Epilepsy & Behavior 25 (2012) 303–306

Contents lists available at SciVerse ScienceDirect

Epilepsy & Behavior

journal homepage: www.elsevier.com/locate/yebeh

The yield and clinical utility of outpatient short-term video-electroencephalographic monitoring: A five-year retrospective study

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ARTICLE INFO

Article history:
Received 28 July 2012
Revised 10 August 2012
Accepted 12 August 2012
Available online 24 October 2012

Keywords:
Psychogenic nonepileptic seizures
Epilepsy
Diagnosis
EEG
Video electroencephalography

ABSTRACT

Outpatient short-term video-electroencephalographic monitoring (OVEM) is recognized as a useful tool in the diagnosis of epilepsy and other paroxysmal disorders. The aim of this retrospective study was to determine the diagnostic yield of OVEM. We analyzed 175 OVEM records of adults (111 females and 64 males) referred over a period of 5 years. The mean length of recording was 3.8 h. The highest yield was found in psychogenic nonepileptic seizures (PNES) (37.1%), followed by interictal epileptiform discharges (17.2%), and epileptic seizures (6.9%). The provisional diagnosis was epilepsy in 77.7% and PNES in 22.3% before the test. Outpatient short-term video-electroencephalographic monitoring changed the pre-test diagnosis in 30.9% of patients. Outpatient short-term video-electroencephalographic monitoring is a useful diagnostic test for PNES. It has a higher yield for PNES than epilepsy.

1. Introduction

Inpatient long-term video-electroencephalographic monitoring (IVEM) is well established as a diagnostic tool in the presurgical evaluation of the epilepsies, characterization of epilepsy syndromes, documentation of seizure frequency, and confirmation of psychogenic nonepileptic seizures (PNES) [1]. It is also useful for detection of nonconvulsive status epilepticus in the intensive care unit [2], as well as for treatment monitoring of status epilepticus [3]. However, it is a resource and labor intensive test that is not widely available. Outpatient short-term video-electroencephalographic monitoring (OVEM) has emerged as another diagnostic tool which may be useful in some patients. The indications for this test and its place in routine clinical practice are not clearly defined. This study was undertaken to evaluate the yield and clinical utility of OVEM.

2. Methods

This study was conducted at Monash Medical Centre, a tertiary care teaching hospital in Australia, with approval from the Human Research Ethics Committee. We retrospectively analyzed all adult patients (≥16 y) who underwent OVEM from January 2005 to December 2009 in our neurophysiology laboratory. No patients were excluded based on the pre-test frequency of clinical events.

The demographic data of patients were retrieved from the electronic database of the neurophysiology laboratory. Provisional diagnoses prior to the test and other relevant clinical data were obtained from the referral form and medical records. All referrals had been made by neurologists. The OVEM reports were scrutinized to extract the following information: length of the recording, interictal non-epileptiform abnormalities, interictal epileptiform discharges (IED), capture of epileptic seizures, capture of PNES, and the diagnosis after OVEM. Focal slowing and background/generalized slowing were classified as interictal non-epileptiform abnormalities. The IED comprised focal discharges (sharp waves and sharp-and-slow waves) and generalized discharges (generalized spike-and-wave activity, generalized polyspikes, generalized polyspike-and-wave discharges, generalized paroxysmal fast activity, and photoparoxysmal response). Epileptic seizures were diagnosed on the basis of typical semiology and electrographic ictal rhythm. Psychogenic nonepileptic seizures were diagnosed based on typical semiology accompanied by electroencephalographic (EEG) artifact, as described by us in a previous publication [4].

Outpatient short-term video-electroencephalographic monitoring was recorded according to an established protocol. Regular antiepileptic drugs were not ceased or tapered for the test. The recording was conducted in a quiet room with the patient lying in a comfortable, reclining chair to induce natural sleep. At the beginning of the recording, 3 min of hyperventilation was done followed by intermittent photic stimulation. When PNES was suspected in the referral, verbal suggestion was used by the EEG technician to induce habitual events. The placebo induction was not used. The video-EEG data were acquired using Compumedics digital EEG system (Compumedics Ltd., Melbourne, Australia) with the international 10-20 system of

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1525-5050/$ – see front matter.
http://dx.doi.org/10.1016/j.yebeh.2012.08.018

electrode placement. Typically, the recording continued for 3–4 h with rare exceptions.

The outcome of OVEM was quantified using two measures: diagnostic yield of abnormalities and change of the pre-test diagnosis. The diagnostic yield was defined as the number of positive tests divided by the total number of tests. This was expressed as a percentage with 95% confidence intervals (CI). The difference between pre-test and post-test diagnoses was expressed as a percentage to quantify the diagnosis change. STATA (version 11) statistical software (StataCorp LP, TX, USA) was used for data analysis.

3. Results

A total of 175 records from 175 patients were studied. There were 111 (63.4%) females and 64 (36.6%) males with an age range from 16 to 87 years (mean 36). The mean length of recording was 3.8 h (range 1 to 6.8). Pre-test frequencies of clinical events were ≤1 per week (30.1%), 2–6 per week (48.7%), and ≥7 per week (21.2%).

Focal slowing was found in 24 recordings (13.7%), whereas 18 (10.3%) demonstrated background slowing and generalized slowing. Interictal focal and generalized epileptiform discharges were recorded in 15 each (8.6%). Epileptic seizures were captured in 12 patients (6.9%). Psychogenic nonepileptic seizures occurred in 65 (37.1%) patients.

The diagnostic yield for PNES was found to be 37.1% (95% CI 30.2%–44.5%). It was 17.2% (95% CI 12.1%–23.3%) for IED and 6.9% (95% CI 3.8%–11.4%) for epileptic seizures.

Before OVEM, 136 (77.7%) patients carried the provisional diagnosis of epilepsy, while the rest were suspected to be having PNES. The test changed the diagnosis in 54 (30.9%). The most striking change in the diagnosis was from epilepsy to PNES in 28.6% (95% CI 22.3%–35.6%). In 2.3% (95% CI 0.7%–5.4%), the diagnosis changed from PNES to epilepsy.

4. Discussion

In this series, we have demonstrated that OVEM has a higher yield for PNES than epileptic seizures and IED. The yield of PNES was more than five times that of epileptic seizures. We have also shown that OVEM resulted in diagnosis change from epilepsy to PNES in over one-fourth of patients. These figures indicate the clinical utility of OVEM in the diagnosis of PNES.

4.1. Yield of PNES

The practical value of OVEM in capturing PNES has been demonstrated in previous studies. Most studies have reported PNES yields comparable to our finding (Table 1) [5–8]. Two studies conducted by the same group found higher yields of 67% [9] and 63.5% [10]. The researchers employed a well-designed protocol for seizure induction, and all patients were clinically suspected to have PNES prior to the test, which may account for the higher yield. Another study reported 60% yield, and the researchers used placebo induction [11]. One study found a lower yield of 16.8% [12]. The reason for this discrepancy is unclear, but under-representation of PNES in the study sample and the lack of verbal suggestion for seizure induction in the OVEM protocol are possible explanations.

It would be useful to compare our findings with IVEM and routine EEG (REEG) (Table 1). A study from an epilepsy monitoring unit reported PNES in 24% of patients during IVEM [1]. It should be noted that in their cohort, 69.5% of studies were done for diagnostic purposes, and the rest were for presurgical evaluation. Hence, one might expect a higher yield than 24% for PNES if all the studies were performed for diagnostic purposes. In comparison, the yield in REEG is much lower [13].

Placebo induction is a way of increasing the yield of PNES during EEG. However, this method may trigger atypical, non-habitual, nonepileptic events as well as true epileptic seizures, limiting its practical value [14]. The ethical limitations of the technique have been highlighted [15]. An induction protocol for PNES without placebo has been described [16]. This method could be incorporated into OVEM protocols to increase the yield of PNES.

4.2. Yield of epileptic seizures

The yield of 6.9% in our study is comparable with the findings of most studies (Table 1). A higher yield of 40% in the study by Srikumar et al. is most probably due to overrepresentation of patients with intractable epilepsy with frequent seizures [7]. Though not specified in the papers, similar sampling bias could be the explanation for higher yield found in two more studies [6,17]. In comparison to OVEM, IVEM has a higher yield for epileptic seizures [1], whereas the yield is similar or marginally lower in REEG [13].

Table 1
Comparison of outpatient short-term video-EEG studies with two representative studies on inpatient long-term video-EEG and routine EEG.

Reference	N	Age (mean) years	Pre-test diagnosis	Post-test diagnosis	Test type	Length (mean) h	ES yield %	PNES yield %	IED yield %	Induction technique
Seneviratne et al. (current study)	175	16–87 (36)	EP 77.7%, PNES 22.3%	EP 17.1%, PNES 37.1%, inconclusive 45.72%	OVEM	3.8	6.9	37.1	17.2	HV, IPS, VS
Kamel et al. (2010)	34	15–73 (22)	EP 100%	EP 100%	OVEM	6	5.9	0	47	HV, IPS
Tallawy et al. (2010)	36	(25.2)	EP and paroxysmal nonepileptic events	NS	OVEM	2	13.9	30.6	NS	HV, IPS, VS
Modur et al. (2008)	179	11–86 (39)	NS	EP 36%, PNES 15%	OVEM	4–4.5	5	16.8	NS	HV, IPS
Varela et al. (2007)	52	NS	PNES 100%	PNES 67%, inconclusive 33%	OVEM	NS	0	67	NS	HV, IPS, VS
Benbadis et al. (2004)	74	>18	PNES 100%	PNES 63.5%	OVEM	1–2	2.7	63.5	NS	HV, IPS, VS
McGonigal et al. (2004)	143	14–75	'Attack disorders'	NS	OVEM	40–50 min	4.9	35.7	NS	HV, IPS, VS
Del Giudice et al. (2002)	100	<17 (6)	EP, NE	EP, NE	OVEM	2	25	27 (NE)	NS	NS
Srikumar et al. (2000)	45	3–11 (7.9)	EP 84.4%, 'to study behavior' 15.6%	NS	OVEM	4.6	40	38	NS	NS
Bhatia et al. (1997)	50	7–51 (22.7)	PNES 100%	NS	OVEM	5	0	60	NS	PL
Connolly et al. (1994)	43	<16 (3.2)	EP 100%	EP 100%	OVEM	2–3	83	NS	NS	NS
Rowan et al. (1987)	166	10–75	EP, PNES	NS	OVEM	6–8	48	43	NS	HV, IPS, PL
Ghougassian et al. (2004)	131	16–88 (40.5)	EP 55.7%, PNES 6.9%, uncertain 37.4%	EP 48.9%, PNES 30.5%, inconclusive 20.6%	IVEM	1–13 days (5.6 d)	43.5	24	43	NS
Angus-Leppan (2007)	1000	2 days-101y (31.3)	NS	EP 30%	REEG	NS	4.5	1.5	28.2	HV, IPS

EP, epilepsy; ES, epileptic seizures; HV, hyperventilation; IED, interictal epileptiform discharges; IPS, intermittent photic stimulation; IVEM, inpatient long-term video-EEG monitoring; N, total number; NE, nonepileptic events; NS, not specified; OVEM, outpatient short-term video-EEG monitoring; PL, placebo induction; PNES, psychogenic nonepileptic seizures; REEG, routine electroencephalogram; and VS, verbal suggestion.