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Home video telemetry in children: A comparison to inpatient video telemetry

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ABSTRACT

Purpose: Home Video Telemetry (HVT) combines ambulatory EEG with simultaneous video recording. No previous reports have compared HVT and inpatient video telemetry (IVT) in a purely paediatric population. This study compares HVT and IVT in this group in terms of diagnostic efficacy, recording quality and acceptability to parents/carers.

Methods: 33 HVT and 29 IVT patients aged 1–17 years were included. Information regarding patient demographics, ictal capture, diagnostic utility, recording quality (e.g. video clarity, EEG artefacts) and parent/carer preferences was documented. Difficulties using HVT equipment were recorded.

Results: 62% of IVT patients and 64% of HVT patients had typical attacks during the recording. 59% of IVT and 70% of HVT recordings were considered to have answered the referral question. Study quality was similar in both groups. In HVT studies the rate of equipment difficulties was 52%; problems included camera positioning and failure to turn on the infrared button at night. Diagnostic information was lost in 15% of patients. 76% of parents/carers of HVT patients would choose this investigation again.

Conclusions: The diagnostic efficacy and study quality of HVT and IVT are similar in paediatric patients. HVT is acceptable to most parents/carers. User error may compromise the investigation in a minority of cases but did not impact on diagnostic utility. Adoption of HVT investigation could provide an accessible and economic alternative to IVT.

1. Introduction

Epilepsy affects 36,000 children in the UK and is associated with a mortality rate twice that of the general population [1,2]. Making an accurate diagnosis can be difficult and up to 30% of children admitted acutely with paroxysmal events initially diagnosed as epileptic have their diagnosis overturned [3]. EEG has long been used to aid in the diagnosis of epilepsy but it relies heavily on ictal capture as a normal inter-ictal EEG does not refute a diagnosis of epilepsy and neither does an abnormal EEG fully confirm the diagnosis [4].

For these reasons ictal EEG is considered a much more accurate diagnostic tool. In children seizure frequency may be high and an attack may be captured on a routine outpatient recording. However, long-term EEG monitoring is often required to obtain an ictal recording. Inpatient video telemetry (IVT) is considered the gold standard for ictal recording as it provides both EEG data during seizures and also invaluable clinical information on seizure semiology [5]. However, IVT is a rare and expensive resource as it relies on admission to a hospital bed. Consequently, waiting times may be long resulting in delayed diagnosis. Ambulatory EEG in the patient's home is a much cheaper option for long-term EEG recording and has the advantage of keeping the child in the home environment where the paroxysmal events are reported to occur, as well as avoiding disruption to the parents' routine and childcare arrangements [6]. However, until recently ambulatory EEG had the major disadvantage of not providing video information and interpretation of the EEG recording alone can be difficult, particularly in identifying artefact and differentiating psychogenic from frontal lobe seizures. The recent development of ambulatory EEG systems which provide synchronised video (which we term home video telemetry, HVT) offers a potential alternative to expensive IVT.

Although the new technique has been assessed with favourable results in groups of adult patients, reported use in children is limited

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[7–10]. There are special considerations in investigating epilepsy in children which may cause results to differ in comparison to adults. Increased physical activity, a lower tolerance of the hospital environment and a higher burden of learning difficulties may cause difficulties across both home and hospital settings. Furthermore, the pressures on parents/carers of children with epilepsy may lead to different preferences in investigations.

It is important for those charged with delivering an epilepsy service for children to assess new investigations in a paediatric setting. The purpose of the present study was to evaluate the diagnostic efficacy and technical quality of HVT by comparison with IVT in a purely paediatric group.

2. Methods

For the purposes of this study we define HVT as a study using ambulatory EEG with synchronised video. We prospectively included 33 consecutive patients referred for HVT between 2014 and 2017. A comparative group of 29 IVT patients was obtained over the same period. Parents/carers of the patient were given a choice by the referring neurologist regarding which investigation their child received, unless circumstances arose as follows. Firstly, HVT was directly offered to patients whose IVT had been cancelled at short notice due to bed reallocation during times of high demand. Secondly, HVT was not offered to patients who required anti-epileptic drug (AED) withdrawal prior to the investigation.

The inclusion criteria were: aged under 18 years, video telemetry duration of 24–72 h and parental/carer consent for the investigation. Any IVT patient who had undergone AED withdrawal was excluded to ensure a fair comparison to the HVT group. The standard international 10–20 EEG electrode placement system was used with the addition of a single channel ECG electrode. Electrodes were placed in hospital for both groups.

All equipment was provided by the same manufacturer (XLTek/Natus), with a standard camera being used for IVT and a high definition camera for HVT, both with infrared capabilities. The parents/carers in the HVT group were given instructions on use of equipment prior to returning home. Advice on the requirements for a successful investigation was also given, including confining children to one room during the day (with the exception of the bathroom), placing the camera on a stable surface, optimising camera angles, providing good lighting during daytime hours and switching on the infra-red function during night time.

Patients were required to return to hospital every 24 h for change of battery, electrode checking, data upload and review to ensure that the recording to date was successful. They also returned to hospital at the end of the investigation where the electrodes are removed.

Data was collected using a proforma completed by clinical physiologists (EEG technologists) including the following information for both HVT and IVT groups:

1 Assessing the diagnostic yield of the investigation
   - Reason for request grouped into three categories:
     i Diagnosis of attacks
     ii Classification of epilepsy/syndrome and/or identification of focus
     iii Quantification of seizures including subtle/ subclinical seizures and pre/post medication change assessment
   - Number of attacks captured
   - Nature of attacks
   - Whether referral question was answered
2 Quality of recording
   - Whether all, some or none of attacks were video recorded
   - Quality of video recording at night (in particular whether the night vision and infra-red facilities were switched on for HVT recordings)
   - Quality of EEG recording. Quality was deemed satisfactory if interpretation was not impeded by technical issues such as loss of an electrode.
   - For HTV: any user issues with setting up or using the equipment
3 Assessing acceptability of investigation to patient/parent/carers:
   - Whether they would have preferred HVT or IVT
   - Reasons for their choice

Recording quality was assessed by experienced clinical physiologists. Any electrodes needing to be re-sited were attended to as quickly as feasible (usually within one hour) for IVT recordings and on a daily basis for HVT recordings. Information about details of any learning difficulties (LDs) and AED use was gathered retrospectively from the clinical neurophysiology departmental database and consultant letters from Paediatric Neurology clinics. A sub-analysis of LD severity was not undertaken as the group was not large enough for such an analysis.

All data was anonymised by patient EEG number and collated into a Microsoft Access database. Ethical approval is not a requirement for a service evaluation of routine clinical practice (UK NHS National Research Ethics Service guidelines). The project was registered as a service evaluation with Sheffield Children's Hospitals NHS Trust Clinical Effectiveness Unit (number: 1055).

Statistical analysis was performed using GraphPad prism (version 7). Statistical tests included Chi-square, Fishers exact test, unpaired student t-test, Mann-Whitney U test and one-way ANOVA analysis, as appropriate. Qualitative free text responses were reviewed by eye and key themes recorded.

3. Results

A total of 62 patients were included in the study, 29 in the IVT group and 33 in the HVT group. No significant differences in patient characteristics were seen between the two groups (Table 1). The reasons for requesting both HVT and IVT were also similar, with the majority of both studies being undertaken for diagnostic purposes (Table 1).

Ictal event capture was similar in both groups; 62% of IVT studies captured events, 64% of HVT recordings (Table 2). When attacks were captured the mean number of attacks seen was not statistically different between the two groups. Overall, both HVT and IVT studies answered the question asked of them (59% and 70%, respectively), with no significant difference observed between the two methods. Across both groups, epileptic events were the most common type of ictal event captured (Table 3).

In the HVT group, recording quality and problems with equipment were assessed (Fig. 1). Night video quality was higher in the IVT group;

Table 1
Patient demographics and study details.

	IVT n = 29	HVT n = 33	P value	Statistical test
Male: Female	14:15	16:17	> 0.99	χ^2
Mean age (yrs)	7.4	6.7	0.52	t-test
Age Range (yrs)	1-17	1-15		
No. on AEDs	22 (76%)	26 (79%)	> 0.99	χ^2
Median no. of AEDs	1	1		
Learning Difficulties	12 (41%)	16 (49%)	0.62	χ^2
Reasons for referral				
Diagnosis	16 (55%)	17 (52%)		
Classification of epilepsy	7 (24%)	6 (18%)		
Quantification of seizures	6 (21%)	10 (30%)		
Study duration (days)				
1	20 (69%)	15 (45%)		
2	7 (24%)	16 (49%)		
3	2 (7%)	2 (6%)		
Median duration	1	2	0.94	Mann-Whitney