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Diagnostic Utility of Overnight Video Electroencephalography (VEEG) to Routine EEG in Case of Seizure Disorder

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Abstract: ***Overnight sleep EEG has been widely used for diagnosis, classification and management of seizures over routine EEG. The high sensitivity of awake and sleep EEG over routine EEG in the diagnosis of epilepsy is well known. No such study has been undertaken in patients of North East India. Therefore, the present study was performed to study the sensitivity of minimum 12 hour EEG in the diagnosis of epilepsy. The study was carried out in the Comprehensive Epilepsy Care Centre, GNRC Hospitals, Six Mile, Guwahati, from June 2011 to July 2011. 129 referred patients were subjected to overnight video EEG with mean recording time of 12 hours. Usually the patients were connected between 5:00 PM to 10:00 PM in the previous evening and the recordings were continued upto 5:00 AM to 10:00 AM next morning.. Routine activation procedures were followed. The recorded awake and sleep EEG was reviewed and findings were observed for background activity, response to activation, presence of benign variants, and presence of epileptiform activity. Epileptiform activities were recorded in 22 of 129 cases (17.05%) during awake record. While continuing the recording during sleep, epileptiform activities were detected in 86 of 129 (66.66%) patients. The increased sensitivity of sleep EEG over routine EEG is comparable to previous studies. 16 (12.4%) patients were documented to have at least one episode of seizure. 19 (14.72%) patients were found to have a normal sleep EEG, who clinically had history of seizure. In conclusion, the minimum 12 hours overnight EEG during both awake and sleep states is a highly sensitive diagnostic tool in the diagnosis and management of epilepsy.***

Keywords: seizure, overnight EEG, epileptiform activity.

1. Introduction

Overnight Video EEG monitoring is widely used for diagnosis of patients having seizure disorder and other paroxysmal behavioral events. The main referral categories are diagnosis (i.e. epileptic versus non-epileptic disorders), seizure classification and management accordingly.

However, overnight video EEG is a sophisticated technical equipment and a large staff of specially trained personal are required for its proper functioning. An overnight video EEG session is generally considered useful if it had altered the diagnosis and/or therapy, or if it has answered the question asked by the referring physician. These outcome-measures depend also on clinical decisions made before or after the monitoring[1].

Very few studies have systematically examined the diagnostic utility of overnight EEG to routine EEG in this North Eastern part of the country. Therefore, the aim of our study is to assess the diagnostic usefulness of overnight video EEG and to observe the advantage of overnight video EEG over routine 1 hour EEG.

2. Methods

Data from 129 random admissions in video EEG Lab were taken from June 2011 to July 2011 in a tertiary epilepsy research centre. The Guwahati Neurological Research Centre (GNRC), Six Mile, is one of the tertiary epilepsy research centers in North Eastern India. Its video EEG Unit consists of 5 beds for overnight video EEG recording. It has around 1500 short term EEG referrals and 780 overnight video EEG referrals annually. Out of these, 93 patients were found to have clinical history of seizure. The rest 36 patients were found to have other complaints like headache, giddiness, neurosis, psychosis, abnormal behavior, panic attacks etc.

Prior to admission to overnight video EEG recording, all patients were extensively investigated. During the admission, they were observed for seizures/paroxysmal behavioral events by video surveillance.

Our Comprehensive Epilepsy Care Centre video EEG monitoring unit has 5 beds separated by partitions in a large hall with bedside dining and attached toilet facility. This arrangement provides a combination of social life and privacy. Five video (Nicolet) EEG recording machines with one 64-channel and four 32-channel cable telemetry were used for monitoring. The mean recording time was 12 hours starting at 6:00 PM in the evening followed by photic stimulation and hyperventilation activation procedures. The record was carried out overnight and was terminated at 6:00 AM in the morning next day. EEG technicians continuously monitor the patients and the EEG and during night-time all patients were continuously observed by five individual cameras and a central surveillance unit. Children are always admitted together with the parents or caretakers. Besides, EEG technicians, nurses were always present in order to examine the patients' seizures and provide emergency drugs and life-supporting treatment, if necessary.

The EEG was evaluated by visual inspection. Video EEG recording of the clinical events and relevant portions of the interictal EEG sections were edited and stored on a day-to-day basis. The night time recordings were overviewed the following morning by the clinical neurophysiologists. Automatic detection of seizures or spikes was not used.

3. Results

A total of 129 patients underwent for overnight VEEG examination which included 1 hour EEG in the evening followed by 12 hour overnight VEEG for complete evaluation. In the first 1 hour EEG, all the patients underwent photic stimulation and hyperventilation. 102(79%) patients show alpha drop out, 99(76.74%) patients show vertex waves and 97(75.2%) patients show sleep spindles in the first hour EEG session. As shown in the Table1, 22(17%) patients show epileptiform activity in the first 1 hour EEG record.

Table 1: Results after first 1 hour of EEG record

Parameters	Positive results
Hyperventilation	129
Photic stimulation	129
Alpha dropout	102(79%)
Vertex	99(76.74%)
Spindle	97(75.19)
Epileptiform activity	22(17.05%)

The results of 12 hour overnight VEEG record are shown in table2 as follows-

Table 2: Results of Overnight (12 Hour) VEEG record-

Parameters	Positive Results
Theta activity	125(96.89%)
K-Complex	120(93.02%)
POST	111(86.04%)
6 Hz Spindle	121(93.79%)
14 Hz Spindle	116(89.92%)
Focal Slow Activity	85(65.89%)
Generalized Fast Spike	16(12.4%)
Focal Spike	63(48.83%)
Generalized Spike	39(30.23%)
Polyspike	15(11.62%)
Sharp Wave	79(61.24%)
Focal Spike and Slow Wave	65(50.3%)
Events	16(12.4%)
Epileptiform activity recorded	86(66.66%)

As shown in table 2, after 12 hour VEEG, 125 (96.9%) patients have theta activity, 120(93%) have K Complexes, 111(86%) have POSTs, 121(93.8%) have 6 Hz spindle and 116(90%) have 14 Hz spindle during their sleep. 86(66.66%) patients have epileptiform activity recorded during overnight VEEG which shows an increased sensitivity of 49.61% above 1 hour EEG. Regarding abnormal epileptiform activity recorded, focal slow activity were seen in 85(65.9%) patients, generalized fast spikes were seen in 16(12.4%) patients, focal spikes were seen in 63(48.8%) patients, polyspikes were seen in 15(11.6%) patients, sharp waves were seen in 79(61.2%) and focal spike and slow waves were seen in 65(50%) patients who were admitted for overnight VEEG recordings.

Regarding seizure classification, 39(30%) patients were diagnosed to have focal seizure, 21(16.3%) patients were diagnosed to have focal seizure with generalization, 22(17%) patients were diagnosed to have generalized seizure and 36(28%) patients were diagnosed to be normal after analyzing the 12 hour VEEG records. These results are shown in table 3 as follows-

Table 3: Seizure classification after overnight VEEG-

Seizure Type	Numbers Diagnosed
Focal seizure	39(30.23%)
Focal seizure with generalization	21(16.27%)
Generalized seizure	22(17.05%)
Normal	36(27.9%)

Lastly, coming to the sensitivity of overnight VEEG, it was found that 17(13.2%) patients were diagnosed as epileptic after overnight VEEG who were admitted for other reasons than seizure, 58(45%) patients were diagnosed as epileptic after overnight VEEG but not confirmed after 1st hour EEG record, 16(12.4%) patients were diagnosed as normal after overnight VEEG which were diagnosed otherwise after 1 hour EEG and 19(14.7%) patients were diagnosed as normal after overnight VEEG which were previously diagnosed to have seizure in 1 hour EEG. These results are shown in table 4 as follows-

Table 4: Advantages of overnight VEEG over 1 hour EEG-

Diagnosis	Numbers diagnosed
Patient diagnosed as epileptic after overnight VEEG but diagnosed as normal before (admitted for other reasons)	17(13.17%)
Patient diagnosed as epileptic after overnight VEEG but not after 1 hour EEG	58(44.96%)
Patient diagnosed as normal after overnight VEEG but not after 1 hour EEG	16(12.4%)
Patient diagnosed as normal after overnight VEEG but epileptic after 1 hour EEG	19(14.72%)

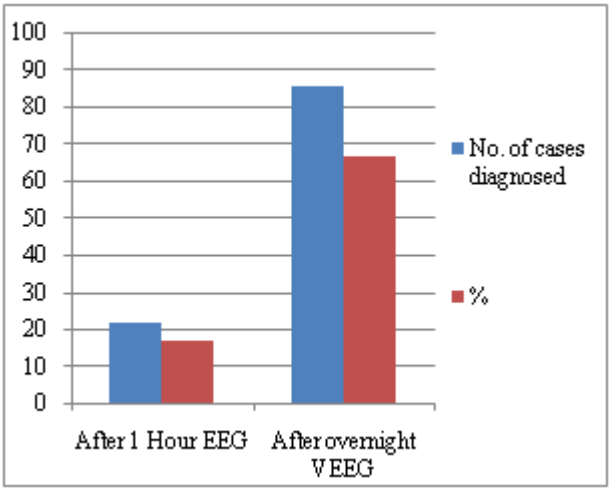

Figure: Figure showing number cases and their percentages diagnosed to be epileptic after 1 hour EEG and after overnight VEEG.

In the above figure, the number of cases and their percentages diagnosed to be epileptic after 1 hour EEG and after overnight VEEG are shown. It is clearly seen in the figure that there is around four fold increase in the diagnosis of epilepsy when overnight VEEG was undertaken.

4. Discussion

Overnight VEEG is one of the best diagnostic tools for patients with seizures or paroxysmal behavioural events. Few studies have systematically examined the diagnostic

utility of VEEG in India. Some studies have specifically examined the sensitivity and/or specificity of VEEG for diagnosis and presurgical localization. Binnie et al.[3] evaluated the records of 181 patients who underwent video-EEG monitoring and found that useful diagnostic information was obtained in 68% of cases. Mohan et al.[4] retrospectively studied the records of 444 patients who had video EEG monitoring for diagnostic purposes and reported that 73% successfully obtained diagnostic information. Yoshinaga et al.[5] reported that inpatient video EEG monitoring changed the referral diagnosis in 37(20%) of 183 consecutive children admitted. No previous studies have addressed the diagnostic advantage of overnight VEEG over conventional 1 hour EEG.

In our study, it was observed that of the 129 patients undergoing the study 22(17%) patients were found to have epileptiform activity in 1 hour EEG which increases to 86(66.66%) after undergoing overnight VEEG which corroborates the study conducted by Binnie et al. (3). It clearly shows a fourfold increase in detection of epileptiform activity in overnight VEEG over 1 hour EEG which is very significant.

In our study, it was seen that 39(30%) patients were diagnosed to have focal seizure, 21(16.3%) patients were diagnosed to have focal seizure with generalization, 22(17%) patients were diagnosed to have generalized seizure and 36(28%) patients were diagnosed to be normal after analyzing the 12 hour VEEG records which corroborates with the study conducted by Ghougassian D. F. et al.[2]. Hence, overnight VEEG helps in classification of seizure which further assists the clinician to manage the treatment protocol of the patients. Again, it was found that after overnight VEEG 17(13.2%) patients were diagnosed as epileptic who were admitted for other reasons than seizure, 58(45%) patients were diagnosed as epileptic which were not confirmed after 1st hour EEG record, 16(12.4%) patients were diagnosed as normal which were diagnosed otherwise after 1 hour EEG and 19(14.7%) patients were diagnosed as normal which were previously diagnosed to have seizure in 1 hour EEG. This shows there is a direct advantage of overnight VEEG over conventional 1 hour EEG which is quite significant.

5. Conclusion

The minimum 12 hours overnight video EEG during both awake and sleep states is a highly sensitive diagnostic tool in the diagnosis and management of epilepsy. It has clear advantage over conventional 1 hour EEG for detection of seizure as well as for classification of seizure. It can also be used to see ictal events for further classification and management of seizures.

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