A retrospective study of Electroencephalographic (EEG) findings and its interpretation in Adults and children

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Abstract

Introduction: Electroencephalogram [EEG] is one of the best and only device for epileptic seizures, which measures cerebral function. It is a convenient and relatively inexpensive way to demonstrate the physiological manifestations of abnormal neuronal excitability that underlie epilepsy.

Aim: To collect the common conditions of EEG data retrospectively and interpret the clinical findings in adult patients and children.

Materials and Method: Retrospective study, by collecting and reviewing 829 patients and their EEG reports in children and adult conducted at central research laboratory. Presenting clinical complaints were epilepsy, syncope, Headache, giddiness, viral brain infections, psychiatric conditions, alcohol withdrawal syndrome, global developmental delay. The EEG results were categorized as normal EEG and epileptiform discharges in all patients, while separate analysis was done in patients with epilepsy.

Results: Among 829 patients, Male predominance was noted in the study 473 [57.05%]. Maximum patients were in the age group between 0-5 years [39.04%]. The presenting complaints were epilepsy [82.62%] followed by syncope [4.34%], headache [3.25%], giddiness [3.01%]. EEG reports were found to be normal in 532 [64.17%] patients while epileptiform discharge was seen in 297 [32.82%] patients. The EEG reports of patients with epilepsy were found to be normal in 433 [63.1%] and abnormal with epileptiform discharges in 252 [36.78%] of patients.

Conclusion: Majority of cases are with epilepsy where EEG is performed to diagnose the condition. In addition, EEG is done among younger age groups especially children below 10 years of age. Other than epilepsy, EEG investigation is requested most commonly in symptoms like syncope and giddiness.

Keywords: Electroencephalogram, Epilepsy, Seizure

Introduction

Electroencephalography [EEG] detects the electrical activity which is produced by the brain cells. These brain cells produce tiny signals known as impulses.(1) It is one of the first and the only real time monitor which helps in tracking, recording brain wave pattern and also in detecting the epileptic seizures. EEG is the powerful monitor which measures the cerebral function in seriously ill. In comparison to Magnetic resonance imaging [MRI] and computed tomography [CT], EEG gives functional information, while the other two gives structural information.(2) EEG continues to play a major role in diagnosis and management of patients with epilepsy, in conjunction with the remarkable variety of other diagnostic techniques developed over the last 30 years. It is a convenient and relatively inexpensive way to demonstrate the physiological manifestations of abnormal cortical excitability that underlie epilepsy.(3)

Activity of epileptiform is specific, but not sensitive for epilepsy, as there is transient loss of consciousness or other paroxysmal event which can be compared clinically to epilepsy. Regarding the sensitivity and specificity, EEG has relatively low sensitivity in epilepsy, which varies between 25–56%, while there is a better specificity, but variable between 78–98%.(4) Presently, EEG is indicated mainly to diagnose, evaluate different types of epilepsy. EEG can also be used in diagnosis of syncope, head injury, brain surgery, encephalitis (an inflammation of the brain), a brain tumor, encephalopathy (a disease that causes brain dysfunction), memory problems, sleep disorders, stroke, and dementia. EEG can also be used in comatose patients in order to determine the level of brain activity.(5)

Misinterpretation or over interpretation of non epileptogenic, non specific EEG abnormalities or spiky paroxysmal variants of cerebral rhythms are one of the reasons for over diagnosis of epilepsy.(6) Standard activation procedure of routine EEG recordings include hyperventilation (up to three minutes) and photic stimulation (using published protocols).(7) Although potentiation and yeild of epileptiform discharge may occur up to 24 hours after partial and generalized seizures, there is insufficient high quality evidence that within this period interictal EEG increases the likelihood of obtaining interictal epileptiform discharge [IED]. Prolonged interictal sampling using EEG monitoring increases yield by about 20%, and presently available through 24 hour ambulatory multichannel digital EEG.(3) Recognition of EEG should be obtained under optimal conditions and the interpretation of the

results should be performed by an expert Epileptologist.[4]

There is limited data which indicates that EEG could be harmful which may lead to over diagnosis and unnecessary treatment when used for diagnostic confirmation. There is a general agreement among epileptologists that over reading is more harmful than under reading the data and that less experienced clinicians are more likely to over interpret benign patterns and variants as epileptic. Hence, the purpose of this present study was to collect the common conditions of EEG data retrospectively and interpret the clinical findings in adult patients and children.

Materials and Method

This study is retrospective, carried out in central research laboratory at tertiary care hospital, Bangalore, India. The data was collected from July 2013 to Dec 2016 for a period of 3 years 5 months. All the cases were entered in manually maintained EEG register, later which was entered into a Microsoft excel for statistical analysis. The clinical information of all the patients was collected and the reason for EEG evaluation was noted. Problems presented were categorized as epilepsy, syncope, giddiness, headache, head injury, psychiatric problems, viral infections, alcohol withdrawal syndrome, organophosphorous poisoning.

For each patients EEG was recorded using a digital equipment machine from Nihon Khoden, Japan, with minimum duration of 30 minutes. The electrodes were placed on the scalp according to the 10-20 international system.[8] For standardization, we classified the background activity as normal [organized, symmetrical] or abnormal [disorganized and asymmetric]. The examination of EEG was done for a specific epileptiform abnormality which was classified as general or focal, the interictal sharp wave or spike. We evaluated for the presence of topography of bursts of slow waves and epileptiform paroxysms. These epileptiform paroxysms were further classified into spike wave and poly spike wave. EEG findings were categorized as normal for the age, localized or generalized epileptiform discharges and non-epileptiform dysfunctions.

All the data were entered manually in a register systematically and then entered into Microsoft excel sheet before analysis. The data was analyzed using descriptive statistics. Quantitative data was expressed as mean and standard deviation, while qualitative data was expressed as percentage and frequency distribution.

Results

Total of 829 patients were included in the study. Male predominance was noted in the study 473 [57.05%], while 356 [42.94] were female. Maximum patients were in the age group between 0-5 years [39.04%] **[Fig. 1]** followed by patients between 11-18 years [18.57%]. In the age group between 0-5 years, maximum patients were male, 188 [61.43%], while females were 118 [38.56%]. In age group between 26-35 years, both male and females were same in number, 40 [49.38%] and 41 [50.61%] respectively. The distribution among different age groups is been represented in **Fig. 2**.

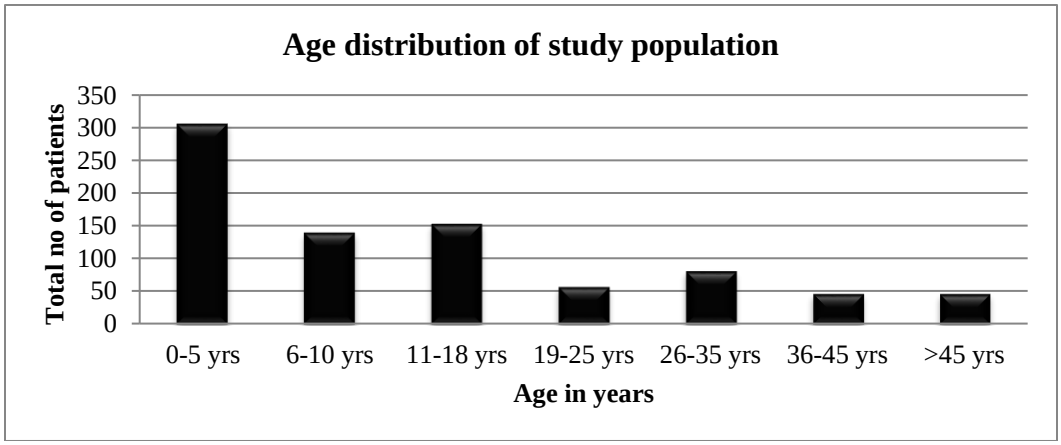

Fig. 1: Age wise distribution of study population

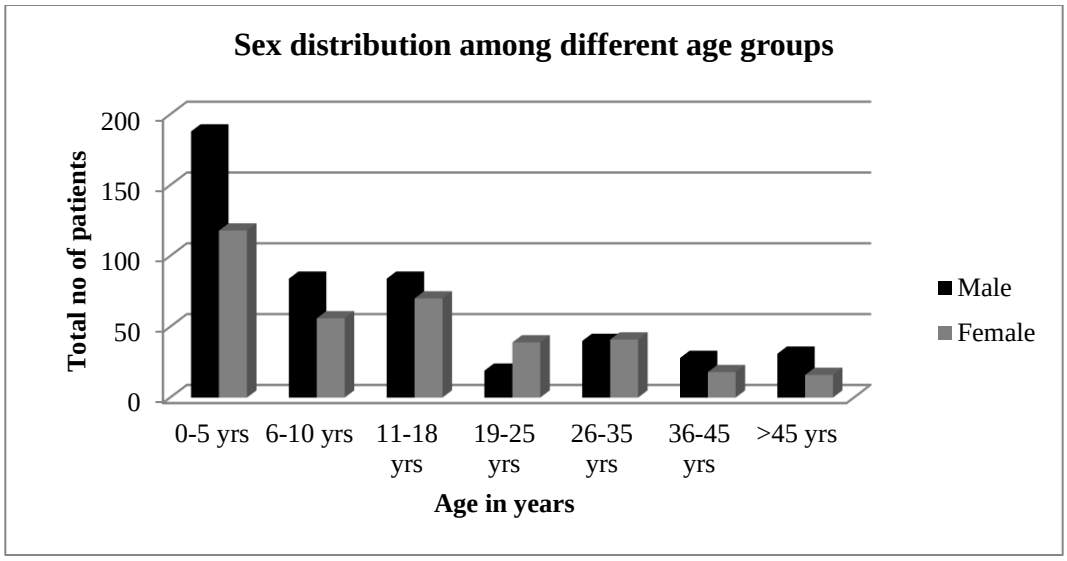

Fig. 2: Sex distribution of patients among different age groups

The presenting complaints were epilepsy [82.62%] followed by syncope [4.34%], headache [3.25%], giddiness [3.01%]. Many other complaints were also presented by the patients which has been summarized in the below **Table 1**.

Table 1: Causes of EEG with presenting complaints

Sl. No	Presenting complaints	Total no of patients [N= 829]	Percentage %
1	Epilepsy	685	82.62
2	Syncope	36	4.34
3	Headache	27	3.25
4	Giddiness	25	3.01
5	Viral brain infection	17	2.05
6	Psychiatric disorders	14	1.68
7	Alcohol withdrawal syndrome	09	1.08
8	Breath holding spells	07	0.84
9	Global developmental delay	06	0.72
10	Head injury –Road traffic accident [RTA]	02	0.24
11	OP poisoning	01	0.12

EEG reports were analyzed in 829 patients and were found to be normal in 532 [64.17%] patients while epileptiform discharge was seen in 297 [32.82%] patients **[Fig 3].**

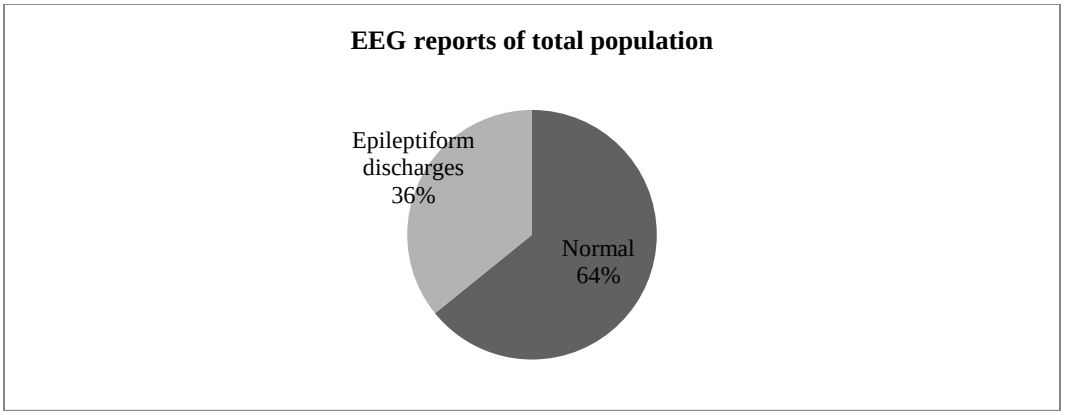

Fig. 3: EEG reports of total population

Further to this a detailed analysis was done in patients who were presented with a maximum complaints i.e., Epilepsy. Among the patients with known case of epilepsy the EEG reports were looked into. The EEG reports of these 685 patients with epilepsy were found to be normal in 433 [63.1%] and abnormal with epileptiform discharges in 252 [36.78%] of patients **[Table 2].**

Table 2: EEG reports of patients with epilepsy

EEG report of patients with epilepsy	Total no of patients [N= 685]	Percentage %
Normal EEG	433	63.21
Epileptiform discharge	252	36.78

Discussion

Though the number of study population is large, still larger studies are required to conclude better. The reason for doing EEG study among adults and Children is diverse. Though the principal indication is to perform EEG in patients with epilepsy, only one third of the patients are referred for this test. Majority of studies, which have been reported on patients with epilepsy, concluded that chance of detecting interictal epileptiform discharges [IEDs] from the first EEG performed differs between 29% to 55% of patients.[9-11] However, in some of the studies, it is more evident that there could be 70% of cases with EEG positive.[12] Our present retrospective data also supports the earlier discussion, which reported the difference between 29%-55% of IEDs reported among the patients.

Patients with certain brain pathology like with stroke, traumatic brain injury, and global developmental delay may show some type of abnormality in EEG. These EEG findings may have no practical application until and unless it is been associated with certain clinical problems. In the present medical trend and era of advanced neuro-imaging facilities, unnecessary request to perform EEG may increase the load on the laboratory and may not provide any beneficial information. Therefore selection of the patients for whom EEG has to be recommended, should be purely based upon the knowledge and experience about epilepsy and also it is equally important to identify clinically about various cerebral pathology to pick up best of EEG results. Similar study by Salam and his colleagues in 2014[13] supports our data. More such studies are required from different centers performing EEG to justify the results.

In certain specialized tertiary care units, video EEG as well as ambulatory long term EEG monitoring will be helpful in recording / monitoring EEG in order to obtain ictal waves. While these facilities are not available at many centres.[14] Therefore at many cases, there is a possibility of misinterpreting or misdiagnosed as epilepsy in children as well as in adults. Certain paroxysmal events where there could be possibility to be mistaken the situation or the condition for epilepsy could be staring, syncope, dystonia, behavioral sleep disturbances, psychogenic seizures.[14,15]

Conclusion

In our study, the majority of cases are with epilepsy where EEG is performed to diagnose the condition. In addition, EEG is done among younger age groups especially children below 10 years of age. Other than epilepsy, EEG investigation is requested most commonly in symptoms like syncope and giddiness. Hence, such more number of studies with larger population with specialized units is required in adults as well as in children.

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