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Video ambulatory EEG: A good alternative to inpatient video telemetry?

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ABSTRACT

Purpose: Video ambulatory EEG (V-AEEG) is a new technique which could add increased capacity for long term EEG monitoring to overstretched inpatient video telemetry (IPVT) services. We compare V-AEEG and IPVT for diagnostic efficacy, recording quality, patient acceptability and technologist time required.
Methods: Forty-one V-AEEG and 64 IPVT adult patients were included. Patients were investigated to diagnose attacks or to obtain polysomnography (PSG) prior to multiple sleep latency test (MSLT). Number of attacks recorded, whether the diagnostic question was answered, quality of video and EEG recording and patients' preference for investigation at home or in hospital were noted. For V-AEEG patients, ease of procedure and extra technologist time required were recorded.
Results: Of patients investigated for diagnosis of attacks, 74% V-AEEG patients and 62% IPVT had typical attacks during the investigation. All PSGs were useful in interpreting the MSLTs. Diagnostic questions were answered by 73% V-AEEGs and 73% IPVTs.
Quality of EEG and video recording was similar using V-AEEG and IPVT.
Four patients had difficulty using V-AEEG equipment but diagnostic information was lost in only one. 5% of V-AEEG patients would have preferred hospital investigation but 45% of IPVT patients would have preferred home investigation. Extra technologist time for home visits (mean 2 h) was required only for the first 7 patients.
Conclusion: Video EEG recording quality and diagnostic efficacy from V-AEEG are similar to IPVT. V-AEEG is acceptable to most patients and does not require additional technical time. Hence, V-AEEG offers a convenient, economical alternative to IPVT.

1. Introduction

Long-term video EEG monitoring is a valuable technique for differentiating epileptic from non-epileptic attacks [1] and for assessing the suitability of patients for possible surgical treatment for refractory focal epilepsy. It is also useful in the management of patients with sleep disorders by helping diagnose attacks from sleep and to assess the quality and quantity of sleep the night before multiple sleep latency testing (MSLT) in patients with hypersomnolence [2]. Techniques available to monitor EEG over a period of days or weeks include video telemetry and ambulatory EEG recording. The former requires a bed stay making it an expensive investigation often with limited capacity and long waiting times. Furthermore patients' attacks often do not occur in a hospital environment. Ambulatory EEG has the advantage of being offered to patients in their home, thus allowing a more natural environment conducive both to seizure occurrence and a less disturbed night's sleep. Although a much more economical investigation, ambulatory EEG, until recently, had the serious disadvantage of lacking simultaneous video recording. This made it a less than ideal tool for characterizing seizures and in particular differentiating between frontal lobe seizures and psychogenic seizures. In addition, identification of EEG artefacts without video can be very difficult. We have previously attempted to obtain video recording with ambulatory EEG by offering patients a 'stand-alone' camcorder to use when patients have attacks [3]. This was of limited value as the recording was not continuous, so brief seizures were missed altogether and in more prolonged seizures the initial clinical features were often not recorded. The Kings College group in the UK have pioneered the use of home video telemetry using conventional video telemetry equipment in patients' homes and performing continuous EEG and synchronized video recording for a prolonged period of several days [4]. Although comparison with

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inpatient video telemetry has shown it to be both cost and diagnostically effective, the technique has required significant time for supervision from technical staff as well as logistical issues with transportation of cumbersome equipment. The advent of new commercially available ambulatory EEG systems which have the facility of time locked synchronized video recording offers a potentially attractive, practical alternative for performing long term video EEG monitoring in the patient's home. The purpose of this study was to compare the results obtained from home video telemetry using synchronized video ambulatory EEG (V-AEEG) with conventional inpatient video telemetry (IPVT). The aim of the study was to compare V-AEEG with IPVT in terms of diagnostic efficiency, quality of video EEG recording, acceptability to patients and the amount of extra technologist time required for home studies over and above that required for conventional inpatient video telemetry.

2. Methods

Forty-one consecutive adult patients attending for V-AEEG were entered into this prospective study from 1/11/2013 to 1/1/2016. All V-AEEG patients underwent a 48 h recording. The study was not randomized as patients were selected for suitability for investigation at home by the referring Neurologist. Factors favouring home investigation included learning diability requiring constant care, phobia/dislike of hospitals and where undisturbed sleep was deemed important for diagnosis. A comparison group consisted of the first 76 consecutive patients admitted for conventional IPVT for diagnostic purposes from 1/11/2013. To produce a comparable group, inpatients admitted for longer than 48 h were excluded leaving 64 patients in the inpatient group. No patients in either group were subjected to anti-epileptic drug withdrawal or sleep deprivation and none were being assessed for epilepsy surgery. In both groups standard 10:20 EEG recordings were performed and in those patients where a sleep disorder was part of the differential diagnosis, polygraphic channels (electrooculography, submental EMG and tibialis anterior EMG) were added. All equipment was supplied by the same manufacturer (XLTek/Natus) and used similar recording and analysis software. A standard camera was used for the in-patient studies whereas the newer V-AEEG equipment was provided with a high definition camera.

All patients having V-AEEG were provided with written information in advance of the procedure explaining the requirements for a successful examination. This included the need to confine themselves to the living room and the bedroom (with the exception of bathroom care), advice on optimizing camera angles and video quality, the need to note timing of attacks and pressing of the event button and the need to exclude pets from the immediate environment to avoid equipment damage. A contact telephone number was provided for use in case of difficulties. Patients attended the department for electrode placement and then were discharged home for the period of monitoring. Initially a technologist visited the patient on their arrival at home to check that they had set the camera up satisfactorily. At the end of the recording the patient returned with the equipment to hospital for electrode removal.

The technologist performing the video EEG investigation completed a pro-forma with the patient's help. The pro-forma can be seen in full as an on-line supplement but its purpose was to obtain the following information:

1. Assessment of diagnostic efficacy:
   - Reason for request grouped into 3 possibilities:
     i. Differentiating between epilepsy and non-epileptic attack disorder (NEAD)
     ii. Diagnosing parasomnias
     iii. Assessing quality and quantity of sleep on the night prior to MSLT the following day
   - Number and type of attacks captured
   - Whether the diagnostic question was answered
2. Assessment of quality of recording:
   - Whether all or at least some attacks were seen on video
   - Whether the quality of the nighttime video was satisfactory
   - Whether the EEG quality was satisfactory
3. Estimation of acceptability to patients:
   - All patients were asked for their preference for Home or Hospital investigation
   - The V-AEEG patients were asked about ease of performance of the investigation
4. Estimation of the extra technologist time required for home visits for V-AEEG

The data was anonymized and entered into a Microsoft Access database and analyzed using Microsoft Excel and GraphPad Prism software (version 6.05). Statistical tests included 2×2 contingency table analysis with Fisher's exact test and *t*-tests for numerical data. Significance was defined at the 5% level. The study was approved by the Sheffield Teaching Hospitals NHS Foundation Trust Clinical Effectiveness Unit (project registration number 6707).

3. Results

Patient demographics can be seen in Table 1.

3.1. Diagnostic efficacy

The reasons for requesting video-EEG investigation in the two groups can be seen in Table 2.

Of the patients investigated for diagnosis of paroxysmal attacks (NEAD vs Epilepsy and Parasomnias) 25/34 (74%) of V-AEEG had typical attacks and 31/50 (62%) of IPVT had typical attacks (Fisher's exact test not significant). The median number (and range) of attacks were 2 (1–20) for V-AEEG and 3 for IPVT (1–22, although 1 outlier had more than a hundred absence seizures during the recording). There was no significant difference in number of attacks recorded between V-AEEG and IPVT (unpaired *t*-test).

Final diagnoses in those who had attacks in 25 V-AEEG patients and 39 IPVT patients were epilepsy (12% vs 16%), NEAD (24% vs 61%), parasomnias (48% vs 10%) and other non-epileptic events (8% vs 13%). The other non-epileptic events were heterogeneous; examples included a cardiac cause for loss of consciousness (1), unresponsive episodes due to natural sleep (2) or schizophrenia

Table 1
Patient demographics.

	V-AEEG	IPVT
Number	41	64
Mean age (years)	43	42
Age range (years)	17–72	18–74
Male:female (number)	15:26	32:32

Table 2
Reasons for video-EEG request.

Reason for request	V-AEEG (n = 41)	IPVT (n = 64)
Epilepsy vs NEAD	15 (37%)	43 (67%)
Diagnosis of parasomnias	19 (46%)	7 (11%)
Pre-MSLT PSG	7 (17%)	14 (22%)