The Role of Telemetry (Simultaneous Video and EEG Monitoring) in the Proper Management of Epilepsy

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ABSTRACT:

BACKGROUND:

Telemetry is defined as simultaneous video and EEG monitoring of presumably epileptic patients while they are hospitalized in telemetry ward so that one or more of the habitual seizures or funs are captured and recorded; these events would be visualized and analyzed later by expert epileptologists for the sake of proper diagnosis, classification, presurgical evaluation or else.

OBJECTIVE:

To define and evaluate simultaneous Video –EEG monitoring in epilepsy management.

METHODS:

Two hundreds consecutive telemetries at King's College Hospital in London over the period of nine months starting from Jan 2007 back to May 2006 were reviewed and the conclusive yields were evaluated.

RESULTS:

It showed that the three main indications for referral were to be 'the diagnosis' in a proportion of 56.5% 'presurgical evaluation ' in 19.8% and ' classification' in 15.2% whereas other application like assessment for vagal nerve stimulation (VNS) candidacy , sleep studies , follow up and frequency estimation constitute the remaining 8.5 % . It was conclusive in 63% for 'classification', 60 % for 'diagnosis', and only 34%for presurgical evaluation, whereas categorically was conclusive in 56.55 of all referrals.

CONCLUSION:

The study shows that telemetry is a crucial and probably an indispensable tool if the proper understanding of the problem, and consequently proper handling and management are to be considered.

***KEY WORDS*:** telemetry, video-eeg monitoring, epilepsy, management.

INTRODUCTION:

Monitoring in epilepsy was introduced for purposes very different from those for which it is now used. The earliest reports include those on cinematographic recording of seizures by Hunter and Jasper in 1949.[1] Gastaut and Bert in 1954 drew attention to the artificiality of conventional EEG recordings in the laboratory, and predicted that in the future EEGs would be recorded under natural conditions, presenting a variety of stimuli and real life situations.[2] In the 1960s a team at l' Hospital St. Anne in Paris began EEG and video telemetry to study effects of behavior and cognitive activities on EEG in epilepsy and suggested that these methods might have clinical applications.[3,4]

The word *'telemetry'* means recording from a distance; this means that the patient's EEG (electrical signals from brain, recorded by electrodes), can be transported at a distance to the EEG machine (computer), via a cable. *Video-telemetry* allows the patients' EEG and their video images to be viewed together simultaneously allowing the EEG to be recorded over a much longer period of time than a routine EEG, greatly increasing the chance of detecting abnormalities and recording an attack. The aim is generally to record if possible, 3 or 4 of the patient's habitual seizures or funny turns. A unit capable of accommodating several patients is usually the most cost effective.

There is a variety of recording methods for video-EEG monitoring. It can be performed as an in-patient or out-patient study; the cost as well as the diagnostic yield of video-EEG monitoring is variable depending on the system utilized.[5] In-patient studies are the usual with a range of hospital stay of 1-21 days and an average stay of one week.

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Utilizing digital video-EEG, computer-assisted monitoring for a brief duration (as an out-patient study) may be allowed; it may be ideal in patients with frequent seizures or spells.[6] It may be useful particularly in patients evaluated for diagnostic classification who are experiencing either spontaneous or provoked clinical events. In recent years, portable telemetry systems with simultaneous video capability have become available and provide good quality monitoring in home or work environment; this method would be cost saving as in-patient expenses are avoided.[7]
The study aimed to give a clear definition for the role of simultaneous Video-EEG monitoring in the management of epilepsy including the proper diagnosis, classification, presurgical evaluation, and follow up. A number of questions were put for the sake of this research and a trial to answer these questions through the reviewing task was made.
The questions include:

1-How many patients were assessed for epilepsy?
2-How many patients were turned to have epilepsy?
3-How far telemetry was conclusive:
 -because epilepsy was suspected and then rejected
 -because epilepsy was suspected and then confirmed
 -because the frequency of seizures was estimated
 -because the classification of epilepsy was made
 -because non epileptic seizures (NES) were suspected and then rejected
 -because NES were suspected and then confirmed
5-How far scalp telemetry was useful for presurgical evaluation?

PATIENTS AND METHODS:

Two hundreds of consecutive telemetries of 83 males and 117 females were reviewed at King's College Hospital in London. The telemetries reviewed covered the period from 29-January-2007 back to 24-May-2006. The work (the task of reviewing) took about ten months starting on November 2006 until the end of august 2007.
The criteria of inclusion for different telemetries in the study are:

1- The patient should be hospitalized for one day or more
2- The patient should have a telemetry with a video and simultaneous EEG

The ambulatory EEG, the electrocorticography, and the polysomnography were reviewed regarding the EEG details both in original reports and stored CDs; being not associated with videos all were *excluded* from the study and were mentioned only under the *'test type'* title in the *database.*
The patients with *scalp telemetry*, *intracranial telemetry*, and *day case* were included.
Statistically the results were expressed as absolute numbers and percentages. The data were analyzed in respect to the descriptive statistical analysis.

RESULTS:

Table 1 shows the characteristics of the study; the proportion of females was higher than males. The type of test was shown with scalp telemetry being the highest percentage. Although ambulatory EEG, the electrocorticography, and the polysomnography tests were reviewed regarding EEG details, they were excluded from the study since not accompanied with video recordings.

Table 1: Characteristics of the study

Characteristics	No. of Patients	Proportion
Gender		
Male	83	41.5%
Female	117	58.5%
Test		
emetry	171	85.5%
ory EEG	17	8.5%
orticodraphy	5	2.5%
ial telemetry	3	1.5%
e EEG	3	1.5%
nography	1	0.5%
	200	100%

The tests with both EEG and video recordings (scalp telemetry, intracranial telemetry, and day case EEG) were included in the task of 'reviewing'; the number of patients studied was therefore 177.

Reviewing the 177 cases revealed that the most common reason for referral was the 'diagnosis of epilepsy'; table 2 shows the reasons for referral.

Table 2:The reasons for referral

The reason	No of patients	Proportion
Diagnosis of epilepsy	100	56.5%
Presurgical evaluation	35	19.8%
Classification of seizures	27	15.2%
Assessment for VNS candidacy	6	3.4%
Sleep study		
Follow up study	4	2.3%
Frequency estimation	3	1.7%
Total	2	1.1%
	177	100%

The study shows that the outcomes were conclusive in (100) patients out of the (177) patients (56.5%) whereas the outcomes were not conclusive in the remaining (77) patients (43.5%). Table 3 shows the outcome of main reasons for referral.

Table 3: Outcome of the main reasons for referral

Reason for referral	Conclusive		Non-conclusive		Total	
	No	Proportion	No	Proportion	No	Proportion
Diagnosis of Epilepsy	60	60%	40	40%	100	100%
Presurg, evaluation						
Classification of seizures	12	34%	23	66%	35	100%
Others	17	63%	10	37%	27	100%
Total						
	11	73%			15	100%
	100		4	27%	177	
			77			

Further analysis of the details of the 60 patients with conclusive outcome who were referred for 'diagnosis of epilepsy' revealed that 29 patients (48.3%) were with NES, 28 patients (46.7%) were epileptics (two of them had concomitant NES), 2 patients with periodic movements of sleep, and one patient with brain myoclonus (Fig 1).

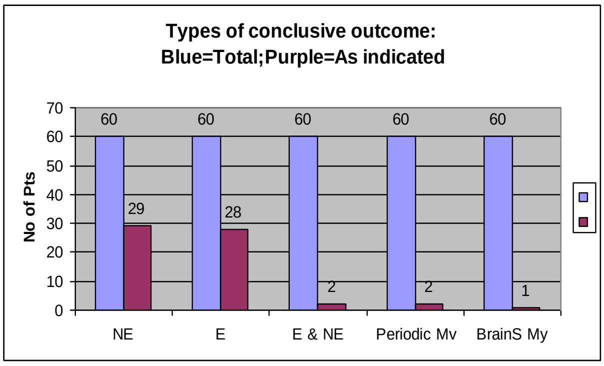

Figure 1: Outcomes in 60 conclusive tests for D of E

DISCUSSION:

It was shown that the *main reason* of referral for King's telemetry is to establish a diagnosis of epilepsy or to exclude it through documenting an alternative diagnosis usually of NE events; the percentage being *56.5%* of all referrals for telemetry. This seems logic since 'the video-EEG prolonged monitoring is an important auxiliary diagnostic instrument in epilepsy.[8]

King's telemetry was categorically *conclusive* in *56.5%*, of *all reasons* of referral. It was *conclusive* in *60%* of cases referred for *diagnostic reasons*; the conclusive outcome for *'diagnosis of epilepsy' reason* of referral (fig 1) showed that the most prevalent diagnosis was non epileptic seizures (*NES*) in a percentage of *48.3%* whereas *epilepsy* (E) was the second diagnosis with a proportion of *46.7%* of conclusive outcomes.

Differential diagnosis between epilepsy and NE seizures is in many centers the commonest reason for referral to epilepsy monitoring; the differentiation is not an easy task because, even in true epileptic seizures, ictal EEG changes are not necessarily present, or may not be 'epileptiform'.[9] Some attacks (notably atonic, and SPS) may be accompanied by an electro-decremental pattern of EEG which may be generalized or regional which is then restricted usually to the vertex; this may be unrecognizable in the presence of artifacts and even if detected, may be indistinguishable from the changes of arousal, which may occur at the onset of nocturnal NES.[10,11] Moreover, brief frequent nocturnal attacks with bizarre, 'hypermotor' activity often occur in epilepsy of mesial frontal origin notably supplementary motor area (SMA) where the unusually violent behavior together with lack of identifiable EEG change due to artifacts may lead to an erroneous diagnosis of NES. Alsaadi et al (2004) concluded that video-EEG telemetry is crucial in establishing a diagnosis in patients with seizures.[12]

Identification of potential *surgical candidate* is a major indication for telemetry in highly selected patients with intractable epilepsy.[13]About 20% of all patients with epilepsy and 45% of patients with partial epilepsy will experience medically refractory seizures.[14]Intracranial telemetry is performed in selected candidates for localization of the ictal onset zone or functional mapping.[15] In our series *35* patients were referred for PSE, *12* patients had conclusive outcomes *(34%)* whereas the remaining *23* patients *(66%)* were not conclusive***;*** *three* intracranial telemetries were done, *two* were conclusive. Continuous EEG video-monitoring has an established role in localizing the seizure focus for epilepsy surgery.[16]The rationale for surgical treatment is excision of the epileptic zone (EZ); surgical treatment for intractable TLE had been demonstrated to be more effective than medical therapy.[17]Greater than 80-90% of patients with medial TLE or substrate-directed epilepsy may be rendered almost seizure-free following a total excision of the epileptic zone.[18,19]Less favorable surgical candidates are patients with non-lesional extratemporal epilepsy.[20] However Scott et al (1999) showed that scalp telemetry was conclusive in only 13% (5 of 36) of MRI negative patients where it was possible to hypothesize a discrete potentially resectable EZ.[21]

Twenty seven patients were sent for *classification* of seizures and/or epileptic syndromes; they are known epileptics through history and previous investigations. The differentiation may be between an ‘absence’ and a brief CPS, or between a primary and secondarily generalized seizure. Sometimes there may be an emergence of a new seizure type that may seem strange for the family or different from the habitual seizures, which may imply a re-evaluation for a better orientation and understanding; such distinction may be useful for the proper management and drug choice since different drugs are used for different seizure types or it may raise a possible surgical alternative.

In *King's telemetry* in the aspect of classification, there were *17* patients with a conclusive outcome *(63%)* against *10* patients (*37%)* with negative outcome; the high diagnostic yield of video-EEG monitoring in *classifying seizure-type* has been confirmed.[9,22]Our results are in *concordance* with those of Ebersole (1987) and Perry et al (1983) who stated that prolonged EEG studies are superior to the routine EEG in detecting seizures (ictal events) with a proportion of (50-70%) for prolonged EEG, compared to (2.5-7%)for routine EEG.[23,24] The diagnostic classification was altered in 19 of 40 patients (a proportion of 47.5%) by telemetry in one study [22]whereas previously unrecognized seizure-types were identified in 20% of patients with epilepsy. Improved seizure control occurred in 60-70% of patients after appropriate classification.[9]

CONCLUSION:

The study showed that telemetry was conclusive (63%) in classification, (60%) in epilepsy diagnosis while was only (34%) conclusive in presurgical evaluation; categorically it was conclusive in

(56.5%) for all reasons of referrals. This shows that telemetry is a crucial tool that provides valuable information to diagnose or to classify the type of epileptic syndromes and may be useful to localize the epileptogenic zone.

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