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Correlation of MRI brain findings and EEG study in children and adults with clinically diagnosed seizures.

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A B S T R A C T

Introduction: *Seizures are result of abnormal electrical activity in brain and are caused by diverse etiology. The aim of the study was to correlate MRI brain findings and EEG study in children and adults with clinically diagnosed seizures in children and to compare the diagnostic yields of MRI and EEG individually and in combination.*

Material and methods*: The study consists of fifty patients (50) with an age range from 11month to 55 years with first onset seizures who underwent MR imaging and EEG. Sensitivity was calculated to both MRI and EEG separately and together. Chi square test was applied. 95% confidence interval of sensitivity was calculated. Epi info version 3 was used for statistical calculations.*

Results*: Out of 50 cases, 48% were male and 52% female. Out of 50 cases, 27 cases (54%) showed epileptogenic foci on MRI, most common being mesial temporal sclerosis(26%) followed by altered signal intensity areas in subcortical white matter(18 %). Out of 50 cases, 28 (56%) showed focal epileptiform abnormalities on EEG. Out of 50 cases, 15 (30%) were both MRI positive and EEG positive, 10 (20%) were both MRI and EEG negative, 12(24%) were only MRI positive and 13(26%) were only EEG positive.*

Conclusion*: MRI and EEG are primary methods of choice for evaluation of patients with seizure; MRI is able to identify structural brain lesions that can serve as foci for origin of abnormal electrical discharge that might be surgically resectable if the patient needs surgical management.*

Key Words: *Epilepsy, Magnetic Resonance Imaging, EEG.*

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I. Introduction:

Seizuresareresult of abnormalelectrical activity in the brain which is a consequence of very diverse pathologies ranging from transient metabolic changes to chronic space occupying lesions, Prompt treatment is necessary and reducesthechanceofrecurrent seizures.[1]

Epilepsyisachronicconditioncharacterizedbyrecurrentseizuresprovokedbyanacutesystemicorneurologicinsult .Anepilepticseizureisaclinicalmanifestationofabnormal,excessiveneuronalactivityarisinginthegreymatterofthecerebralcortex.

MagneticResonanceImaging(MRI)istheprimaryimagingmodality ofchoiceintheinvestigationofpatientswithseizures because of its versatility and noninvasive nature .[2]

MRI is important in ascertaining the presence or absence of structural pathologies which serve as epileptogenic foci and also in categorizing patients into those who requires urgent surgical intervention such as ones with high-grade glioma, Arteriovenous malformations, infections and malformations of cortical development and patients who can be managed conservatively with medications [3]

The international league against epilepsy (ILAE) for nueroimaging has examined the usefulness of and the indications for nueroimaging in the evaluation of children and adults with newly diagnosed epilepsy [4,]

Nearly, 50% individuals imaging studies in children with new onset seizure were reported abnormal.[1] 15-20%ofimaging studies provideusefulinformationonetiologyorseizurefocusand2-

4%providedinformationthatpotentiallyalteredimmediatemedicalmanagement.[5,6,7,8]

Our studyis aims toCorrelate MRI brain findings and EEG study in children and adults with clinically diagnosed seizuresin children and to compare the diagnostic yields of MRI and EEG individually and in combination.

II. Material And Methods

The study consists of 50 patients (50) with an age range from 11months to 55 years with one or more episodes of seizures underwent MR imaging and EEG. The study was started after the approval from the ethical committee. Written informed consent was obtained from all the participants. The study was done in SHRI MP SHAH MEDICALCOLLEGE, JAMANAR fromJanuary 2018 to December 2019.

MRI protocol:

MR images were obtained using **Siemens (1.5 Tesla)** machine at MP shah medical college JAMNAGAR using a Head coil and gradient strength of **45mT**,the protocol consisted of axial, Sagittal T1 weighted sequence (T1W), and axial and sagittal T2 weighted sequence (T2W), and Fluid attenuation inversion recovery sequence (FLAIR), axial Gradient echo (GRE) and Diffusion weighted imaging (DWI) and Inversion recovery sequences.

Sample size of patients:

50 patients who underwent EEG and MRI at SHRI MP SHAH MEDICALCOLLEGE, JAMANAR from January 2018 to December 2019 were chosen in randomly.

Inclusion criteria:

Patients with age group of 6 months to 55 years with the 1 or more episodes of GTCS or focal seizures with adequate MRI evaluation and EEG evaluation.

Exclusion criteria

Patients with surgery due to MTS, metabolic and systemic disorders, indefinite clinical diagnosis of seizure and those with inadequate MRI and EEG evaluation.

STATISTICAL ANALYSIS

Quantitative variables were expressed in terms of mean, standard deviation or median interquartile range with confidence interval of 95%. The entire qualitative variable was expressed in terms of proportion. Chi square test of significance ($p<0.005$) was used to test for the difference in proportion. The correlation between MRI brain and EEG was studied using Mcnemer test.

Positive MRI cases with etiology.(Age group: children and adults) (n=27) (Table 1)

MRI epileptogenic lesions	Total (n=27)	%
Mesial temporal sclerosis	7	26
Infarcts	2	7
Intra parenchymal haemorrhage	1	3
Thinning of corpus callosum	3	11
Cerebral atrophy	3	11
Infection (Nuerocysticercosis)	2	7
Altered signal intensity areas in subcortical white matter	5	18
Mega cisterna magna	1	3
Arachnoid cyst	1	3
Cystic encephalomalacia	1	3
Gliotic area (post traumatic hemosiderin deposit)	1	3

Combined Sensitivity of MRI and EEG: (All age groups) (Table 2)

	Positive	Negative	Sensitivity.
MRI	27	23	54%
EEG	28	22	56%
MRI +EEG	40	10	80%

Chi square test. (Table3)
MRI and EEG correlation.

MRI	EEG		Total (n= 50)
	Normal	Abnormal	
Normal	10 (20%)	13 (26%)	23 (46%)
Abnormal	12 (24%)	15 (30 %)	27 (54%)
Total	22 (44%)	28 (56%)	50 (100%)
Chi square test statistic is 0.0472and P value is 0.828036 which shows no relation between EEG and MRI.			

Positive MRI cases with etiology. (Age group< 20yrs) (Table 4)

MRI epileptogenic lesions	Total (n=20)	%
Mesial temporal sclerosis	5	25 %
Thinning of corpus callosum	3	15 %
Cerebral atrophy	3	15%
Infection (Nuerocysticercosis)	1	5%
Altered signal intensity areas in subcortical white matter	5	25%
Mega cisterna magna	1	5%
Arachnoid cyst	1	5%
Cystic encephalomalacia	1	5%

Combined Sensitivity of MRI and EEG: (Age group< 20yrs) (Table 5)

	Positive	Negative	Sensitivity.
MRI	20	18	52%
EEG	24	14	63%
MRI +EEG	31	7	81 %

Chi square test. (Age group< 20yrs) (Table 6)

MRI	EEG		Total (n= 38)
	Normal	Abnormal	
Normal	6 (15%)	12 (32%)	18(48%)
Abnormal	8 (22%)	12 (32 %)	20 (52%)
Total	14 (37%)	24 (63 %)	38 (100%)
Chi square test statistic is 0.181 and P value is 0.638036 which shows no relation between EEG and MRI.			

III. Results

In this study of 50 patients with all age groups 27 patients (54%) had positive findings on MRI, the most common epileptogenic lesions, were mesial temporal sclerosis in 7 patients (26%) and Altered signal intensity areas in subcortical white matter in 5 patients (18%) followed by cerebral atrophy and thinning of corpus callosum in 3 patients (11%). Other causes were neurocysticercosis acute, chronic infarcts, metabolic disorders **(Table 1).**

There were 15 patients (30%) with an abnormality on both MRI and EEG. So, abnormal MRI and EEG were concordant in 30% of subjects in this study. There were 10 patients (20%) where both MRI and EEG were normal ,**The sensitivity for MRI is 54 % and EEG is 56 %, combined sensitivity for MRI and EEG is 80% (Table 2).**

However there is **no statistical significant difference** between MRI and EEG as shown in the Chi-square test with p-value of 0.0.47 **(Table 3).**

Among patients of less than 20 years of age 20 patients (52%) had positive findings on MRI, the most common epileptogenic lesions, were mesial temporal sclerosis in 5 patients (20%) and Altered signal intensity areas in subcortical white matter in 5 patients (25%) followed by cerebral atrophy and thinning of corpus callosum in 3 patients (15%). Other causes were neurocysticercosis **(Table 4).**

There were 12 patients (32%) with an abnormality on both MRI and EEG. So, abnormal MRI and EEG were concordant in 32% of subjects in this study. There were 6 patients (15%) where both MRI and EEG were normal, The sensitivity for MRI is 52 % and EEG is 63 %, combined sensitivity for MRI and EEG is 81% **(Table 5).**

However there is no statistical significant difference between MRI and EEG as shown in the Chi-square test with p-value of 0.63 **(Table 6).**

IV. Discussion

The preliminary goal in evaluating a patient with a seizure is to establish whether the seizure resulted from a metabolic process or a focal pathology in central nervous system,

Neuroimaging is central to the evaluation of patients with seizures, especially in the identification of a structural brain lesion that can be the epileptogenic focus.

This study evaluated 50 patients who presented with a clinical diagnosis of 1 or more seizure.
All 50 patients in the study had undergone EEG and MRI of brain.

Patient characteristics:

Age range of our patients was 11 months to 55 years, majority of the patients were in the age group of 0 to 10 years (23 patients, 46 %), next common age group was 10 to 20 years (14 patients, 28%)

The number of male patients were 24 (48%) and female patients 26 (52 %).

MRI

In this study among our patients of all age groups with one or more seizure episodes **27 patients (54 %)** had abnormal findings on MRI. *Which is was less compared to study by* **Amisha G Patel, Kavita U Vaishnav (2019)** [14] In our study among the potentially epileptogenic lesions, mesial temporal sclerosis was most common cause (7 patients, 26 %) and the next common cause was altered signal intensity areas in sub cortical white matter (5 patients 18%), and other Predominant causes were thinning of corpus callosum (3 patients , 11 %) and age disproportionate cerebral atrophy (3 patients , 11 %).

Infarcts were seen in 2 patients (7%), particularly among adults Neurocysticercosis was also seen in 2 patients (7 %)

Among our 38 patients under 20 years of age, number of male patients was 18 (47%) and female 20 (53%) and 20 patients **(52%)** out of 38 patients had abnormal MRI, which is comparable to another study by **Mohan B., Ranoji (2018**) which reported share of (**44.64 %)** abnormal MRI in children and adults younger than 18 years with first onset seizure [13].

Reported incidence of detection of epileptogenic lesions using only MRI varies between 14% and 48% in different studies [10].

Del Brutto et al in 2012 concluded that cysticercosis are the leading cause of acquired epilepsy worldwide and the main reason for a higher prevalence of epilepsy in developing countries [11,12].

EEG

Of the 50 patients who underwent EEG in this study, 28 patients

(56 %) showed focal epileptiform activity and 22 patients (44%) showed normal recordings which included generalized nonspecific waves and background beta and delta waves which could not be attributed to the seizures.

The sensitivity of EEG in subjects presenting with seizure was 56 % in this study.

A study by Amisha G Patel1, Kavita U(2019) concluded with a sensitivity of 65 % for EEG in evaluation of seizures [14]

Among our 38 patients under 20 years of age, 24 patients (63%) had abnormal EEG, which is comparable to study by **Mohan B.,Ranoji (2018) with a sensitivity of 35%** [13]**.**

MRI and EEG correlation:

There were 15 patients (30 %) with an abnormality on both MRI and EEG. So, abnormal MRI and EEG were concordant in 30 % of subjects in this study, which is similar to another study. There were 22 patients (44 %) where both MRI and EEG were normal.

There were 12 patients (24 %) with an abnormal MRI but normal EEG. This study shows that EEG was normal in 24 % of patients with epileptogenic lesions on MRI

Combined sensitivity of MRI and EEG in demonstrating focal anatomical or physiological abnormality was 80% which is similar to study by Amisha G Patel1, Kavita U(2019) [14]

Combined sensitivity of MRI and EEG in demonstrating focal anatomical or physiological abnormality in patients under 20 years was 80% comparable to 66.9 % Mohan B.,Ranoji (2018)[13.]

Limitations of the study

- Histopathological diagnosis was not done in all the cases of space occupying lesions (granulomatous lesions and tumors).
- CSF analysis was not done in all cases of meningitis and meningo-encephalitis. Diagnosis of these cases was made on imaging appearances only.

V. Conclusion:

MRI and EEG are primary diagnostic tools in patients with presenting with seizures,

MRI is central to the evaluation of patients with seizure, especially in the identification of structural brain lesions that could be the epileptogenic foci. Information obtained may help to decide medical or surgical management strategy.

MRI is important in identifying anatomical pathology whereas EEG demonstrates physiological abnormality, either of them alone have relatively low sensitivity in identifying the pathology (MRI: 54% and EEG 56% sensitivity), however in combination they have a very high sensitivity (80%)

We recommend that all patients with seizures should have an MRI study along with EEG.

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