Electroencephalographic (EEG) Pattern in Patients with Generalized Seizures in Adolescents

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ABSTRACT

A total of 98 patients (male = 57 and female = 41) with ages ranging from 15 to 25 years (average age of 20) were studied. The cases were referred as clinically diagnosed Generalized Seizures. The Clinical Neurological Pattern observed in these patients showed 57 of the 98 (58.16%) had Generalized Tonic Clonic Seizures (GTCS); 1.02% (n = 1) Tonic Seizures (TSz); 7.14% (n = 7) Nocturnal Seizures (Noct Sz); 3.06% (n = 3) with Absence Seizures (Absc Sz); 11.22% (n = 11) each showing Adolescent Myoclonic Epilepsy (AME) and Juvenile Myoclonic Epilepsy (JME) respectively; and 8.16% (n = 8) indicated the symptoms of Complex Partial Seizures (CPS).

The data according to EEG-findings was broken into the following six study groups: I) Focal Slowing (FS), II) Generalized Slowing (GS), III) Focal Sharp Waves/Spikes (FSWS), IV) Generalized Sharp Waves/Spikes (GSWS), V) Generalized Slowing + Focal Spikes (GSFS), VI) Normal.

The EEG findings, on analysis, showed that 56 of the 98 (57.14%) had an abnormal EEG. The relationship of various types of Generalized Seizures with EEG-patterns showed that a majority of the patients had an EEG-abnormality, which showed as GSWS (Group IV) (36.73%) and GS (Group II) (19.38%). Similarly, 42.85% of the cases were found with Normal EEG results (Group VI) and 1.02% cases had the EEG-abnormality as FS (Group I).

The role of EEGs in the diagnosis of seizures was evaluated by comparing the Clinical Neurological Pattern of the cases with their EEG-findings. The results presented in this study showed that 42.85% of the cases had concordance with EEGs and neurological pattern. Overall, 57.13% of the cases were found to show dis-concordance.

Details of the findings show that the 42.85% of the cases indicating [GTCS (27), Noct Sz (6), TSZ (1), AME (4), JME (2), Absc Sz (2)] in neurological patterns were found with Normal EEG-findings. Similarly 8.16% and 6.12% of the cases showing [GTCS (5), AME (1), JME (2)], [AME (1), JME (4), CPS (1)], in their respective neurological patterns had non-specific EEG findings consistent with JME. The cumulative percentage of 57.13% (i.e., 42.85% + 8.16% + 6.12%) of cases showed the different neurological manifestations as compared to the final diagnosis confirmed by the EEG-examinations only.

The results of the present study yielded the conclusion that 42.85% of the cases examined were diagnosed as having Generalized Seizures and Adolescent Myoclonic Epilepsy, which is concordant with EEG findings. The rest of the 57.13% patients were finally diagnosed with EEG tests only, indicating its importance in the

final diagnosis; and thereby its usefulness in appropriate management, especially with syndromatic classification of seizures in young adults.

(Key words: generalized seizures, EEG-pattern, clinical neurological pattern, adolescents).

INTRODUCTION

Electroencephalography (EEG) is a valuable test in the definition of epileptogenic areas beyond the structural lesion (Kutsy 1999). The findings of Niedzielska, et al. (2001) revealed that in patients with seizures in the acute phase of stroke, EEG examination is very helpful in making the proper therapeutic decision by recognizing the status epilepticus. Martinez, et al. (2000) reviewed Electroencephalograms and found that epilepsy with a typical spike and wave (SW) pattern should be considered benign, while those with a slow SW pattern should be considered malignant, and those with fast SW pattern treacherous.

Arnold, et al. (1996) concluded that childhood epilepsies comprise a broad range of disorders, which vary from benign to progressive and disabling. Generalized seizures have a broad spectrum in children.

The widespread use of EEG in clinical practice and its comparison with Neurological Pattern is a major development in the treatment of patients with specific syndromes, as well as with ill-defined spells thought to be epileptic in nature. Jerger, et al. (2001) compared the EEG analysis of their cases with neurologist's judgment. Similarly Kabiraj, et al. (2003) studied the EEG-pattern in Complex Partial seizures and made comparisons with their clinical neurological pattern.

To enhance the further diagnostic use of EEG it is important to determine how strongly patterns are correlated with clinical seizures. In an earlier study Hammer, et al (1999) concluded that EEG monitoring and neuroimaging may be critical for clarifying the focal or generalized nature of epilepsy in infants. Similarly, Nowack, et al. (2002) studied EEG patterns and lateralized bursts of theta, and found the rhythm of the pattern to be most strongly correlated with seizures. Watanabe, et al. (2000) and Bauzano, et al. (2001) concluded that EEG aspects of epilepsies help in the confirmation of diagnosis. Similarly, Massa, et al. (2001) conducted a study to search for clinical or EEG markers allowing early detection of patients prone to such complications. The current literature review and the importance of further research on the subject brought us to conclusion that a comprehensive study with particular reference in EEG-patterns was required in epileptic Seizures, in Saudi Arabia. The present study was designed to highlight the following objectives:

- To establish the relationship of clinically diagnosed Generalized Seizures with EEG-pattern.
- To determine the effective role of EEG, in diagnosis of patients suffering from epileptic seizures.

MATERIALS AND METHODS

The present research work is a hospital-based study, conducted in Riyadh, Saudi Arabia from January 1998 - September 2002. Ninety-eight epileptic patients (male = 57 and female = 41) with ages ranging from 15 to 25 years were studied. The clinically diagnosed predominant seizures were Generalized Seizures.

Experienced Neurologists and Clinical Neurophysiologists performed the EEG tests and neurological examinations on all patients. A digital EEG (Nicolet Voyageur) was used with an international 10-20 system, and standard parameters.

Keeping in view the clinical diagnosis and EEG-characteristics, the patients were divided into the following six study groups: Group I) Focal Slowing, FS (n = 1), Group II) Generalized Slowing, GS (n = 19), Group III) Focal Sharp Waves/Spikes, FSWS (n = 0), Group IV) Generalized Sharp Waves/Spikes, GSWS (n = 36), Group V) Generalized Slowing + Focal Spikes, GSFS (n =0), and Group VI) Normal, (n = 42). The data was analyzed using Microsoft Excel software.

RESULTS

The comparison of EEG-changes of Sharp Waves/Spikes frequently found in patients belonging to Generalized Seizures is shown in Table 1. The number of patients in Generalized

Seizures falling in study groups IV, II, and I, indicated the abnormal EEG percentage values as (36.73%, 19.38% and 1.02%) respectively. A total of 42.85% of the cases were found with Normal EEG results. None of the patients were found in study groups III or V (Table 1).

Table1: Comparison of EEG-Changes of Sharp Waves/Spikes in Generalized Seizures in Age Ranging From 15 to 25 Years.

Clinical Seizure Class.	Grp-I FS %	Grp-II GS %	Grp-III FSWS %	Grp-IV GSWS %	Grp-V GSFS %	Grp-VI NML %
GSZ N = 98	1.02 n = 1	19.38 n = 19	0.0 n = 0	36.73 n = 36	0.0 n = 0	42.85 n = 42

FS = Focal Slowing, GS = Generalized Slowing, FSWS = Focal Sharp Waves/Spikes, GSWS = Generalized Sharp Waves/Spikes, GSFS = Generalized Slowing + Focal Spikes, NML = Normal

The comparison of the diagnosis based upon Clinical Neurological Pattern and EEG examination in Generalized Seizures is summarized in Table 2. It was observed that 42.85% of the patients (n = 42) were found to show concordance [i.e., diagnosed as GTCS (25); AME (3); JME (3); Noct Sz (1); Absc Sz (1); CPS (7); and AME (2)] in neurological pattern were found as GSZ and AME in EEG-findings.

Overall 57.13% of the cases were found to show dis-concordance in neurological pattern and their EEG findings. Their detail is such: the 42.85% of the cases indicating [Noct Sz (6) + GTCS (27) + TSZ (1) + AME (4) + JME (2) + Absc Sz (2)] in clinical neurological pattern were found as Normal in EEG-findings. Similarly, 8.16%, and 6.12% of each showing [GTCS (5) + AME (1) + JME (2)], and [AME (1) + JME (4) + CPS (1)], in neurological symptoms were found with non-specific and JME EEG findings, respectively (Table 2).

DISCUSSION

The cases referred from a primary health center in the present study were clinically diagnosed as

Table 2: Comparison of the Clinical Neurological Pattern and EEG Findings for Diagnosis of Generalized Seizures (N=98).

S N	Patient #	Clinical Neurological Pattern	EEG-Findings	Con/Dis-Con (%)
1	42	GTCS (27) TSz (1) Noct Sz (6) AME (4) JME (2) Absc Sz (2)	NORMAL	42.85%
2	8	GTCS (5) AME (1) JME (2)	NON-SPECIFIC	8.16%
3	40	GTCS (25) Noct Sz (1) Absc Sz (1) AME (3) JME (3) CPS (7)	GSZ	40.8%
4	2	AME (2)	AME	2.04%
5	6	AME (1) JME (4) CPS (1)	ME	6.12%

GTCS = Generalized Tonic Clonic Seizures, TSz = Tonic Seizures, Noct Sz = Nocturnal Seizures, AME = Adolescent Myoclonic Epilepsy, JME = Juvenile Myoclonic Epilepsy , Absc Sz = Absence Seizures, CPS = Complex Partial Seizures.

Generalized Seizures in the patients ranging from 15 - 25 years in age.

The relationship of Generalized Seizures was established with their EEG-pattern. The frequency of EEG-abnormalities as Generalized Sharp Waves/Spikes (GSWS) in Group-IV was significantly higher (36.73%) when compared to other study groups, (Groups I and II). Arnold, et al. (1996) reported that Generalized epilepsies include a broad spectrum of EEG changes in children. Similarly, an earlier study by Al-Suleman (2001), found the EEG-abnormalities were epileptiform activity, generalized in 51% of the cases. The percentage of cases in the present study showing Normal EEG (Group VI) was found to be 42.85%. However, the frequency of EEG-abnormalities identified as Generalized Slowing, GS (Group II) and Focal Slowing FS (Group I) were 19.38% and 1.02% respectively.

The analyzed results of our study showed that the incidence of EEG-abnormality as Generalized Sharp Waves/Spikes, GSWS

(Group IV) is highly prevalent and significant in GSZ (36.73%), when compared to other study groups. However, the frequency of abnormalities (36.73%) identified in GSWS (Group IV) in this study is comparatively lower than the abnormalities (51.73%) observed in the same group IV, in 10 - 14 year old patients with Generalized Seizures in our previous study (Kabiraj M.M, et al 2003). These findings may be age dependent, indicating the occurrence of abnormalities as GSWS decreases with age. There are pathgnomonic EEG-features in all of the sub-types of epileptic seizures (Kabiraj M.M, et al 2003). However, the above EEG abnormalities in the cases falling in Groups III & V in the present study were non-existent.

Matinez, et al, (2000) studied the clinical characteristics of epileptic children and analyzed their EEG patterns. Similarly Bauzano, et al. (2001) described the idiopathic generalized epilepsies of childhood, forming a heterogeneous group of epileptic syndromes, with certain clinical and electroencephalographic characteristics in common.

The most frequent EEG-abnormalities in the present study were observed as GSWS (Group IV), in GSZ, as these are major diagnostic electro-cerebral features reported in almost all series of epileptic seizures (Table 1).

We compared the Clinical Neurological Pattern of the cases with their EEG-findings to diagnose seizures with certainty. In earlier studies performed by Niedzielska, et al. (1997), Jerger, et al. (2001), and Kabiraj, et al. (2003), the EEG-findings were compared to a neurologist's clinical judgment to detect the early seizures. Similarly Hammer, et al. (1999) concluded that EEG monitoring and neuro-imaging may be critical for classifying focal or generalized nature of epilepsy in children. Kutsy (1999) and Niedzielska, et al. (2001) indicated that in patients with any seizure disorder, the EEG examination is the mainstay in making the proper therapeutic decision and defining the probable epileptogenic area.

The results of comparison of Neurological patterns with EEG-findings in the present study showed that overall 42.85% of the cases had concordance with their EEGs. Our findings were as follows: [GTCS (25) + AME (3) + JME (3) + Noct Sz (1) + Absc Sz (1) + CPS (7), AME (2)] in clinical neurological pattern were found as Generalized Seizures and Adolescent Myoclonic Epilepsy in EEG-findings.

Overall 57.13% of the cases were found to show dis-concordance in Neurological Pattern and their EEG findings. Their detail is as follows: in the 42.85% (n=42) of cases indicating [GTCS (27) + Noct Szs (6) + TSZ (1) + AME (4) + JME (2) + Absc Sz (2)] Neurological Patterns were found as Normal in EEG-findings. Similarly, 8.16% (n=8), and 6.12% (n=6) of cases showing [GTCS (5) + AME (1) + JME (2)] and [AME (1) + JME (4) + CPS (1)], in neurological symptoms were non-specific and JME EEG findings, respectively (Table 2).

CONCLUSIONS

The EEG is a dynamic test. It expresses the ongoing electrical activity of brain at the time of recording. Overall, normal EEG does not exclude the presence of epileptic seizures. The patient may be under the control with anti-epileptic drugs (AEDs) at the time of EEG-test or interictal phase.

The cumulative percentage of 57.13% (i.e., 42.85% + 8.16% + 6.12%) of cases showed different neurological manifestation when compared to the final diagnosis confirmed by the EEG-examinations.

The present study can conclude that 42.85% of the cases were diagnosed as having clinical Generalized Seizures, which is concordant with EEG findings. The rest of the 57.13% patients were finally diagnosed with the EEG-test only, re-emphasizing its importance in the final diagnosis especially in syndromatic classification of seizures in adolescence.

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