International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Magnetic Resonance Imaging of Adults Presenting with First Onset Seizure

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Abstract: ***Seizures are a common medical emergency and presentation to emergency departments. All seizure cases needs thorough assessment by a neurologist and require proper neuroimaging. The initial investigation of the patients presenting with seizures is commutated Tomography. However, Magnetic Resonance Imaging (MRI) is the modality of choice for proper assessment. This study aims to classify brain imaging findings in adults aged between 18 to 80 years who have presented with the first onset of seizures. Methods: This is a prospective observational study done in the Department of Radiodiagnosis, Jorhat Medical College and Hospital from January 2023 to December 2024. The imaging features of patients aged between 18 to 80 years, presenting with the first onset of seizures have been analyzed. Results: In our study, 50 patients presenting with seizures were investigated with CT and MRI. Out of 50 patients aged from 18 to 80 years, 46% (n=23) of the patients do not have any abnormalities.18 % (n=9) of the patients show infectious lesions.20 % (n=10) of the patients have infarction or bleed.6% (n=3) of the patients have intracranial tumors and 10% (n=5) of the patients have other miscellaneous findings. Conclusion: 54% out of the 50 people undergoing MRI imaging show positive findings. The rest 46% do not show any positive findings.***

Keywords: seizures, brain imaging, MRI, CT scan, neuroimaging

1. Introduction

Seizures are characterized by brief manifestations of symptoms brought on by abnormally high or synchronized neural activity in the brain, as stated by the International League Against Epilepsy. Paroxysmal discharge from clusters of neurons, brought on by neural activation or inhibition, is the primary pathology. As a life - altering experience, an unprovoked first seizure greatly raises the risk of intracranial abnormalities.

The main stray of investigation in a patient presenting with the first onset of a seizure is MRI (Magnetic Resonance Imaging). MRI is more sensitive for detecting early disease. Appropriate history regarding the onset and type of seizure is very important**.**

2. Materials and Methodology

Patients who presented with the first onset of seizure falling in the age group of 18 years to 80 years in Jorhat Medical College and Hospital are being evaluated for any intracranial positive finding by undergoing imaging studies in the Department of Radiodiagnosis in Jorhat Medical College and Hospital.

a) Protocol
A dedicated head coil is used for imaging studies on patients presenting with the first onset of seizures. MRI sequences that are used are axial and sagittal T1W images to see the cortical thickness and grey - white matter junction. Axial T2W/FLAIR is done to see any abnormal hyperintensities in the subcortical and cortical regions. Axial DWI/ADC sequence is very important to find out if any diffusion restriction is present. Axial T2*/SWI sequences are used to find any blooming artifact indicating hemoglobin breakdown. Axial T1 post - contrast image is a very important sequence to find out if any enhancement pattern is present. Perfusion MRI is done in patients with cerebral infarction.

b) Criteria for inclusion and exclusion -
The patient in the age group of 18 years to 80 years, presenting with the first onset of seizure have been included in the study.
The patients with known causes of epilepsy disorder have been excluded from the study.

3. Results

Our study was a retrospective hospital - based cross - sectional study of 50 patients presenting with new - onset seizures. The age group of 18 - 80 years was included in the study. Of the total 50 patients, 34 were males and 16 were females.

Most of the patients presenting with new onset seizures have no detectable abnormality in the brain. Post - ischemic/hemorrhagic changes are the most common pathological finding followed by infection and intracranial tumors. Vascular malformation and mesial temporal sclerosis account for 2 % each.

For patients presenting with new onset seizures above 65 years of age, the most common etiology is post - ischemic/hemorrhagic changes.

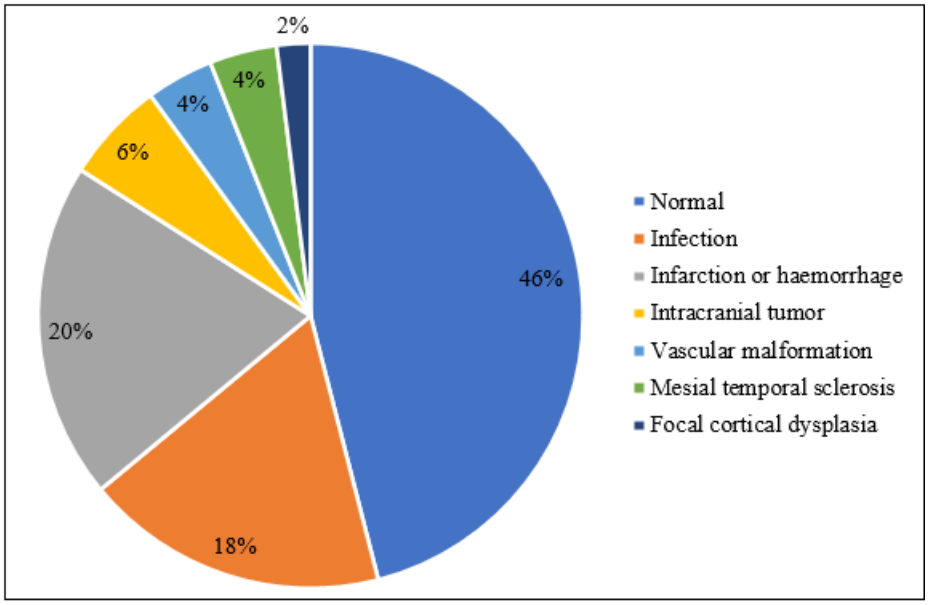


Figure 1: MRI findings of cases presenting with new - onset seizure

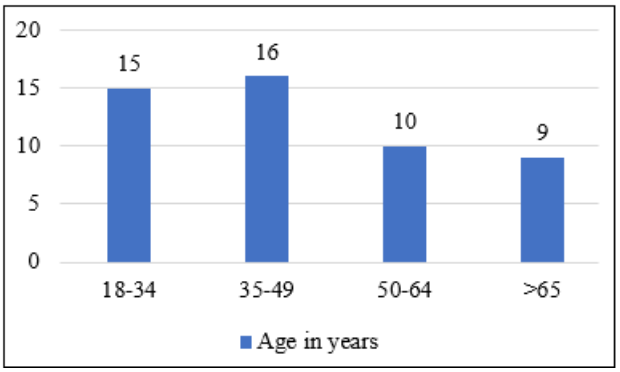


Figure 2: Age - wise distribution of cases presenting with new onset seizures.

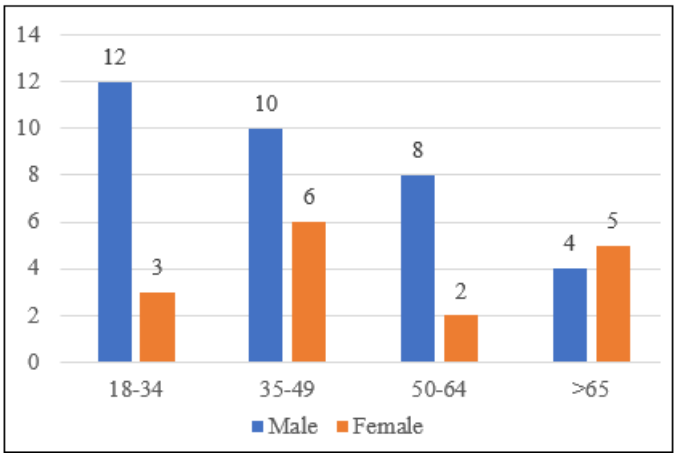


Figure 4: Distribution of the cases according to sex in different age groups

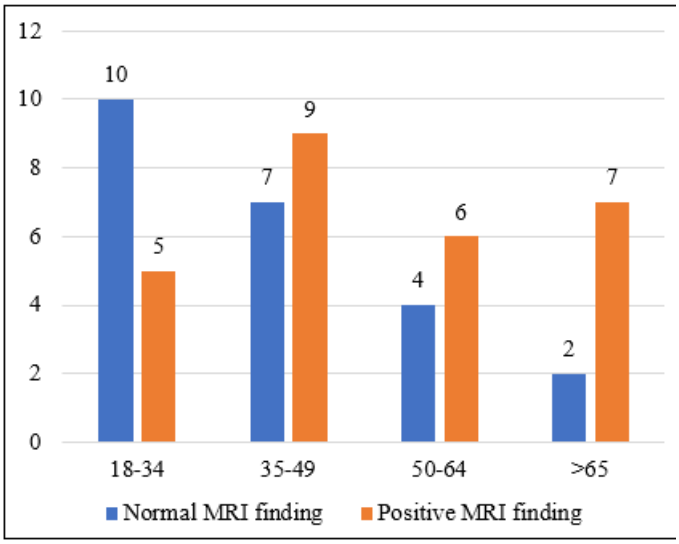


Figure 3: Age - wise distribution of normal and positive findings of MRI

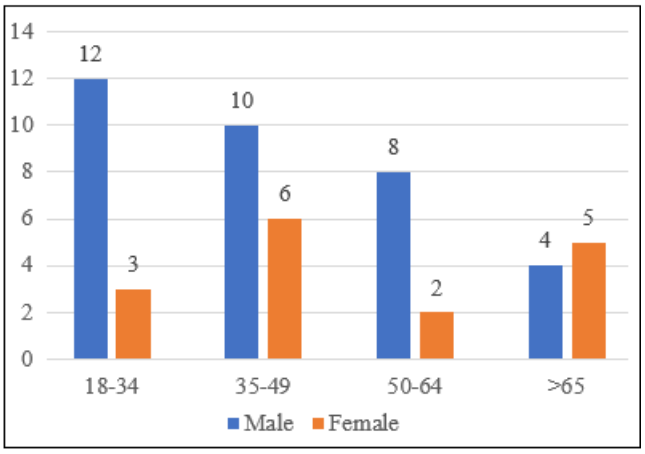
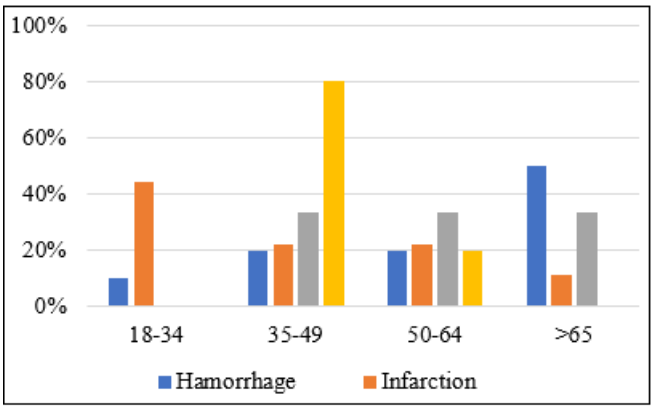


Figure 5: Distribution of cases according to different age groups



4. Discussion

The potentially epileptogenic lesions are revealed by MRI in a majority of patients who have been newly diagnosed with seizure disorder. In our study, a large proportion (46%) of the patients did not show any detectable cause on MRI study of the brain.

Infections are prevalent etiologies of seizures, encompassing viral encephalitis, bacterial meningitis, and abscess development. Parasitic or fungal infections can induce seizures in adults, particularly in immunocompromised individuals. In our investigation, among the 9 patients with seizures of infectious origin, 4 had tuberculoma, 3 had neurocysticercosis, and 2 had Japanese encephalitis. Tuberculoma constitutes 15 - 50% of cases in poor nations. The MR characteristics of the tuberculoma are contingent upon whether the granuloma is non - caseating, caseating with a solid core, or caseating with a liquid core. The noncaseating granuloma exhibits iso/hypointensity on T1 - weighted imaging and hyperintensity on T2 - weighted images. The granulomas exhibit uniform enlargement upon contrast injection. The caseating solid granuloma typically presents as isointense or hypointense on T1 - weighted images, featuring an isointense or hyperintense rim, and appears isointense to hypointense on T2 - weighted scans. The lesions exhibit rim enhancement on post - contrast imaging. The granulomas exhibiting central necrosis appear hypointense in the center on T1 - weighted images and hyperintense on T2 - weighted imaging, demonstrating rim enhancement following contrast delivery.3 Neurocysticercosis is the predominant etiology of newly developed seizures in India. Inflammation next to the cysticercosis presents as an abrupt seizure condition. During the inflammatory phase induced by the deceased parasite, cerebral cysticercosis lesions manifest as small enhancing rings on CT and MRI, accompanied by varying degrees of edema in the adjacent brain tissue.[4]

Japan, Korea, and India are among the countries where JE is prevalent in the population. In most cases, the brain stem, cerebral cortices, cerebellum, cerebral white matter, and spinal cord are not involved in JE lesions; nevertheless, the substantia nigra, basal ganglia, and thalami are frequently affected. Five and six. On the other hand, JE in children and adults may present differently in terms of lesion size, location, number of affected locations, and extent. The endemic area shows good specificity for T2WI hyperintensities in thalami for JE.[5, 11]

Vascular malformations Some vascular malformations may present with epilepsy. Cavernous malformation is the most common vascular malformation that sometimes presents seizures. Arteriovenous malformations may sometimes cause seizures when secondary hemorrhage or mass effect occurs. MRI helps in better characterization and making a definitive diagnosis preoperatively. In our study out of 3 patients with vascular malformation presenting with seizure, 2 patients were diagnosed with cavernous malformation, and 1 patient was diagnosed with arteriovenous malformation. One of the most important things to look for when analyzing a cavernous malformation MRI is a full hemosiderin ring, which may be detected with the T2 sequence. Apart from recent bleeding, other distinguishing features include the absence of edema and the presence of blooming artifact on the T2 GRE sequence.[7]

Trauma, ischemia, and hemorrhage Trauma and stroke are major etiology for epilepsy in young to older adults. In general, such lesions do not represent a dilemma either in detection or in diagnosis. In our study, 6 patients presenting with new onset of seizures had been diagnosed with infarct with or without secondary hemorrhage.4 patients in our study with a history of a significant road traffic accident have been found to have a diffuse axonal injury. However, in some selected cases, the MRI may assist in lesion characterization and management.

The symptoms of mesial temporal sclerosis include a degeneration of the dentate gyrus's pyramidal and granule cells as well as neurons, as well as a reconfiguration of the hippocampus and signs of altered energy metabolism. The majority of cases of temporal lobe epilepsy are caused by mesial temporal sclerosis. When these individuals' MR abnormalities are correlated with their EEG, it becomes a valuable indicator of therapy efficacy.[8]

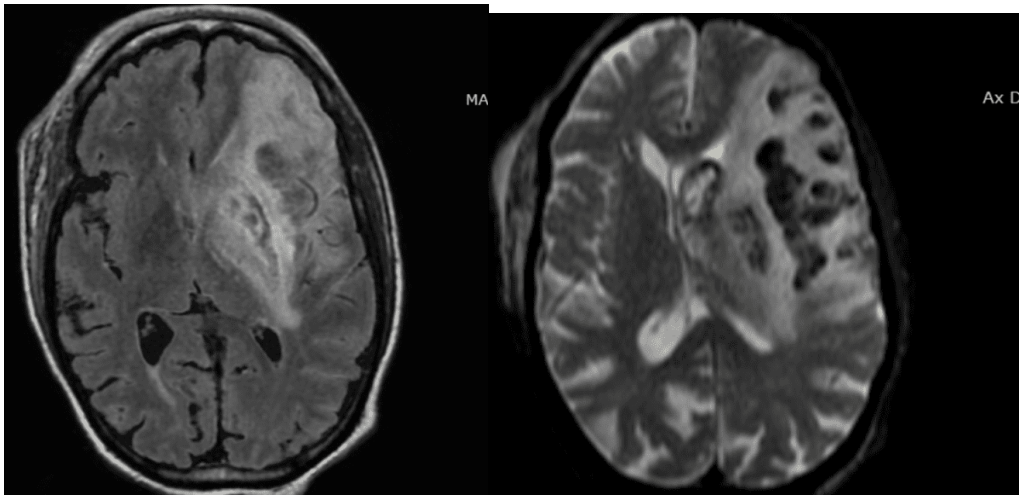
T2 strong signal and hippocampal atrophy are MRI findings found with MTS. Loss of hippocampus internal architecture, which is characterized by reduced grey - white matter distinction, is another observation. Ipsilateral fornix and mamillary body atrophy are secondary findings. Additionally, the ipsilateral temporal lobe and hippocampus collateral white matter atrophy can be observed. In most situations, these secondary results aren't very useful because they're associated with advanced MTS and can be misleading if the main abnormality isn't first observed.[9]

Tumors - Most of the intracranial tumor can cause a seizure. In our study, 2 of the patients presenting with new - onset seizures have been diagnosed to be meningioma and another patient has been diagnosed to be glioblastoma. Meningiomas are the most common non - glial tumors affecting the central nervous system. MRI is the modality of choice for investigating meningioma.

Various other women experiencing convulsions when pregnant along with hypertension and proteinuria are referred to have epilampsia. Researchers have found that the occipital lobes are the most common site of white matter edema in eclamptic women.[10]

5. Cases

Case1



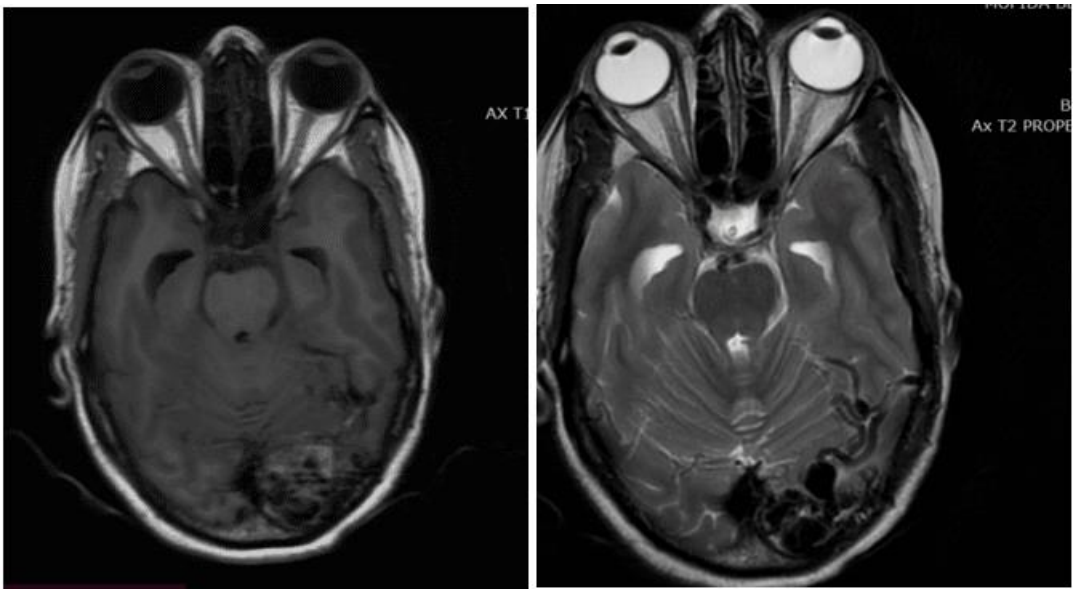
A B

64 - year - old female presenting with new - onset seizure and altered mental status, with imaging features consistent with cerebral infarct.

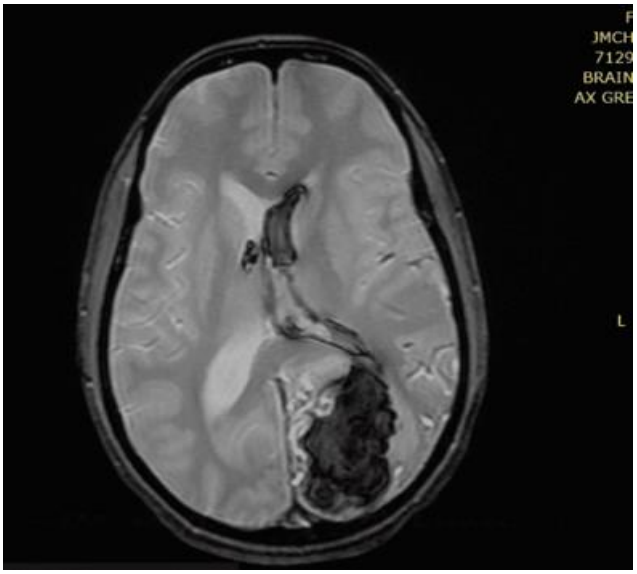
T2 image axial (A) shows hyperintensity involving the cortical and subcortical region of the left fronto parietal lobe and left basal ganglia.

GRE image (B) shows a blooming artifact noted in the involved areas suggestive of hemorrhagic transformation.

Case 2



A **B**



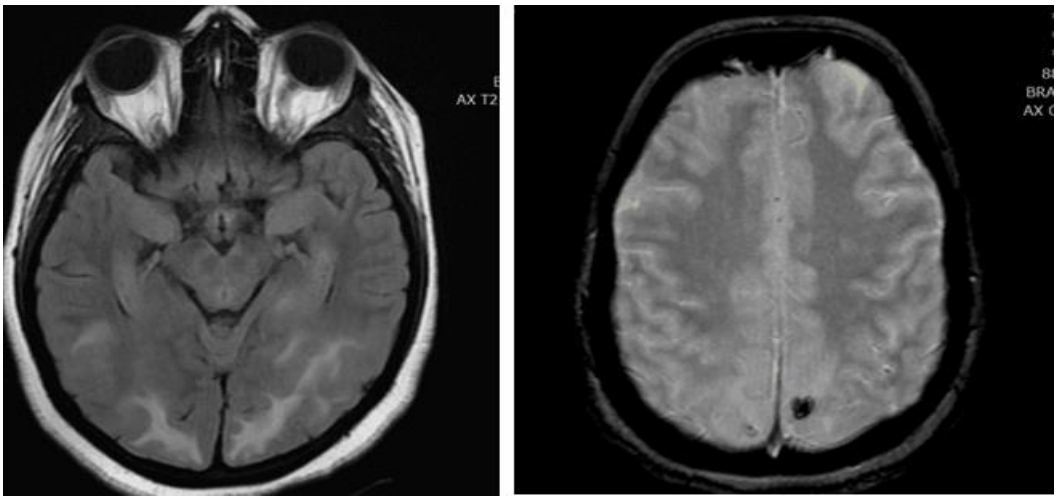
C

Patient of 25 years of age presenting with seizure with the imaging finding consistent with cerebral AVM.

T2 axial images (A and B) demonstrate a large nidus with prominent flow voids in the left occipital lobe.

C GRE (C) image shows a blooming artifact in the left occipital lobe with extension to the lateral ventricles (Left>Right)

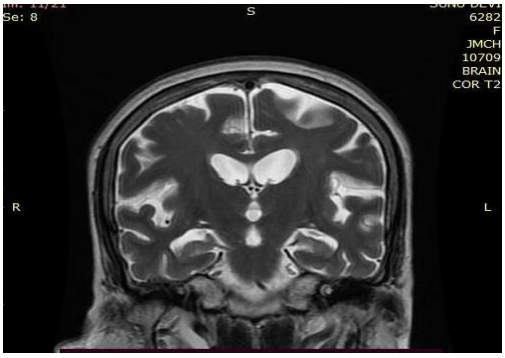
Case 3



A **B**

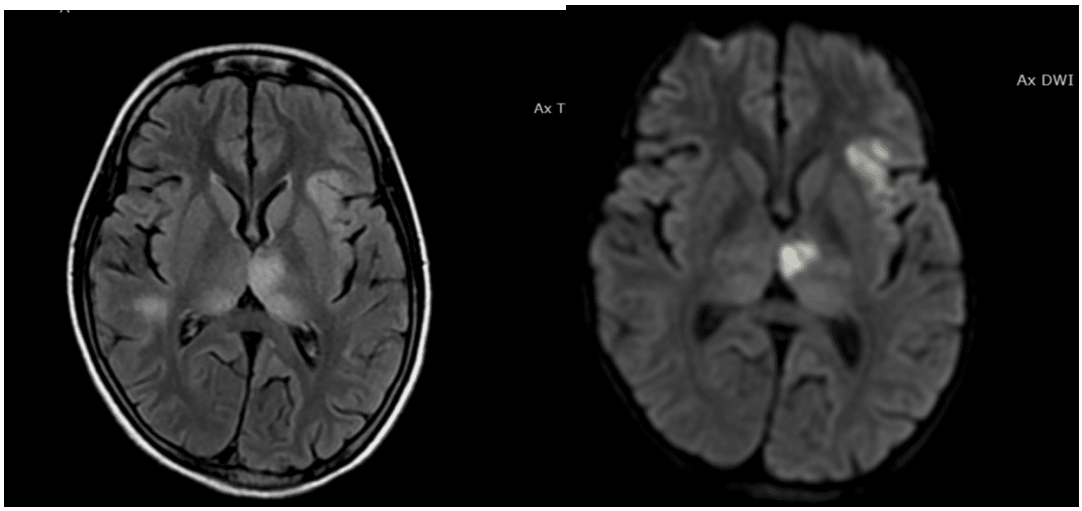
35 - year - old pregnant female presented with a new onset seizure. The imaging findings are consistent with PRESS. T2W image (A) shows vasogenic edema involving the posterior parietal lobes. GRE image (B) shows a blooming artifact at the left posterior parietal lobe which is suggestive of a microbleed.

Case 4



A 40 - year - old male has been brought to the emergency room and presented with one episode of seizure. The coronal T2W image shows a reduction in the height with a loss of architectures of the bilateral hippocampus. The imaging features are consistent with Mesial temporal sclerosis.

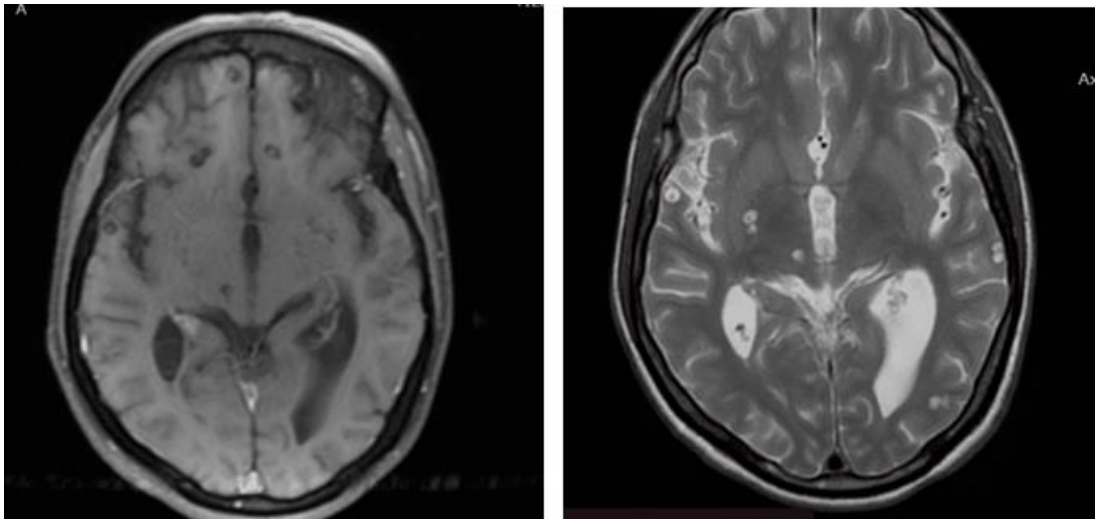
Case 5



A **B**

Patient with a known case of Japanese encephalitis came with a new - onset seizure. T2W image (A) of the patient shows hyperintensity involving the bilateral thalamus, subcortical region of the right parietal lobe, and left parasylvian area. On DWI (B) there is significant diffusion restriction involving the left thalamus and left perisylvian area

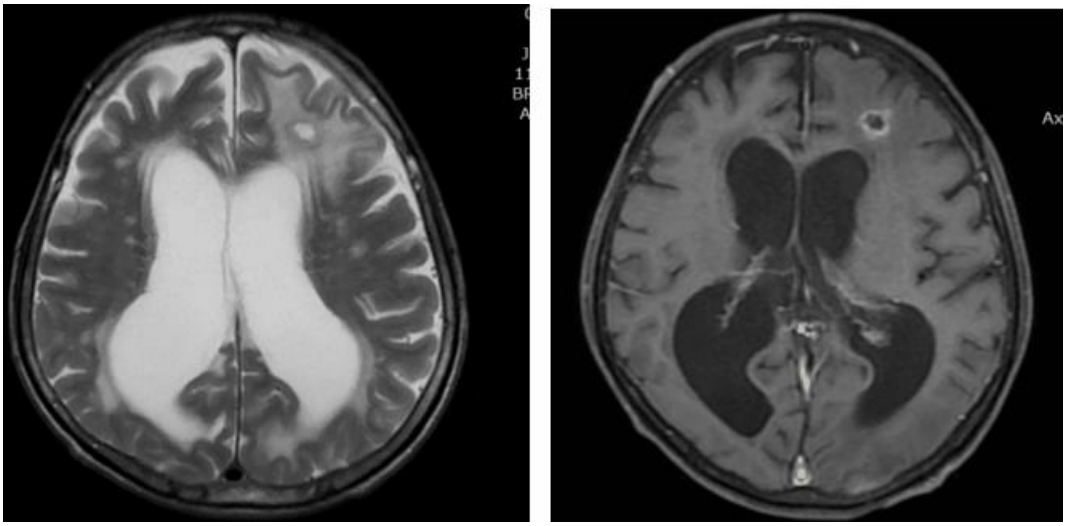
Case 6



A **B**

Patient presenting with new onset of seizure shows multiple hypointense lesion noted in bilateral frontal, right parietal lobe and midbrain in the right side on T1W image (A). There is T1 hyperintense foci noted in the lesion giving a typical appearance of scolex formation. On T2 WI (B) the corresponding lesions appear hyperintense. There is evidence of perilesional edema suggesting it to be in the vesicular stage of neurocysticercosis.

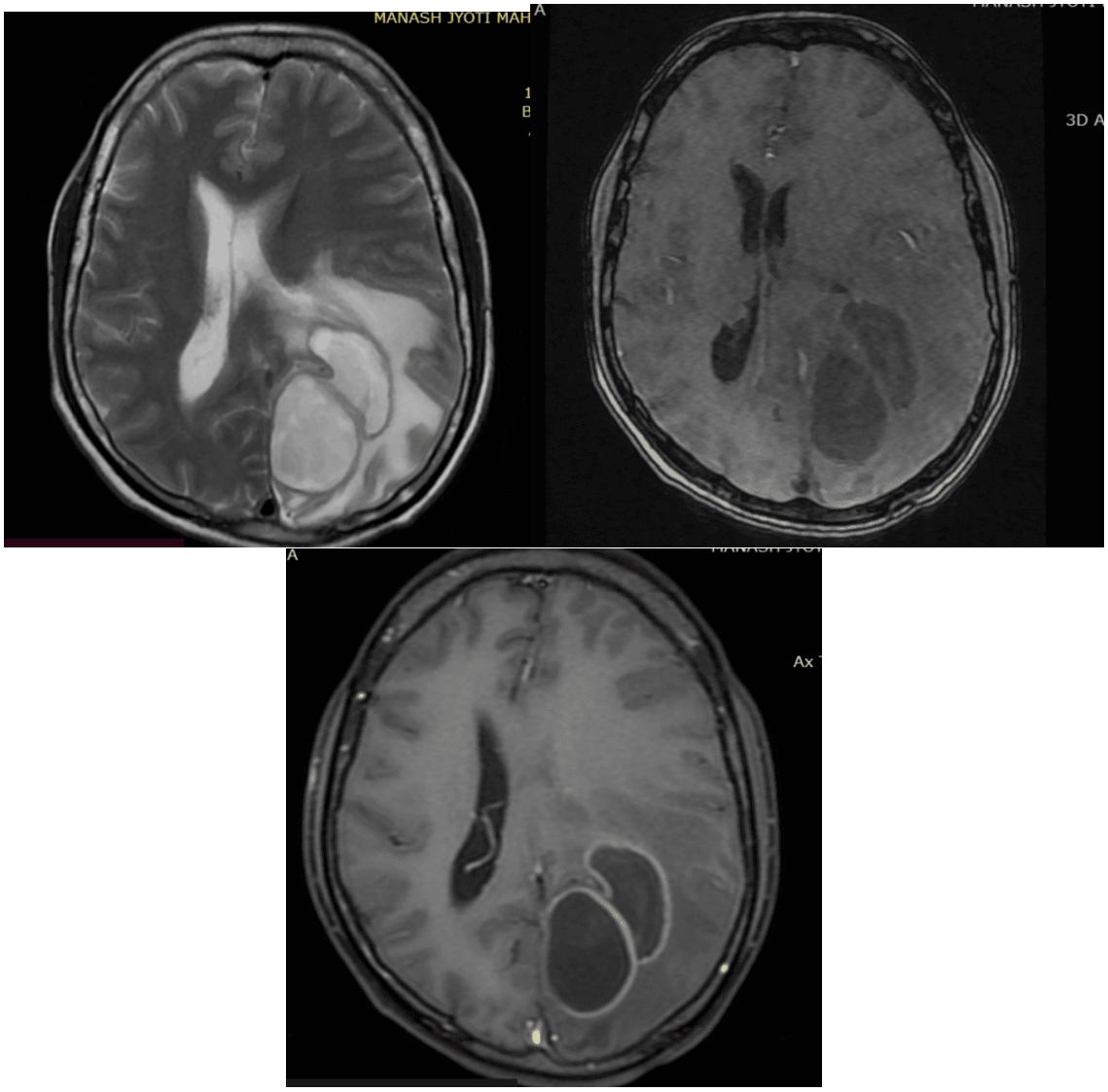
Case 7



A B

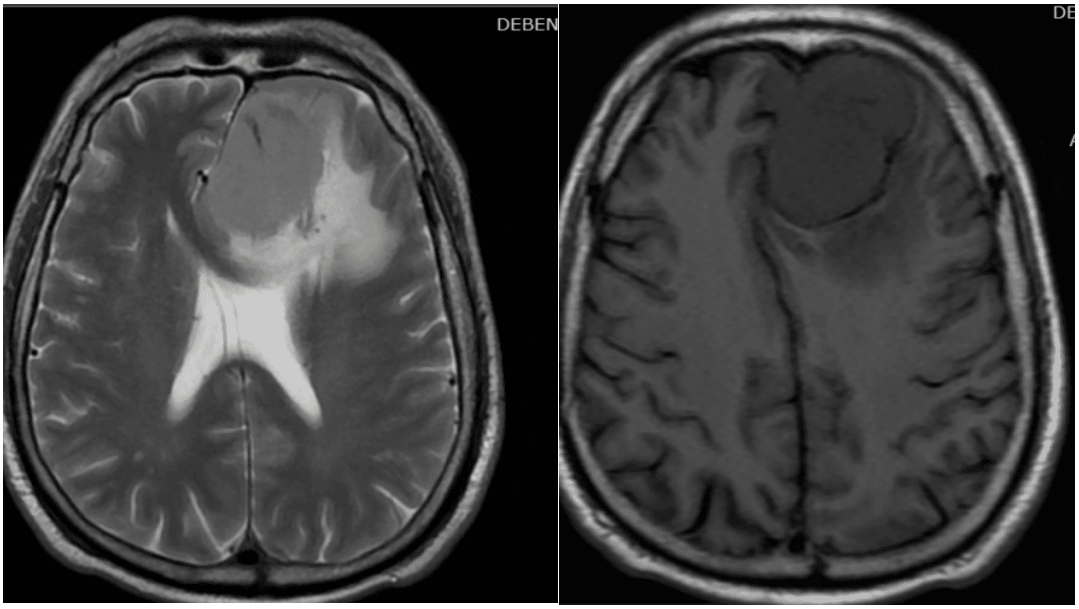
Patient with known case of pulmonary tuberculosis presented with new onset of seizure, shows T2 (A) hyperintense lesion in the subcortical area of right frontal lobe with extensive perilesional edema. On post - contrast T1 WI (B) the lesion shows peripheral enhancement which is consistent with tuberculoma.

Case 8



Patient with new onset seizure shows T1 (A) hypointense and T2 (B) hyperintense cystic lesion in the noted in the left parietal lobe with perilesional edema. On post - contrast axial image (C) there is there is peripheral enhancement of the lesion noted. The findings are consistent with the brain abscess.

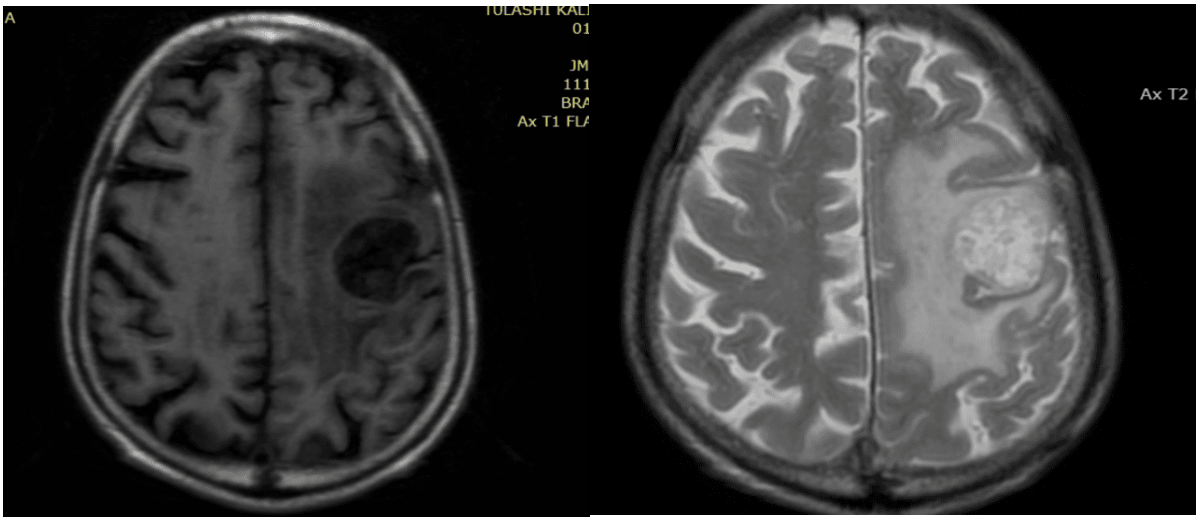
Case 9



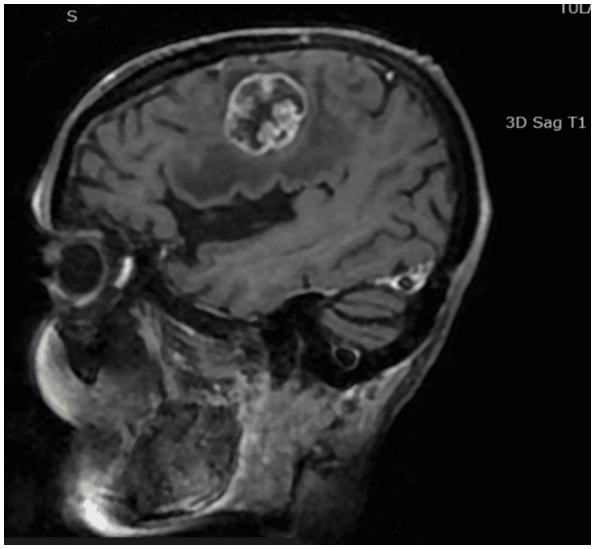
A **B**

56 - year - old patient presented with the first episode of a seizure. On imaging shows an extra - axial T2 (A) hyperintense and T1 (B) hypointense lesion in the left frontal lobe with a CSF cleft sign. The imaging features are consistent with meningioma

Case 10



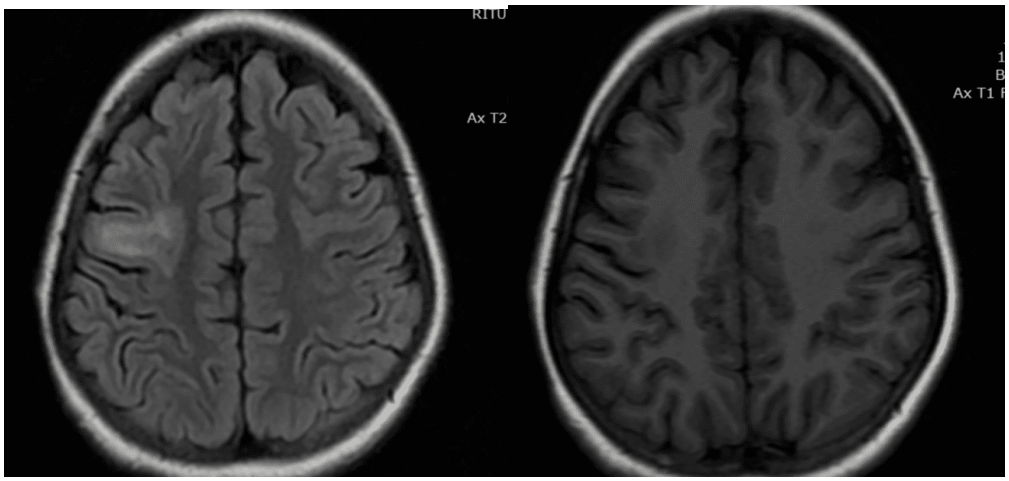
A **B**



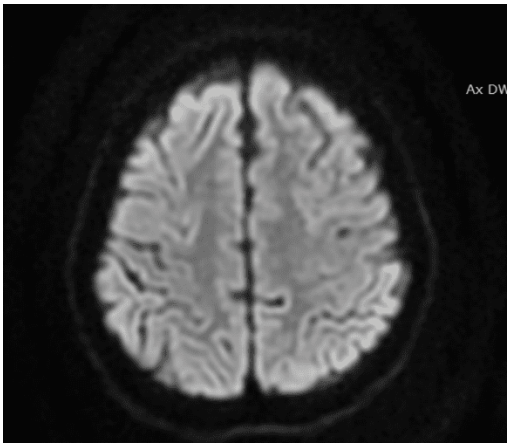
C

Patient aged 57 years presenting with first onset seizure shows T1 (A) hypointense and T2 (B) hyperintense lesion noted in the left frontal lobe with extensive perilesional edema in axial image. There is effacement of the adjacent sulci and gyri. On T1 post - contrast sagittal image (C), the lesion shows heterogenous enhancement with hypointense area at the central part of the lesion suggesting to be necrotic changes. On HPE correlation, the lesion found out to be Glioblastoma Multiforme

Case 11



A **B**



C

27 years old patient presenting with first onset seizure shows T2 FLAIR (A) hyperintense area noted in the right side high frontal lobe with no evidense of perilesional edema giving a typical appearnance of 'Transmantle sign'. On DWI

(C) there is no restricted diffusion in the involved area. On T1 (B) WI thre is no significant abnormality noted. The findings are consistent with focal cortical dysplasia.

6. Conclusion

MRI is the main diagnostic modality for the evaluation of patients with new - onset seizures in the outpatient setting to evaluate for underlying structural causes. The decision to perform the MRI with IV contrast should be considered taking into account the higher frequency of cerebrovascular lesions and tumors as identifiable seizure causes with increasing age**.** MRI has improved our ability to detect epileptiform foci in patients presenting with first - time seizures. Though the first investigation done is CT, there is an opportunity for further research to be done on the role of MRI in patients with the first seizure. Therefore, in a patient with a normal MRI further investigation is done to find out the cause of seizure and to find out the epileptiform focus.

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