

Retrospective study of MRI Findings of Temporal Lobe Epilepsy

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ABSTRACT

Temporal lobe epilepsy is a condition characterized by recurrent unprovoked seizures originating from the medial and lateral temporal lobe. MRI plays an important role in locating and defining anatomic epileptogenic foci. Patients and method a retrospective study of a cross sections was carried out at the MRI department of Al Salaam General Hospital in Mosul City from March 2001 to September 2002. The study sample consist of 50 patients (22 male and 28 female) There age ranging between (6-70) years, they were investigated by MR imaging of the brain using 1.5T Philips Company . The patients age at seizure onset ranged from (1-68) years. The duration of epilepsy ranged from (1month-18 years). Result : The MRI finding were a normal in 29 patients (58%) and abnormal MRI in 21 patients (42%) . The commonest finding among those with late onset seizure was infarction while the commonest MRI finding in the early onset group is mesial temporal sclerosis. Conclusion: The incidence of mesial temporal sclerosis is low in this study.MRI is recommended in every patient with temporal lobe epilepsy.

Key wards: MRI, Temporal lobe epilepsy, mesial sclerosis.

INTRODUCTION

Definition:

Epilepsy is a common neurologic disorder the word epilepsy is derived from the Greek word epilepsia meaning to take hold of or to seize ^[1] Epilepsy is a chronic condition of recurrent unprovoked seizures. It is a symptoms of brain disease rather than a disease itself ^[2].

Temporal lobe epilepsy (TLE): Defined in 1985 by the international league Against Epilepsy (ILAE) as a condition characterized by recurrent unprovoked seizures originating from the medial or lateral temporal lobe. The seizures associated with TLE consist of simple partial seizures without loss of awareness and complex partial seizures ie, with loss of awareness. The individual loses awareness during a complex partial seizure because the seizure spreads to involve both temporal lobe which cause impairment of memory ^[3]. TLE, now more commonly called complex partial seizure disorder so as to include seizure that originating from the frontal foci. Since the condition may involve gross disorder of thought and emotion, patient with TLE frequently come to the attention of psychiatrists. But since symptoms may occur in the absence of generalized grand mal seizure, physicians may often fail to recognize the epileptic origin of the disorder. Indeed, misdiagnosis and failure of diagnosis are common in TLE ^[4].

Anatomy: Familiarity with normal anatomy, variations and pathology of hippocampus and temporal lobe is essential to evaluate this region adequately.

The hippocampus : is a curved structure located along the medial temporal lobe , the hippocampus is divided into three segments based on its morphology or its relationship to the brain stem : the head , the body and the tail the head located at anterior aspect of the brain stem and is also referred to as pes hippocampus. The body is a cylindrical structure in the axial plane situated adjacent to the brain stem. The tail rapidly narrow as sweeps upward behind the brain stem. In cross section the hippocampus is complex functional unit composed of two interlocking c_ shaped gray matter structures. The cornu ammonis and the dentate gyrus. structures surrounding the hippocampus include the parahippocampal gyrus inferiorly, the ambient (perimesencephalic) cistern medially which separate the hippocampus from the brain stem, the choroidal fissure and temporal horn superiorly and the temporal horn laterally ^[1].

Along the medial aspect of the hippocampus, the dentate gyrus forms a narrow, notched band. The hippocampal formation plays a crucial role for certain kinds of learning and memory^[5].

The amygdala (the amagdaloid nucleus): is located in the temporal lobe beneath the uncus .It is always superior to the temporal horn.

MRI of the amygdala the hyppocampus is best performed in the coronal plane perpendicular to the axis of the hippocampus. The amygdala and the hippocampus are isotense relative to the gray matter on all pulse sequences. The best landmark separating amygdala from hippocampus is the anterior temporal horn, known as uncal recess^[1].

Temporal lobe : extends from the temporal pole to the occipital lobe , lying below the lateral sulcus. It contains:

- (1) Transverse temporal gyri of Heschl : Lies buried within the lateral sulcus and extends from the superior temporal gyrus toward the medial geniculate body. They are the primary auditory areas of the cerebral cortex .
- (2) Superior Temporal gyrus: Is associated with auditory functions. It contains Wernicke's speech area in the dominant hemisphere and contains the planum temporale on it's superior hidden surface^[6] . On parasagittal MR images the posterior extent of the Sylvian fissure and the underlying dorsal aspect of the superior temporal gyrus are used as landmarks to estimate the region of the Wernicke's second motor speech area.
- (3) Middle temporal gyrus,(4) Inferior temporal gyrus,(5) Lateral occipitotemporal gyrus (fusiform gyrus) : Lies between the inferior temporal sulcus and the collateral sulcus^[7] .

Clinical Feature:

- Past history of febrile convulsion.
- Seizure longer than frontal lobe seizure (typically > 2 min), with a slower evolution and more gradual onset / offset.
- Auras common. It typically comprises visceral, cephalic, gustatory, dysmnestic, or affective symptoms. The rising epigastric sensation is the commonest aura; others include perceptual or autonomic auras.
- Partial awareness commonly preserved, especially in early stages, and slow evolution of seizure.
- Prominent motor arrest or absence (the motionless stare).
- Post-ictal confusion and dysphasia common.
- Autonomic changes (e.g . pallor, redness, and tachycardia).
- Automatism. less violent than in frontal lobe epilepsy, and usually oroalimentary or gestural and sometimes prolonged^[8].

Pathophysiology:

Hippocampal sclerosis is the most common pathologic finding in TLE . Hippocampal sclerosis involves hippocampal cell loss in CA1and CA3 region and the dentate hilus the CA2 region is relatively spared^[8].

MRI Studies: MRI is the neuroimaging modality of choice for patients with temporal lobe epilepsy^[29].

MRI is very important in planning for epilepsy surgery because of its ability to detect temporal lobe lesion that can cause seizures.

MRI uses a magnetic field and radio waver to produce images. MRI can be used to study many different properties of cerebral tissue^[9].

The most common types of MRI images an T₁ weighted images and T₂ weighted images(or FLAIR sequences) .Gd-enhancement is usually not required in children or young adult while in older patients with resent onset Gd – enhanced images should be obtained to exclude tumors. New onset seizure in an adult warrants T2Wor FLAIR imaging and T1W imaging before and after gadolinium enhancement . On other hand , chronic seizure in an adult probably do not require Gd- enhanced images unless the frequency , intensity , or the nature of the seizure has changes^[10]. MRI is the neuroimaging modality of choice for patient with TLE. All patient was newly diagnosed TLE should has a high_ resolution MRI^[3] .

Functional MRI: MRI is an essential tool in the investigation of a patient with suspected temporal lobe pathology^[30]. One of the newest MRI technique useful in epilepsy is functional MRI. Using special MRI sequences, areas of specific brain function can be localized by imaging patients while they perform specific tasks. For example, area of language function in the brain can be visualized by having the patient do language – related tasks during the scan . This information is often very useful to the neurosurgeon; the proximity of these areas to the seizure – causing region can be determined before surgery^[9].

Indication For Imaging :

1. Epilepsy onset after the age of 20 years.(2)Seizures with local feature clinically. (3) EEG showing a focal seizure source,(4)Epilepsy that is refractory to medical treatment, (5)Children with abnormal development,(6)Abnormal finding on physical examination^[11,12].

Cause of TLE:

Mesial temporal sclerosis, Benign and malignant neoplasm, Vascular malformation, Post traumatic brain injury, Cortical dysplasia, Past infection, Cerebrovascular diseases, Cryptogenic : a cause is presumed but has not been identified^[3,8,9].

Mesial Temporal sclerosis (hippocampal sclerosis)

Hippocampal sclerosis produces a clinical syndrome called mesial temporal sclerosis (MTLE) also known as Ammon s Horn sclerosis . MTLE begins in late childhood, then remits , but reappears in adolescence or early adulthood in a refractory form^[3,8].

Hippocampal sclerosis refer to the neuronal loss and gliosis of the hippocampus^[13] . It is the most common cause of complex partial seizures^[9].

Neuropathologically , the distribution and extent of neuronal loss and gliosis within the hippocampus (topographical pattern of hippocampal sclerosis) may be related to different surgical outcomes in patient with TLE treated by surgery . Several distinct topographical type of hippocampal atrophy in patient with TLE have been described with MRI imaging^[13] . In mesial temporal sclerosis the hippocampus is smaller than normal this usually occur on one side of the brain but can occur bilaterally in 10_15% of cases. MRI detect mesial temporal sclerosis by demonstrating this size asymmetry and abnormal signal within the atrophied hippocampus^[9] . Most studies have reported hippocampul signal changes as hyperintense in T2 weighted sequences other hippocampul findings include hypointensity and disruption of normal internal architecture on T1 weighted sequences^[1] . T1 weight images are best for detecting size asymmetry and T2 weighted images are most sensitive for detecting signal changes. A special T2 weighted sequence called FLAIR is even more sensitive for detecting signal abnormalities^[9] . Volume loss and T2 signal changes can be assessed quantitatively as by visual inspection^[1] . The volume measurement of the hippocampal formation on MRI can be especially helpful when there is bilateral hippocampal atrophy^[9].

The validity of hippocampal volume measurement is highly dependent on the quality of the images from which measures are made. Early studies using thick (5mm or more) and non contiguous section give rise to some anomalous results , section must be less than or equal to 3mm for an accuracy of volume measurement of 5% . Although unilateral hippocampal sclerosis is the most common precursor of temporal lobe epilepsy bilateral hippocampal damage has occurred if the volume loss is equivalent bilaterally, no significant left to right volume difference will be observed and hence a normal ratio will be reported. Similarly, bilateral volume loss in which one hippocampus has lost more volume than the other generate an abnormal ratio but the evidence of bilateral damage is not revealed^[14]. Complete loss of digitations in the hippocampals head may be used as a major diagnostic criterion to establish the MRI diagnosis of mesial temporal sclerosis. This morphologic sign may also be useful in diagnosis of bilateral MTS or to validate the MR diagnosis of MTS when there is no obvious atrophy or change in signal intensity^[15].

The hippocampus , fornix and mamillary body are components of a single limbic circuit , the hippocampal fibers project to the mamillary body via the fornix it has been previously suggested that neuronal damage of the hippocampus including the subiculum may cause atrophy of the ipsilateral fornix and mamillary body as a result of neuronal degeneration recently MR detection of the asymmetrically small fornix or mamillary body has been suggested as useful presurgical lateralizing sign of hippocampal sclerosis in patient with TLE^[16].

Neoplasm:

Neoplasms are differentiated from mesial temporal sclerosis on MRI by the presence of an abnormal enhancement after intravenous contrast administration. The most common type of neoplasm are low grade astrocytoma and oligodendroglioma in adults, and gangliogliomas and pilocytic astocytomas in children .More aggressiveand malignant neoplasms do occur and may demonstrate prominent contrast enhancement on MRI^[9] . FMRI studies of brain cancer, lesions and other brain pathologies still to be explored^[28]

Astrocytomas:

On MRI, low grade astrocytoma are well circumscribed , produce little or no mass effect or oedema , with variable enhancement with contrast.

Most of them are hypointense to gray matter on T1W images and hyperintense on T2W images^[1].

Oligodendroglioma:

MR signal characteristics of oligodendroglioma are similar to those of other glioma, isointense relative to gray matter on T1 weighted images and hyperintense on T2 weighted images. Calcification, hemorrhage, and cystic changes are responsible for heterogeneous appearance.

Gangliogliomas :

These tumors occur most frequently in the first and second decade. They are cystic, well circumscribed, and calcified and may contain mural nodule. The temporal lobe are the most frequent site of involvement, although these tumors are found throughout the brain.

MRI commonly demonstrate a heterogeneous mass that is predominantly hypointense on T1weighted images and hyperintense on T2 weighted images. Most gangliogliomas show some contrast enhancement^[1].

Pilocytic astrocytomas:

These are nearly as common as low grade diffuse astrocytoma in epilepsy series. These lesion may form cyst and calcify, they typically have a component that enhances intensely^[17].

Vascular Malformation:

Usually a cavernous angioma or an arteriovenous malformation. MRI detect almost all intracranial vascular lesion^[1].

Cavernous Angiomas:

They are the most common vascular malformation associated with temporal lobe epilepsy. Usually have characteristic appearance on MRI due to presence of small amount of hemorrhage^[9].

They are large vascular spaces without discrete arteries or veins. These lesions may contain calcification, hemorrhage, or thrombus.

Cavernous angiomas affect all age groups, and may be multiple or familial. Seizure are the most frequent clinical presentation, particularly in cases of multiple cavernous angiomas. The central nidus has a heterogeneous appearance with increased signal intensity on T1W and T2W images indicative of subacute hemorrhage^[1].

Arteriovenous Malformation (AVM) :

An AVM consist of a group of abnormal vessels that form direct arteriovenous shunt without an intervening capillary network. On MRI, there is a region of serpiginous flow voids on both T1W and T2W images that represents the AVM nidus, dilated feeding arteries and draining veins^[1,17].

Trauma :

Post traumatic brain injury also can cause seizure. The MRI finding depend on the extent and nature of the injury, as well as the elapsed time since injury^[9]. The prevalence of post traumatic epilepsy is significant because of the large number of head injury, but fortunately only small proportion of patient with head injury develop epilepsy. The presence of an acute hematoma, a depressed skull fracture or a history of early post traumatic seizure, increases the risk of late epilepsy. The frontal and temporal lobes are the most common site of injury particularly the orbital surface of the frontal lobes, the ventral surface of the temporal lobe, and the frontal and temporal poles^[1,17]. Months after the injury, cortical and subcortical atrophy may be detected by MRI. Other finding include areas of abnormal signal related to scarring or prior hemorrhage^[1,9].

Cortical dysplasia :

Cortical dysplasia is a focal area of abnormal brain development. Although the abnormal area is present before birth, seizures usually do not occur until childhood or adulthood. It is much less common than tumors. Its MRI appearance is similar to the tumors, with mass effect and abnormal signal. Contrast enhancement, however, does not occur with cortical dysplasia, cortical thickening more than 4 mm and blurring of the interface between gray and white matter also manifest on imaging.

Mild or microscopic cortical disorganization may be undetectable by MRI using current techniques^[9,17].

Infection:

Infection are a frequent cause of seizure worldwide. Seizure may occur in acute, subacute, and chronic meningitis, in encephalitis, and in infectious space occupying lesion. Early seizure are an important predisposing factor for late unprovoked seizure.

Most viral CNS infection produce an aseptic meningitis or meningoencephalitis. Seizure are common in these patient. Seizure may occur in children with acute bacterial meningitis. Bacterial infection may result in cerebritis and abscess formation, in which seizure is a common presenting symptoms patient with CNS tuberculosis may present with seizure

which may occur with acute phase of tuberculous meningitis or in association with a tuberculoma. The MRI appearance of tuberculoma is variable depending on the host reaction, the amount of macrophages, fibrosis and gliosis. As these component increase, there is tendency for granuloma to become more hypointense on T2 weighted sequence. Tuberculoma and adjacent oedema are usually hypointense on T1 weighted images with nodular or ring like enhancement after gadolinium injection. Helminthic infection, such as echinococcosis, may be associated with seizure^[17].

Cerebrovascular Diseases:

Stroke is one of the most frequent causes of seizures in adults. Infarction is the most common cause of stroke-related seizure, most likely owing to much higher incidence than hemorrhagic condition such as subarachnoid hemorrhage and intracerebral hemorrhage which have higher epileptogenicity. Seizure are presumed to arise from gliotic tissue at the periphery of the infarcted zone. Seizure that occur more than 2 weeks after stroke have 50% chance of causing chronic epilepsy^[17].

PATIENT AND METHOID

A retrospective study of a cross Sections over a period of 15 months from March 2001 to September 2002 was conducted on 50 patients with a clinical diagnosis of temporal lobe epilepsy who were referred from neurologists, neurosurgeons and psychiatrics for MRI of the brain at Al Salaam General Hospital in Mosul city. The study sample consist of 50 patients (22 males and 28 female) their age ranging between (6-70) years with the mean (25.8%). Seizure onset age ranging from (1- 68) years with the mean (18.5%) with a duration ranging from (1 month – 18 years). Data were collected regarding age at seizure onset, duration of epilepsy prior to MRI study, family history of epilepsy, history of febrile convulsion in early childhood, history of previous trauma, previous medical and surgical history. All patient were evaluated by 1.5 T MRI scanner (Philips) with a standard head coil. The parameters used for MRI examination of the patient were as follow:

1. Axial T₂ W with a slice thickness of 5mm with an inter slice gap of 1mm.
2. Axial T1W – SE with a slice thickness of 5mm with inter slice gape of 1mm.
3. Coronal FLAIR with a slice thickness of 4mm with 0.5 mm inter slice gap.
4. Coronal T1W with slice thickness of 4mm with inter slice gap of 0.5. This sequence was done for only patients in whom the previous three scans were negative.
5. T₁ Sagital with a slice thickness of 5mm.
6. Gd enhanced scans in different planes were done only when the initial scans show a lesion which required further delineation and characterization with contrast enhancement.

RESULTS

Sample of this study consist of 50 patients with temporal lobe epilepsy who had MRI of the brain, there were 28 of them i.e (56%) female and 22of them i.e (44%) male. So male to female ratio 0.78: 1(Table1).

Table 1: show sex distribution

Sex	No. of patients	Percentage
Male	22	44%
Female	28	56%
Total	50	100%

The age of patients ranging between (6-70) years with the mean (25.8%), the patients age at seizure onset ranged from (1-68) years with a mean age of (18.5%), 31 patients had their seizure onset under or by the age of 20 years (early onset group), 19 patients had their seizure at or after the age of 21 years (late onset group).

The relationship between MRI finding and the age of seizure onset is demonstrated in (Table2), there were a higher tendency of those with late onset epilepsy to have an abnormal MRI (52.63%) compared with those with early onset epilepsy (35.5%).

Table 2: Show relation between age of onset and MRI finding

Age of onset	No. of patient	MRI finding	
		Normal	Abnormal
Early onset	31	20 (64.5%)	11 (35.5%)
Late onset	19	9 (47.36%)	10(52.63%)

The distribution of MRI finding according to seizure onset age show that infarct, non specific white matter ischemia and porencephaly found in the late onset group while mesial temporal sclerosis and developmental anomalies were found in the early onset group, tumor and vascular malformation found in both age group. 33 patients (66%) had complex partial seizure, 17 patients (37%) had simple partial seizure.

Table 3: Show type of seizure

Type of seizure	No. of patient	Percentage
Complex partial seizure	33	66%
Simple partial seizure	17	37%
Total	50	100%

The study show 4 patient had family history of epilepsy and there is no relation between family history of epilepsy and the detection of MRI abnormalities. Six patients had history of trauma, 4 of them show atrophy of the brain in the MRI while in 2 the MRI of the brain was normal.

Table 4: Show relation between history of trauma and the MRI finding

History of trauma	No.Of patient	MRI finding	
		Normal	Abnormal
Present	6	2	4
Absent	44	27	17
Total	50	29	21

The MRI finding were: normal MRI in 29 patients (58%) and abnormal MRI in 21 patients (42%) including brain atrophy in 5 patients, infarction 4 patients, mesial temporal sclerosis 2 patients, tumors 3 patients, developmental anomalies 1 patient, non specific white matter ischemia 2 patients, vascular malformation 2 patients.

Table 5: Show MRI finding in study sample

MRI finding	No. of patients	Percentage
Normal MRI	29	58%
Brain atrophy	5	10%
Infarction	4	8%
Mesial temporal sclerosis	2	4%
Tumors	3	6%
Developmental anomalies	1	2%
Porencephaly	2	4%
Non specific white matter ischemia	2	4%
Vascular malformation	2	4%
Total	50	100%

The duration of epilepsy at time of referral to MRI ranged from 1month to 18 years, 23 patients had epilepsy for < or equal to 2years at time of MRI examination, 11patients had epilepsy for (2 – 5) years, 10 patients had epilepsy for (5-10) years and 6 patients had seizure for (10 – 18) years. The MRI finding according to the duration of epilepsy show the highest percentage of abnormal MRI was found in those with seizure duration for < or equal to 2 years.

Table 6: Show distribution of different MRI finding according to the duration of epilepsy

MRI pathology	Duration (years)				Total
	≤ 2years	2 –5 years	5-10 years	10-18 years	
Tumors	2		1		3
Infarction	3	1			4
Mesial temporal sclerosis	1		1		2
Vascular malformation	1				1
Brain atrophy	2	1	2		5
Non specific white matter ischemia	2				2
Porencephaly	1			1	2
Developmental anomalies		1			1
Normal MRI	11	7	6	5	29

DISCUSSION

MRI has rapidly gained wide spread acceptance for the investigation of intracranial diseases. Absence of radiation, the high soft tissue contrast, multiplaner imaging capabilities, high spatial resolution with adequate signal to noise ration and the absence of CT related beam hardening artifacts, the latter restricting the assessment of temporal lobe and hippocampus, are all extremely important advantages of MRI over CT. [18]. MRI plays an important role in locating and defining anatomic epileptogenic foci. The present study revealed that MRI finding were normal in (58 %) of patient and abnormal in (42%) of patient while abnormalities found on MRI in (69.9%) of group of 73 patients with drug resistant epilepsy by Cakirer et al (2002). [19]

So detection rate in our study is lower than that study because Cakirer et al study was based on selected population of medically intreatable or refractory patient, while our study population was a mixture of patients with different severity and responsiveness to medical treatment. The incidence of mesial temporal sclerosis was low in this study (4%) while in Brooke et al study mesial temporal sclerosis was found on MRI in (21%). [20] .A general tendency towards non referral of patient with long duration of epilepsy, in addition to the non performance of coronal T1W scan for patients with initial scan show an extra hippocampal pathology are possible causes.

On a study by Elster and Mirza (1991) evaluated 150 patients with temporal lobe epilepsy using MRI, they found tumoral mass lesion 19 (12.7%) of their patient. In our work tumor found in 3 patient (6%) only and were found in early and late onset group.

Douglas (1971)[22] found that the risk of neoplasm decline with longer seizure duration. Considering infarction were detected in 4 patient representing (8%) of the whole study population this is comparable to the finding of Cakirer[19] who found cerebral infarct areas in 8(10.9%) of 73 epileptic patients .Regarding vascular malformation were detected in 2 patient (4%) who is comparable with the study of Bronen et al [23] who retrospectively analyzed the MR scans of 33 patient with tumor and 8 patients with vascular malformation. The present study revealed that brain atrophy were the most frequent MRI abnormality and were found in 5 patient (10%), 4 of them have history of trauma. Trauma is said to be the cause of seizure in 13–17% of epilepsy patients. [24]

Regarding early onset versus late onset seizures there was a higher tendency of the late onset group to have abnormalities on MRI (47.37%) compared with early onset group (35.5%).The commonest MRI finding in the late onset group was infarct (21.05%) the second commonest finding was brain atrophy (15.78%) our result differ from those of Alkllak et al (1999)[25] who found brain tumor followed by infarction to be the commonest two finding found in (38.5%) and (23%) respectively, similar result found in other study [26] .The commonest MRI finding in early onset group is mesial temporal sclerosis (18.2%) followed by vascular malformation and developmental anomalies (9.09%). Kramer et al [27] studied 143 children and adolescents with epilepsy, abnormalities on MRI were found in 50 patients (34.9%) compared with (35.5%)in our study which is slightly higher because their study included patient with both generalized and partial epilepsy. 23 patients in this study had seizure for ≤ 2 years with only 6 patients with seizure for

> 10 years and no patient had seizure for more than 18 years this reflect a general attitude toward non referring epileptic patient with long duration of seizure disorder for MRI.

CONCLUSION

- MRI has a high success rate in detecting and defining structural brain lesion associated with temporal lobe epilepsy, thus identifying surgical candidate.
- The detection rate of abnormalities on MRI was higher among patients with late onset seizure compared with patients with early onset seizure.
- The commonest MRI findings among patients with late onset seizure were infarction followed by brain atrophy while the commonest findings among patients with early onset seizure were mesial temporal sclerosis followed vascular malformation and developmental anomalies.
- The incidence of mesial temporal sclerosis in this study is low compared to other study, a general tendency toward non referral of patients with long duration of epilepsy for MRI is a possible explanation.
- The MRI finding according to the duration of epilepsy show the highest percentage of abnormal MRI was found in those with seizure duration for ≤ 2 years.
- There is no relation between family history of epilepsy and the detection of MRI abnormalities.

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