Sensitivity of Magnetic Resonance Imaging as Evaluating Tool in Patients Presenting with Temporal Lobe Epilepsy

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ABSTRACT

Objective: To establish the sensitivity of MRI brain in diagnosing temporal lobe epilepsy.

Study Design: Cross sectional study.

Place and Duration of Study: Neurology Department Pak Emirates Military Hospital, Rawalpindi Pakistan, from Jan 2021 to Dec 2021

Methodology: Non-randomized convenient sampling was done.110 patients (55 in each group) were enrolled. All MRIs were reported by senior radiologists who were blinded regarding patients' history. All MRIs were done using epilepsy protocol. Independent sample t test was used to compare means between two groups and Chi square test was used to assess relationship between categorical variables

Results: A total of 110 individuals were enrolled in this study. Mean age of study population was 38.91±12.52 years with 67(63.81%) males and 48(36.19%) females. Two by two table analysis was done, and it revealed a sensitivity of 42.31% and Specificity of 94.34% of MRI as a diagnostic tool in temporal lobe epilepsy.

Conclusion: TLE is a prevalent disease which in majority of cases is diagnosed accurately on clinical criteria. MRI brain with epilepsy protocol might be used if there is any diagnostic uncertainty.

Keywords: Epilepsy, EEG, MRI, PEMH, Tumor.

INTRODUCTION

Epilepsy is a common neurological condition and millions of people are suffering from this disease all over the world. 5 to 10 cases per 1000 individuals are suffering from this disease worldwide.[1] Local prevalence of epilepsy in Pakistan is 9.9/1000 individuals.[2] Temporal lobe epilepsy makes the commonest seizure disorder affecting about 50 million individuals worldwide. It has complicated and extensive etiology, most commonly secondary to neurodegenerative process known as "hippocampal sclerosis". Other causes include infective etiologies, tumors, trauma, vascular anomalies, genetic conditions and cryptogenic. Around two third of patients can be managed with medicines while rest one third are refractory to standard anti-epileptic drugs. In such individuals once epileptic focus is identified, surgery is the treatment of choice.[3] In around 80% of patients with refractory seizures,

temporal lobe is the most common site, with frontal and parietal lobes being 5 and 15 % respectively.[4] "Complex partial seizures" is the typical presentation of TLE, however, it may present as focal aware seizures, focal, impaired awareness seizures or focal to secondary generalized tonic clonic seizures.

Both EEG and neuroimaging are vital in patients with suspected temporal lobe epilepsy. While ictal EEG can be diagnostic of temporal lobe epilepsy, inter-ictal EEG may be normal in such patients. It also cannot localize focus of origin which is essential in its surgical management. In such cases neuroimaging such as MRI is an important tool in diagnosis. Focal lesions associated with epilepsy in general and TLE in particular can be detected and localized with MRI. MRI findings commonly associated with TLE include reduced size/volume of hippocampus and increased T2 signal of hippocampus.[5-6] More than 55% of MRI misses epileptogenic lesions in western population however; they have a high specificity.[7] MRI is also used to localize lesions before surgical excision in case of refractory epilepsy. Other imaging modalities that maybe used to identify epileptic focus include

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positron emission tomography (PET) with or without FDG labeling, magnetic resonance spectroscopy (MRS), SPECT scanning and magnetic spectroscopy.[7] However, as these modalities are both expensive and rare in Pakistan, they are not commonly used here. Out of all epilepsy patient groups, TLE patients who are refractory to treatment, widely undergo surgical treatment. After TLE treatment, a success rate of around 80 to 90 %, after 5 years follow up can be observed.[8]

As discussed, MRI is an important tool in both diagnosis and management in cases of TLE and it is relatively commonly available. However, its sensitivity and specificity as a diagnostic test has not been studied in our population. This study aims to bridge this gap by studying its diagnostic efficiency in local population in Pakistan.

METHODOLOGY

This cross-sectional study was done at neurology department, Pak Emirates Military Hospital Rawalpindi and Armed Forces Institute of Radiology and Imaging (AFIRI). Duration of study was from Jan 2021 to Dec 2021. Study design was cleared by ethical committee ex Pak Emirates Military Hospital via letter no A/28/EC/306/2021, dated 1st Dec 2020. Participants were inducted in this study after written and verbal consent.

Non-randomized convenient sampling was done in neurology OPD of Pak Emirates Military Hospital. Considering a local prevalence of temporal lobe epilepsy of 9.9 per 1000 individuals,[9] with sensitivity and specificity of MRI for diagnosis of Temporal lobe epilepsy at 43% and 95% while keeping a confidence level of 95%and power of study at 80%, a sample size of 40 individuals (20 diseased and 20 controls) was calculated using OpenEPI sample size calculator. We aimed to enroll 110 patients (55 in each group in order to improve our results.

Inclusion Criteria: Patients of any gender, more than 12 years of age, diagnosed cases of temporal lobe epilepsy using EEG with clinical criteria, who have given consent were selected in diseased group. While equal number of healthy controls were taken from OPD visiting as attendants of patients.

Exclusion Criteria: Patients with pre-existing structural brain lesions, space occupying lesions, any history of neurosurgery, any head trauma leading to loss of consciousness or admission in neurosurgery ward, cerebrovascular accidents, subarachnoid hemorrhage, meningitis, encephalitis, or patients with EEG seizures activity extending beyond temporal lobe etc., were excluded from study.

A case of temporal lobe epilepsy was defined as individuals with typical symptoms of temporal lobe epilepsy, whether controlled on medications or not, with typical EEG findings of temporal lobe epilepsy including but not limited to inter ictal EEG with spike and wave pattern or slow and sharp complexes located in temporal region or ictal EEG with rhythmic theta waves of 5 to 7 Hz frequency.

Individuals fulfilling abovementioned inclusion and exclusion criteria were inducted in this study after informed verbal consent. Following consent all patients were directed to AFIRI to undergo MRI Brain. All MRIs were reported by senior radiologists who were blinded regarding patients' history. All MRIs were done using epilepsy protocol by same machine (Toshiba Atlas 1.5 Tesla). Changes such as hippocampal sclerosis, loss of volume of temporal lobe, tumors of temporal lobe and vascular anomalies in temporal region, seen in T1, T2 and FLAIR sequences were considered diagnostic for temporal lobe epilepsy.

Individuals with radiological signs of temporal lobe epilepsy were noted down and sensitivity, specificity, positive predictive value and negative predictive value were calculated using two by two table. Categorical data such as gender was expressed as percentage and frequencies and nominal data such as age was expressed as mean with standard deviation. Independent sample t test was used to compare means between two groups and Chi square test was used to assess relationship between categorical variables. Microsoft Excel 365 and Statistical package for Social Sciences (SPSS) version 25 was used to analyze data.

RESULTS

A total of 110 individuals were enrolled in this study, however 5 individuals failed to follow up with MRI Scans resulting in 105 individuals (52 in diseased group and 53 in control) available for final analysis. Mean age of study population was 38.91±12.52 years with 67(63.81%) males and 48(36.19%) females. About 78(74.29%) of study population was married. There was no significant difference between demographic features of both groups as shown in Table-I.

Diseased group consisted of 52 individuals. Demographic details is given in Table-I. The mean

duration of treatment in this group was 15.42±9.82 years. Majority of patients were on 2 or more anti-epileptic medications with relatively good adherence, although only 31(59%) reported good control of seizures in form 1 or none breakthrough fits in 6 months. Only 9(17.31%) individuals had family history of seizure disorder in first- or second-degree relatives. Patients mostly presented with Focal unaware seizures 29(55.77%) also known as complex partial seizures. Details of this group are given in Table-II.

Table-I: Demographic Features of Study Population (n=110)

Variable	Diseased group (n=52)	Controls (n=53)	*p*-value
Age	37.75±12.64	40.83±12.41	0.347
Gender			
Male	36(69.23%)	31 (59.62%)	0.128
Female	16(30.77%)	22 (40.38%)	
Marital Status			
Married	38(73.08)	40(76.92%)	0.390
Unmarried	14(26.92%)	13(23.08%)	
MRI Findings	22(42.31%)	3(5.77%)	2.321

Table-II: Characteristics of Patients in Diseased Group (n=52)

Characteristic		Frequency
Psychological Stress		21(40.38%)
No of Antiepileptics	1	10(19.23%)
	2	28(53.85%)
	3	10(19.23%)
	4	4(7.69%)
Duration of Treatment (years)		15.42±9.82
Seizure Control	Good	31(59.62%)
	Bad	21(40.38%)
Missed medications	Rarely	18(34.62%)
	Occasionally	18(34.62%)
	Frequently	16(30.77%)
Family History	Yes	9(42.31%)
	No	43(57.69%)
MRI Findings	Yes	22(42.31%)
	No	30(57.69%)
Type of Seizure	Focal Aware Seizures	9(17.31%)
	Focal Unaware Seizures	29(55.77%)
	Focal to secondary generalized	14(26.92%)

In diseased group 22(42.31%) had MRI findings suggestive of temporal lobe epilepsy. Among these 22, 16(72.72%) had evidence of unilateral hippocampal sclerosis, 3(14.64%) had bilateral hippocampal sclerosis, 2(9.09%) had increased T2 signal intensity unilaterally in mesial temporal lobe and 1(4.55%) had evidence of mass lesion.

Two by two table analysis was done, and it revealed a sensitivity of 42.31% and sensitivity of 94.34% of MRI as a diagnostic tool in temporal lobe epilepsy. Positive predictive value of MRI was calculated at 88% and negative predictive value at 62.5%. Accuracy of diagnostic test was calculated at 68.57% and *p*-value of <0.001 was observed, as seen in Table III.

Table-III: 2x2 Table

	Epilepsy Diagnosed as Per Criteria		*p*-value
	Yes (n=52)	No (n=53)	
Positive MRI Findings			
Yes	22(42.31%)	3(5.66%)	<0.001
No	30(57.69%)	50(94.34%)	

DISCUSSION

Epilepsy is a chronic neurological condition which can be diagnosed by clinical features and EEG findings specific for this condition. Since MRI is an expensive investigation with a limited role in management, in routine it is not frequently used, however in extra ordinary circumstances such as break through seizures, refractory seizures, tumors, refuting an alternate diagnosis or planning a surgery management of refractory seizures, it is considered.

In our study the most common seizure was focal seizures with impaired consciousness also known as complex partial seizures, which was in accordance to conclusion by BEATE *et al.*,[10] Noncompliance to medications was observed in all individuals with 58.35% patients missing upto two doses in a month, which is a big number. Another study related to compliance to AEDs, done in 2021 at Pak Emirates Military Hospital Rawalpindi also showed that 44.4% participants were non-compliant to medications.[11] Majority of patients suffering from temporal lobe epilepsy were males. A study conducted by Siddiqui *et al.*, on Pakistani population, showed that male gender was more frequently suffering from TLE.[12] In our study males made bulk of our patients. One of the reasons can be as the hospital in which this study was conducted mostly deals with army personnel who are mostly males. However female patients also come frequently as wards or wives of armed personnel or in private clinics. The most common finding encountered on MRI is hippocampal sclerosis and gliosis which is in agreement with study conducted by Danial *et al.*, which concluded that 5% and 2 % Temporal lobe seizures can also come from temporal lobe tumors and vascular malformations respectively however both

were excluded in our study.[13] Post-ictal confusion and headache were usual in TLE patients and dysphasia points towards speech associated temporal lobe.[14]

Conventional MRI is the most commonly used imaging modality in the evaluation of patients with temporal lobe epilepsy (TLE). It has low sensitivity and specificity (42% and 80 % respectively) in identifying TLE changes and there is a huge proportion of false negatives.[15] However if specific MRI Brain Epilepsy protocols and state of art 3, 9 etc Tesla machines are used the sensitivity and specificity can jump to 97% and 97 % respectively in detecting abnormalities. In various other studies done it was concluded that MRI brain was far more superior in identifying lesions associated with temporal lobe epilepsy.[16-20]

In an epidemiological study of epilepsy in Pakistan, published in JPMA, 2003, epilepsy in general is idiopathic and identified early in pediatric population. Most common seizure pattern identified was generalized type. In the same study it was also highlighted that knowledge related to this disease in general population is very less. It is a very concerning issue as this is a very serious disease and if it is not taken seriously and effective and timely management is not done, it can cause significant morbidity and mortality.[21]

Psychiatric symptoms are commonly associated with temporal lobe epilepsy. Different types of diseases are commonly linked to TLE like depression, anxiety and mood disorders. Ertem at el showed that mood related diseases were quite common in TLE patients followed by psychotic disorders.[22]

Early recognition of these psychiatric disorders is very important as timely identification can decrease the burden of morbidity and without any delay treatment may be started. Holistic approaches should be used in which psychiatrist and psychologist in addition to a neurologist be employed.

Epilepsy and Psychogenic non-epileptic seizures (PNES) are closely related disorders and may be considered different entities but diseases related to each other. Psychogenic non-epileptic seizures pose a great challenge as a large number of patients suffering from these conversion disorders are treated as a case of epilepsy. Timely involvement of psychiatrist can help in managing this condition.[23]

LIMITATION OF STUDY

Patients were not subjected to random sampling. Sample size was not too large as MRI is quite an expensive modality and can only be used judicially. Subjects were included from one department hence this study lacks generalization. These limitations can be addressed in future studies by increasing sample size and other study designs.

CONCLUSION

TLE is a prevalent disease which is usually diagnosed accurately on clinical criteria. MRI brain with epilepsy protocol might be used if there is any diagnostic uncertainty or neurosurgical team plans to remove the epileptic foci by surgery. More sophisticated and powerful MRI machines like 6 or 9 tesla may give more details and understanding of this disease.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

TS & BK: Data acquisition, data analysis, critical review, approval of the final version to be published.

MH & UN: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AY & KHN: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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