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PROJECT REPORT

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Month & year of submission: October 2006

CERTIFICATE

I, Dr. Thomas Chemmanam, hereby declare that I have actually carried out the project under report

Place: Trivandrum
Date: 12.10.2006

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PROJECT REPORT

AN AUDIT ON THE COST - EFFECTIVE UTILIZATION OF VIDEO EEG MONITORING

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Program: DM Neurology

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CONTENTS

INTRODUCTION

Video-EEG monitoring (VEM), the synchronous display of the ictal EEG pattern and the paroxysmal behaviour is being increasingly used in the epilepsy monitoring units (EMUs) all around the world. It helps to clinically classify paroxysmal events and to correlate them with the corresponding electrical activity in the brain. It may be used for various specific indications, most commonly to confirm the diagnosis of a seizure disorder, classify seizure type(s), assess seizure frequency and precipitating factors and for surgical localization (1-5). Additional physiologic parameters that can be evaluated during video-EEG monitoring include the electrocardiogram, electromyogram, and respiratory function (6). These assessments may be necessary in classifying a physiologic nonepileptic disorder associated with paroxysmal clinical events. The two most commonly used indications for video-EEG monitoring are for diagnostic classification (ie epilepsy vs nonepileptic spells) and to evaluate surgical candidacy in patients with medically refractory partial seizure disorders. Surgery is usually contemplated in patients with medically refractory partial epilepsy, being considered for a focal cortical resection (1). Video-EEG monitoring is essential in determining the localization of the epileptic zone in patients being considered for surgical ablative procedures (7). The high diagnostic yield of video-EEG monitoring in adult patients with recurrent and unprovoked spells has been confirmed (3). In many patients with recurrent spells, the scalp recorded interictal EEG study, neurologic history and examination and contemporary neuroimaging procedures may be insufficient to permit appropriate classification of the spells. Recognising the ictal pattern may be pivotal in making the diagnosis of epilepsy in selected patients. Types of VEM units vary depending on the aims and the resources available to the epilepsy centre (1,8,9). Long term in patient or short term (day only) monitoring may be performed.

Long term video EEG monitoring serves as an example of the types of advances that have occurred in medicine driven by the power of modern technology. However, as an expensive, labour intensive technique that requires expert training for effective utilization, it has also been the subject of scrutiny in these times of fiscal restraint in medicine. Therefore it is incumbent on those who rely on this technique to define its proper use to maximise diagnostic utility while minimising cost (10). This is especially important in a developing country set up, where the number of referred patients for VEM, may far exceed the available slots in the limited centres with adequate technical infrastructure.

There are only very limited data regarding the utility and cost effectiveness of VEM. Most of these data are from developed world and there is hardly any similar data from the developing world. It is therefore extremely important to conduct properly designed studies to assess the utility and cost-effectiveness of VEM, in the developing country scenario.

Review of Literature

At the 96th Annual Meeting of the American Psychiatric Association in 1938, Robert S. Schwab presented a photographic method for the synchronized recording of patient and EEG on a single film, thus initiating the era of long term audiovisual EEG monitoring (11). Presently VEM is established as the principle tool for evaluating seizure and seizure like disorders. The synchronous display of paroxysmal behaviour and EEG is ideal to clinically characterize paroxysmal spells and to correlate it with corresponding electrical activity of brain. Combined with modern neuroimaging techniques, it also forms the basis for presurgical evaluations of the medically intractable localization-related partial epilepsies (10).

Rationale for Long-Term VEM

Routine EEG, although a useful and relatively inexpensive diagnostic tool, is limited in its ability to answer important diagnostic questions primarily because of its restricted temporal sampling. Only about 50% to 60% of epileptic patients show epileptiform activity during an initial EEG, even with the use of activation procedures including hyperventilation, photic stimulation and light sleep (12). As many as four EEGs may be necessary to record interictal discharges in > 90% of epileptic patients (13). Interictal epileptiform discharges are more common during non-rapid eye movement sleep (14,15), but, unfortunately, prolonged periods of sleep often are not recorded during a standard EEG. In addition, seizures are captured during routine EEG in only 2.5% to 7% of the time (16,17). Interictal epileptiform discharges may be modified by the presence of antiepileptic medication (18). The interictal EEG pattern also may be an unreliable indicator of the classification of seizure type and may result in ineffective treatment strategies (18). The routine EEG may be insensitive (ie fail to identify epileptiform discharges) and yield non-specific findings. Paroxysmal alterations (either non-specific or potentially epileptiform discharges) may be identified in a patient with non-epileptic behavioural events (12,19). Long term VEM can extend over hours, days or even weeks. All forms of intermittent EEG abnormality are thus more likely to be recorded, especially those related to sleep-wake cycle. The sensitivity and specificity of ictal EEG is superior as a diagnostic tool to interictal EEG (11,18 - 20). Moreover long term VEM, evaluates the simultaneous behavioural and EEG features of a patient's seizures, "in condition as close as possible to those of life itself" (21).

Indication for Long-Term VEG monitoring

The four basic indications for long term VEM are diagnosis of events (epileptic vs non epileptic), classification of seizures, quantification of seizure frequency and presurgical evaluation (10).

Diagnosis of events

For proper treatment and to avoid ineffective and occasionally dangerous over treatment, epilepsy must be distinguished from nonepileptic paroxysmal events including those of cardiac, cerebral (eg: movement disorder and parasomnias), endocriniologic and psychogenic origin. Even when interictal abnormalities are found, a diagnosis of seizure disorder is only supported, not established. Long term VEM may be the only way to make a correct diagnosis. An estimated 20% of patients referred to comprehensive epilepsy programs for medically refractory "seizures" do not have epilepsy (3). Patients with an underlying psychiatric disease including depression, anxiety, psychosis and a somatoform disorder may experience recurrent spells that emulate seizure activity (22 - 25). Psychogenic spells or pseudoseizures may be present in the absence of a major psychiatric disease (24,25). Patients with psychogenic spells may have repetitively normal EEG recordings, a remote history of emotional or sexual abuse, a paradoxical increase in seizure frequency with the use of AEDs and unusual symptoms during the ictus, suggesting a behavioural disorder (22-25). The spells may be prolonged and associated with headache, generalized pain or crying (24,25). On many occasion, the clinical symptoms alone may be insufficient to differentiate nonepileptic behavioural events from seizures. Clinical factors that may suggest a seizure disorder include events that occur during sleep, abnormal routine EEG, MRI identified lesional pathology and history of remote symptomatic brain disease (22-24). Studies have shown varying proportion of patients referred for VEM, to be finally diagnosed to have nonepileptic behavioural events (3,26). In one study which evaluated the outcome of 274 patients undergoing VEM for classification of 'undetermined events, despite a complete neurological examination, MRI and routine EEG, it was found that 55% of patients were experiencing nonepileptic behavioural events. A combination of seizures and psychogenic spells occurred in 5.5% of patients (22). More than 80% of patients with a normal routine EEG, MRI and neurologic history and examination had psychogenic spells in a previous study done from Sree Chitra Institute, Trivandrum (25).

Seizure type classification

Proper treatment of patients with epilepsy depends on a correct classification of seizure type. Classification of seizure type(s) may not be possible by history and routine EEG study. Complex Partial Seizures and atypical absence seizures may present as similar brief spells. A generalized seizure may also be difficult to distinguish from a partial seizure with secondary generalization by history or observation. The high diagnostic yield of video EEG monitoring in classifying seizure type has been confirmed (Ref). The diagnostic classification was altered in 19 (47.5%) of 40 patients in one study by inpatient video EEG monitoring. Previously unrecognised seizure types were identified in 20% of patients with epilepsy (1).

Quantification:

Enumerating seizures by long term VEM is feasible when they are frequent. This qualification is important when seizures are subtle, such that they may go unnoticed by both patient and observer. This is frequently the case with absence seizures. Serial VEMs can be used to titrate antiepileptic medications in this seizure type (10).

Presurgical evaluation

VEM is performed in individuals with pharmacoresistant partial epilepsy for surgical localization (26). Identification of potential surgical candidate is a major indication for VEM is highly selected patients with physically, socially and medically disabling seizures (26-30). Although intracranial EEG has long been regarded as the gold standard for localizing epileptogenic foci before resective surgery, it is considerably more expensive than non-invasive studies, and it is associated with a low but clinically significant rate of morbidity and mortality (31). Invasive EEG may be unnecessary with adequate noninvasively acquired data in cases of epilepsy of medial temporal onset or due to discrete structural lesions. In a study using VEM, high resolution MRI with volumetrics, neuropsychological assessment, positron emission tomography and single photon emission computed tomography, Kilpatrick et al reported that in 75 patients with MRI – detected lesions, a seizure focus was successfully localised in 91% (32). Surgical treatment has been shown to be safe and effective for selected patients with intractable partial epilepsy (8,30). The putative beneficial effect of surgery is an improvement in the quality of life that allows the individual to become a participating and productive member of society (30). The most common operative procedure involves resection of the epileptic brain tissue in the anterior temporal lobectomy (33). The rationale for surgical treatment is the excision of the epileptogenic zone (27-30). More than 80-90% of patients with medial temporal lobe epilepsy or substrate- directed epilepsy may be rendered seizure free or near seizure free after a total excision of the epileptic zone (33). Identification of patients for epilepsy surgery requires a comprehensive, multidisciplinary evaluation (34-36). Subsequent to admission to the epilepsy monitoring unit, the patient's characteristic seizure activity is observed. Multiple clinical events may need to be recorded before making a determination of the site of seizure onset (34). Examination of the patient during the ictus by trained personnel may be important to determine the presence of a periictal neurologic abnormality.

Interictal EEG analysis:

The localizing value of interictal EEG abnormalities is controversial. In cases of TLE in which unilateral discharges coincide with the ictal discharge, the surgical outcome is excellent (33). In cases of TLE with unilateral hippocampal atrophy on MRI and congruent unilateral interictal spikes, ictal EEG provides no additional information (37). An analysis of predictors of outcome of anterior temporal lobectomy for intractable epilepsy revealed that unilateral hippocampal atrophy and interictal discharges concordant to the location of ictal onset were significantly associated with excellent seizure control. (33)

Disadvantages of video EEG monitoring

The potential disadvantage of VEM includes the inherent cost of the electrophysiologic study (3). In addition to the use of increasingly limited hospital beds, the performance of VEM in the context of a comprehensive epilepsy program requires the involvement of a highly trained multidisciplinary team, including EEG scientists, nursing staff, epileptoglogists, neuropsychologists, psychiatrists, imaging specialists and technicians and expensive monitoring equipment. The ictal EEG pattern also may be difficult to interpret because of myogenic and movement artefacts such as eye blinking.

The presence of a subtle epileptiform discharges may be difficult to distinguish from the background. In selected seizure types (eg auras or simple partial seizures), these may not be a definite scalp recorded EEG alteration (1-6). Finally, patients may not have a typical clinical spell during VEM. The prolonged interictal EEG study may not prove a reliable indicator of spell classification.

Cost of Long term VEM

The average cost of 24 hours of VEM in SCTIMST, which is in a developing country is approximately Rs. 1500 Indian Rupees. The average cost of 24 hours of VEM during an inpatient hospitalization in the developed country set up ranges from $1,000 to $3000 (38). Compared to the cost of improper diagnosis & treatment, with consequences ranging from long term disability caused by uncontrolled seizures to payment for unnecessary & potentially dangerous medications, VEM can be a major cost-saving procedure with life-altering benefits for properly selected patients. It has been documented that medical expenses were 2.78 times greater for patients who had poor seizure control (daily seizures) when compared to those who had good seizure control (39). Extrapolating from their data, the mean annual cost for the poorly controlled group, which also had a lower employment rate, was $ 8684 as compared to $ 3120 for the well-controlled group. Another study has shown that more than half of the total cost of epilepsy care was spent on the quarter of the epileptic population with the most frequent seizures (40). The annual medication costs for those with more than one seizure per month was nearly 3 times that for patients with good control. The well-controlled group was also nearly twice as likely to be involved in gainful employment as the group with greater that 1 seizure per month. The poorly controlled groups above include those patients who may benefit from surgical treatment, which involves one of the primary uses of VEM. If surgical intervention is successful, a previously poorly controlled high cost patient may be able to join the ranks of the well-controlled patients benefiting both the individual and society at large. Intractable non-epileptic events affect 325, 000 people in the United States (10). These misdiagnosis results in a huge annual cost and VEM will help to curtail this unwanted expenditure.

The utility of VEM studies per se has had limited evaluation, and its cost effectiveness, even less so (8,41). It is important to justify the resource allocation required for VEM, and that its utility be thoroughly investigated. This is especially important is a developing country set up where the available resources are limited and a cost effective allocation of resources are mandatory. We intended to audit the existing system of VEM in the comprehensive epilepsy case program of a tertiary referral hospital in a developing nation.

AIMS &
OBJECTIVES

1) To determine the objective of referral for and final outcome of long term inpatient VEEG monitoring in the epilepsy monitoring unit of a tertiary hospital.

2) To audit the current VEM practice in the epilepsy monitoring unit (EMU) of the comprehensive epilepsy programme of a tertiary referral hospital.

MATERIAL & METHODS

This study was conducted through the Comprehensive Epilepsy Program of the Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum. We prospectively studied the clinical and VEM data of 143 consecutive patients who underwent this procedure during a 10-month period from September 2004 to July 2005. All the patients who underwent VEM were referred from outpatient epilepsy clinic.

Technical considerations

We have 3 VEEG units in the hospital, under the comprehensive epilepsy care programme. We used scalp disk electrodes according to the 10/20 system of placement. Anterior temporal (T1 & T2) electrodes were also placed in all the patients. At least 16 channels of EEG and one channel of EKG were monitored. The equipment is incorporated with spike and seizure detection programs for on-line analysis (42).

Monitoring procedure

We perform VEM as an inpatient procedure. One of the relatives of the subject stayed in the monitoring room throughout the procedure. Patients in whom the duration of VEM was less than 3 hours were not included. Patients who were on antiepileptic medications had their medicines withdrawn gradually. The monitoring was continued till 2 or 5 or more events were recorded. For presurgical evaluation, we insist on recording at least 2 habitual seizures in those with strictly unilateral interictal epileptiform abnormalities and at least 5 habitual seizures in those with interictal bitemporal epileptiform or equivocal abnormalities. We used sphenodial electrodes and employed specific triggering events when required.

Events detection

The events were detected by patient's caregivers who triggered an event signal, a trained EEG technologist who visually scanned the VEEG or a computer equipped spike and seizure detection program. Samples of interictal EEG & events identified were reviewed by at least 2 epileptologists experienced in the procedure.

Analysis of Events

The Ictal semiology was carefully analysed to look for features that help in lateralising and localizing the seizure origin. Attempt was made to clinically categorize each seizure into temporal or extra temporal origin of either left or right hemispherical origin and further localization was done when possible. The interictal EEG abnormalities were interpreted and coded according to the Mayo System of Classification of EEG abnormalities. The onset of the abnormal ictal EEG activity and its speed, and postictal slowing, if any, were ascertained.

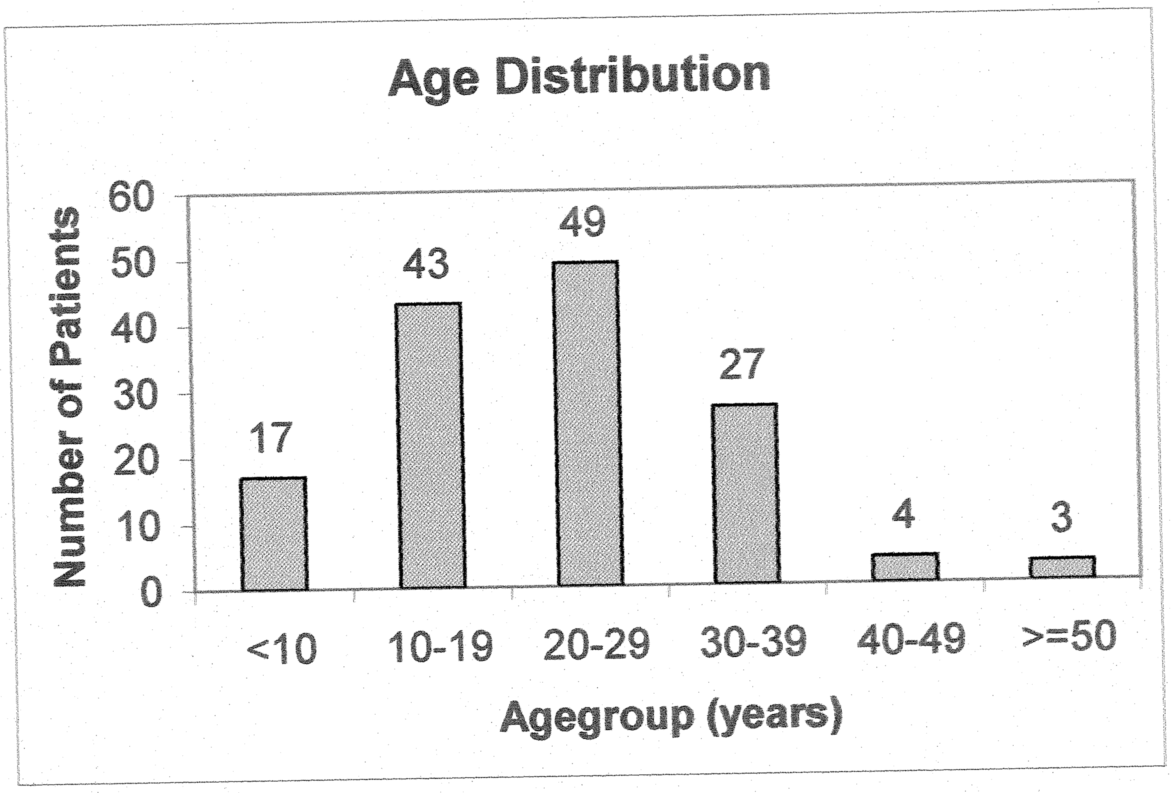
In addition to the demographic profile, we evaluated in detail, the objective of referral for VEM, premonitoring diagnosis, premonitoring scalp EEG abnormality, the clinical and electrographic features of the recorded events, the pattern of AED withdrawal, the outcome of VEM and the cost to the patient.

RESULTS

Patient characteristics

143 patients underwent VEEG as part of this study during a period of 10 months from September 2004 to July 2005. The age of 143 patients (88 males, 55 females) ranged from 1 to 59 (mean 22) years; 27 of them were ≤12 years. The distribution of patients according to age is shown in Fig 1.

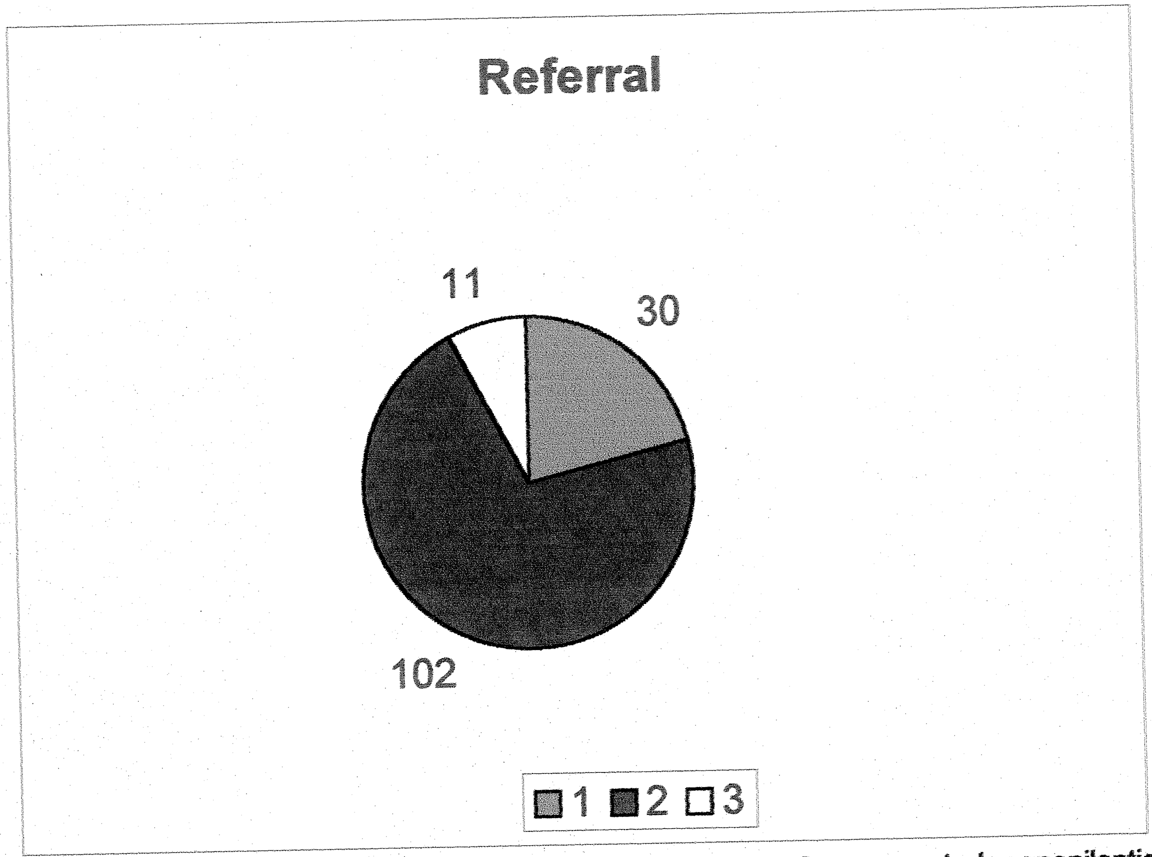
Figure 1



Referral diagnosis

The objectives of referral for VEEG are shown in Fig 2. Medically refractory CPS for presurgical evaluation constituted 102 (71.3%) of the referrals. 30 patients (21%) were referred for classification of seizures and 11 patients were referred specifically for suspected non epileptic events.

Figure 2



1= classification of seizures; 2= presurgical evaluation; 3= suspected nonepileptic events (Fig 2)

Details of Epilepsy

The mean age of onset of the epilepsy was 11 years (range 1 month to 56 years). The average duration of epilepsy prior to VEM was 11.3 years. The maximum mean duration of epilepsy prior to VEM was observed in the group referred for presurgical evaluation, which was 12.17 years. Patients with suspected nonepileptic events had an average duration of symptoms of 7.23 years prior to the VEM. The seizure frequency in the last one year prior to the VEM in the different referral groups is shown in table 1. The mean percentage of secondary generalised seizures in the total group was 18%.

Table 1

REFERRAL	FreqGroup 1	2	3	4	Total
Seizure classification	8	6	12	4	30
Presurgical work up	16	22	58	6	102
Non epileptic events	2	3	5	1	11
Total	26	31	75	11	143

1 – Daily seizures; 2 - > 1/ week , but not daily; 3 - < 1/week , but > 1/ month;4 - < 1/ month

Premonitoring scalp EEG

Interictal epileptiform abnormalities (IEDs) were present in the premonitoring EEG in 98 patients (68.5 %). 79 patients (55.2 %) had temporal IEDs, out of which 23 had bitemporal IEDs. Extratemporal IEDs were observed in 46 patients (32.2%), out of which the most commonly observed was frontal IEDs. Temporal Intermittent Delta Activity (TIRDA) was observed in 5 patients. Premonitoring scalp EEG in the patients with suspected nonepileptic events was normal in all except two patients.

AED Treatment

41patients were on more than 2 antiepileptic drugs (AEDs) at the time of VEM, whereas only 17 patients were on monotherpy. 7 patients out of the ten who were suspected to have nonepileptic events were on polypharmacy. 2 patients were not taking any AEDs at the time of VEM. The distribution of the number of the AEDs taken by the patients is shown in table 2. The most commonly used AED was Carbamazepine. Newer AEDs were used in 46 patients

Table 2

No of AEDs	Frequency	Percent
0	2	1.4
1	17	11.9
2	83	58.0
3	30	21.0
4	9	6.3
5	1	.7
6	1	.7
Total	143	100.0

AED withdrawal for monitoring

115 patients had their AEDs withdrawn at some point of time during the VEEG recording, whereas 28 patients were continued on the same AED dose during the VEM. 44 patients were totally off AEDs at some point of time during VEM. The duration without any AEDs in these patients ranged from 4 hours to 106 hours.

VEEG Recording

The mean duration of VEM was 63.5 hours (SD – 42.47(range 3 hrs to 336 hrs). 78 patients underwent VEM for more than 48 hours whereas only 4 patients had the procedure discontinued in the first 8 hours. VEM recorded no events in 7 subjects. The number of events recorded ranged from 0 to 25 with a mean of 2.99 events per patient. 15 % of seizures were secondary generalized. 95 patients (66.4%) did not have any secondary generalized seizure during the VEM. None of the patient had status epilepticus or clustering of attacks requiring ICU care. Apart from tongue bite in 7 patients and postictal psychosis in one patient, there were no serious complications as a consequence of the VEM. Sphenoidal electrodes were used in 27 patients. IEDs were detected during VEM in 126 (88%) of patients, out of which 117 had temporal IEDs and 50 patients had extratemporal IEDs.

Discontinuation of VEM

VEM was discontinued in 123 patients (86%) after recording sufficient number of events. 11 patients had VEM discontinued due to technical reasons while in 7 patients VEM had to be discontinued since no events could be recorded even after prolonged monitoring.

POST VEM DIAGNOSIS

The diagnosis of epilepsy was confirmed in 131 out of the 143 patients. The most common syndromic diagnosis was that of localisation related (symptomatic) temporal lobe epilepsy related to mesial temporal sclerosis. 12 patients were found to have nonepileptic behavioural events, out of which 4 had coexistent epilepsy. The most significant outcomes after the VEM are shown in table 3.

Table 3

OUTCOME MEASURE	NO OF PATIENTS	PERCENTAGE
EPILEPSY SURGERY	51	35.6
CHANGE IN DIAGNOSIS	18	12.5
CHANGE IN TREATMENT	81	56.6
AED REDUCTION	27	18.8
PSEUDOSEIZURES	8	5.6
EPILEPSY+ PSEUDOSEIZURES	4	2.8
NO RECORDED EVENTS	7	4.9
ICTAL SPECT	10	6.9

COST

The monthly income of the patients in the study ranged from Rs 100 to Rs 40000 (median Rs 2500). 30 out of the 143 patients (21%) were employed and supporting their family. The rest were unemployed and were dependent on parents or spouse or close relatives. The mean monthly expenditure for AED alone was Rs 631. The expenditure for VEM including travel and stay for one relative ranged from 100 to Rs 19700, with a mean value of Rs 6748.

12 patients who were diagnosed to have pseudoseizures were spending a mean amount of Rs 452 every month on AEDs. Patients with refractory seizures who were selected for surgery after VEM had a mean monthly expenditure of Rs 663 for AEDs alone. Twenty seven (18.9%) patients had a modification of their AED regimen after the VEM, which led to a reduction in mean monthly expenditure of Rs.327.

A patient satisfaction survey was done which showed that 99% of patients tolerated the procedure and showed willingness to undergo the procedure again and recommend someone else to undergo the procedure if required.

DISCUSSION

Assessment of the diagnostic value and cost effectiveness of a high cost and time consuming procedure such as VEM is much needed in a developing country scenario because of economic constraints and inadequate infrastructure prevalent in these regions. Unfortunately, very little information is available to this effect from developing nations. A previous study done from Sree Chitra Institute for Medical Sciences and Technology, Trivandrum, Kerala found VEM helpful to establish or exclude the diagnosis of epilepsy, to classify seizure types and other events and in the presurgical evaluation of patients with medically refractory partial seizures. (23) We undertook this study to audit the existing system of VEM in the comprehensive epilepsy care programme of a tertiary referral hospital.

Patient demographics and objectives of referral

143 patients of both sexes over a wide age range underwent VEM in this study; 27 of the patients were $\leq$12 years, in whom seizure classification was a major objective of referral for VEM. This is expected, since many of the seizures occurring in children are difficult to classify and VEM will be helpful in such situations. Srikumar et al reported that short term VEM (up to 6 hours) is a useful method for investigating children with epilepsy or nonepileptic behavioural events (NEBEs) who have frequent episodes. (43)

Majority of the patients in this study were referred for VEM as part of presurgical work up for medically refractory seizures. There may be a selection bias while choosing the patients for undergoing VEM in our centre. Generally, the proportion of patients referred for VEM for various objectives varies according to the functioning pattern of the epilepsy monitoring unit. Because of the limited availability of well-equipped comprehensive epilepsy care centres in the country, there is a pressing demand to perform more epilepsy surgeries and this may be reflected in the dominant number of patients referred for presurgical work up in this study.

The patients who underwent VEM had a mean duration of epilepsy of 7 years prior to the VEM. This was maximum in the group with medically refractory epilepsy who were referred for presurgical work up (mean 12 years). This reflects the delay in the referral process of medically refractory cases of epilepsy to comprehensive epilepsy centres. Repeated seizures over a long period of time could lead to development of foci of secondary epileptogenicity thus leading to the alteration of the epileptogenic process making some of these patients unsuitable for epilepsy surgery (44). The mean duration of illness prior to VEM in the patients with suspected nonepileptic behavioural events was also considerably high, with a mean period of 7 years. It may be impossible to differentiate these events from true seizures from preliminary evaluation including neuroimaging.

AED dose reduction during VEM

115 patients had their AED dosage reduced during the VEEG recording and 44 patients were totally off AEDs at some point of time during VEM. There was no significant increase in the proportion of generalised seizures during VEM and none of the patients had status epilepticus or clustering of seizures, which required ICU care. The study shows that supervised reduction of AED dose during VEM can be undertaken without any unwanted side effects. Moreover, stereotyped seizures could be recorded in majority of our patients, thus highlighting the fact that long term inpatient VEM could simulate real life situation, even after withdrawing AEDs.

Duration of VEM

Duration of VEM exceeded 8 hours in all but four patients, and 78 patients had undergone VEM for more than 48 hours. Considering the expense and technical expertise involved in VEM it is prudent to minimise the duration of VEM, if possible. Many studies have highlighted the utility and cost effectiveness of short term VEM and outpatient based VEM. (23) However it is difficult to propose an optimum duration of VEM as a general guideline since the decision to discontinue VEM depends on many, factors, most importantly the objective of referral for the study. Since the majority of patients in our cohort were referred for presurgical evaluation, which required documentation of satisfactory number of habitual seizures, short term VEM of 8 hours or less could not have provided the desired result. Hence we feel that long term VEM has definite added advantage over short term recording in the setting of a comprehensive epilepsy centre where deciding the suitability of patients for epilepsy surgery is of utmost importance.

OUTCOME OF VEM

Fifty-one (35.7%) patients were found to be suitable candidates for epilepsy surgery, which was approximately half the number of patients who were referred for presurgical evaluation. 3 patients who were referred for classification of seizures were also found to be suitable candidates for surgery. Majority of patients were selected for anterior temporal lobectomy for temporal lobe epilepsy symptomatic to mesial temporal sclerosis. 9 out of 15 patients who had bitemporal IEDs on premonitoring EEG were also found to be suitable candidates after VEM. More than 80-90% of patients with medial temporal lobe epilepsy or substrate- directed epilepsy might be rendered seizure free or near seizure free after a total excision of the epileptic zone (33). Eighty (55.9%) patients had a significant change in the treatment after VEM, the majority of which was based on the decision about their surgical candidacy.

12 patients were found to have nonepileptic behavioural events, out of which one was previously unsuspected. Majority of these patients were on polypharmacy and the mean duration of illness before VEM was 7 years with a mean monthly expenditure for AEDs alone of Rs 452. These figures expose the unwanted financial burden on the individual and the society as a whole due to the unnecessary expenditure on AEDs, which could be eliminated by the VEM. The proportion of patients represented in this study could represent only the tip of the iceberg since our sample of patients was a highly selected group referred to a tertiary care hospital. In addition to the financial gain, establishment of the correct diagnosis leads to elimination of the side effects due to AED polypharmacy and also removes the social stigma that is attached to epilepsy in these patients and it provides opportunities for alternative appropriate treatment. Documenting the nonepileptic events by VEM is the only definitive way to make a diagnosis in these patients. 4 patients had coexistent epilepsy and without VEM, these patients could be wrongly interpreted as medically refractory and even considered for invasive treatments like epilepsy surgery.

Twenty-seven (18.9%) patients had a modification of their AED regimen after the VEM, which led to a reduction in mean monthly expenditure of Rs.327. 18 patients (12.5 %) had a change in their diagnosis after VEM. All the patients included in the present study were seen in outpatient epilepsy clinics by an epileptologist prior to referral for VEM. The study shows that long term VEM can provide useful information in addition to the clinical judgement and preliminary evaluation, even to the experienced epileptologist.

46 patients who underwent VEM in our study did not have any significant change in outcome when compared to the premonitoring data except for confirmation of the seizure type. Although it is frequently stated that therapeutic benefits from long-term VEM are limited to some, while others despite correct identification of seizure type, may remain intractable to AED therapy (10), this view regards the only worthwhile benefit from VEM as reduction in seizures. However, changes in the patient's perceptions, attitudes, and understanding of the disease, as well as those of family members that may be occasioned by the VEM admission are neglected and undervalued.

Finally, the disadvantages of long term VEM like the inherent cost and technical demand has to be weighed against the potential direct and indirect benefits. We found that long term VEM has great utility in reducing the direct costs associated with AED therapy for improperly diagnosed cases and in selecting medically refractory epilepsy cases for epilepsy surgery. The financial and social cost of chronic uncontrolled seizures to the patient, the family and the general community is considerable. These include costs associated with repeated emergency department presentations and hospital admissions, epilepsy-related injuries, general practitioner and specialist consultations, medial investigations, social and workplace upheaval, and associated psychiatric co morbidity. Poorly controlled seizures have often been associated with neurocognitive impairment, lower levels of school performance, higher levels of depression, impaired psychosocial skills and an increased risk of death. However, many of these costs remain unquantified and under recognized. Moreover it is difficult to quantify the social stigma and emotional stress associated with poor controlled epilepsy and wrongly diagnosed cases of epilepsy. An assessment of the utility of VEM would be incomplete without incorporating all these under recognized, but important factors.

CONCLUSIONS

1) The most common indications for referral for long term VEM were presurgical work up in cases of medically refractory partial seizures, classification of seizures and identification of non-epileptic events. The proportion of patients in each group will vary according to the functioning of each epilepsy monitoring unit

2) Duration of VEM will vary depending on the objective of referral and the reproducibility of habitual events. Long term VEM has definite added advantages over short term VEM in the setting of a comprehensive epilepsy programme.

3) Long term VEM was efficient in reproducing habitual events in majority of the patients referred for the study.

4) Supervised AED withdrawal during long term VEM is a safe practice and does not change the pattern of habitual seizures.

5) Long term VEM is a safe and well tolerated procedure, and none of the patients had any life threatening complication even with complete withdrawal of AEDs

6) A significant proportion of patients (36%) could be selected as candidates for epilepsy surgery. VEM monitoring is one of the most crucial tools in the presurgical evaluation of a patient with medically refractory seizures

7) Eighty (55.9%) patients had a significant change in the treatment after VEM, the majority of which was based on the decision about their surgical candidacy.

8) Twenty seven (18.9%) patients had a modification of their AED regimen after the VEM, which led to a reduction in mean monthly expenditure of Rs.327.

9) Twelve (8.4%) patients were confirmed to have NEBEs, out of which one was previously unsuspected. VEM is the only definitive way to make a diagnosis of NEBEs. Majority of these patients were on polypharmacy and the mean duration of illness before VEM was 7 years with a mean monthly expenditure for AEDs alone of Rs 452.

10) Summarising, long-term VEM has a significant role in the diagnosis and management of patients with difficult to control epilepsies. VEM is invaluable in differentiating NEBEs from epileptic seizures, and thereby reduce the unnecessary cost and side effects of AED treatment. If used judiciously, VEM is a cost - effective procedure.

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AN AUDIT ON THE COST – EFFECTIVE UTILIZATION OF VIDEO EEG MONITORING

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DEMOGRAPHIC DATA

Name: Hospital No(HNO)

Age (yy/mm) Sex: (1 = Male, 2 = Female)

Date of recording: -- -- ---- to -- -- ---- (DD/MM/YY)

OBJECTIVES OF REFERRAL (Yes = 1, No = 0)

To identify seizure type(CLASS) -----------

Presurgical evaluation(PRESURG) -----------

Distinguish between epileptic and
Non epileptic events (SZ – NEA) -----------

To identify pseudoseizures (PSE) -----------

Seizure exacerbation (INCSZ) -----------

PRE – MONITERING DIAGNOSIS (PREDX) -----------------
(Ascertained by history in hospital)

Seizure/ event type
(1 = CPS, 2 = MYO, 3= BEH, 4= STARE, 5= LOC, 6= NEA/Pseudo sz, 7= Epilepsy + NEA, 8= SLEEP, 9= DROPS, 10= Sec GTCS)
BEH – behavioural problems like episodic violence, SLEEP – Sleep related behaviour.

EPILEPSY/EVENT CHARACTERISTICS

Age of onset of the seizures/event (years) (AGEONS): -----------------

Duration of epilepsy/event (years) (DUR) -----------------

Seizure frequency score (in last 12 months) (FREQ) -----------------

No: of seizures/event pt had in last 3 months (NOL3M) -----------------

No of seizures/event pt had in last 1 month (NOL1M) ----------------

No seizures/event pt had in last 1 week (NOL1W) ----------------

When was the last sec generalized seizure(LSGSZ) ---------------

No of sec generalized seizure in last 3 months(SG3M) ---------------

Percentage of sec generalized seizures(GSZFQ%) in last one year ---------------

PRE – MONITORING SCALP EEG

Interictal epileptiform abnormalities (IEA) (1= YES, 0= NO) ----------------

If present,(IEDIST) (1= focal, 2= generalized, 3= both) ----------------

Temporal IEDs (TIED) (0=none,1=R, 2=L, 3=B/L) ----------------

Other IEDs(OIED)
(0= none, 1= ET, 2= generalized, 3= both) ---------------

If extratemporal (ET) (1= F, 2= P, 3=C, 4= CT, 5=Occipital) ------------------

Temporal delta slowing (TDELTA)
(0= None, 1= R, 2= L, 3= B/L) ------------------

AED TREATMENT

No of AEDs (AED No) -------------

Current AEDs ---------- ----------- ----------- --------------

Dosage(mg/day) ---------- ----------- ----------- --------------

AED WITHDRAWAL FOR MONITORING

No of AEDs discontinued(AEDDISC) ------------------

Approx % reduction of AEDs:

First 24 hrs -------------- -------------------- --------------- --------------

Second 24 hrs -------------- ------------------- ---------------- ---------------

Third 24 hrs -------------- ------------------- -------------- ---------------

Fourth 24 hrs ------------- ------------------- --------------- ----------------

No of AEDs not discontinued (AENDISC) ----------------

Where barbiturates withdrawn (1= yes, 0= no) ---------------

Where benzodiazepines(CLB/CZP) withdrawn? ---------------

No hours patient was totally off AEDs during recording ---------------

VEEG RECORDING

Total duration (hours) (VDUR) --------------

Time of seizure occurrence relative to sleep
(Majority of seizure) (SZTIME) --------------
(1= Patient awake, 2= patient asleep)

Precipitating/ triggering factor (PPT) -------------
(0= none, 1= Eating 2=Jogging, 3=HV)

No of hours after start of monitoring when first seizure
Was recorded (FSZT) -------------

Percentage of AED dose at first seizure (%AE1SZ) -------------

No of hours after start of monitering when
3rd seizure was recorded (3SZT) ------------

Percentage of AED dose at 3rd seizure (%AE3SZ) ------------

Total no of seizures recorded (NOSZ) ------------

No of seizures with secondary generalization (SECGEN) ------------

Time of occurrence of sec gen seizure after start of monitering (SGSZTIM) -------------

Time of occurrence of sec gen seizure after total AED withdrawal (GSZTAES) -----------

Percentage of AED dose at secondary generalized seizure (%AESG) -----------

No of seizures excluded (EXCSZ) -----------(technical,
other reasons, variability)

Non-epileptic attacks (NEA) -------------- (1= yes, 0= no)

Clustering of attacks – 3 szs in 24 hours (CLUST) ------------- (1= yes, 0= no)

Status epilepticus requiring ICU care (SE) ------------- (1= YES, 0= no)

Total duration of hospital stay in days (STAY) ----------- (1= YES, 0= NO)

Sphenoidal electrodes used (SPH) ------------- (1= yes, 0= no)

IEDS ON VEEG

IEDS ----------------- (1= yes , 0= no)

If present, (IEDIST) --------------- (1= focal, 2= generalized, 3= both)

Temporal IEDs(TIED) -------------- (0= none, R= 1, L =2, B/L =3)

Other IEDs(OIED)
(0= none, 1= ET, 2= generalized, 3= both) -------------------

If extratemporal (ET)
(F = 1, P=2, C=3, CT=4, Occipital =5) -----------------

Temporal delta slowing (TDELTA)
(0= none, 1= R, 2= L, 3= B/L) -----------------

No of AED at discharge (AEDD) ----------------

AEDs at discharge ------------- -------------- --------------- ----------------

Dosage ------------ -------------- --------------- ---------------

REASONS FOR STOPPING MONITORING(RSTOP)

(1= sufficient seizures recorded, 2= Rec sec gen seizures, 3= No events recorded, 4= Lack of cooperation , 5= Unrelated medical illness, 6= Non medical (personal,financial,) 7= Others)

POST – VEEG DIAGNOSIS

Epilepsy (DEFDX) --------------- (Yes = 1, No =0)

Syndromic diagnosis of epilepsy (SYND) ----------------

Non-epileptic events only (NEE) --------------- (yes = 1, no = 0)

Epilepsy + Non epileptic events (E + NEE) -------------- (yes = 1, no = 0)

OUTCOME OF VEEG (Yes = 1, No = 0)

Epilepsy surgery (SURG) --------------

Change in diagnosis (CHNGDX) --------------

Change in treatment (CHNGRX) --------------

AED reduction/ withdrawal(R/S AED) -------------

Pseudoseizures (PSEUD) ---------------

Epilepsy + pseudoseizures (E = PSEUD) --------------

Reduction in AED adverse effects (RAEAE) -------------
-
No recorded events (NOEVT) -------------

Ictal SPECT undrertaken (ISPECT) -------------

COMPLICATIONS (yes = 1, 0= no)

Tongue bite (TBIT) -----------------

Postictal psychosis (PPSY) ----------------

Fall and injuries (INJ) ----------------

Shoulder dislocation (SHDX) ----------------

Bone fracture (BFX) ----------------

Infection / allergic rash at electrode site (RASH) --------------

Any other (OTHER) -----------------

COST

Category of the patient

Monthly income of the family

Patient earning or not (yes = 1, no = 0)

If not, who is the breadwinner? (1= spouse, 2= parents, 3= relative, 4= none)

Average amount spend for AED in a month -----------------

Amount spend by the patient
VEEG and hospital stay ------------------

Travel and stay outside for one person -----------------

How many visits before this to this hospital ------------

Approx amount paid for each visit ------------

PATIENT SATISFACTION SURVEY (yes =1, no = 0)

Did you tolerate the procedure? (yes/no)

If there is a drug, which could be administered to hasten the seizures and thereby reduce the monitoring time will you be ready to receive it? (yes/no)

Would you like to undergo the procedure again, if necessary? (yes/no)

Would you recommend someone else to undergo the procedure in this hospital, if needed? (yes/no)