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How to choose a practicable duration time for capturing paroxysmal events by prolonged video electroencephalogram monitoring in the elderly?

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ABSTRACT

Purpose: To measure association between paroxysmal events and length of monitoring to identify a practicable duration time for capturing seizures in the elderly.
Methods: Consecutive inpatients 60 years and older who were admitted to the Epilepsy Center and underwent prolonged video electroencephalogram (VEEG) monitoring (VEM) were reviewed retrospectively. Electronic medical records were reviewed to collect information regarding sex, age at onset of symptoms and examination, concurrent epilepsy, frequency of seizures, diagnosis before and after examination, antiepileptic drugs (AEDs), brain magnetic resonance imaging (MRI), and VEEG findings.
Results: A total of 184 consecutive elderly inpatients were enrolled. The mean age was 67.1 ± 6.1 years (range, 60–89 years), with 69 females and 115 males. Mean length of monitoring was 20.4 ± 18.9 h (range, 1 h–6 days). During LTM, 89 patients (48.4%) recorded paroxysmal events, including 58 epileptic seizures (43.3%) and 31 non-epileptic events (16.8%). All non-epileptic events were captured during the first 24 h. All first epileptic events were detected during the first 4 days, with 98.9% of them recorded by the end of the 2nd day. Increased seizure incidence ($p = 0.000$, odd ratio [OR] = 0.075, 95% confidence interval [95% CI]: 0.035–0.163) and length of monitoring ($p = 0.001$, OR = 1.044, 95%CI: 1.017–1.071) were independently associated with paroxysmal events capture.
Conclusions: It may be practicable to monitor for 24 h when a non-epileptic seizure is suspected, with expected monitoring duration of 2 days when an epileptic seizure with daily or persistent frequency is considered, except for pre-surgical evaluations.

1. Introduction

Video electroencephalogram (VEEG) monitoring is regarded as the gold standard diagnostic tool for diagnosing seizure disorders, classifying seizure types, and evaluating surgical candidates with intractable epilepsy [1–4]. Further, inpatient prolonged VEEG monitoring (VEM) is a widely used diagnostic tool for seizures and other paroxysmal behavioral events [5–7]. Accordingly, VEM typically ranges from 1 h to 24 h, but can be prolonged for several days or weeks when necessary. Moreover, VEM is an established investigation for adult and pediatric patients with paroxysmal clinical events, raising the diagnostic possibility of epilepsy [8,9]. Epilepsy is frequent in the elderly, with an estimated prevalence of 1–2% in people over the age of 60, and 7.7% in institutionalized patients over 65 [10,11]. Elderly patients can have episodes that mimic seizures but may be the result of syncope, a sleep disorder, or psychiatric illness [12].

Few studies have focused on the optimal time of VEM for capturing seizures, with the study subjects being adult patients with a mean age of around 30 or 40 years [13–16]. Consequently, the appropriate length of monitoring for detecting paroxysmal events in old patients is still unknown. Considering the high-cost and time-consuming characteristics of VEM, the aim of this study was to measure association between paroxysmal events and length of monitoring to identify a practicable and economical duration time for capturing paroxysmal events in the elderly.

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2. Methods

2.1. Study setting and subjects

This study was conducted in the epilepsy monitoring unit (EMU) in Peking Union Medical College Hospital (PUMCH), a tertiary hospital in Beijing, China. Patients came from all over China and got admitted for VEM only after an epilepsy clinic visit or referred by a general neurologist in charge of the Neurology ward. The center was founded in 2008 and had four EMU beds. Over 4300 patients have undergone VEM so far. Consecutive inpatients 60 years and older who were admitted and underwent VEM between January 2008 and December 2016 were reviewed retrospectively. Electronic medical records were reviewed to collect information regarding sex, age at onset of symptoms and examination, concurrent epilepsy, frequency of seizures, diagnosis before and after examination, antiepileptic drugs (AEDs), brain magnetic resonance imaging (MRI), and VEEG findings. Scalp electrodes were placed according to the International 10–20 System. Digital VEEG recordings were obtained using a 19 digital EEG system. Constant patient surveillance during VEM was performed by an EEG technologist or nursing staff well-experienced in response testing and acute seizure management.

Seizure frequency was classified as daily (one or more seizures per day), persistent (less than one seizure per day but at least one seizure in the last six months), rare (less than one seizure per six months), or undefined (seizure frequency cannot be specified because of recent epilepsy onset) [17].

2.2. Measures

A trained EEG technician and epileptologist independently reviewed all VEEG data and marked specific events. Special attention was given to the onset of events recorded by the patients or caregivers. Two of the authors (XQ Zhou and HY Sun) independently reviewed interictal and ictal VEEG. All identified events were condensed and further reviewed independently by two of the authors (JH Chen and XQ Zhou). This study was approved by the Human Research Ethics Committee of Peking Union Medical College Hospital.

Seizure types were confirmed based on VEM and using the International League Against Epilepsy classification for epilepsies [18], and classified as focal onset, generalized onset, or unknown onset [19]. Paroxysmal events were classified into one of the following three categories: epileptic seizure, when a concurrent ictal EEG pattern was demonstrated; psychogenic non-epileptic seizure (PNES), defined as an event mimicking an epileptic seizure but devoid of concurrent ictal or post-ictal EEG changes; other nonepileptic event, defined as a physiological event (cardiogenic or metabolic cause) or event related to another neurological disease (such as a sleep disorder, movement disorder, migraine, or transient ischemic attack) [20].

The expected monitoring duration was decided before VEM according to seizure frequency and demand, which meant that the duration was usually at least one hour if the frequency was rare, 24 h or longer if frequency was daily or persistent, and prolonged until at least three paroxysmal events were captured if pre-surgery evaluation was demanded. For pre-surgery evaluation in patients on AEDs, the dose was reduced at a rate of one-third of the total daily dose every 24 h. Once targeted events were recorded three times, the patients resumed their usual AEDs regimen.

2.3. Statistical analysis

Descriptive statistics included frequencies and percentages for categorical variables and means, medians and standard deviations for continuous variables. The non-parametric Mann-Whitney *U* test was used for intergroup comparison of continuous variables. Chi-square test or Fisher's test was used for intergroup comparisons of categorical variables. Kruskal-Wallis test was used when

Table 1
Comparison of features between the positive and negative VEM subgroups with or without paroxysmal events captured.

Features	Positive VEM subgroup	Negative VEM subgroup	P value
Admission age (years)	66.42 ± 5.43	67.72 ± 6.57	0.239
Onset age (years)	61.61 ± 12.97	62.19 ± 15.49	0.400
Female:Male	37:52	32:63	0.269
Follow-up (months)	12.0 ± 13.7	13.9 ± 15.7	0.565
Diagnosis			
Stroke	12	12	0.864
Tumor	2	5	0.285
Trauma	2	2	1.000
Autoimmune encephalitis/PNS	28	20	0.108
Dementia/Degeneration diseases	5	10	0.224
CNS infection	4	5	0.809
Sleep disorders	7	2	0.070
Movement disorders	2	3	1.000
Syncope/Posture hypotension	2	8	0.102
Metabolic/Toxic encephalopathy	2	0	0.233
Migraine/Others	1	2	1.000
TIA	1	2	1.000
Unprovoked seizures	15	24	0.163
PNES only	6	0	0.010
Positive IEDs findings	39	32	0.158
MRI abnormalities	37	42	0.718
On AEDs	34	33	0.625
Seizure frequency			
Daily	71	23	0.000
Persistent	18	53	0.000
Rare	0	11	0.001
Undefined	0	8	0.007
Duration of monitoring	25.70 ± 22.02	15.47 ± 13.73	0.000

VEM = prolonged VEEG monitoring. PNS = paraneoplastic neurologic syndrome. IEDs = interictal epileptiform discharges. TIA = transient ischemic attack. PNES = psychogenic non-epileptic seizure. AEDs = antiepileptic drugs. EP = epileptic event.