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PATTERNS OF EEG(ELECTROENCEPHALOGRAM) FINDINGS IN PATIENTS WITH NEUROLOGICAL DISORDERS

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ABSTRACT:
OBJECTIVE: To study the patterns of EEG in patients with neurological disorders

BACKGROUND: EEG is still relevant in the diagnosis and management of patients with seizure disorders and extends to other neurological conditions, however local data is limited

METHODS: The EEG record of 230 patients between July 2019 to January 2020 was reviewed. EEG request forms and EEG reports were examined. Socio demographic data, clinical data and neurologist's comment on EEG were extracted and recorded on the proforma.

RESULT: Total of 230 patients had completed the results that could be traced. Mean age 29.95, 117(50.9%) were males while 113 (49.1%) females. The results also showed that EEG was normal in 58.3% of patients

CONCLUSION: EEG still plays a very important role in the investigation of neurological conditions especially epilepsy in developing countries. EEG facilities should be readily available.

KEY WORDS: Electroencephalogram, patterns, neurological disorders

INTRODUCTION: Electroencephalogram (EEG) is record of electrical activity through the electrodes placed on the scalp which reflects the summation of action potential generated by cortical neurons. It was discovered by German psychiatrist Hans Berger in 1929. EEG compares the voltages recorded in two different regions and plot it against time. A standard array of metal electrodes is placed on the scalp of the patient and over a 30-minute period brain electrical activity is sampled from different regions of the cortex. EEG recordings use standard montages. Montages provide a means of viewing data in an organized fashion. EEG of an awake, relaxed healthy adult with the eyes closed give frequencies of 8-12 hertz alpha activity. In transition from wakefulness to sleep EEG waveforms become slower in frequency either in 4-7 hertz theta range or <4 hertz delta range. Similarly these slow waveforms can be seen diffusely in all EEG leads focally. State of the patient carries vital importance in recording EEG. Theta and delta waves during drowsiness signify encephalopathy of variable etiologies. Epileptiform discharges are representative of seizures electrically. They can be seen in the form of spike and sharp wave complexes.

EEG is relevant in the diagnosis and management of patients with seizure disorders and its main clinical application, is for classification[1-5]. Its diagnostic relevance also extends to conditions such as cerebrovascular diseases, head injuries, psychiatric illnesses and encephalopathy [3,4,5] Similarly EEG plays a vital role in differentiating non epileptic or pseudo seizures due to conversion disorder from epilepsy. EEG findings in psychiatric patients may include generalized or focal slowing or paroxysmal epileptiform discharges. These findings are not specific as far as primary psychiatric disorder is concerned but they contribute to variable processes associated or leading to psychiatric illness. These include co-morbid organic brain pathologies, dementia, encephalopathy due to various etiologies and drug effects. As a result of a variety of conditions in which EEG is used as a diagnostic tool, some studies have questioned the appropriateness or otherwise of its use[7,8]. Even though some Nigerian authors reported that EEG services are limited and that the available ones are probably under- utilized [9,10] authors from industrialized nations have reported over use or misuse of EEG as diagnostic and management tool[7,8,11,12]. However, EEG is still of relevance in the

investigation of neuropsychiatric conditions especially in developing countries where financial constrains could be a major challenge when it comes to carrying out some neuroimaging procedures on patient. The aim of the present study was to carry out prospective review of all requests for EEG sent to the EEG unit of the hospital, and evaluate its relevance in the management of various neuropsychiatric conditions.
but stiffness alleviates with continued activity. The effect lasts about five minutes. There is no history of backache, spine trauma, sphincteric involvement, dysphagia, dysarthria, shortness of breath, cyanosis or blurring of vision. He is a shop keeper by occupation with two children. He denies cigarette smoking or alcohol use. Family history is significant for similar complaints in his mother,younger brother and his son (Figure A). On physical examination he has frontal baldness, a narrow and elongated hatchet-shaped face with a transverse smile. There is bilateral ptosis with masseter and temporalis wasting. Diffuse calf muscle hypertrophy is seen in legs. Cranial nerves are normal. Percussion myotonia (on the right abductor pollicis brevis muscle), tongue and grip myotonia is positive. Tone is normal. Muscle power of the Medical Research Council (MRC) grade is 5/5 in both upper and lower limb muscle except bilateral handgrip which is of MRC grade 4/5. Reflexes are absent in upper and lower limbs with a flexor plantar response bilaterally. Sensory system is normal. Gait and coordination is intact. Rest of the systemic examination is unremarkable.

MATERIALS AND METHODS:

Patient recruitment and inclusion/exclusion criteria: Data was collected from the neurology department of Liaquat national hospital. Pre-designed questionnaire used for collection of data. Questionnaire contained information including demographics (Age, Gender), pertinent history (Drug, Family, substance abuse) Source of referral, Activation procedure if performed during EEG,EEG findings(detailed mentioned in questionnaire) Provisional diagnosis made by physician/psychiatrist referring for EEG, patterns of EEG, Conclusion drawn and EEG correlation with the provisional diagnosis. EEG unit's records, including EEG request forms and EEG reports were reviewed.

Data Analysis Procedure:

The data was analysed using Statistical Package for the Social Sciences (SPSS) version 20.
Quantitative variable that is age and number of patients will be presented as mean and standard deviation. Qualitative variables like gender, pertinent history (Drug, Family, substance abuse), Source of referral, EEG findings (detailed mentioned in questionnaire) Provisional diagnosis made by physician referring for EEG and conclusion drawn other than seizure disorder presented as frequency and percentage. Chi square was applied as a test of significance for qualitative variables. P value < 0.05 was taken as significant

RESULTS:

Socio-demographic characteristics of patients referred for EEG Total of 230 patients had complete results that could be traced. Mean age 29.95, 117(50.9%) were males while 113 (49.1%) females

Source of referral: Around 57.4% from neurology department, 28.7% from paediatrics and 6.1% from internal medicine

Provisional diagnosis by the referring doctors:
Generalized tonic clonic seizures accounted for 45.7% of patients, complex partial seizure 20.4%, simple partial 3.5% and febrile seizures 0.4%
Provisional diagnosis other than seizure disorder:
Cerebral palsy 6.1%, Dementia 4.8%, delirium 3% and 0.4% hypoxic brain injury, autism and learning disability

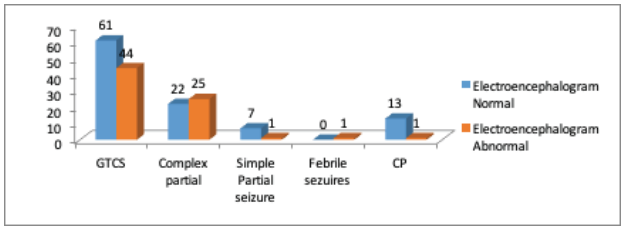
Characteristics	n(%)
Age (Mean ± SD)	29.95 ± 25.87
Gender	
Male	117(50.9)
Female	113(49.1)
Spiritual Treatment	
Yes	2(0.9)
No	228(99.1)
Drug History	
Lerace	55(23.9)
Epival	27(11.7)
Tegral	9(3.9)
Hitop	2(0.9)
Phenobarbitone	1(0.4)
Family History	
Present	3(1.3)
Absent	226(98.3)
Occupation	
Professional	9(3.9)
Home maker	7(3)
Retired	3(1.3)
Addiction	
Yes	1(0.4)
No	228(99.1)
Source of Referral	
Neurology	132(57.4)
Peads	66(28.7)
Internal Medicine	14(6.1)
Psychiatry	1(0.4)
Others	17(29.1)
Activation Procedure	
Yes	195(84.5)
No	32(13.9)
Provisional Diagnosis	
GTCS	105(45.7)
Complex partial	47(20.4)
Simple Partial seizure	8(3.5)
Febrile seizures	1(0.4)
CP	14(6.1)
Provisional Diagnosis other than seizure	
Dementia	11(4.8)

Delirium	7(3)
Hypoxic brain injury	1(0.4)
Autism	1(0.4)
Slow learner	1(0.4)

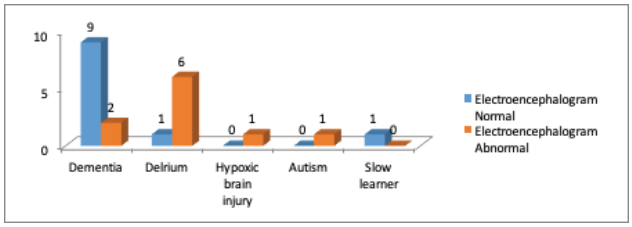
EEG Pattern	
Beta rhythm	6(2.6)
Theta rhythm	32(13.9)
Delta rhythm	19(17)
Theta/delta	16(7)
Delta/theta	4(1.7)
Triphasic	1(0.4)
Sharp	7(3)
Spikes	7(3)
Spike and wave	16(7)
Alpha	101(43.9)
Epileptiform Discharge	
Yes	29(12.6)
No	200(99.6)

EEG Findings: EEG diagnosis based on the interpretation of EEG records by the neurologist showed that 134(58.3%) had normal record while 95 (41.3%) had abnormal records. The breakdown of abnormal records generalized seizures occur in 44(61.1%) and complex partial 25 (34.7%)

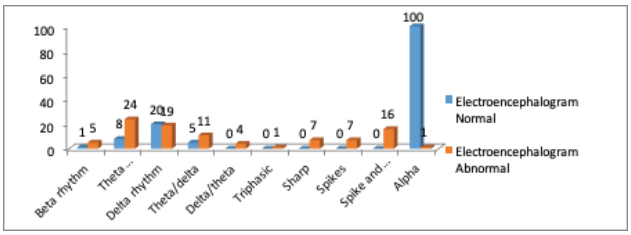
Provisional Diagnosis	Electroencephalogram	
	Normal	Abnormal
GTCS	61	44
Complex partial	22	25
Simple Partial seizure	7	1
Febrile seizures	0	1
CP	13	1



Provisional Diagnosis other than seizure	Electroencephalogram	
	Normal	Abnormal
Dementia	9	2
Delirium	1	6
Hypoxic brain injury	0	1
Autism	0	1
Slow learner	1	0



EEG Pattern	Electroencephalogram	
	Normal	Abnormal
Beta rhythm	1	5
Theta rhythm	8	24
Delta rhythm	20	19
Theta/delta	5	11
Delta/theta	0	4
Triphasic	0	1
Sharp	0	7
Spikes	0	7
Spike and wave	0	16
Alpha	100	1



DISCUSSION:

Results of our study showed that almost half of the referrals to the EEG unit came from Neurology department followed by pediatrics 28.7%, internal medicine 6.1%, psychiatry 0,4% and other outpatient departments 29.1%. The result of this study differs from that of Peter et al which reported highest referral rate from internal medicine followed by family medicine. Our study would suggest that more departments are aware of and make use of EEG facility in investigating their patients. Routine EEG has limited value as a screening test in organic brain disorder[18,2] , an abnormal EEG would support the clinical diagnosis. As shown by the present study that the use of EEG by internists and psychiatrist was limited. EEG plays a pivotal role in differentiating non-epileptic or pseudo-seizures from epilepsy. A detailed literature review searched from 1966-2003 revealed a consensus towards development of specific indications for EEG in psychiatry. When all psychiatric patients underwent routine EEG as a screening tool abnormalities were detected in 20-39% of patients. [16,17,18]The provisional diagnosis of the referring doctors in this study showed that seizures were the commonest reason for referral, among them generalized tonic clonic were present in 45.7%, complex partial in 20.4%, simple partial 3.5%, and febrile seizures in 0.4%. Finding from this study that epilepsy was the commonest reason for which patients were referred is similar to some studies in Europe(12)and Africa(14)but differ from the USA(11) where Harman et al reported that the commonest reason for referral was altered mental status. Provisional diagnosis other than seizure was made as dementia in 4.8%, delirium in 3%, hypoxic brain injury, autism and learning disability in

0.4% respectively. In delirium EEG usually showed slowing of posterior dominant rhythm and theta/delta slowing with poor background rhythm and loss of reactivity to eye opening or closing. These EEG findings although non- specific but they are suggestive of variable metabolic factors leading to delirium like in alcohol and sedative withdrawal. EEG findings may include attenuation of voltage and prominence of beta activity.[12] In dementia EEG plays pivotal role as far as diagnosis and prognosis is concerned. Like in early stages of Alzheimer's disease 50% of the patients may have a normal EEG while in moderate to severe stages 90% of patients showed slowing. EEG slowing parallels cognitive decline. Three year follow up data showed that EEG slowing at the time of diagnosis is predictive of poorer prognosis.[13] The results also showed that EEG was normal in 58.3% of patients. Previous reports showed lower percentage of their patients with normal EEG reports [10,16] however a normal EEG does not exclude epilepsy. Smith(1) reported that around 10% of patients with epilepsy never showed epileptiform discharges and that an abnormal EEG demonstrating interictal epileptiform discharge does not itself confirm that an individual has seizure disorder. In our study epileptiform discharges were seen in 12.6% of cases. Our study also focused on specific patterns of EEG in patients brought for EEG recording. Most commonly observed was alpha rhythm in 43.9%, theta in 13.9%, delta in 7% Frequency distribution showed that patterns seen in normal EEG included alpha in 74.6%, delta in 14.9%, theta in 6%, theta/delta in 3.7% and beta in 1%. Among those with the abnormal EEG the most common pattern was theta in 25.3%, followed by delta in 20%, spike and wave pattern in 16.8%, sharp in 7%, spikes in 7% and beta in 5.3%. Among abnormal EEG conclusion was diffuse neuronal dysfunction in 64.2%, generalized seizure disorder in 20%, focal seizure disorder right sided in 6.3%, left sided in 5.3% and focal slowing in 2.1%
EEG has low sensitivity in the diagnosis of epilepsy but better specificity. Some authors are of the opinion that substantial numbers of EEG requests are made on the basis that EEG can exclude the diagnosis of epilepsy in patients with low clinical suspicion of epilepsy[7,8,12] there is therefore the need for clinicians to be more selective in making requests for EEG.

CONCLUSION:

EEG still plays a very important role in the investigation of neurological conditions especially epilepsy in developing countries. Efforts should therefore be made to ensure that hospitals in developing countries are equipped with EEG facilities.

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Saba Zaidi; concept, data collection, data analysis, manuscript writing, manuscript review
Amsa Khan; data collection, data analysis, manuscript writing, manuscript review