

Original Research Article

A study of correlation of CT scan brain and EEG in epilepsy

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Abstract

Introduction: Epilepsy is a neurological disorder marked by sudden recurrent episodes of sensory disturbance, loss of consciousness, or convulsions, associated with abnormal electrical activity in the brain. Epileptic seizures are episodes that can vary from brief and nearly undetectable to long periods of vigorous shaking. These episodes can result in physical injuries to the patients.

Aim: To study the correlations of CT scan Brain and EEG in epileptic patients.

Materials and methods: This study was done at Mahatma Gandhi Memorial Hospital (MGM), Warangal, and Telangana State. Duration of the study is from 2002 to 2003. The patients admitted with seizures were included after considering the exclusion of metabolic causes and infective causes. The seizures in these patients were classified as per the classification of International classification of epileptic seizures.

Results: Out of 150 cases subjected to CT scan brain 90 (60 %) cases were normal and 60 cases (40%) showed focal lesions on CT scan. All 150 patients of epilepsy were subjected to EEG which was recorded using 18-channel instrument, Normal EEG was observed in 83 cases (55%), and Generalized epileptic potentials were seen in 41 cases (27.3%) and epileptic foci was seen in 26 cases (17.3%).

Conclusion: A significant correlation was observed between focal EEG changes and focal lesions in CT scan brain.

Key words

Epilepsy, Computerized tomography, Electroencephalogram, Tonic-clonic seizures, Epileptic foci, Glioma.

Introduction

Epilepsy is a common clinical presentation accounting for 0.6% of hospital admissions. In majority of cases, when first seen, the causative factors are not evident by history and clinical examination alone. Hence, diagnostic tools like serum biochemistry, Electro Encephalogram (EEG) and Computerized tomography (CT) scan are employed. EEG is used for functional or electrical mapping of brain and not used for diagnosis and confirmation of epilepsy because in as many as 50% epileptics' single interictal recording may be normal. Normal EEG does not exclude the presence of epilepsy. EEG if abnormal helps in classifying seizures, selecting appropriate antiepileptic drugs, withdrawing antiepileptic drugs and planning for surgery. The various abnormalities in EEG include abnormalities of background activity like diffuse or localized reduction in amplitude seen in terminal stages of cerebral degenerative process and after occlusion of a major cerebral artery. Localized slow activity is seen in hematoma, tumor, contusion, and ischemia. Abnormalities of rhythm Includes Frontal Intermittent Rhythmic delta activity (FIRDA) seen in patients with anterior diencephalic damage. Paroxysmal or epileptiform discharges like three hertz spike and slow complexes in absence seizures, multiple spikes, generalized spike and wave discharges in primary generalized epilepsy. CT scan though normal in majority of the cases is an important investigation to detect and to identify the structural lesions of the brain. If the patient can able to undergo CT scan, it helps to identify treatable lesions like tuberculomas, cysticercosis, intracranial space occupying lesions, arterio-venous malformations, cortical dysplasia, hydrocephalus, tuberculous meningitis, so that a specific treatment can be initiated. CT and EEG thus provide us with a powerful combination of structural and functional methods in the evaluation of epilepsy, yielding more valuable information than can be provided with either method alone. Aim of the study was to study the correlations of CT scan Brain and EEG in epileptic patients.

Materials and methods

This study was done at Mahatma Gandhi Memorial Hospital (MGM), Warangal, and Telangana State. Duration of the study was 2 years from 2002 to 2003. The patients admitted with seizures were included after considering the exclusion of metabolic causes and infective causes. The seizures in these patients were classified as per the classification of International classification of epileptic seizures. Routine investigations like blood counts, blood sugar, serum electrolytes, complete urine examination, Electro cardiogram (ECG), X-ray chest etc were done. Thorough physical examinations with emphasis on neurological examinations were done in all patients and the details were noted. All the patients in the study were subjected to EEG and CT scan brain without and with contrast. CT has made possible the visualization of intracranial lesions without discomfort and risk to the patient. Thus CT scan forms a screening method in excluding the organic disease and forms method of choice to study morphological change in epilepsy.

EEG is of great importance in the diagnosis of epilepsy in particular together with methods of provocation of epileptic potentials and in localizing epileptic foci. Thus, morphological and functional methods, CT and EEG, provide a powerful combination in the diagnosis of epilepsy with more valuable information than a single method. Patients were given specific treatment where indicated in addition to anticonvulsant therapy. All the patients were followed up for a variable period of time.

Results

Total of 150 cases of epilepsy were included in this study. Out of these 81 (54%) patients were males and 69 (46%) were females. All the patients were subjected to CT scan brain without and with contrast and EEG. Out of 150 cases 90 cases were normal and 60 cases showed focal lesions on CT scan. Age wise incidence of CT results was tabulated in **Table - 1**. As the age group increase number of focal lesions increased.

Number and percentage of the CT lesions are tabulated in **Table - 2**. Gender wise incidence of focal lesions showed male preponderance. Male to Female ratio was 1.7: 1.

Table - 1: Age wise incidence of CT results.

Age in years	CT scan - Normal	CT scan - Focal lesions
17-30	50	14
31-40	16	07
41-50	10	09
51-60	07	09
61-70	04	10
>70	03	11
Total	90	60

Table - 2: Number and percentage of CT lesions.

Lesion	Number of cases	Percentage
Granuloma	24	44.8 %
Tuberculoma	16	24.1%
Cysticercosis	12	18.9%
Glioma	03	5.1%
Glios	02	3.4%
Meningioma	02	3.4%
Metastasis	01	1.7%
Total	60	100%

All 150 patients of epilepsy were subjected to EEG which was recorded using 18-channel instrument in addition to routine recording during rest, also provocation by various methods like hyperventilation and repetitive photic stimulation were employed. Normal EEG was observed in 83 cases (55%), Generalized epileptic potentials were seen in 41 cases (27.3%) and epileptic foci was seen in 26 cases (17.3%). These results were tabulated according to the age groups (**Table - 3**). Study of correlation of CT and EEG was made as per **Table - 4**.

All 83 patients with normal EEG underwent CT scan brain. CT scan was found normal in 52 cases; likewise all 26 patients with epileptic foci

in EEG are subjected to CT scan. 10 patients showed normal CT findings, 16 patients showed focal lesion. When all 41 patients with generalized epileptic potentials are subjected to CT, 28 had normal CT and 13 had focal lesion.

Table - 3: Age wise distribution of EEG results.

Age in years	Normal EEG	Generalized epileptic potential EEG	Epileptic foci EEG
17-30	17	12	03
31-40	16	10	04
41-50	12	08	03
51-60	14	06	06
61-70	13	03	07
>70	11	02	03
Total	83	41	26

Table - 4: Correlation of CT and EEG.

EEG	CT - Normal	CT - Focal lesion
Normal (n= 83)	42	29
Epileptic foci (n=26)	10	16
Generalized epileptic potential (n=41)	28	13
Total (n=150)	90	60

In this study, out of 150 patients, 122 had generalized tonic-clonic seizures, 25 had partial seizures. Out of 25, 12 had simple/complex partial seizures with secondary generalization, 7 had complex partial seizure, 6 had simple partial seizures, 3 had myoclonic seizures (**Table - 5**). Maximum percent of CT scan abnormalities were detected in patients with complex partial seizures (85.7%) and least in patients with myoclonic epilepsy.

Patients with myoclonic epilepsy showed highest percentage of abnormal EEG and patients with generalized tonic-clonic showed least percentage of abnormal EEG (**Table - 6**).

Out of 150 cases studied, focal neurological deficit was found in 10 cases. When these patients are subjected for EEG, correspondence of lateralization was found in 6 cases, 2 patients had generalized EEG abnormality and 1 had an

EEG focus on the opposite side and 1 had normal EEG. When the same 10 cases subjected to CT brain, correspondence of lateralization was found in 8% and in remaining 2 patients CT was found to be normal.

Table - 5: CT findings and seizure type.

Seizure type	Total	CT scan abnormal	CT scan normal	Percentage of abnormality
Generalized tonic-clonic	122	41	81	33.6 %
Myoclonic	03	-	03	0 %
Simple/complex partial with secondary generalization	12	09	03	75 %
Complex partial	07	06	01	85.7%
Simple partial	06	03	03	50%
Total	150	59	91	

Table - 6: EEG findings and seizure type.

Seizure type	Total	EEG abnormal	EEG normal	Percentage of abnormality
Generalized tonic-clonic	122	47	75	38.5 %
Myoclonic	03	03	-	100 %
Simple/complex partial with secondary generalization	12	08	04	66.6 %
Complex partial	07	06	01	85.7%
Simple partial	06	03	03	50%
Total	150	67	83	

Discussion

Epilepsy is a chronic disorder characterized by recurrent seizures, medical and psychosocial implications. Incidence of epilepsy is 20 to 50 per 1 lakh population. Occurrence of epilepsy is more common among males and in the first two decades of life. Cause of epilepsy varies in different age groups and geographical locations. Congenital and genetic conditions are the most common causes in early childhood. In infancy metabolic and perinatal insults are the leading causes. In older children and young adults, hippocampus sclerosis, drug abuse and trauma are important causes; in the elderly population vascular etiology is common cause. History and physical examination, laboratory investigations, lumbar puncture and cerebrospinal fluid (CSF)

analysis to know about the acute or chronic infectious cause or subarachnoid hemorrhage, CT scan and EEG are used as investigation modalities. EEG remains a major technique for investigation of epilepsy. Easy availability and cost effectiveness has made EEG a very useful tool in cases of epilepsy but also in several neurological conditions like encephalitis, sleep disorders, dementias, encephalopathies of metabolic origin. In cases of epilepsy, interictal and ictal EEG recording provide useful information. Ictal EEG is always abnormal in general tonic-clonic seizures but it is difficult to record during the event as the seizure activity is unpredictable. Interictal EEG plays an important role in the diagnosis and treatment of epilepsy, which is a disorder of cortical hyperinstability.

CT scan has been one of the most significant and revolutionary advances among imaging modalities. CT plays such a vital role today that good practice in clinical neuroscience is not conceivable without its utilization. On CT cross sectional images of the skull and brain are obtained. The attenuation density of each area is expressed by a number called a Hounsfield Unit (HU) named after the inventor, Godfrey N. Hounsfield. The final axial image resembles the cut section of brain as seen as dissection tables and pathology specimens. The chances of finding an abnormality on CT scan in patients with epilepsy depends on a number of factors which include seizure type, age, mental status, focal neurological deficits, abnormalities on EEG.

In this study, total 150 cases of epilepsy were evaluated with CT scan and EEG. Normal CT findings were present in 90 (60%) patients, but the Ladurner, et al. [1] found normal CT scan findings in about 46 % of the cases in their study in epilepsy and Daras, et al. [2] in 37.4% of cases. This difference could be due to the difference in determining factors like the type of seizure disorder, the presence of psychiatric or neurological deficits and the age of the patient. So it is difficult to establish comparisons between groups of epileptic patients. CT was found abnormal in 60 (40%) patients and Daras, et al. [2] in 62.6 % of cases. The abnormality detected is in the form of focal lesions like calcified granulomas, tuberculomas, neurocysticercosis, space occupying lesions (SOL) and gliosis, When we analysed the above lesions, calcified granuloma was found in majority of cases 44.8% (24 cases out of 60). Tuberculomas in 24% (16 cases out of 60), Bansal Be, et al. [3] and others in India, found tuberculomas in 39.5% of cases in their study of epilepsy. Next commonest lesion was cysticercosis, seen in 18.9 % (12 out of 60 cases), in 30 % by Naidoo DV, et al. [4] and glioma in 5 % of cases, meningioma in 3.4%, metastasis in 1.7 % (1 in 60). Percentage of tumors in a study by Reinkainen, et al. [5] is 17% and 8.8 % by Haan J, et al. [6]. When CT results were arranged according to age subgroups, we

found that as the age increased the percentage of patients with focal lesions increased. The percentage of focal CT lesions in the age group of 17-30 years is 21.8% and in 41-50 years in 47.3% and increased to 78.4 % in age group above 70 years. Similarly the percentage of normal CT results in 17-30 years is 78.1% and in 41-50 years 52.6 % and decreased to 21.4% in the patients above 70 years. Ladurner, et al. [1] and Mc Gahan, et al. [7] also showed similar findings in their study conducted at university of Graz, Austria.

The seizure type and their CT scan analysis were done. We found that the patients with the highest percentage of CT scan abnormalities were those with simple partial seizures 83.3 % (5 out of 6 cases). Wadia, et al. [8] in India found in 68 % of the cases. The percentage of CT abnormalities in complex partial seizures was 71.4% (5 out of 7 cases) and in simple/complex partial seizures with secondary generalization was 75% (9 out of 12 cases) and in generalized tonic-clonic seizure was 33.6 % (41 out of 122 and myoclonic seizures was 0% (0 out of 3 cases). In our study a correlation was made between CT scan and clinical neurology. In 80% of patients CT and neurological findings had shown lesion on the same side that is in comparison to 55% in a study conducted by M. Schumacher, et al. [8] at Tubingen and 82 % in a study conducted by Ramirez-Larsepas, et al. [9].

EEG was found to be normal in 55% of patients (83 out of 150 cases), and abnormal in 45% (67 out of 150), Brechet R, et al. [10] in 65% of cases. Out of 67 patients, 41 (27.3%) showed generalized epileptic potential and epileptic foci in 26 patients (17.3%). There were a similar percentage of patients with normal EEG results in all age groups. Similarly, the percentage of EEGs showing epileptic foci did not significantly vary across age subgroups. As the age increased, the percentage of EEGs showing generalized epileptic potentials decreased. EEG and CT both were found normal in 28% (42 out of 150 cases) of cases.

When we correlated EEG with seizure type, the highest percentage of abnormal EEG was found in myoclonic epilepsy 100% (3 out of 3 cases) and next was in patients with complex partial seizures (85.7%) which were in correlation with the study conducted by Haan J, et al. [11]. Least percentage of correlation was seen in generalized tonic-clonic seizures (47 out of 122 cases) 38.5%. By comparing EEG and neurological findings in 10 patients with abnormal neurological status, the EEG correlated with the neurological findings in 6 patients (60%) in this study. A significant correlation was found between focal EEG changes, which are epileptic potentials and focal lesions detected in CT. In 16 out of 26 patients (63.5%) with epileptic foci in EEG, CT had showed focal lesions, 38.6% by Sorel, et al. [12] but focal abnormality was detected in 29 out of 83 (34.9%) patients with normal EEG and in 31.7% of patients with generalized epileptic potential in EEG, Scollo-Lavizzari, et al. [13] in 35.7 % and Sorel, et al. [12] in 18%.

Conclusion

The use of CT for patients with epilepsy has been greatly diminished by the availability of Magnetic Resonance Imaging (MRI); CT is still the technique of choice for the investigation of patients with seizures and epilepsy under certain conditions. CT can accurately detect hemorrhage, infarctions, gross malformations, ventricular system pathologies, and lesions with underlying calcification. EEG gives information about the electrical activity that is happening in the brain. Patients with some types of epilepsy have unusual electrical activity in their brain all the time, even when they are not having a seizure. When they have an EEG done, the results can show certain brain wave pattern which characterizes a particular disorder. In this study, a significant correlation was observed between focal EEG changes and focal lesions in CT.

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