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ORIGINAL ARTICLE / KLİNİK ÇALIŞMA

Outcome of Long-Term Video-EEG Monitoring

Uzun Süreli Video-EEG Monitörizasyon Sonuçları

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Summary

Objectives: Long-term video-electroencephalogram (EEG) monitoring (VEM) is a diagnostic system used for many purposes, including the precise categorization of epileptic seizures, excluding non-epileptic seizures, and finding the seizure onset zone. The aim of this study was to demonstrate the importance of the VEM in the diagnosis and differential diagnosis of epilepsy.

Methods: Data of patients who were hospitalized in the video-EEG unit of Dicle University Neurology Department between 2012 and 2016 were retrospectively evaluated. The records of 245 patients that were of at least 24-hours duration were included in the study.

Results: The mean duration of recording was 3.3±1.3 days. Clinically observed seizures were detected in 37.5% (n=92) of the patients. Of those, 21.2% (n=52) were evaluated as epileptic seizures and 16.3% (n=40) were defined as non-epileptic seizures. The proportion of psychogenic non-epileptic seizures was 14% (n=36). The mean length of the recording of the first seizure attack was 1.6 days. Interictal EEG abnormalities were found in 13.4% (n=33) of the patients. The mean duration of the disorder was 7.3 years.

Conclusion: Medical history, physical examination, and routine EEG procedures can be misleading factors in the diagnosis of epilepsy. VEM is a crucial technique to differentiate diagnoses in patients with treatment-resistant epilepsy and to precisely diagnose the seizure type and the epileptic syndrome.

Keywords: Electroencephalogram; epilepsy; video-electroencephalogram.

Özet

Amaç: Uzun süreli video-EEG monitörizasyonu (VEM); epilepsi nöbetlerini sınıflamak, non-epileptik nöbetleri ayırt etmek ve nöbet başlangıç alanını saptamak gibi çok çeşitli durumlarda kullanılan faydalı bir tanı yöntemidir. Bu çalışmada epilepsi tanı ve ayırıcı tanısında VEM uygulamasının önemini vurgulamayı amaçladık.

Gereç ve Yöntem: Dicle Üniversitesi Nöroloji Kliniği Video EEG Ünitesi'nde 2012–2016 yılları arasında yatmış olan hastaların VEM raporları geriye dönük olarak incelendi. En az 24 saatlik kayıtlar dikkate alınarak toplam 245 hasta çalışmaya dahil edildi.

Bulgular: Ortalama kayıt süresi 3.3±1.3 gün idi. Doksan iki hastada (%37.5) klinik olarak nöbet gözlendi. Bunların 52'si (%21.2) epileptik, 40'ı (%16.3) non-epileptik nöbetler olarak değerlendirildi. Psikojen non-epileptik nöbet (PNEN) oranı %14 (36 hasta) olarak saptandı. İlk nöbetin kaydedilme zamanı ortalama olarak 1.6 gün idi. Otuz üç hastada (%13.4) interiktal EEG'de anormallik saptandı. Ortalama hastalık süresi 7.3 yıl idi.

Sonuç: Epilepsi hastalarının tanısında öykü, muayene, rutin EEG ile sınırlı kalındığında yanılma ihtimalinin olabileceğini, tedaviye dirençli olgularda PNEN ayırıcı tanısı için, nöbet tipi ve epileptik sendromun kesin tanısı için VEM yapılmasının önemli olduğunu düşünmekteyiz.

Anahtar sözcükler: Elektroensefalografi; epilepsi; video-EEG monitörizasyonu.

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Introduction

Epilepsy is a clinical condition due to abnormal-synchronous neuronal activity in the brain.[1] The prevalence of epilepsy has been found to be 4-18/1000 in studies.[2] The first step in the evaluation of epilepsy patients is determining whether the clinical presentation is an epileptic seizure.[3] Epilepsy is a clinical diagnosis based on the history provided by patients or witness, which is a subjective method. It is clinically difficult to be sure about the diagnosis of epilepsy as the seizure history is not always obtained and sometimes it is inadequate.[4] Therefore, video-EEG monitoring (VEM) is used for definitive diagnosis and classification of epilepsy.[5]

Long-term VEM, which has been in use since the 1970s, is a method used to diagnose and identify seizures in all age groups. Long-term video and EEG recording is done with VEM, and in addition to typical seizures, IIEEG (interictal EEG) and sleep EEG recording are able to be performed. Multiple seizures of the registered patient are recorded for several days. This allows the physician to clarify whether there is more than one type of seizure (epileptic, psychogenic) with seizure semiology or there are seizures originating from more than one focus.[5–7] Additionally, VEM is the most appropriate method for the evaluation of the diagnosis and treatment of pharmacoresistant patients.[8,9]

In this study, we aimed to examine and present the parameters, such as the diagnoses, focus, and IIEEG abnormalities as a result of the VEM examinations performed on patients whose seizures cannot be controlled despite of treatment or on patients for whom definitive epilepsy diagnosis cannot be made clinically.

Materials and Methods

In this study, VEM reports of patients, who were hospitalized at Video EEG Unit of Dicle University Neurology Clinic between 2012-2016, were retrospectively analyzed. In total, 245 patients were included in the study with at least 24 hours records. Electroencephalographic data are recorded digitally by the Carefusion brand, Nicolet 32-channel EEG device. In our unit, a five-day hospitalization is planned routinely. However, hospitalization can be ended earlier in cases where the seizure is seen in a shorter period of time or on the patient's discretion. Scalp electrodes are placed according to 10-20 system during VEM. The antiepileptic drug (AED) cessation is performed routinely in hospitalized patients. Patient information such as age, sex, number of seizure, type of seizure according to the clinical seizure or seizure history, ictal and IIEEG pathologies, sleep EEGs, reasons of being referred to the VEM unit, and duration of the disease were recorded and analyzed. Epileptic seizures were classified as simple partial, complex partial seizures (CPS), secondary generalized seizures (SGS), absence, myoclonic, generalized tonic-clonic seizure (GTCS), and atonic according to International League Against Epilepsy (ILAE-1981).[10]

Results

Of 245 patients included in the study, 124 were males (50.6%) and 121 were females (49.4%). The mean age was 28±11. VEM records were made between one and five days. Mean admission duration was 3.3±1.3 days. Clinical seizures were observed in 92 (37.5%) patients. Of these, 52 (21.2%) were considered as epileptic and 40 (16.3%) were considered as non-epileptic seizures. Psychogenic non-epileptic seizure (PNES) rate was 14% (36 patients). The first seizure determination was about 1.6 days. This duration was 1.8 days in patients with epileptic seizures whereas it was found as 1.3 days in patients with non-epileptic seizures. Seizure numbers and time distributions of the patients are given in Table 1. Of the patients with epileptic seizures, three (5.7%) had seizure in sleep, four (84.6%) had seizure while they were awake, and five (9.6%) had seizure while both in sleep and awake. Seizure distribution of 52 patients with epileptic seizure and how many of these patients had focus are given in Table 2. Thirty-three patients (13.4%) were observed to have abnormalities in the IIEEG. Distribution according

Table 1. Distributions of seizure frequency-time and interictal EEG pathology frequency

	Epileptic seizure (%)	Non-epileptic seizure (%)
n=92 (%37.5)*	52 (21.2)	40 (16.3)
Number of the seizures±SD	2.6±1.9	7±14
Time of the seizure		
Night	8 (15.3)	6 (15)
Daytime	20 (38.4)	9 (22.5)
Night and daytime	5 (9.6)	3 (7.5)
Interictal EEG pathology	8 (15.3)	3 (8.3)

*Seizure hours of all patients could not be obtained. (Seizure hours of 19 patients with epilepsy, and 22 patients with PNES could not be obtained)
EEG: Electroencephalography. SD: Standard deviation; PNES: Psychogenic nonepileptic seizure.

Table 2. Distribution of epileptic seizures

	n=52 (%)	Focus determinations (%)
Secondary GTCS	18 (34.6)	7 (38.8)
GTCS	13 (25)	
CPS	9 (17.3)	6 (66.6)
Absence	4 (7.6)	
Myoclonic	4 (7.6)	
Focal motor	3 (5.7)	3 (100)
Atonic	1 (1.9)	

GTCS: Generalized tonic-clonic seizure; CPS: Complex partial seizure.

Table 3. Seizure types and iEEG that the patient told in his/her history, who did not have any seizure in VEM

	iEEG		
	Abnormal	Normal	Total
GTCS (78.8%)	16	97	113
Partial (13.7%)	4	17	21
Myoclonia (7.1%)	1	10	11

VEM: Video-EEG monitoring; iEEG: Interictal electroencephalography; GTCS: Generalized tonic-clonic.

Table 4. Duration of the disease

Mean symptom duration (year)	7.3 (1 m-44 y)
Those who have epileptic seizure	9.9 (2 m-40 y)
Those who have non-epileptic seizure	6.9 (1 m-44 y)
Those who have interictal EEG pathology	8.3 (1 m-25 y)
Those who do not have seizure, and have normal EEG	6.1 (1 m-32 y)

EEG: Electroencephalography; m: Months; y: Years.

to the seizure type was given in Table 1. iEEG abnormality was observed in 22 patients, who had no seizures during VEM (14.3%). GTC seizures were observed to be the most common seizure with the rate of 78.8% among the types of seizures described in the histories of the patients who did not have seizure during VEM (Table 3). In patients with IIEEG abnormalities without seizures, the interictal abnormality determined was found to be compatible with the type of seizure stated in the history in nine patients (40.9%). Four of these nine patients (44.4%) had focal, and five (55.5%) had generalized epileptic abnormalities. When the reasons of VEM requests were examined, it was found to be requested for the differentiation of epileptic seizures and PNES in 223 (91%) patients, for the detection of epileptic focus in 14 (5.7%) patients, for the diagnosis in eight (3.2%) patients and for the determination of whether the typical non-epileptic attack was epileptic or not. The mean duration of illness was found as 7.3 years in general. Details are given in Table 4.

Discussion

In cases where the diagnosis of epilepsy is tried to be made only with clinical findings, misdiagnosis rate is over 30%, and differential diagnosis of syncope and PNES is very difficult. For this reason, electro-clinical evaluation is important to be performed.[11] Electroencephalography (EEG) is one of the important diagnostic tool used in the evaluation of seizures and identification of semiology. As the American Society of Clinical Neurophysiology suggests, EEG is a short part received from the patient's life. 30% of the patients with epilepsy have normal IIEEG. Recurrent routine EEG imaging is recommended to capture epileptic abnormalities.[12,13] The rate of capturing epileptiform abnormalities in the first routine EEG after the seizure was 29-55% whereas it can increase to 39-72% in the third EEG.[14] The detection rate of epileptiform activity was found to be 68%, which is similar to the third routine EEG, in a 72-96 hours ambulatory EEG recording performed on patients with recurrent paroxysmal events. The sensitivity of long-term EEG is similar to the routine EEG. While the detection rate of interictal epileptic abnormalities with VEM was found to be 30-40% in the literature, EEG abnormality was found in 13.4% of the patients, and in 15.3% of the patients having epileptic seizure in our study.[11,15]

Long-term VEM is a useful tool used in various situations such as examination of seizures and synchronous EEGs, classification of epileptic seizures, differentiation of non-epileptic seizures (PNES, syncope, movement disorders, sleep disorders), and identification of onset area if the patient is a candidate for surgery.[16] Despite of its high cost, it is necessary to avoid recurrent EEGs to be performed in cases where the patient is misdiagnosed and to avoid unnecessary treatment costs.[17] In previous studies the mean duration of recordings was found between three and four days.[18] In our study, the mean recording duration was 3.3 days. In a study by Cox et al.,[17] a three-day monitoring was considered sufficient for diagnostic recording in 2/3 of individuals who had at least one seizure per week.In the study by Lobello et al.,[19] seizures were recorded in the first two days in the 87% of the patients.In our study, the mean duration of catching the first seizure was 1.6 days. Studies have

shown that 98% of the clinical events can be seen at the end of the fifth day, and that the five-day recording period was sufficient.[20] Psychogenic non-epileptic seizures were reported to occur earlier in some studies[21] whereas no difference was reported in some of them.[19] In our study, no significant difference was observed between the onset time of epileptic and non-epileptic events (1.8 days-1.3 days). In our study, clinical events were observed in 37.5% of the patient. In other studies, the recording rate was found to be 50-83%.[7,10,21–23] In our clinic, VEM is requested for patients with rare seizure and medication is not stopped routinely. These may have caused less clinical events. VEM is very important in the diagnosis of patients with epilepsy or PNES, or both.[4] According to a study, catching the seizure rate of VEM was observed to be 73%. Unfortunately, referring the pharmacoresistant epilepsy patients to the VEM units takes a long time.[8] In our study, the rate of non-epileptic seizures was found to be 16.3% in patients who were referred to the VEM. This rate was found to be 11-55% in other studies.[5]

Diagnosis for epileptic seizures and PNES is one of the clinical conditions that cause confusion. Misdiagnosis leads to long-term use of wrong and unnecessary drugs, side effects, additional financial burden, delay in the recovery of the patient, and therefore, social problems.[22] In our study, 14% of PNES was observed. VEM is the gold standard for the diagnosis of PNES since the brain electrical activity of the patient and the video recording of the identified seizure are performed simultaneously.[13,23] PNES is the most commonly observed non-epileptic event in epilepsy centers. In some patients, epilepsy and PNES may exist together.[24] In our study, no epilepsy and PNES association was observed. This may be related to the discharge of patients after their seizures are observed. In the United States, 5-20% of epileptic patients are reported to also have PNES. Psychogenic non-epileptic seizures should also be differentiated from physiologic non-epileptic events such as syncope, cataplexy, migraine, and paroxysmal movement disorder.[13,25] VEM studies have shown that patients with frequent paroxysmal attack receive AED. Differentiation of PNES and epileptic seizure is known to be made only by examining video recordings in many patients. More definitive diagnosis can be made through the combination of clinical semiology and electrophysiology.[4] There is no laboratory test or imaging method that can be used to distinguish epileptic seizures and psychogenic non-epileptic seizure. High prolactin levels can be used to distinguish GTCS seizures from PNES.[13] Prolactin and postictal EEG can be used in the diagnosis of PNES. However, it is helpful in diagnosis, not diagnostic.[26] Delayed diagnosis of the psychogenic non-epileptic seizure was reported as about seven years.[22] In our study, the duration of the disease in the PNES group was 6.9 years. Duration of the disease is the most important prognostic factor in the diagnosis of PNES.[27,28] This method is available in a small number of specialized centers and is an expensive method, and this makes its accessibility difficult.[22]

Conclusion

VEM is very important in the diagnosis of patients with epilepsy or PNES, or both. We think that there may be a possibility of misinterpretation of the epileptic patients if only history, examination, and routine EEG of the patient are considered, and that VEM has a great importance for the differential diagnosis of PNES in pharmacoresistant patients, and for the definitive diagnosis of epileptic syndrome and seizure type. It is important to perform VEM in treatment-resistant patients without loss of time since the prolongation of the disease duration has a negative effect on the prognosis in both epileptic patients and patients.

Ethics Committee Approval

Local ethics committee approval was obtained.

Peer-review

Externally peer-reviewed.

Conflict of interest

The authors declare that they have no conflict of interest.

Authorship Contributions

Concept: D.A.; Design: D.A.; Data collection &/or processing: D.A.; Analysis and/or interpretation: D.A.; Literature search: D.A.; Writing: D.A.

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