

Comparative analysis of the hippocampus T2-relaxometry values in epileptic patients due to hippocampal sclerosis and those due to other causes

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Abstract

Introduction: Mesial temporal sclerosis (MTS) is the most common pathology in patients undergoing anterior temporal lobectomy. Magnetic resonance imaging (MRI) is valuable in detecting MTS. **Aims and Objectives:** To study Comparatively the hippocampus T2 Relaxometry values in epileptic patients due to hippocampal sclerosis and those due to other causes. **Methodology:** This was a Prospective study of 6 months duration (May 2013 - October 2013) at Sri Ramachandra hospital, Department of Radiology and Imaging Sciences in A population of 30. T2 relaxometry values of the bilateral hippocampus for all the 30 patients were collected and analyzed. Un-paired t-test was used for the statistical analysis. **Result:** The majority of the Patients were Female i.e. 53.3 % followed by Male 46.7%. Out of the total 30 patients 10 (33%) were patients of epilepsy and 20 (67%) were Non –epileptic patients. T2 values >121ms strongly suggests the presence of hippocampal sclerosis. It is more likely that an increase in the hippocampal T2 relaxation time is significant enough to suggest the possibility of more severe degree of hippocampal damage. **Conclusion:** MR T2 Relaxometry is highly sensitive in evaluating hippocampus and hence, can be used as an excellent quantitative tool in the diagnosis of Hippocampal Sclerosis in epileptic patients


Key Words: Hippocampus, T2 Relaxometry, Mesial temporal sclerosis (MTS), Epilepsy.

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INTRODUCTION

Mesial temporal sclerosis (MTS) is the most common pathology in patients undergoing anterior temporal lobectomy. Magnetic resonance imaging (MRI) is valuable in detecting MTS. Reduced hippocampal volume and elevated T2 signal are associated with MTS, and both quantitative T2 and volumetric measurements have been associated with hippocampal cellular loss that characterizes this condition. Although MTS is often

bilateral, it is typically maximized to one or the other mesial temporal region, and the side of ictal onset is associated with greater sclerotic change. Seizure control after temporal lobectomy is associated with MRI-detected MTS. Asymmetric MTS is associated with a marked postoperative reduction or cessation of seizures in 70 to 90% of patients, whereas symmetric MTS or the absence of MTS on MRI is associated with a marked reduction or cessation of seizures in 70 to 90% of patients, whereas symmetric MTS or the absence of MTS on MRI is associated with a marked reduction or cessation of seizures in ^{1,2,3}. Epilepsy is a familiar neurological disease characterized by recurrent seizures. Even though epilepsy is presently generally well manageable with modern antiepileptic drugs, there still remain about 30% of patients with epilepsy who do not respond to optimal treatment⁴. These patients are then understood to have intractable or medically refractory epilepsy. Most of the patients have had good outcomes after surgery, and this regularly depends on the presurgical evaluation by EEG and magnetic resonance imaging (MRI). Unilateral

hippocampal sclerosis (HS) is the most frequent pathological finding in temporal lobe epilepsy (TLE), and up to 65% of cases of TLE can be attributed to pathology arising entirely in the hippocampus⁵. Visual (qualitative) assessment of T2-weighted changes (hyperintense signal on T2-weighted images and atrophy) was the earliest method that demonstrated an association among hippocampal pathology and MR-detectable signal abnormality. Hippocampal volume loss is a sensitive and specific pointer of hippocampal sclerosis in the clinical setting of epilepsy, and hippocampal volumetric study can quantify atrophy in TLE patients. T2 relaxometry is another quantitative technique to determine the frequency and severity of T2 abnormality. Hippocampal T2 relaxation time increases in patient of hippocampal sclerosis⁶. Mesial temporal sclerosis (MTS) is the most common known pathologic substrate of epilepsy. Tissue hydration is quantified via T2 relaxometry⁷ and hippocampal atrophy is quantified via hippocampal volumetry⁸. The most common radiologic manifestation of MTS seen in clinical practice is a unilateral atrophic hippocampus with increased signal, with a normal-appearing contralateral hippocampus. The surgical approach to temporal lobe epilepsy (temporal lobectomy) is also driven by the concept that MTS is a unilateral phenomenon. However, autopsy studies and, more recently, quantitative MR studies (volumetry and T2 relaxometry) indicate that MTS is present bilaterally in a substantial percentage of patients with temporal lobe-onset seizures^{9, 10, 11}. For the sake of illustration, the entire spectrum of MTS can be divided into four possible conceptual categories¹¹: (a) unilateral hippocampal damage, in which MTS is present unilaterally, and the contralateral hippocampus is completely normal, (b) bilaterally asymmetric damage, in which MTS is present bilaterally, but is more severely represented on one side, (c) bilaterally symmetric damage, in which MTS is present and of equivalent magnitude in both hippocampi, and (d) symmetric normal hippocampi, in which neither hippocampus has changes of MTS. This fourth category is conceptually useful in the context of this discussion, because distinguishing mild MTS from a normal hippocampus is often not straightforward, either with MR imaging or with qualitative pathologic analysis. These four groups represent conceptual points along a continuous distribution of hippocampal damage ranging from normal to severe MTS in one or both hippocampi. Most cases of MTS encountered for presurgical evaluation in general clinical practice will have hippocampal atrophy, increased signal, or, more commonly, both¹⁰⁻¹⁴. The accuracy of visual inspection of an appropriately. Performed MR examination in the setting of clear unilateral MTS exceeds 90%. A recent

evaluation of fluid-attenuated inversion-recovery imaging sequences showed an accuracy of 97% with pathologic determination of MTS as the standard of reference.

MATERIAL AND METHODS

This was a Prospective study of 6 months duration (May 2013 - October 2013) at Sri Ramachandra hospital, Department of Radiology and Imaging Sciences in A population of 30 patients of either sex who presented themselves in Radiology department whose reports and image data's are collected prospectively during the study period. A detailed history with various patient's data which includes patient demographic details, hospital ID, and study reports are collected and entered in a specially designed Proforma. MR imaging was performed on 1.5-Tesla MRI scanner (Magnetom Avanto, 18 channels, Siemens Medical Solutions, Erlangen, Germany) with a matrix head coil used as both transmitter and receiver. T1W, T2W, diffusion-weighted, and HEMO sequences were obtained in axial plane with 5mm slice thickness and 30% interslice gap. For dedicated hippocampal study, inversion recovery (IR) oblique coronal images and oblique coronal T2W images (TR 5470, TE: 90, FOV: 200, slice thickness 2 mm) covering the whole brain were acquired. Oblique coronal plane was perpendicular to the long axis of hippocampus. The images were assessed for hippocampal atrophy, loss of defined morphologic structure of hippocampus, increased T2W signal and decreased T1W signal and a T2 relaxometry sequence is done to assess the T2 relaxation time of hippocampus using 16 - echo sequence. All the patients' data within the study period were collected. Patients were selected irrespective of their age group, gender and pathologic findings excluded from the study. T2 relaxometry values of the bilateral hippocampus for all the 30 patients were collected and analyzed. Un-paired t-test was used for the statistical analysis.

RESULT

Table 1: Gender Wise Distribution of Patients for the study

Sex	No. Of patients	Percentage (%)
Male	14	46.7
Female	16	53.3
Total	30	100

The majority of the Patients were Female i.e. 53.3 % followed by Male 46.7%

Table 2: History / Cause Wise Distribution of Patients for the study

History	No. Of patients	Percentage (%)
Epilepsy	10	33
Non-Epilepsy	20	67
Total	30	100%

Out of the total 30 patients 10 (33%) were patients of epilepsy and 20 (67%) were Non –epileptic patients.

Table 3: Hippocampi T2 Relaxometry MRI data in controls and different groups

Side	Data	Controls or normal (ms)	TLE (ms)	ETLE / Unclassified (ms)
	Mean	101.57	142.95	104.6
RIGHT	Number of patients	20	4	4
	Standard deviation	6.87	18.85	4.91
	Range	88.2 - 117.2	133 - 175	100 - 111
	Mean	100.72	126.8	107.1
LEFT	Number of patients	20	2	4
	Standard deviation	6.86	5.8	3.46
	Range	91 - 119	121-132	104 - 112

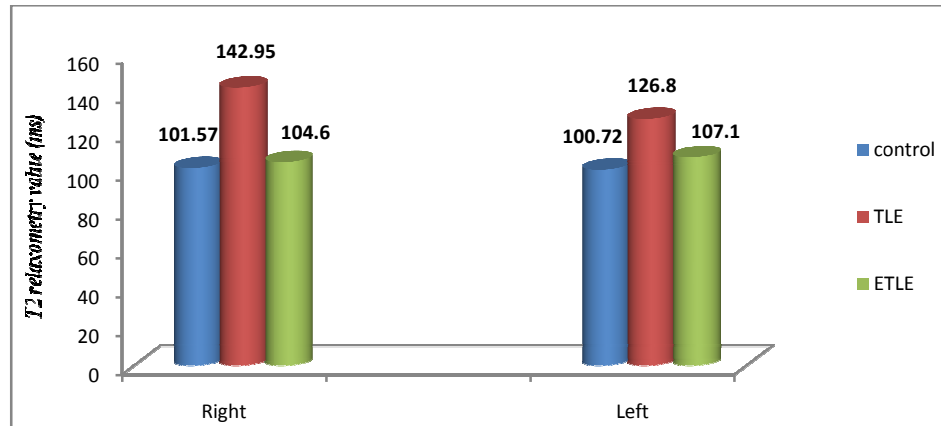


Figure 1: Mean T2 relaxometry values in right and left hippocampi in controls and different groups

DISCUSSION

T2 relaxometry is a quantitative magnetic resonance tool that can be used to increase the sensitivity of identifying hippocampal abnormalities above that of visual assessment alone. T2 Relaxometry of hippocampus study was done on a population of 30 patients who presented themselves in Radiology department. Of these 10 patients had the history of seizures / epilepsy and 20 patients who had no symptoms of seizures or epilepsy were chosen as control volunteers. The range of measured T2 relaxation values from 20 control / non epileptic subjects was 88.2 - 117.2 ms with a mean of 101.57 ms and standard deviation (SD) of 6.87 on the right hippocampi and the range of measured T2 relaxation value on the same on left side hippocampi was 91 - 119 ms with a mean of 100.72 ms and standard deviation of 6.86. T2 relaxation times were calculated using 16-echo Carr-Purcell-Meiboom-Gill sequence which is basically a multiple spin-echo sequence. There was a significant increase in T2 relaxometry value of the hippocampus in some patients with history of seizure disorder when compared to those in non epileptic patients which are suggestive of hippocampal damage due to hippocampal sclerosis. In some patients, with history of seizure, 60% had T2 relaxation value more than 121 ms on unilateral hippocampus. T2 range of measured T2 relaxation values of epileptic patients was 133-175 ms with a mean of 142.95 ms and SD of 6.87 on the right hippocampi which

are suggestive of right Hippocampal Sclerosis. Patients who had features of left hippocampal sclerosis had T2 relaxation value range of 121-132 ms with a mean of 126.8 ms and a SD of 5.8. There is no considerable difference in hippocampal T2 relaxation times between extratemporal/unclassified group and control values in which the mean T2 value was 104 and 107 in the right and left hippocampus respectively. Therefore, in this study, T2 values >121ms strongly suggests the presence of hippocampal sclerosis. It is more likely that an increase in the hippocampal T2 relaxation time is significant enough to suggest the possibility of more severe degree of hippocampal damage.

CONCLUSION

MR T2 Relaxometry is highly sensitive in evaluating hippocampus and hence, can be used as an excellent quantitative tool in the diagnosis of Hippocampal Sclerosis in epileptic patients.

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