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Study of the Electroencephalography (EEG) Referral Patterns at a Tertiary Care Centre: An Audit.

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Abstract:-

- ***Introduction*:**

EEG has developed, over a past few decades, into a major diagnostic Neurology tool. However due to lack of proper EEG knowledge among the referring personnel, the valuable tool is often misused. Than in turn leads to loss of efforts, money and time; especially in a resource limited state, like ours.

- ***Aims and Methodology*:**

We aimed to study the EEG referrals and yield at out tertiary care hospital by retrospectively performing an audit of the departmental records regarding EEGs performed over a period of 6 months.

- ***Results:***

The frequency of EEG patient requests were maximum in the Children (26.2%) followed by the Adolescents (22.2%). There was no significant Gender difference among Normal EEG patients nor among Abnormal EEG patients. The most common referral indication overall were Seizures (33.6%) followed by Epilepsy (25.17%). A high proportion of EEG requests were done for Doubtful seizures/pseudosiezures(11.5%) and Syncopy and "Funny turns"(10.7%). Of all the EEGs done, 20.63% of EEGs were reported as abnormal. The highest percentage of abnormal EEGs were seen In patients referred for Encephalopathy (87.5%), followed by Epileptic patients with seizure Recurrence (41.1%). Lowest EEG abnormality yield was seen with Epilepsy patients on follow-up (8.2%), Syncopy and "Funny turns" (5.88%), Doubtful seizures/pseudosiezures (6.36%). Around one thirds (36%) of the referrals for EEG were deemed as *"inappropriate"* requests.

- ***Conclusion*:**

A high proportion of patients are inappropriately referred for EEGs which leads to wastage of manpower, finances and time, especially so in a resource limited place like ours.

I. INTRODUCTION

The standard interictal electroencephalography (EEG) recording is not a diagnostic test for seizure or epilepsy. In unselected patients it has very poor positive and negative predictive value for epilepsy(1,2,3). Epileptiform abnormalities are common in the asymptomatic population(4,5,6,7) and around 40% of children with epilepsy will have a normal EEG between seizures(8,9).

The primary use of the EEG is to help further characterise seizure types and/or epilepsy syndrome once a clinical diagnosis of epilepsy has been made(10). In some cases, the ictal and interictal EEG abnormality is characteristic of a specific epilepsy syndrome or points towards an underlying aetiological diagnosis and can therefore guide further management(11). Also evidence suggests an EEG use, if possible, in first 24 hours after a seizure(12). and in neonatal seizures(10,13) Besides, in children or adults with epilepsy which fails to respond to standard treatments and/or seizures and progressive neurologic problems, EEG may be warranted but this should be obtained through a neurologic consultation(10). An urgent EEG is indicated in all unconscious patients suspected of non-convulsive status epilepticus or subclinical seizures, encephalitis and brain death(14,15,16). Also EEGs obtained after a first unprovoked seizure might offer insights into recurrence risk and/or the need for further neuroimaging(17) and as such EEG is also recommended also in first non-febrile seizure in children(18).

A single EEG procedure can also produce misleading information(19). While it can show specific epileptiform discharges in many patients with epilepsy(20), similar discharges are seen in 10% of patients who have undergone intracranial surgery and 3% of individuals with psychiatric disorders who do not have epilepsy(21). Though these specific discharges are rarely seen in people without symptoms(22), it is crucially important to recognise that normal phenomena, artefacts, and nonspecific abnormalities, occurring in about 20% of the general population, are open to misinterpretation and yield false positive results(23). Consequently , the existing UK Guidelines (NICE and SIGN guidelines)(24,25) recommend *against* the routine use of EEG as a diagnostic test for clinical events like blackouts, when the clinical picture does not clearly indicate epilepsy.

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Previous studies have suggested that over 50% of EEG requests are inappropriate, most commonly reflecting non-specialist use of EEG as a diagnostic tool in the investigation of clinical situations where there is little / no clinical evidence to suggest epilepsy(26), meaning the study is very unlikely to offer information of value in caring for the patient(27,28). Given the limited nature of the EEG resource in many parts of the world, including ours, it is critical that inappropriate referrals be avoided.

II. AIM AND METHODOLOGY

The aim of the study was to analyse the EEG referral indication patterns to our tertiary care hospital and their feasibility of referral.

We performed a retrospective audit of the records of all the EEGs done over a 6 months duration in the year 2018 in the department of Neurology; Govt. Super-Speciality Hospital, Srinagar. We used both the initial referral slips and the Printed report copies. Only patients for whom proper referral notes were available were included in the study. Requests for sleep, sleep deprived or video-EEG were included. Data was analysed using SPSS for Windows, version 11.5, and p-Value taken as measure of significance.

III. RESULTS

A total of 950 consecutive patient EEG records were analysed that qualified for evaluation. The frequency of EEG patient requests were maximum in the Children (**26.2%**) followed by the Adolescents (**22.2%**), followed by those in the Young and Middle age Adults group(**20.4%**), then the Elderly(**18.7%**) and lastly the Infants(**12.4%**).

Among the Infants the main referral indications were Seizure and Encephalopathy. Among Children the main referral indications were Epilepsy and Seizures. Among Adolescents the main referral indications were Doubtful seizures/pseudosiezures, Seizures and Epilepsy. Among the Young and Middle age Adults group the main referral indications were Seizures and Pseudosiezures, Syncopies, Behavioural abnormalities and Dizziness. Among the Elderly age group, the main referral indications were Encephalopathy, Syncopy, Seizures and Behavioural alterations.

There were 496 Males **(52.2%)** and 454 Females **(47.8%)** with no significant Gender difference among Normal EEG patients nor among Abnormal EEG patients, except that on subgroup analysis there was a prominent Female predominance (**p-Value <0.05**) of the EEG requests in the Adolescent age group and this was seen particularly in Normal EEG group. (**Tables 1 and 2**)

AGE CATAGORY	***MALES***	***FEMALES***	***TOTAL***	***p-Value***
INFANTS	40	48	88	< 0.05
CHILDREN	102	91	193	< 0.05
ADOLESCENTS	129	46	175	**> 0.05** (*significant*)
YOUNG AND MIDDLE AGED ADULTS	72	99	169	< 0.05
ELDERLY	55	74	129	< 0.05
TOTAL	398	356	754	

Table 1:- Age and Gender Distribution among Patients with Normal EEG.

AGE CATAGORY	***MALES***	***FEMALES***	***TOTAL***	***p-Value***
INFANTS	17	13	30	< 0.05
CHILDREN	31	25	56	< 0.05
ADOLESCENTS	16	20	36	< 0.05
YOUNG AND MIDDLE AGED ADULTS	12	13	25	< 0.05
ELDERLY	22	27	49	< 0.05
TOTAL	98	98	196	

Table 2:- Age and Gender Distribution among Patients with Abnormal EEG.

The most common referral indication overall were Seizures (**33.6%**) followed by Epilepsy which in turn consisted mainly of Follow-up patients (**21.6%**) than the Recurrences (**3.57%**). These were followed by EEG requests for Doubtful seizures/pseudosiezures(**11.5%**), followed by those for Syncopy and "Funny turns"(**10.7%**). A significant proportion of referrals had No clear history on referral forms (**7.3%**). Encephalopathy was an indication in **5.8%** of referrals. Other indications included Behavioural abnormalities(**2.9%**), Febrile seizures (**1.89%**) and Headache/miscellaneous symptoms (**0.6%**).

Of all the EEGs done, **20.63%** of EEGs were reported as *abnormal*. Expectedly, the highest percentage of abnormal EEGs were seen In patients referred for Encephalopathy **(87.5%)** , followed by Epileptic patients with Recurrence of seizures **(41.1%).** This was followed by those with Behavioural abnormalities **(28.5%)** and

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Febrile seizures **(27.7%).** Among Seizure patients **25.3%** of EEGs were abnormal. Notably the other half of all the EEG patients had significantly low percentages of abnormal reports. These referral groups consist of Epilepsy patients on follow-up **(8.2%)**, Syncopy and "Funny turns" **(5.88%)**, Doubtful seizures/pseudosiezures **(6.36%)** , Headache and other miscellaneous symptoms **(0%)** and those with No clear history **(12.85%). (Figure 1 and Table 3)**

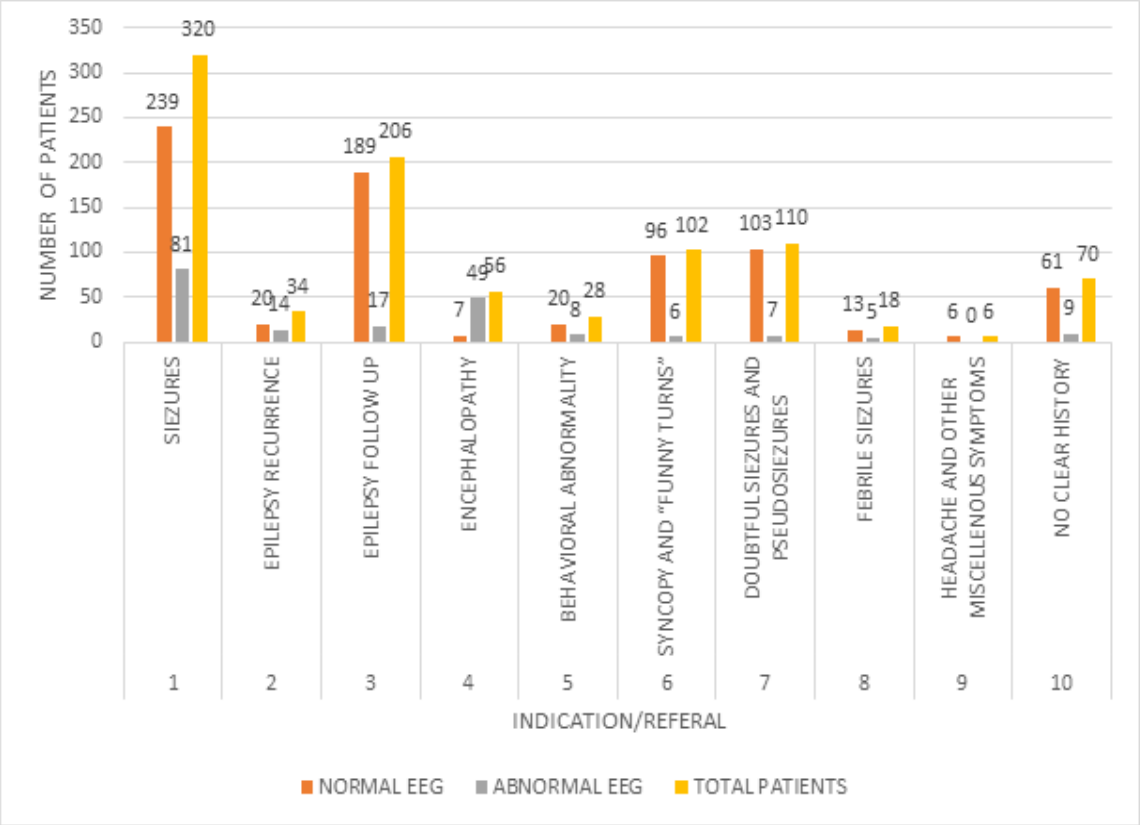

Fig 1:- Distribution Of Normal And Abnormal Patients Against Each Indication/Referal Category.

S.No.	*INDICATION/REFERAL*		*NORMAL*	*ABNORMAL*	*TOTAL*
1	SIEZURES		239	81	320
2	EPILEPSY	RECURRENCE	20	14	34
		FOLLOW UP	189	17	206
3	ENCEPHALOPATHY		7	49	56
4	BEHAVIORAL ABNORMALITY		20	8	28
5	SYNCOPY AND "FUNNY TURNS"		96	6	102
6	DOUBTFUL SIEZURES AND PSEUDOSIEZURES		103	7	110
7	FEBRILE SIEZURES		13	5	18
8	HEADACHE AND OTHER MISCELLENOUS SYMPTOMS		6	0	6
9	NO CLEAR HISTORY		61	9	70
	TOTAL		754	196	950

Table 3:- Distribution Of Normal And Abnormal Patients Against Each Indication/Referal Category.

Based on the guidelines for the EEG referrals(24,25) around one thirds **(36%)** of the referrals for EEG were deemed as **"inappropriate**" requests, which consisted mainly referrals for Epilepsy with routine follow-up, Syncopy and "Funny turns", Doubtful seizures/pseudosiezures and symptoms like Headache and related/miscellaneous symptoms. Rest of the referrals were deemed as **"appropriate" (64%).**

IV. DISCUSSION

As seizures are more common in a younger age in developing countries and EEG is requested mostly for the exclusion of seizure, this might explain the reason for EEG referral for age group distribution in our study(29,30). Similar finding was reported in various studies(31,32,33,34).

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Consistent with the slight Male preponderance of Seizures and Epilepsy(29,35) and the fact that the request were in a major proportion made for these indications only, overall , we also had a slightly higher proportion (non-significant) of Males than Females. However there was no significant Male/Female difference in Normal and Abnormal EEG reports on sub-group analysis (**p-Value <0.05**), except for that in the Adolescents were there was a significant Female majority (**p-Value >0.05**). The reason probably is that there is a significant majority of Females in Adolescent age group presenting as Doubtful seizures/pseudosiezures, an indication that has a significant contribution to the EEG referral load.

Consistent with many studies (28), our main referral indications were Seizures and Epilepsy. Not surprisingly a good proportion of requests made were for Syncopy/"Funny turns" and Doubtful/pseudosiezures **(22.3%).** D Smith et al(26) studied requests for electroencephalography in a district general hospital via a retrospective and prospective audit and found a high proportion of patients referred for such indications (42%). A good portion of referrals were those with No clear history/indication mentioned on the referral forms **(7.36%),** although the proportion was better than that compared with many other studies including that of Joshi. S et al from Nepal(35) and P. Nicolaides et. al. from Alder Hey(27).

Our study revealed almost **80%** of the EEGs performed were normal. This figure is more than many other studies done in this respect, including a Zimbabwian study by Adamolekun B et. Al.(36) who's study revealed around 47% EEGs as normal, and also Joshi. S. et. al. from Nepal revealing around 56% as normal EEGs(35).

Expectedly the proportion of Abnormal vs Normal EEGs were highest for Encephalopathy followed by Epilepsy with recurrence and Behavioural abnormalities. Seizure referrals that form a large portion of total EEGs done had around one forth positive EEG findings.

Of note is the low yield of Epilepsy patients referred for a routine follow up, **8.2%.** The same is reiterated by various epilepsy and EEG guideline that mention the relative futility of referring an Epilepsy patient to EEG without other indications including medication changes and recurrances(1,2,3). What was also noted was the very low abnormal EEG yield in patients referred for Syncopy/"Funny turns" and Doubtful seizure/ pseudosiezures patients, 5.8% and 6.3% respectively. Moreover, referrals for Headache and related Studies had nearly 100% normal results. It has been proven that these very groups of patients have no indications of a routine EEG study and these referral indications have been deemed as "inappropriate" by many researchers(27,28) and the related Guidelines(24,25). Keeping in view that these groups including Epilepsy patients referred for routine EEGs, formed a major proportion of referrals for EEGs (around **44.4% !**), it is understandable that our study revealed an unusually high proportion of Normal EEGs.

The obvious reason for such high proportion of **"inappropriate"** EEG requests is the common understanding even among physicians, that EEG can easily diagnose Seizures(26,27). Similar findings of high "inappropriate" EEG referrals have been shown by Smith et al(26) and Pearse et al(28). Also our hospital has a direct referral system from allied and peripheral hospitals, that make it more vulnerable to inappropriate EEG requests made by the novice.

We recommend educational interventions among the referring physicians and other related staff regarding proper EEG referrals and Guideline implementation.

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