, <sup>7</sup>spikes bioccipital, <sup>8</sup>sharp wave bitemporal.

**Table 5: Frequency of different types of EEG abnormalities.**

Type of abnormality	Frequency	%
Slow wave	10	52.64
Sharp wave	8	42.10
Spike	1	5.26

**Table 6: Frequency of sites of EEG abnormality.**

Site	Frequency	%
Occipital	9	50
Frontal	6	33.34
Temporal	3	16.66

**Table 7: Distribution of EEG abnormalities in different types of migraine.**

Type of migraine	Total No.	Normal EEG	Occipital	Temporal	Frontal
Migraine with aura	20	12	5	0	3
Migraine without aura	40	30	4	3	3

**Table 8: The distribution of different EEG abnormalities in different types of migraine.**

Type of migraine	Total No.	Normal EEG	Slow wave	Sharp wave	Spikes
Migraine with aura	20	12	6	5	0
Migraine without aura	40	33	4	3	2

**DISCUSSION:**

In this study, we have found that migraine is more common in females than males in different age groups. The ratio being 1:2.3 in patients 10 to 20 years old, 1:3.3 in patients between 21 to 30 years, and all patients above 30 years are females which is comparable to a study in Iran in 2004.<sup>(19)</sup> Migraine without aura is more common than migraine with aura in our study group with ratio of 2:1. Both types are more common in females. Most patients who have migraine with aura have normal EEG 60% and 40% have abnormal EEG. This result is not comparable to the Iranian study. They have found that 43.8% of patients have normal EEG, and 56.2% have abnormal EEG.<sup>19</sup> Also, in our study, 82.5% of patients with migraine without aura have normal EEG, only 17.5% of them have abnormal EEG. This is also not comparable to the Iranian study, (57.4% normal EEG, vs.42.6% abnormal EEG).<sup>(19)</sup> This could be because of difference in sample size and for most of our cases; EEG is done during attacks of headache, while they have done EEG during ictal and interictal periods. Overall, 25% of our migraineurs have EEG abnormalities, while in Iran, the percentage was 47%.<sup>19</sup> Chi square

is 0.05777958, p-value is 0.81004, which is >0.05. So, the association between EEG abnormality and different types of migraine is not significant. Regarding the relation between side of headache and side of EEG abnormality, we found no significant relationship, because all patients with right sided headache have bilateral EEG abnormalities, while patients with left side headache have left, right, and bilateral EEG abnormalities in equal proportion. All patients with bilateral headache have bilateral EEG changes. So, we conclude that bilateral EEG changes are the most common abnormality regardless of side of headache. EEG abnormalities have been found in occipital, frontal, and temporal areas regardless of side of headache. Slow waves are the most common abnormality (52.64%) seen followed by sharp waves (42.10%) and spikes (5.26%) in descending order these abnormalities (slow wave, sharp wave and spike) are seen more in MWA and changes are more common in occipital region, followed by frontal region. Frontal EEG abnormalities are equally present in both types of migraine. These are comparable to the study done

by Neufeld et al; they found that occipital region EEG abnormality more in MWA.<sup>(20)</sup> And also comparable to the Iranian study. They found slow waves in 70% of patients, sharp waves in 29% and spikes in 8.4%. These abnormalities were found mainly in occipital region<sup>(19)</sup> and incomparable to the study done by Lewis et al; they found that among 64 migraineurs, 73.4% were abnormal EEG and they found that 27% slow wave and spikes and sharp waves in 46.6%.<sup>(21)</sup>

### CONCLUSION:

EEG is not useful as a diagnostic tool for migraine, as the EEG changes found in migraine are nonspecific, they are infrequently associated, and there is no EEG difference between MWA and MWOA. So, clinical criteria are the only way for diagnosis of migraine.

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