

Utilization of EEG in A Teaching Hospital: A Descriptive Cross-Sectional Study

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Abstract

INTRODUCTION

Electroencephalography is a safe, convenient, non-invasive, and inexpensive technique that allows assessment of cerebral function and detects physiological manifestations of abnormal cortical excitability. Published literature about its utilization and application is sparse from this part of the world.

METHODOLOGY

It is a descriptive, cross-sectional study conducted in Nepalgunj Medical College, Kohalpur, Nepal. All the subjects referred for EEG evaluation from January 2019 to December 2020 (two years) were enrolled and EEG was performed. A self-designed proforma was used to record different variables and data was analyzed using Statistical Package for the Social Sciences version 21.0 for Windows.

Result

Of total 246 subjects, 53.3% were male and 58.9% of the subjects were 20 years or younger by age. Maximum

(35.8%) number of referrals came from the department of psychiatry. Generalized seizure discharge was the most common EEG diagnosis and presence of seizure activity was noted in 37% of patients.

Conclusion:

EEG is utilized by different specialties commonly for seizure disorder, psychiatric disorders and headaches.

KEYWORD

Seizure; Epilepsy, EEG, Electroencephalography

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INTRODUCTION

Electroencephalography (EEG) was first discovered by an English physician Richard Caton in the year 1875 when he obtained the first EEG from open brains of monkeys and rabbits. Hans Berger in 1924 made the first EEG recording on the human scalp.¹ It is a relatively safe, convenient, non-invasive, and inexpensive technique that allows assessment of cerebral function and detects physiological manifestations of abnormal cortical excitability.^{2,3} It is commonly used for detecting non-convulsive seizures (NCS) and non-convulsive status epilepticus (NCSE)⁴. It plays a central role in diagnosis as well as management of patients with seizure disorders. It enables the early detection of seizures and timely intervention, which could minimize both direct and secondary medical and neurological complications in both adult and pediatric population.^{3,5,6} Apart from epileptic activity, other clinical application of EEG includes determining brain death in patients, areas of damage following a stroke or head trauma, sleep disorders, various epileptic syndromes, investigating various cognitive functions and development, and in language and clinical research.^{1,7}

In the context of Nepal majority of EEG recordings are requested for evaluation of epileptic activity, both in adult and pediatric age groups. In centers where electro convulsive

therapy (ECT) is available, EEG is also used for monitoring seizure activity during the procedure. Though EEG is not such uncommon investigation especially in the hospital/clinics of the cities, published literature about its utilization and findings is surprisingly sparse in Nepal. We wanted to fill this gap in research with the present study of ours. Aim of the study was to describe the pattern of EEG utilization by different specialties and its findings in various neuropsychiatric conditions.

METHODOLOGY

This descriptive, cross-sectional study was conducted in Nepalgunj Medical College, Kohalpur, Nepal (NGMCK). The hospital caters to the states of Lumbini, Karnali and Sudurpashchim which consists of 31 districts of Western Nepal. It is only among the few centers in Western Nepal where EEG facilities are available. Department of Psychiatry manages the EEG facility and reporting is done by the first author (RP). The ethical approval for the study was obtained from Institutional Review Committee (IRC) of NGMCK. All the subjects referred for EEG evaluation from January 2019 to December 2020 (two years) and whose EEGs were recorded, were enrolled for the study. Verbal consents were obtained from the patients and from parents in the case of children and adolescent. A self-designed proforma was used to record various variables including age, sex, place of residence, referring department, provisional diagnosis (as given by referring department), reasons for referral and presenting symptoms.

Procedure followed for recording and reporting EEG:

We utilize 21-channel computerized EEG machine to record the EEG data of our patients. The standard "International 10-20 System" of electrode placement is followed. EEGs are normally recorded for a minimum of 25-30 minutes for each patient. Recording is routinely done by our technician, who has been properly trained regarding electrode placements, recording of data, noting down artifacts (like eye-blink, eye-movement, movement of body parts, etc.) and other on going important activities like presence of seizure during recording. Technician has also been trained to carry out reactivity procedures such as eye-opening, photic stimulation and hyperventilation. For analyzing the data, thus obtained, we used both "bipolar" as well as "referential" montages. Computerized signal analysis gives us the advantage of re-examining the same EEG signal using different montages or filter setting. Reports were given in a typed printed page, in a semi-structured format used in most EEG centers. Following comments were reported in the beginning: Technical quality of recording, patient's level of cooperation and alertness, artifacts noted. Pattern of background EEG activity was noted then. Abnormal Transient events were noted in the end; e.g., presence of focal seizure, focal slowing, generalized seizure, generalized slowing, etc. First author (who analysed these EEGs) used to keep himself blind to the diagnosis, provided by the clinician, until the completion of the EEG report. Data thus gathered were

analyzed using Statistical Package for the Social Sciences (SPSS) version 21.0 for Windows. Chi square test was used to find any significant association among presenting symptoms and final EEG report.

RESULTS

Total number of cases taken for this study was 246. Table 1 shows the distribution of subjects according to age and sex. Majority (38.6%) of the patients were 11-20 years of age. Male patients were slightly more (53.3%) than females. Majority of the subjects were from rural domicile (63.8%). Maximum number of referrals (35.8%) came from the department of psychiatry, followed by the department of medicine (31.7%). More than two-third of the subjects (78.5%) were referred for evaluation of presence of seizure activity. (Table 2) Loss of consciousness followed by abnormal movements was the most common presenting symptom and both were significantly associated with seizure activity on EEG (Table 3 and 4). Presence of seizure activity was seen in 37% of patients whose EEG were recorded.

Table 1: Distribution of subjects according to age and sex (N=246)

Age range (years)	Female (%)	Male (%)	Total (%)
<1	2	3	5 (2)
1-10	18	27	45 (18.3)
11-20	46	49	95 (38.6)
21-30	33	21	54 (22)
31-40	11	10	21 (8.5)
41-50	1	7	8 (3.3)
51-60	2	7	9 (3.7)
61-70	2	5	7 (2.8)
71-80	0	2	2 (0.8)
Total	115 (46.7)	131 (53.3)	246 (100)

Table 2: Socio-demographic and referral characteristics (N=246)

Characteristics		Frequency	Percentage
Place of Residence	Urban	89	36.2%
	Rural	157	63.8%
Referring department	Psychiatry	88	35.8%
	Internal Medicine	78	31.7%
	Pediatrics	49	19.9%
	Neurosurgery	18	7.3%
	Obstetrics and gynecology	3	1.2%
	Emergency	8	3.3%
Reason for referral	Others	2	8%
	For evaluation of seizure activity	193	78.5%
	For evaluation of treatment	42	17.1%
	For organicity workup	11	4.5%

Table 3: Clinical characteristics and EEG findings(N=246)

Characteristics		Frequency	Percentage
Presenting symptoms	Loss of consciousness	148	60.2%
	Abnormal movements	85	34.5%
	Vacant staring	10	4.1%
	Others	3	1.2%
Clinical/Provisional diagnosis	Seizure disorder	30.9%	
	Seizure disorder with comorbid psychiatric disorder	18	7.3%
	Psychiatric disorder	39	15.9%
	Organic disorders	22	8.9%
	Substance use disorders	10	4.1%
	Febrile illness	14	5.7%
	Headaches	38	15.4%
	Others/Not known	29	11.8%
EEG Report (final)	Normal	155	63%
	Presence of seizure activity	91	37%
EEG Diagnosis	Generalized seizure	71	78%
	Focal Seizure	20	22%

Table 4: Relationship of presenting symptoms and EEG findings

Presenting symptoms	EEG Report		Total	χ ²	p value
	Normal	Seizure activity			
Loss of consciousness	124	24	148	68.79	0.00*
Abnormal movement	24	63	87	72.46	0.00*

*: statistically significant

DISCUSSION

In the present study 53.3% of the subjects were males. It appears overall that seizure activity is slightly more common in males than in females which support our finding.⁸ Male preponderance was also observed in some other studies.^{9,10} We found more than 80% of the subjects were 30 years or younger which has been observed in studies both from Nepal^{9,10} and abroad.¹¹ This findings suggest that patients who are evaluated by EEG are young and in their productive ages. To meet the health care needs of this population, EEG services should be made available in majority of both government and private hospitals in Nepal and other developing countries.

This study showed that department of psychiatry referred the most cases for EEG (35.8%) followed by department of internal medicine (31.7%) and department of pediatrics (19.9%). Psychiatrists in Nepal commonly manage neurological conditions including seizure disorders and as the number of psychiatrists vastly outnumbers neurologists, more epilepsy patients naturally turn up to a psychiatrist than a neurologist. On the other hand, our centre also doesn't have a neurologist. All these factors might have resulted in more EEG requests by the department of psychiatry. A study from Nepal found 46.47% of EEG requests were sent from psychiatry which is more than that of ours while a Nigerian study found 11.3% of EEG referrals from psychiatry.^{9,11} Overall this shows that more departments/specialties are aware and utilize EEG for evaluation of their patients whenever needed. In our study 78.5% of subjects were referred for evaluation of seizure which has been observed in other studies also.⁹ In developing countries including Nepal EEG is mainly utilized for evaluation of seizure whereas other uses of EEG namely sleep disorders and other neuro-cognitive disorders is only scarcely available if at all. We suggest that it is high time that more number of EEGs and manpower to operate it should be made available in government sector and private hospitals of so that EEG can

be utilized in different clinical scenarios, including epilepsy to provide adequate neuro-diagnostic services to those at need.

Loss of consciousness was the most common (60.2% cases) presenting symptom prompting EEG evaluation followed by abnormal movements (35.4% cases). As these are one of the commonly encountered symptoms in seizure;¹² these findings were naturally expected. The clinical diagnoses of the referring clinicians in this study showed that seizure disorder (38.2%) was the commonest diagnosis (seizure disorder 30.9% and seizure disorder with comorbid psychiatric disorder 7.3%). The finding from this study that seizure disorder was the commonest clinical diagnosis for which patients were referred for EEG is similar to some other studies from Nepal and Nigeria.^{9,11}

Though EEG is not indicated in the routine evaluation of headaches¹³, 15.4% of our subjects had headaches as their clinical diagnosis. These subjects might have had headaches with some associated symptoms suggesting a seizure disorder, which had prompted clinicians for EEG evaluation. Interestingly clinicians also referred subjects with psychiatric disorders like depression and substance use disorders without any history of seizure for EEG evaluation. Clinicians in this scenario might have thought the psychiatric symptoms like depression might have been due to some non-convulsive seizure or it may also show their uncertainty in the clinical (provisional) diagnosis; hence ordering EEG evaluation to rule out seizure. In our study generalized seizure discharge was the most common EEG diagnosis (78%) followed by focal seizure discharge (22%). Generalized seizure discharge was the most common seizure in EEG as per other previous studies from Nepal.^{9,14} On the other hand, a study from Bangladesh found focal seizure was more common than generalized seizure discharge.¹⁵ This differences could be due to difference in sample size, sample type and EEG interpreter's variability.

LIMITATIONS OF STUDY

There were some limitations in this study. First, all subjects referred for EEG for two years were enrolled for the study which might have led to some sampling biases. Second, various clinical details of the subjects like primary diagnosis, treatment status etc. were not available; hence could not be included.

CONCLUSION

In our part of the world EEG is utilized by clinicians from different specialties commonly for seizure disorder, psychiatric disorders and headaches. EEG plays an important role in the investigation of neuropsychiatric conditions. The authors hope that in future, utilization of EEG in Nepal extends beyond seizure disorder and includes other conditions like sleep disorders and other neuro-psychiatric disorders.

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CONFLICT OF INTEREST

None

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