Electroencephalographic (EEG) Pattern in Patients with Partial Seizures

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ABSTRACT

The research presented here is a hospital-based study, conducted from January 1998 to September 2002. A total of 74 patients (male=42 and female=32) with ages ranging from 6 months (0.5) to 25 years were studied. All of the patients were clinically diagnosed as having Partial Seizures (PSz).

EEG tests and neurological examinations were performed on all patients by experienced Neurologists and Clinical Neurophysiologists. A digital EEG (Nicolet Voyageur) was used with the international 10-20 system and standard parameters. Keeping in view the clinical diagnosis and EEG-characteristics, the patients were divided into six study groups. The cases were also divided in three age-wise categories: (i) 0.5 - 2 years, (ii) >2 - 9 years, and (iii) > 9 - 25 years.

Age-wise relationships of the patients with Partial Seizures showed that the majority of the patients (55.55%) in the age category (i), and 35.13% in age category (ii), and 39.28% in age category (iii) had the EEG-abnormality as Focal Sharp Waves/Spikes (Group III). The number of patients showing abnormal EEGs as Generalized Sharp Waves/Spikes (Group IV) in the three age-categories were 11.11%, 18.91%, and 3.57% respectively. Whereas, 33.33%, 5.40% and 35.71% of the patients in the above three age categories had unremarkable EEGs (Group VI).

The EEG-abnormality observed in the form of Focal Slowing (Group I) and Generalized Slowing (Group II) was found to be zero percent in the first age-category. However, age category (ii) had 24.32% EEG abnormalities in Group I, and 10.81% abnormalities in Group II. Similarly age category (iii) had 10.71%, and 7.14% EEG abnormalities in the study groups I and II, respectively.

The results of the combined patient population also showed that the occurrence of abnormalities in Group III is more frequent (39.18%) when compared to all other study groups. The percentage of cases (20.27%) with Unremarkable EEG features (Group VI) was also more frequent.

The role of EEGs in the diagnosis of seizures was evaluated by comparing the neurological examinations of the cases with their EEG-findings. The results of the comparison showed that 51.35% (n=38) of the cases had concordance with EEGs and clinical examination for Partial Seizure (PSz), while 2.7% (n=1) of the cases had concordance with Unremarkable EEG-features and Neurological examinations respectively. Overall 45.95% (n=35) of the cases were found to show dis-concordance. Therefore, it may be concluded that EEG examination is a hallmark for the diagnosis and proper therapeutic decisions in all-epileptic disorders.

(Key words: EEG, Focal Slowing, Generalized Slowing, Focal Sharp Waves/Spikes, Generalized Sharp Waves/Spikes, Partial Seizures, Neurophysiology)

INTRODUCTION

Partial seizures are commonly the result of the focal-abnormal electrical activity in the motor and sensory areas of the cerebral cortex. These are also referred to as localization-related seizures. Specific causes of partial seizures include epileptogenic localized areas where neural tissues have been damaged by lack of oxygen, by space taking lesions (SOL), by discrete brain tumors, or by discrete brain lesions of any sort. An Electroencephalograph (EEG) shows characteristic changes substantiating the clinical symptoms, confirming with the partial seizures, and may localize the epileptogenic areas (Health News 2002).

EEG analysis is able to detect and record the electrical impulses arising from the cerebral cortex. The abnormalities are detected by observation of the pattern of the cerebral electrical waves, which may sometimes confirm the type of seizures as partial (focal) or generalized seizures, and may sometimes localize the origin of the seizures.

The widespread use of EEG in clinical practice 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. To enhance the further diagnostic use of EEG it is important to determine how strongly patterns are correlated with clinical seizures.

Singh et al. (1999) and Nowack et al. (2002) studied EEG-patterns, and established a strong correlation with clinical seizures. Other researchers such as Foldvary et al. (2001) and Dunad et al. (2002), worked on the classification of the patterns of EEG and enriched the existing literature.

The current literature review and the importance of further research on the subject brought us to the conclusion that a comprehensive study with particular reference in EEG-patterns was still required in relation to Partial Seizures in Saudi Arabia. The present study was designed to highlight the following objectives:

- To establish the relationship of Partial Seizures with Age in the epileptic patients.
- To determine the role of EEG, in the diagnosis of patients suffering from epileptic seizures.

MATERIALS AND METHODS

This research was a hospital-based study, conducted in Riyadh, Saudi Arabia from January 1998 to September 2002. It includes investigations on 74 patients (42 male and 32 female) suffering from epileptic seizures. The age ranged from 0.5 years to 25 years. The EEG test and Neurological Examinations were performed on all patients by experienced Neurologists and Clinical Neurophysiologists. A digital EEG (Nicolet Voyageur) was used with and 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 (n = 12), Group II) Generalized Slowing (n = 6), Group III) Focal Sharp Waves/Spikes (n = 29), Group IV) Generalized Sharp Waves/Spikes (n = 9), Group V) Generalized Slowing + Focal Spikes (n =3), and Group VI) Unremarkable (n = 15). The cases were also divided into three age categories, which are as follows: (i) 0.5 - 2 years, (ii) >2 - 9 years, and (iii) > 9 - 25 years. The data was analyzed using Microsoft Excel software.

RESULTS

The age-wise comparison of EEG-changes of Sharp Waves/Spikes frequently found in patients belonging to different groups is shown in Table 1. The number of patients within study group III indicated the abnormal EEG percentage values as 55.55%, 35.13% and 39.28% respectively, in all age categories (i, ii, iii), as compared to the other study groups (groups I, II, IV, V, VI).

Similarly, the number of patients in study group IV represented higher values of 11.11% and 18.91% respectively, in the first two age categories as compared to the third age category. The first group showed abnormally higher percentage values (24.32) in the second age category, as compared to the third age category. The EEG-abnormality in study group II showed percentage values of 10.81 and 7.14 for (ii), and (iii), age categories respectively. The percentage of the cases diagnosed with Unremarkable EEGs (Group VI) in the all three age categories was 33.33%, 5.40% and 33.92% respectively. However, the number of cases belonging to study groups I, II, and V, did not

Table1: Age-Wise Comparison of EEG-Changes of Sharp Waves/Spikes in Partial Seizures

Cat	Age-wise Cat.	Grp-I %	Grp-II %	Grp-IIII %	Grp-IV %	Grp-V %	Grp-VI %
i	.5-2 y n=9	0 n = 0	0 n = 0	55.55 n = 5	11.11 n = 1	0 n = 0	33.33 n = 3
ii	>2-9 y n = 37	24.32 n = 9	10.81 n = 4	35.13 n = 13	18.91 n = 7	5.40 n = 2	5.40 n =2
iii	>9-25 y n = 28	10.71 n = 3	7.14 n = 2	39.28 n = 11	3.57 n = 1	3.57 n = 1	35.71 n =10
Tot.	.5 - 25 y n = 74	16.21 n =12	8.10 n = 6	39.18 n = 29	12.16 n = 9	4.05 n = 3	20.27 n = 15

show EEG-abnormality within the first age category.

The EEG changes in the entire study group with a combined patient population (0.5-25 years) were studied. It was observed that EEG-abnormalities of Focal Sharp Waves/Spikes; Focal Slowing; and Generalized Sharp Waves/Spikes (Groups III, I & IV) were significantly higher, (39.18%, 16.21, and 12.16% respectively) as compared to study groups II, V, VI. The changes observed in EEG data as Generalized Slowing and Generalized Slowing + Focal spikes (Groups II & V) were 8.10% and 4.05% respectively. However, 20.27% of the cases were found with Unremarkable EEG findings (Groups VI) (Table1).

The comparison of the diagnosis based upon Neurological and EEG examinations is summarized in Table 2. It was observed that 54.05% of the patients (n = 37 + 1 + 2 = 40), were found to show concordance (i.e., diagnosed as Partial Seizures (PSz) and Unremarkable both in Neurological test and EEG-examinations respectively). The remaining 45.95% of cases (n = 34) showed dis-concordance in Neurological and EEG Examinations.

The details of the dis-concordant cases are as follows: 20.3% cases (n = 15) indicating PSz in Neurological symptoms had Unremarkable EEGs. 12.42% of patients (n = 12) having Generalized Tonic Clonic Seizures (GTCS) as Neurological symptoms were diagnosed as Partial Seizures (PSz) based on EEG-findings. The remaining 13.5% patients (n = 7) had different neurological features as compared to their EEG-diagnosis (such as: patients suffering from GTCS (3), GSz (1), PSz (1+1), and Unremarkable (1) in Neurological examinations showed Unremarkable, Partial Seizures, Independent Foci, Multi focal spikes, and Focal sharp waves in EEGs). Details are presented in Table 2.

Table 2: The Comparison of Diagnosis by Neurological Examination and EEG-Findings (N=74)

# of cases	Neurology examination/ symptoms	EEG-Findings	% Concordance/ Dis-concordance
37	Partial Seizures	Focal Discharges	50 % Concordance
1	Partial Seizures	Focal Spikes	1.35 % Concordance
2	Unremarkable	Unremarkable	2.7 % Concordance
15	Partial Seizures	Unremarkable	20.27 % Dis-concordance
12	Generalized Tonic-Clonic Seizures	Focal Sharp Waves	16.21 % Dis-concordance
3	Generalized Tonic-Clonic Seizures	Unremarkable	4.05 % Dis-concordance
1	Generalized. Seizures.	Focal Spikes	1.35 % Dis-concordance
1	Partial Seizures	Independent . Foci	1.35% Dis-concordance
1	Partial Seizures	Multi-Focal Spikes	1.35% Dis-concordance
1	Unremarkable	Focal Sharp Waves	1.35% Dis-concordance

DISCUSSION

The age-wise relationships of the patients with partial seizures was established in this study. The frequency of EEG-abnormalities as Focal Sharp Waves/Spikes (Group III) was significantly higher in all age categories as compared to other study groups (e.g., Groups I, II, IV, V, and VI). However, in the same Group III, this abnormality was found to be highly significant (55.55 %) in the 0.5 to 2 year age category (i), as compared to age-category ii (35.13%) and age-category iii (39.28%).

The percentage of patients showing EEG-abnormality of Focal Slowing (Group I) was 24.32% in age-category (ii). However, the number of patients showing the EEG-abnormalities as Generalized Sharp Waves/Spikes (Group IV) in age categories (i) and (ii) showed values of 11.11% and 18.91%, respectively. The analyzed results of our study

showed that the incidence of EEG abnormality as Focal Sharp Waves/Spikes (Group III) is highly significant in all age categories as compared to other study groups, and these are path gnomic EEG features in all the sub-types of partial seizures. However, in the first age-category, none of the cases were found in groups I, II & V.

The number of cases with Unremarkable (Group VI) EEG-findings in all three age-categories indicated values of 33.33%, 5.40%, and 33.92% respectively.

In an earlier study, Park et al. (1996) classified seizure onset patterns as rhythmic activity, attenuation, repetitive spikes, or spike wave complexes.

In the present study, the overall results of the combined patients population, ranging from 0.5-25 years, showed that the frequency of abnormality in study Group III (Focal Sharp Waves/Spikes) was significantly higher, (39.18%) when compared to other study groups (Table 1). These findings were supported by Kutluay et al. (2001) who mentioned that in the majority of patients, midline spikes represent focal epileptiform activity and are most commonly associated with seizures of focal onset.

The results of the present combined study showing abnormal EEG percentage values in Group I (Focal Slowing), Group IV (Generalized Sharp Waves/Spikes), and Group II (Generalized Slowing) were also significant (16.21%, 12.16%, and 8.10%, respectively) as compared to other study groups. The change observed in Group V (Generalized Slowing + Focal Spikes) was 4.05% only. However, the percentage of the cases found with Unremarkable EEGs (Group VI) was significantly higher (20.27%) (Table 1). The most frequent EEG-abnormalities in this study were found in Groups III, I, and IV, and these are the major diagnostic electro-cerebral features reported in almost all series of partial seizures.

We compared the Neurological Examinations of the cases with their EEG-findings to diagnose the seizures with certainty. In earlier studies 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. In another similar study performed by Jerger et al. (2001), the EEG-findings were compared to a neurologist's clinical judgment in the detection of early seizures. Similarly, Doose et al. (1997), indicated that clinical and EEG findings are in agreement with a multifactorial pathogenesis of epilepsies with benign focal epileptiform sharp waves.

The results of the comparison of Neurological Examinations with EEG-findings in this study showed that 51.35% of the cases had concordance, and were diagnosed as PSz-patients. Another 2.7% had concordance and were diagnosed with Unremarkable features. Overall, 45.95% of the cases were found to show dis-concordance including the 20.27% of cases indicating PSz in neurological examinations, which were found to show Unremarkable EEG-findings. Similarly, 16.21% of the patients showed dis-concordance such that cases indicating GTCS in neurological examinations were found to be consistent with PSz-patients in EEG-findings. The rest of the 9.45% cases also showed dis-concordance (i.e., seven patients suffering from GTCS, GSz, PSz, and Unremarkable seizures) in Neurological Examinations and were found to show Unremarkable, Partial Seizures, independent foci, multi-focal spikes and Focal Sharp Waves in EEG-findings (Table 2).

The cumulative 45.95% (i.e., 20.27% + 16.21% + 9.45%) of cases showed differences between neurological findings and the final diagnosis confirmed by the EEG-examinations.

CONCLUSIONS

The results this study conclude that 54.05% of the cases were diagnosed as having clinical Partial Seizures with Unremarkable features, which is concordant with EEG findings. The remaining 45.95% of the patients were finally diagnosed with the EEG-test only.

The sensitivity of Partial Seizures diagnosis is increased by another 25.66% (16.21% + 9.45%) depending on EEG-examinations. The overall increase of 77.01% (51.35% + 25.66%) further enhanced the diagnosis of Partial seizures based on the EEG-test. Therefore, it may be concluded that EEG examination is a hallmark for the diagnosis and proper therapeutic decisions in all epileptic disorders.

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