CLINICAL APPLICATIONS OF MAGNETIC RESONANCE IMAGING (MRI) IN EPILEPSY DISORDER

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ABSTRACT

Object: To determine the role and significance of Magnetic Resonance Imaging (MRI) in defining the etiology and severity of epilepsy.

Methods and material

The study population included the patients who were referred to the Department of Radio diagnosis with the complaint of Epilepsy. MRI of 1.5T Philips Achieva Nova was used. This study was an observational study on these patients which was a prospective observational study conducted on epilepsypatients. Plain and contrast MRI were performed to confirm the diagnosis.

Results: The role of MRI as a very important imaging tool in Epilepsy patients owing to its property of excellent soft tissue contrast. Different sequences and variety of recent advances e.g. Diffusion weighted

imaging however CT scan plays very important role as a diagnostic imaging modality especially in patients with epilepsy. MRI plays a very important role in hippocampus sclerosis with the help of epilepsy protocol.

Conclusion: CT scan has got very important role as a diagnostic imaging modality in seizure patients. MR imaging provides adjuvant role in imaging of patients where CT scan was normal or is not able to provide a definitive diagnosis. MRI technique with epilepsy protocol gives best result in hippocampus sclerosis.

Keywords:MRI,Epilepsy protocol,Hippocampus sclerosis

INTRODUCTION

Epilepsy is a common neurological disorder that has a varied presentation and requires two or more unprovoked seizures at least 24 hours apart for diagnosis. Epilepsy is very common, with ~3% of the population affected at some point in their life. Epilepsy is the fourth most commonnon-traumatic neurologic disorder in the United States, following only migraine, cerebrovasculardisease, and Alzheimer disease in prevalence [1]. An estimated 2.2 million Americans have epilepsy, and the incidence is nearly 150,000 new cases annually. One in 26 people will receive a diagnosis of epilepsy during their lives [2]. Worldwide, 50 million people have epilepsy, and the World Health Organization estimates an associated morbidity of nearly 7.5 million disability-adjusted life years (health years lost) by 2015 [3].

Epilepsy can be generally divided into two broad categories:-partial epilepsy and generalized epilepsy.

The most common finding of epilepsy seen in temporal lobe (60%) so it is mostly called temporal lobe epilepsy , frontal lobe (20 %) , parietal lobe (10 %) , Periventricular (5 %) ,and Occipital lobe (5 %). Approximately 10 – 30 % cases of epilepsy are refractory to medication. It is estimated that there may be as many as 200,000 potential candidates for epilepsy surgery in the United States [4].There is a wide range of causes of epilepsy, however in adults with new onset of seizure – 50% will not have any determined cause. The International League Against Epilepsy (ILAT) have beenproposed many types due to behalf of various causes like Idiopathic, Cryptogenic, Provoked epilepsy, Predominantly genetic, Predominantly Acquired.

Epilepsy has long been recognized and treated with antiepileptic medicines by the doctors but now a day most recent advances in neuroimaging like Magnetic Resonance Imaging (MRI) have rapidly change the

understanding of epilepsy and also the way of treatment. Magnetic Resonance Imaging plays a very important role in the diagnosis of epilepsy because of its excellent spatial resolution and its orthogonal planning. MRI is the best modality of choice in neuroimaging compare to CT scan because of its better resolution and better gray white matter differentiation especially in Hippocampus area. MRI is also useful in detection, localization of epileptogenic abnormalities of patients who having seizures compare to CT scan. MR Imaging has a high rate of success in the diagnosis of hippocampal sclerosis in temporal lobe epilepsy. The affected hippocampus is atrophic and hyper intense on both T2W and FLAIR (Fluid attenuated inversion recovery) sequence. Single – photon emission computed tomography (SPECT) and Positron emission tomography (PET) provides information that is complementary to MR Imaging diagnosis. Magnetic Resonance Imaging (MRI) is more useful compare to SPECT and PET scanning to diagnose the cause of seizures [5]. This paper will show the clinical application of MR Imaging in epilepsy and its related disorders.

MATERIAL & METHODS

The presentStudy was a prospective observational study,conducted in the department of Radiology, Uttar Pradesh University of Medical Sciences Saifai, Etawah (U.P.). This study was done on total 50 patients in between the period of one year. The diagnosis of patients was based on history of patients, clinical examinations and number of episodes of seizures.

MR Imaging Techniques and Brain Epilepsy Protocol

The experimental data has been generated by using PHILIPS 1.5 Tesla Achieva Nova by using Brain Epilepsy Protocol at the department of radiology UPUMS Saifai, Etawah.

In the radiology department MRI Scan was performed on 1.5T Philips Achieva Nova machine. MRI Sequence was used T1W & T2W fast spin echo and gradient echo in two orthogonal planes. T2 Fluid Attenuated Inversion Recovery (FLAIR) in axial plane and T2 Coronal oblique 2mm and T1 Coronal oblique 2mm with epilepsy protocol were used. T1 weighted post contrast scan were used by using intravenous contrast of Gadolinium chelate according to weight of patients.

PARAMETERS OF SEQUENCES:-

Image parameter for T2 Axial: –Time of Repetition (TR) 3000-4000, Time of Echo (TE) 100-120 , Slice thickness 5mm , Field of View (FOV) – 230 , Matrix size – 526x526

Image parameter for T2 Flair axial:- Time of Repetition (TR) 7000-9000, Time of Echo (TE) 100-110 , Slice thickness 5mm , Field of View (FOV) – 230 , Matrix size – 526x526

Image parameter for T1 Coronal:- Time of Repetition (TR) 400-600, Time of Echo (TE) 15-25, Slice thickness 5mm , Field of View (FOV) – 230 , Matrix size – 526x526

Image parameters for T2 Sagittal:- Time of Repetition (TR) 3000-4000, Time of Echo (TE) 100-120 , Slice thickness 5mm , Field of View (FOV) – 230 , Matrix size – 526x526

Image parameter for T2 Coronal oblique 2mm (Epilepsy protocol):- Time of Repetition (TR) 3000-4000, Time of Echo (TE) 100-120 , Slice thickness 2mm , Field of View (FOV) – 200 , Matrix size – 526x526 , Flip angle – 140 , Phase – A>P

Image parameter for T1 Coronal oblique 2mm (Epilepsy protocol):- Time of Repetition (TR) 400-600, Time of Echo (TE) 15-25 , Slice thickness 2mm , Field of View (FOV) – 200 , Matrix size – 526x526 , Flip angle – 140 , Phase – R>L

RESULTS AND DISCUSSION:

This study included total 50 patients, age ranges from 2 years to 40 years. Most of the patients were less than 30 years, which comprised 65% of total study population. Most of the patients of this study affected by hippocampal sclerosis40 % (20) patients and 20% (10) patients found parietal lobe ring enhancing lesions like Neurocystecercosis (NCC) or Tuberculoma. 12% (6)patients found normal scan and 18% (9) patients found dysplastic lesion and tumors and10% (5) patients affected by polymicrogyria.

Hippocampal Sclerosis

Hippocampal sclerosis also called as Mesial Temporal sclerosis and is mostly associated with complex seizures (60-85% cases). It is also known as most common structural abnormality in epilepsy patients. Hippocampal

sclerosis is pathologically defined as the loss of pyramidal and granule cell neurons in the Ammon horn and dentate area of hippocampus [6,7,8]. It can also be discovered on MRI, patients with adequately control on epileptic medication. The findings of hippocampal sclerosis on MRI, is the most valuable contribution of MRI to epilepsy surgery [9]. Hippocampal sclerosis is bilateral process; one side of hippocampus is affected than the other in 80% of cases. The side which is more affected is the origin of seizures in patient. The major MRI findings in hippocampal sclerosis are abnormal hyper intense signal on T2-weighted images and atrophy of hippocampus seen. Loss of the normal architecture of the hippocampus. This is best seen on Fast spin echo (FSE) or Inversion recovery (IR) sequence [10]. In our study 20 patients suffered with hippocampal sclerosis shown in Fig 1.

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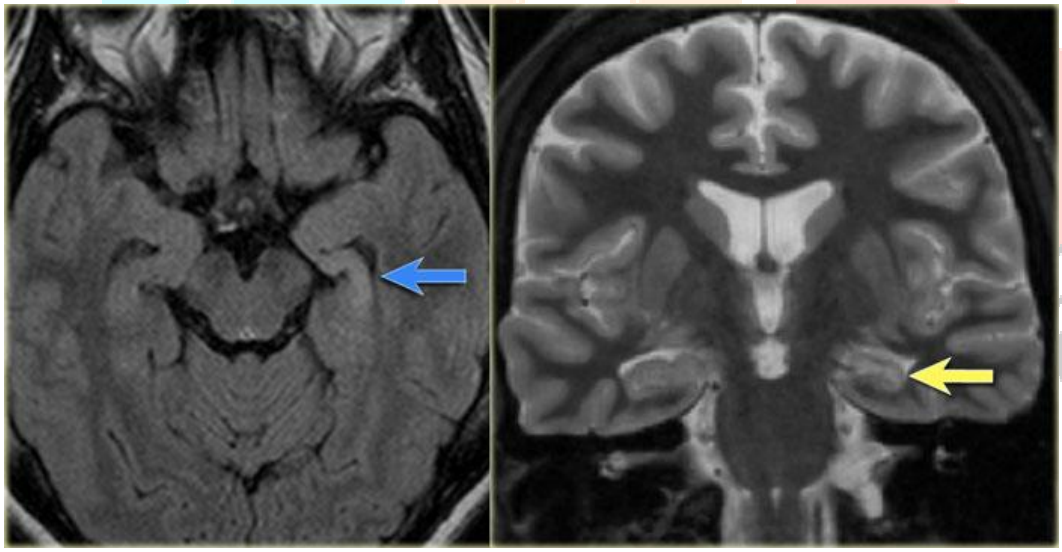

Fig.1 Hippocampus Sclerosis

Anatomy of Hippocampus

The hippocampus is found on the medial aspect of the temporal lobe situated above the parahippocampal gyrus and posteriorly to the amygdale. The hippocampus is divided in two segments on the basic of its shape and relationship to brainstem, the bulbous digitated head, body and a tail. The widespread connection to the brain by hippocampus and limbic lobe explain the significant role of the medial temporal lobe with seizure propagation (Fig. 2).

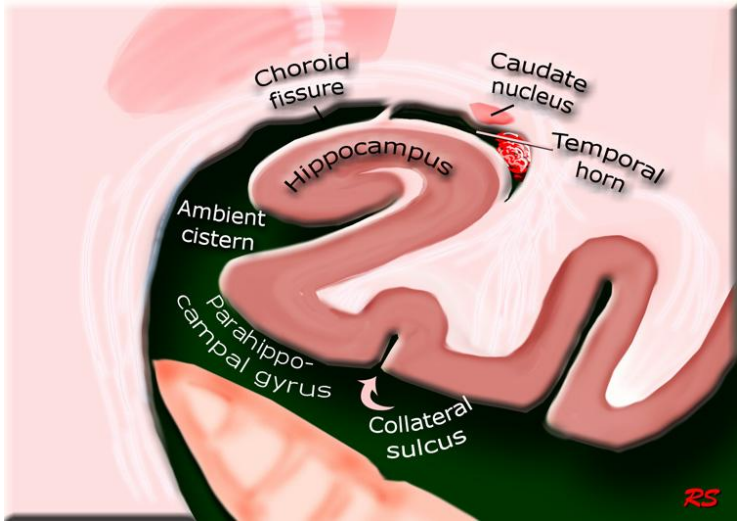

Fig.2 Diagrammatic representation of Hippocampus

Neurocysticercosis

It is a leading cause of seizures and epilepsy in the developing country and now days it is an increasingly important health issue. Cysticercosis is a parasitic infection that results from ingestion of eggs from the adult tapeworm, *Taenia solium* [11, 12]. When cysticercosis involves in to the central nervous system, it is called Neurocysticercosis. Neurocysticercosis is the most common parasitic infection of the brain and a leading cause of epilepsy in the developing country, especially America, India, Africa, and China. Cysticercosis now accounts for up to 10% of emergency room visits for epilepsy in the southwestern United States [13]. Neurocysticercosis is acquired through consumption of food contaminated with feces of a *T.* solium (through oral or fecal contract). Eggs of the tapeworm are shed in stool and contaminate food through poor hygiene. When these eggs are ingested and exposed to gastric acid in the human stomach, they lose their protective capsule and turn into larval cysts, called oncospheres. Oncospheres cross the gastrointestinal tract and migrate via the vascular system to the brain, muscle, eyes, and other structures. Once in the brain, the larval cysts (cysticerci) initially generate a minimal immune response and may remain in the brain as cysts [14,15,16]. NCC involves the generalized tonic - clonic seizure in patients. In adults and children first seen with new-onset seizures and active cysts, seizure recurrence rates at 4 years are as high as 49% [17]. NCC appears as ring enhancing lesion with perifocal edema. In our study NCC found in 10 patients.

Stages of Neurocystecercosis

There are four main stages of NCC, also called as Escobar's pathological stages shown Fig. 3

1- **Vesicular stage:** - In this stage parasite with intact membrane so no host reaction.

2- **Colloidal vesicular stage:-** Normally , patient come for scanning in this stage . In this stage membrane becomes leaky so more perifocal edema is seen. This is the most symptomatic stage of NCC.

3- **Granular nodular stage:**- In this stage edema decreases , enhancement seen.

4- **Nodular calcified stage: -** This is the end stage , no edema seen on scan , calcified cyst.

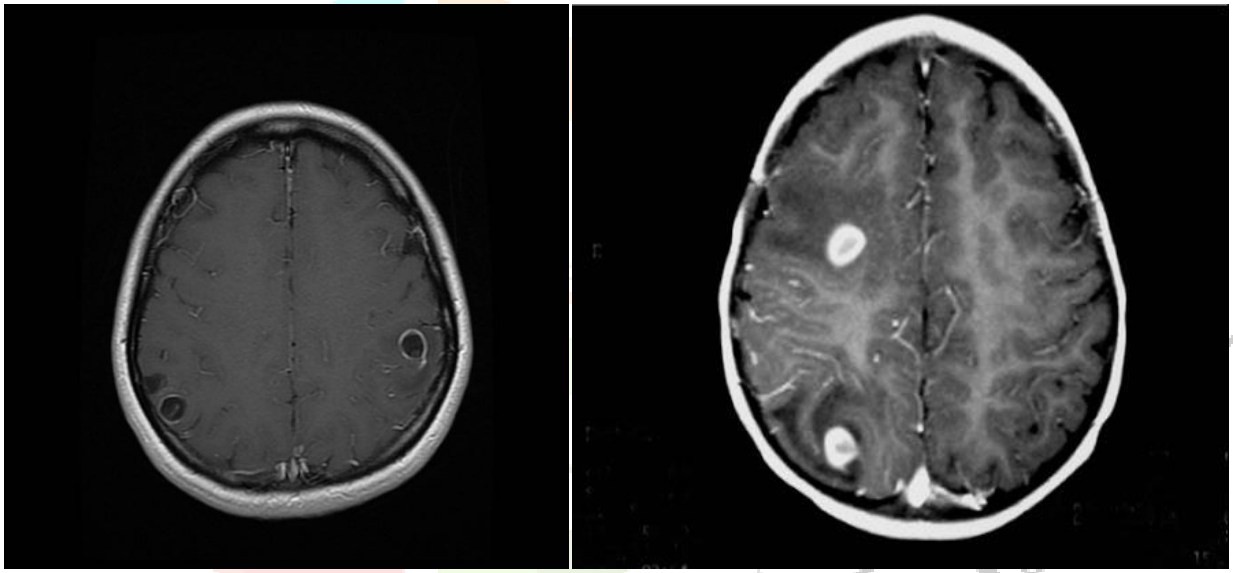

Fig. 3 Images of Neurocystecercosis (NCC)

Polymicrogyria

Polymicrogyria refers to the abnormality of cortical development characterized by excessive cortical thickening and numbers of small gyri and shallow sulci. A number of etiologic factors have been attached to polymicrogyria including prenatal cytomegalovirus infection, cerebral ischemia and genetic disorders [18, 19]. On MR imaging, polymicrogyria seen as thickened cortex and paradoxical smoothing of brain surface with poorly developed sulci. Long TR images show increased signal in the adjacent sub cortical white matter. In polymicrogyria perisylvian region is involve in 80% of cases. MRI is the best modality of choice in diagnosis

of polymicrogyria. The best diagnostic clue is focal cortical thickening.In our study polymicrogyria found in 5 patients (10%) shown in Fig. 4.

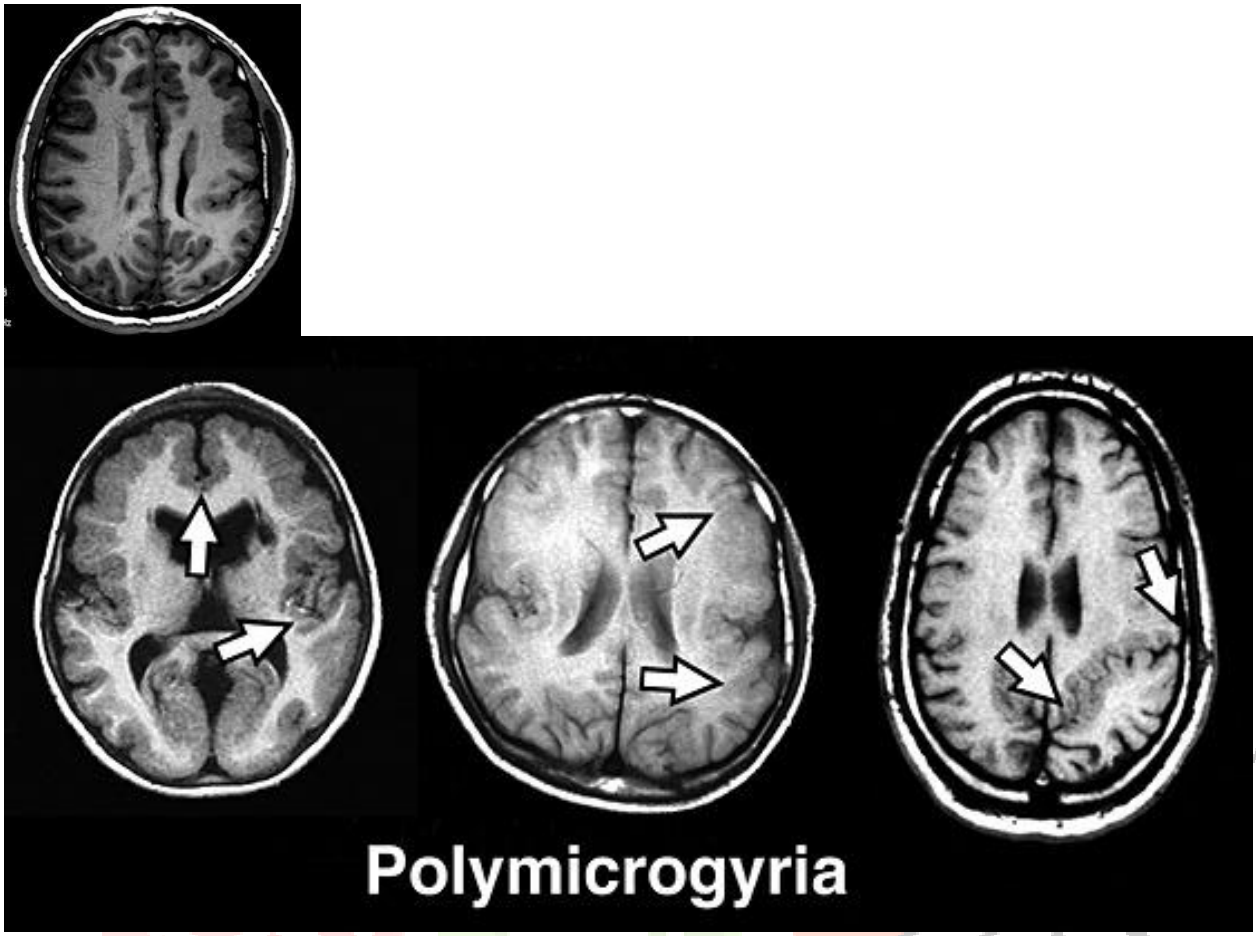

Fig. 4 Images ofPolymicrogyria

Tumours associated with epilepsy

Brain tumors are also responsible for epilepsy in patients. Glioneuronal tumors (70-80%) are most common in epilepsy patients. Seizures are also common in individuals with glioma, with the highest rates of epilepsy (60–75%) observed in patients with low-grade gliomas located in superficial cortical or insular regions. Across all brain tumors Glioneuronal tumors, including Gangliogliomas and dysembryo-plastic neuroepithelial tumors are most likely to have seizure as the presenting symptom [20, 21, 22, and 23]. 50- 76% of the patients with cerebral neoplasm present with epilepsy. In our study brain tumors found in 18% (9) patients.

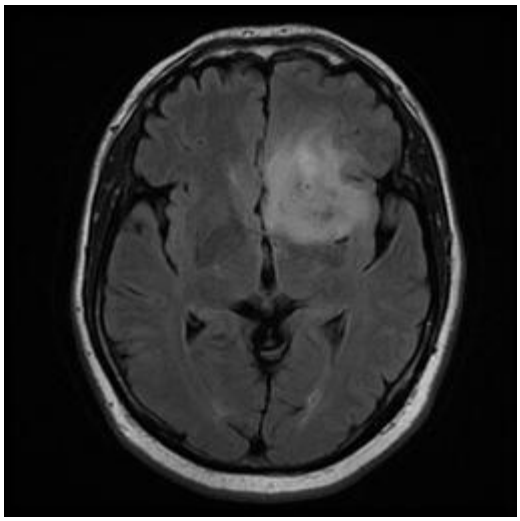

Fig. 5 Images of Tumours associated with epilepsy

CONCLUSION :

MR imaging provides adjuvant role in imaging of patients where CT scan is normal or is not able to provide a definitive and accurate diagnosis of the cause of seizure in a patient is crucial for finding an effective treatment. MRI technique with epilepsy protocol gives best result in hippocampus sclerosis to be highly sensitive and specific in identifying the underlying pathology in partial epilepsy.

CONFLINCT OF INTEREST: There are no any conflinct of interest by author side.

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