Role of Magnetic Resonance Imaging in Assessment of Structural Abnormalities with Epilepsy Protocol in Epileptic Patients

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***Abstract*: Epilepsy is a neurological disorder characterized by recurrent seizures resulting from abnormal electrical discharges in the brain. The role of Magnetic Resonance Imaging (MRI) in assessing structural abnormalities in epileptic patients has been widely recognized. This study aimed to evaluate the efficacy of MRI in detecting potential epileptogenic lesions, particularly using specialized epilepsy protocols. A retrospective study design was adopted, reviewing the medical records of 50-70 epilepsy patients across various age groups at Hamdard Imaging Centre, Delhi. High-resolution 1.5 Tesla MRI was used to identify structural abnormalities. Results highlighted the importance of MRI in epilepsy management, demonstrating that mesial temporal sclerosis (MTS) and focal cortical dysplasia (FCD) are among the most common structural causes identified. Further studies are recommended to explore advanced imaging techniques and their clinical applications.**

Introduction:

Epilepsy is a neurological disorder characterized by sudden and involuntary disturbances in motor, sensory, or autonomic functions, caused by abnormal electrical discharges in the central nervous system (CNS). Approximately 50 million people worldwide are affected by epilepsy, which can develop at any age and is defined by recurrent seizures originating in the brain. Seizures are typically described as temporary signs and symptoms resulting from excessive neuronal activity and can be categorized as either focal or generalized. Temporal lobe epilepsy (TLE) is the most prevalent form of partial epilepsy in adults, with varied causes. Mesial temporal sclerosis (MTS), characterized by neuronal loss and gliosis in the hippocampus and nearby cortices, is a common cause of TLE, along with focal cortical dysplasia (FCD) and low-grade tumors such as ganglioglioma.

Epilepsy often manifests as tonic-clonic seizures, which begin with muscle stiffness causing the individual to fall, followed by alternating muscle contractions and relaxations. These seizures may start as focal seizures in a specific brain region and progress to generalized seizures involving the entire brain. Generalized seizures typically result in loss of consciousness, whereas focal seizures may or may not. Current antiepileptic medications can only suppress seizures without addressing the underlying epileptogenic tendency and are effective for about 60-70% of patients. After an initial seizure, an MRI scan is useful for identifying serious conditions like brain tumors or arteriovenous malformations. Surgery remains the most effective treatment for managing seizures, particularly for those with refractory focal epilepsy. Neurosurgical resection can provide a potential cure by targeting the precise epileptogenic focus identified through MRI.

Imaging plays a crucial role in evaluating epilepsy by pinpointing the source of focal seizures and identifying underlying causes. Uncontrolled seizures can lead to brain damage, cognitive decline, and reduced quality of life. Magnetic resonance imaging (MRI) can detect epileptogenic brain lesions, and advancements in neuroimaging techniques, post-acquisition analytical methods, and machine learning can help identify specific disease subtypes. Certain lesions, such as focal cortical dysplasia, may present different MRI characteristics depending on the patient's age. For example, in infants, the white matter near FCD may show distinct T1 and T2 signal changes due to varying stages of myelination, which can differ in children and adults. Moreover, the appearance of FCD and other lesions may evolve due to brain development or seizure-related changes.

For patients with localization-related refractory epilepsy, MRI should be high-resolution, multi-planar, and multi-sequence (8). Advanced sequences and ultra-high-field MRI can produce high-quality data for extracting diagnostic features of structural or functional brain anatomy.

Electroencephalography (EEG) is commonly employed to identify epileptic seizures because it is cost-effective, portable, and capable of displaying unique rhythms in different frequency ranges. EEGs measure the brain's bioelectric activity by detecting voltage fluctuations among neurons. Functional MRI (fMRI), a non-invasive technique used in clinical practice, can detect subtle hemodynamic changes in the brain during regional activation and assess memory function. However, more research is needed to fully explore its potential in clinical settings.

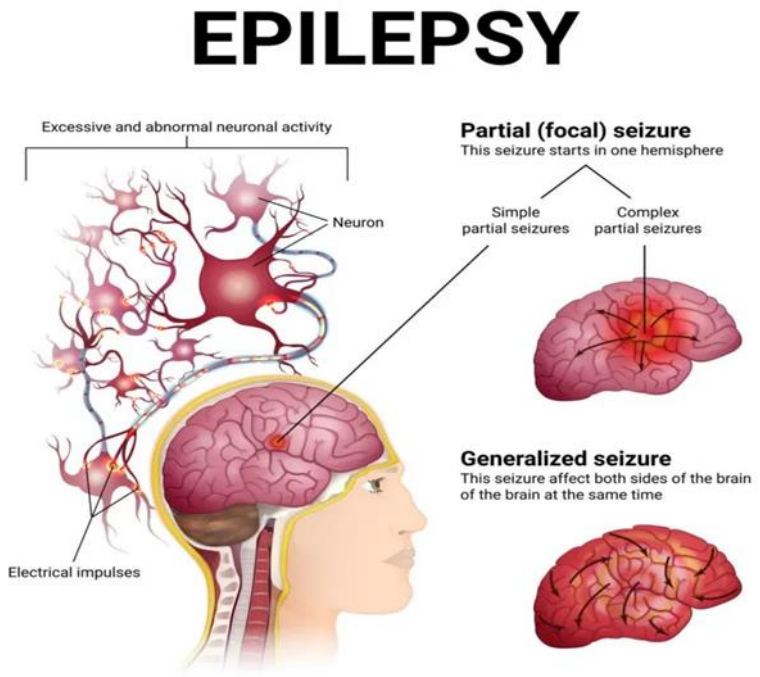


Fig 1. Showing abnormal neuronal activity and generalized and partial epileptic seizures.

ANATOMY OF BRAIN

The brain is a highly complex organ that governs thought, memory, emotion, touch, motor skills, vision, breathing, temperature regulation, hunger, and all processes that control the body. In an average adult, the brain weighs about 3 pounds and is composed of approximately 60% fat, with the remaining 40% consisting of water, proteins, carbohydrates, and salts. The brain contains blood vessels and nerve cells, including neurons and glial cells. Together, the brain and spinal cord form the central nervous system (CNS).

The CNS is divided into two regions: gray matter and white matter. Gray matter, the darker outer region, consists mainly of neuron somas (central cell bodies), while white matter, the lighter inner region, comprises axons (long nerve fibers) wrapped in myelin (a protective sheath). Gray matter is primarily involved in processing and interpreting information, whereas white matter transmits signals between different parts of the nervous system.

The brain can be divided into three main parts: the cerebrum, brainstem, and cerebellum. The cerebrum, located at the front of the brain, is the largest section, consisting of gray matter (the cerebral cortex) on the surface and white matter at its core. It is responsible for initiating and coordinating movement, regulating temperature, and processing sensory information. The cerebral cortex is divided into two hemispheres, each controlling the opposite side of the body. The hemispheres communicate via the corpus callosum, a bundle of

white matter and nerve fibers located in the center of the cerebrum. The surface of the cerebral cortex is characterized by ridges (gyri) and folds (sulci).

The brainstem, situated in the middle of the brain, connects the cerebrum to the spinal cord. It consists of three parts: the midbrain, pons, and medulla. The midbrain (or mesencephalon) is a complex structure containing various neuron clusters (nuclei and colliculi), neural pathways, and other features that facilitate functions such as hearing, movement, and responses to environmental changes. The pons, located between the midbrain and medulla, is the origin of four of the 12 cranial nerves, which are involved in functions like tear production, chewing, blinking, focusing vision, balance, hearing, and facial expression. The medulla, where the brain meets the spinal cord, is vital for survival as it regulates heart rhythm, breathing, blood flow, and reflexive actions like sneezing, vomiting, coughing, and swallowing.

The cerebellum, located at the back of the head, is a fist-sized structure with two hemispheres. The outer layer contains neurons, while the inner layer communicates with the cerebral cortex. The cerebellum's primary function is to coordinate voluntary muscle movements and maintain posture, balance, and equilibrium.

Each hemisphere of the cerebrum is divided into four lobes: frontal, parietal, temporal, and occipital, each responsible for different functions:

1. **Frontal Lobe**: The largest lobe located at the front of the head, it is involved in personality, decision-making, and movement.
2. **Parietal Lobe**: Located in the middle of the brain, it helps in identifying objects and interpreting pain and touch.
3. **Temporal Lobe**: Found on the sides of the brain, it is involved in short-term memory, speech, musical rhythm, and some aspects of smell recognition.
4. **Occipital Lobe**: Located at the back of the brain, it is primarily responsible for vision.

Other critical structures in the brain include:

- **Pituitary Gland**: Known as the "master gland," this pea-sized structure deep in the brain regulates the function of other glands in the body, such as the thyroid, adrenals, ovaries, and testicles.
- **Hypothalamus**: Positioned above the pituitary gland, it sends chemical signals to control the pituitary's function.
- **Amygdala**: Almond-shaped structures located under each hemisphere, they are part of the limbic system and regulate emotions and memory.
- **Hippocampus**: A curved structure located on the underside of each temporal lobe, it is involved in memory and learning and is part of the larger hippocampal formation.

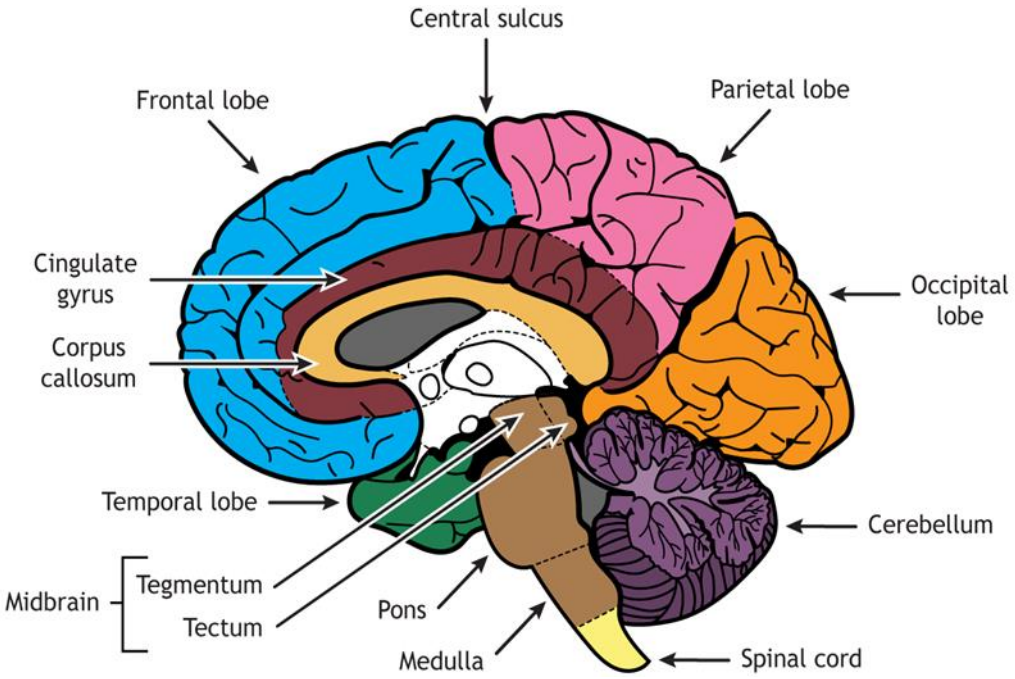


Fig.2. Showing anatomy of brain

Aims & Objectives

- To assess structural abnormalities identified with MRI in epileptic patients.
- To find out which age group have more chances of getting epilepsy.

NEED FOR THE STUDY:

- To review role of MRI in the evaluation of patients presenting with epilepsy with proper seizure protocol to establish correct diagnosis as well as help in prognosis.
- To detect potentially epileptogenic lesions in patients whose seizures are initially un-classified.

Materials and Methods

- **Research Approach**: Retrospective
- **Research Design**: Retrospective survey
- **Instrumentation**: 1.5 Tesla MRI
- **Research Setting**: Hamdard Imaging Centre, Delhi
- **Population**: Epileptic patients of all age groups in Delhi
- **Sample Size**: 50-70 subjects
- **Sampling Technique**: Convenience Sampling
- **Statistical Method**: Descriptive statistical method

Inclusion Criteria:

- Patients aged 5-90 years referred from OPD and IPD for epilepsy evaluation.
- Both genders.
- Patients providing ethical committee permission and confidentiality agreements.

Exclusion Criteria:

- Patients with claustrophobia, metallic implants contraindicated for MRI, traumatic brain injury, febrile seizure disorder, and acute CNS infection.

Study procedure

- Approval will be acquired from the institutional Ethical Committee Jamia Hamdard University
- This is retrospective study which is done on patients presented with epilepsy.
- Age group of 05-90 years will be selected and considered.
- Both Gender will be included.

Research plan

- Topic Selection: 2 months
- Synopsis making: 1 months
- Ethical Approval: 1 month
- Data Collection: 3-4 weeks
- Statistic Data Analysis: 2 months
- Dissertation write-up: 2 months

Data generated during conduct of study was reviewed from the medical records of the patients and then the variables were recorded into the data collection sheet Analysis.

- Data was obtained by descriptive a statistics using, men, standard, and deviation and like ratio test, which was used to Characterize the sample.

- The present study was undertaken to analysis the Association of **Role of magnetic resonance imaging in assessment of structural abnormalities with epilepsy protocol in epileptic patients**

- The Data Obtained Was tabulated In Microsoft Excel Spread Sheet and the Analysis Was Done.

HARDWARE AND ACQUISITION TECHNIQUE

MRI is a non-invasive technique that uses a magnetic field to produce images. It has the ability to identify structural lesions in the brain. A typical epilepsy MRI protocol at 1.5 T includes axial and coronal fluid-attenuated inversion recovery (FLAIR) imaging, T2- and T2∗-weighted images, and a T1-weighted, three-dimensional volume acquisition. To standardize best-practice neuroimaging in outpatient clinics and specialized surgery centres, the most recent guidelines propose the Harmonized Neuroimaging of Epilepsy Structural Sequences (HARNESS) protocol, which includes easy to implement, high-resolution 3D T1-weighted MRI, 3D FLAIR, and 2D coronal T2-weighted MRI. Best quality for these widely available sequences is achieved at 3 Tesla. The use of multiple head coils allows for shorter scanning time in addition to increased signal- and contrast-to-noise ratios. Shorter acquisition times give the option to obtain additional contrasts to interrogate tissue microstructural properties and function. Among them, diffusion-weighted MRI and its analytical extension diffusion tensor imaging (DTI) have been widely used to image the white matter. Advanced models describing diffusion within distinct microstructural constituents, such as high angular resolution diffusion imaging, these models offer more sensitive markers of the microstructural environment of epileptogenic lesions[15]

EPILEPSY PROTOCOL

The ILAE Neuroimaging Task Force recommended a set of acquisition sequences that is currently considered as the optimal epilepsy protocol, the “HARNESS”-MRI protocol.

HARNESS MRI protocol			ADVANTAGES
Magnetization-prepared rapid gradient-echo (MPRAGE, Siemens), Spoiled gradient-echo (SPGR, GE), Turbo field echo (TFE, Phillips)	T1-weighted	3D	High-resolution images that can be reformatted to be viewed on coronal, axial and sagittal planes Optimal visualization of brain anatomy and morphology
3D fluid attenuation inversion recovery (FLAIR)	T2-weighted	3D	3D high-resolution images that can be reformatted to any plane Cerebrospinal fluid nulling enhances visibility of epileptic pathologies such as focal cortical dysplasia, hippocampal sclerosis, tubers, hamartomas, glial scars.
Coronal spin echo (acquisition plane perpendicular to the long axis of the hippocampus)	T2-weighted	2D	High in-plane resolution Optimal visualization of hippocampal internal structure on coronal cuts
Optional sequences			
Gadolinium-enhanced MRI	T1-weighted	3D	Best for assessing tumor-like lesions, vascular malformations, or infectious processes
Susceptibility weighted imaging	T2∗-weighted	3D	Sensitive to iron deposits, blood products and calcifications

LESION DETECTION

Epilepsy is said to have a structural cause if there is a distinct abnormal structural cause present in the brain that is known to substantially increase the risk of seizures. Most of these causes can be seen on imaging of the brain with an MRI. Structural epilepsies in older children and adults most commonly present with focal seizures and have very similar symptoms from event to event. In some cases, seizures can spread to both sides of the brain, leading to a generalized tonic-clonic seizure. Structural abnormalities can be congenital or acquired. A congenital cause is a developmental change in the brain that a person is born with. In some cases of congenital structural causes, seizures begin very early in life while in other cases seizures begin many years after birth, often in later childhood or even early adulthood. An acquired cause is due to a process or injury that occurs in someone with previously normal brain structure. Examples are brain tumors, strokes or head trauma. These injuries lead to the brain being more susceptible to seizures and epilepsy can occur.

Structural Causes Associated With Epilepsy are as following :

1. **Focal cortical dysplasia** -FCD is a term used to describe a focal area of abnormal brain cell organization and development. Brain cells, or "neurons" normally form into organized layers of cells to form the brain "cortex". In FCD, there is disorganization of these cells in a specific brain area leading to much higher risk of seizures and possible disruption of brain function. In cases of FCD, the MRI is abnormal, showing an abnormally

bright focal area on T2 and FLAIR sequences, which often has a characteristic "tail" extending to the margins of the ventricles.

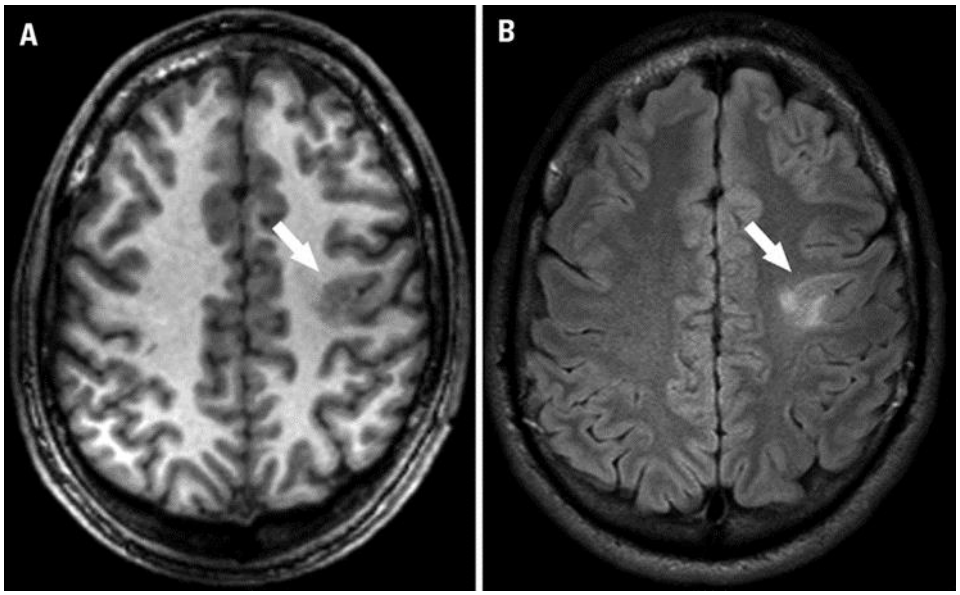


Fig.3. Showing FCD**,** an area of mild cortical thickening, with blurring of the white-gray matter interface in the left frontal lobe in the T1 FFE (fast field echo) axial image (arrow in A), that is also visualized in the FLAIR axial image, along with hyperintense signal in the underlying white matter (arrow in B).

2. **Hypoxic ischemic encephalopathy**- HIE is a condition that happens when there is a loss of oxygen or reduced blood flow to the brain. It most commonly happens in the womb, or at the time of birth**.**

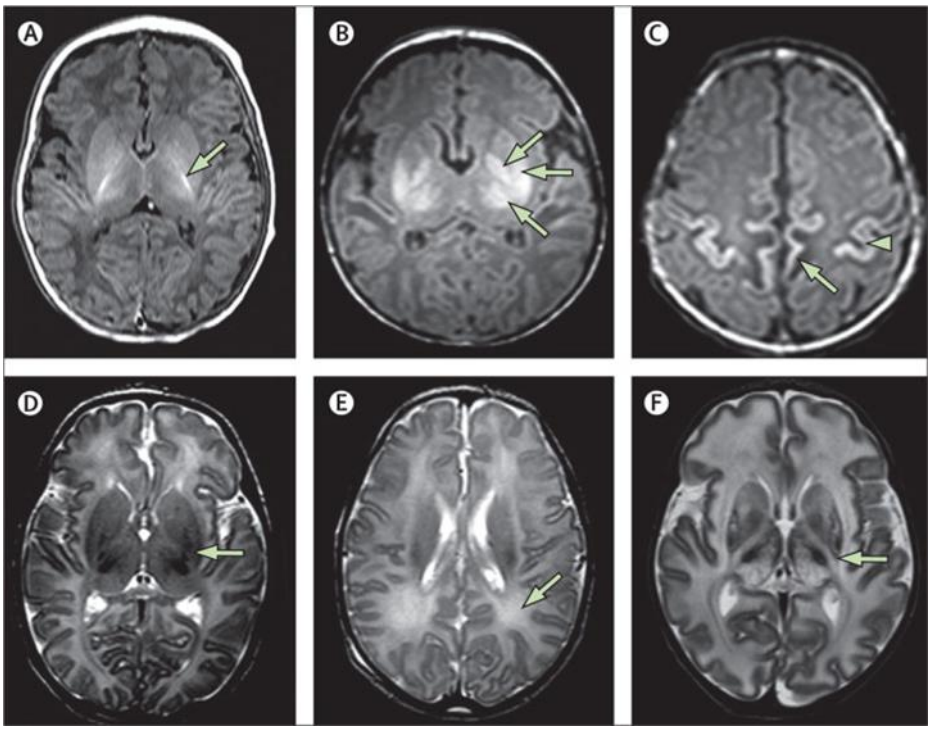


Fig. 4. MRI appearance in neonatal hypoxic–ischaemic encephalopathy[20]

3. **Mesial temporal sclerosis**- MTS is a term used to describe scarring in the deep part of the temporal lobe of the brain. MTS is the most common cause of structural epilepsy and focal seizures in the temporal lobe. MTS affects the hippocampus which is the brain region that is involved in memory formation. Mesial temporal

sclerosis symptoms include the Changes in behaviour, Muscle spasms, Temporal Lobe Epilepsy. The appearance of temporal lobe epilepsy on MRI shows abnormal signal on T2-weighted images in either the hippocampus/amygdala as increased signal of the hippocampus/amygdala relative to other gray matter or the temporal lobe as increased signal in gray/white matter relative to other gray/white matter, atrophic change in the hippocampus/ amygdala or temporal lobe, structural or mass deformity, solid or cystic, calcification or haemorrhage on T1- or T2- weighted images and extratemporal lobe abnormalities·

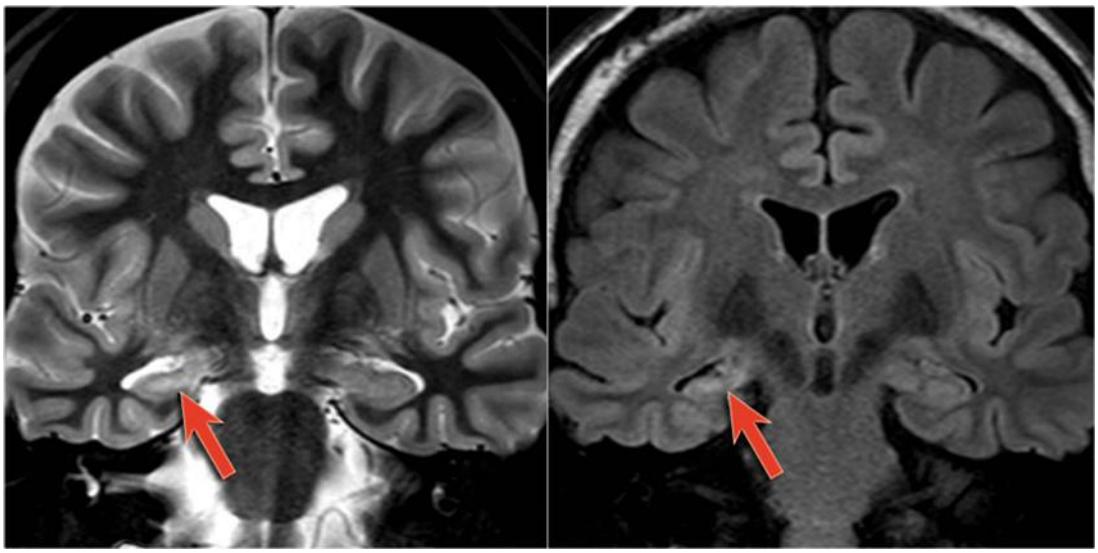


Fig.5. The coronal T2WI and FLAIR images show right-sided mesial temporal sclerosis.
Notice the volume loss, which indicates atrophy and causes secondary enlargement of the temporal horn of the lateral ventricle. The high signal in the hippocampus reflects gliosis·

4. **Traumatic Brain Injury (TBI)-** It is a well-recognized cause of seizures and epilepsy. Traumatic brain injury is the result of an external force on the head. Depending on the type and severity of trauma a person experiences, TBI may cause bruising of the brain (brain contusion), bleeding inside the brain (intracerebral haemorrhage), bleeding between the coverings of the brain and the brain (subdural or subarachnoid haemorrhage), bleeding between the skull and coverings of the brain (epidural hematoma). Even if bleeding occurs outside of the brain it can have an impact on brain tissue by compressing the brain and disrupting normal brain anatomy and function. TBI can also cause mild to severe swelling of the brain (intracerebral edema.

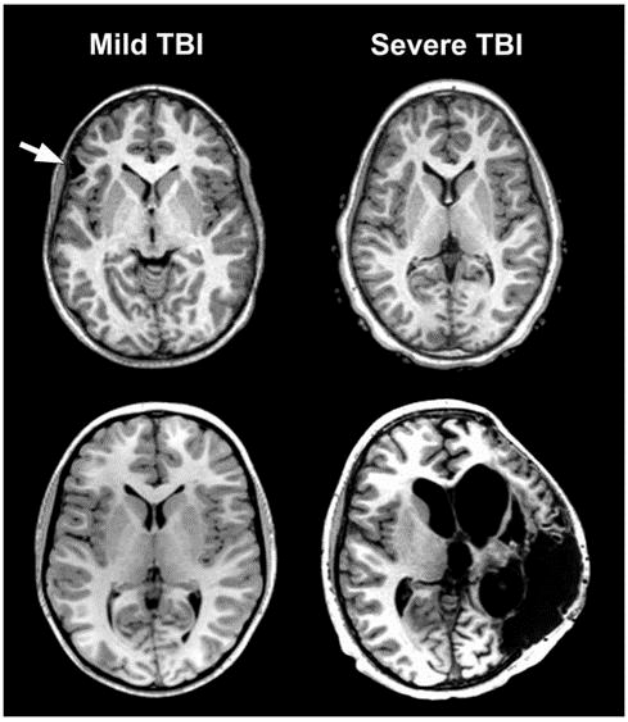


Fig.6. Showing Traumatic Brain Injury[24]

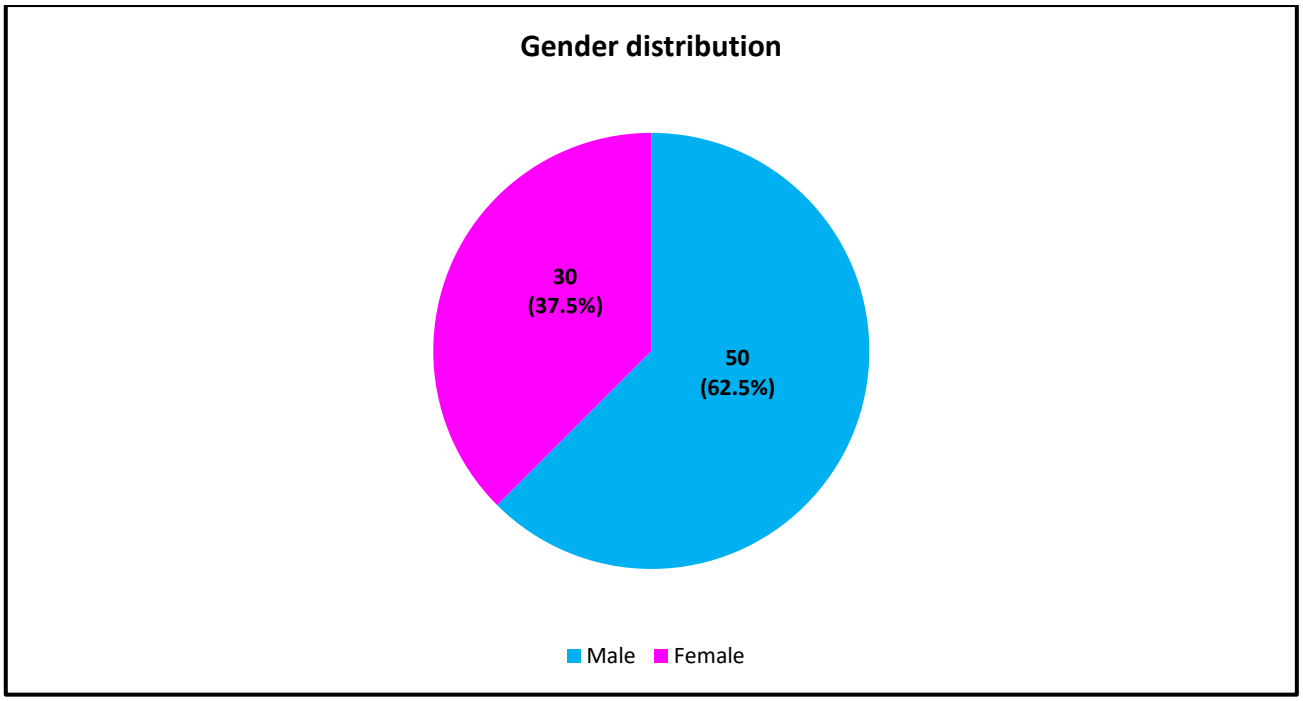
RESULT

Table 1: Descriptive Statistics for age

(n = 80)	Range	Mean	S.D.
Age (Years)	7 Months to 73 Years	21.8	19.0

Table 2: Gender distribution

		Frequency	%
Gender	Male	50	62.5
	Female	30	37.5



Gender: This column represents the different categories for gender, which in this case are "Male" and "Female".

Frequency: This is the count of individuals in each gender category.

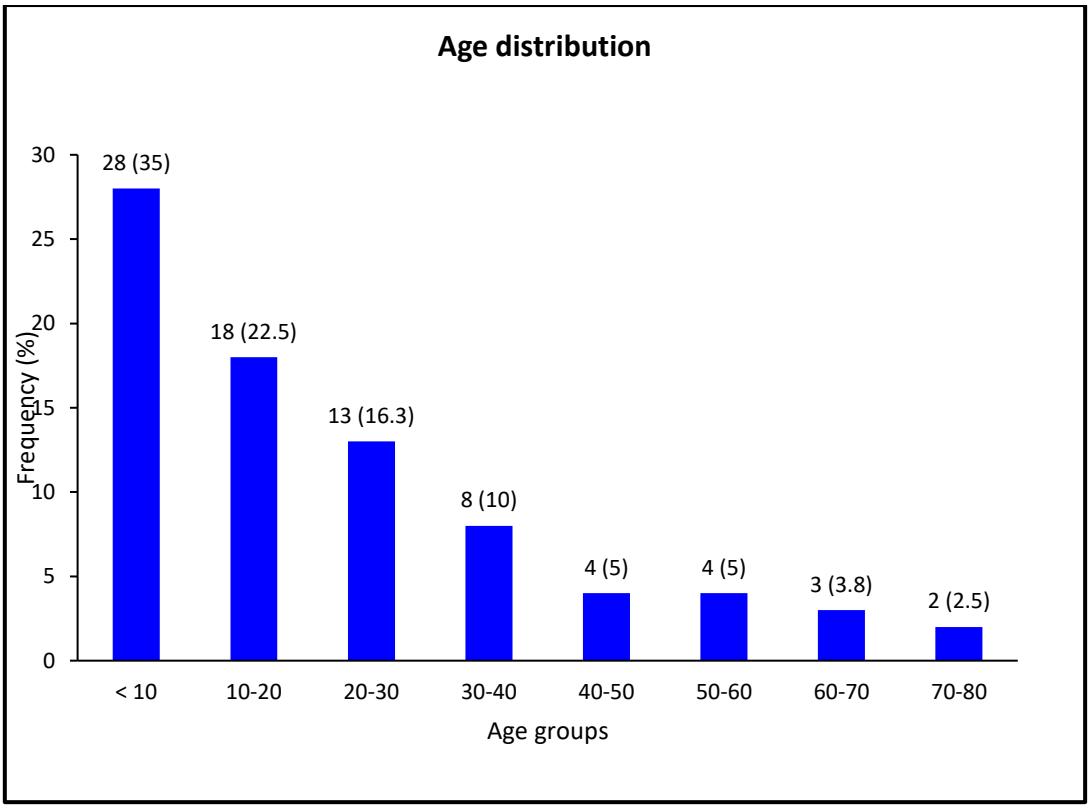
- There are 50 males.
- There are 30 females.

Percentage (%): This shows the proportion of each gender in relation to the total population, expressed as a percentage.

- The population consists of 80 individuals in total.
- Males make up 62.5% of the total population.
- Females make up 37.5% of the total population.

Table 3: Age distribution

		Frequency	%
Age groups	< 10	28	35
	10-20	18	22.5
	20-30	13	16.3
	30-40	8	10
	40-50	4	5
	50-60	4	5
	60-70	3	3.8
	70-80	2	2.5



EXPLANATION

Age Group: This column represents the different age categories.

- For example, "< 10" means individuals who are less than 10 years old, "10-20" means individuals who are between 10 and 20 years old, and so on.

Frequency: This is the count of individuals in each age group.

- For example, there are 28 individuals who are less than 10 years old, 18 individuals who are between 10 and 20 years old, etc.

Percentage (%): This shows the proportion of each age group in relation to the total population, expressed as a percentage.

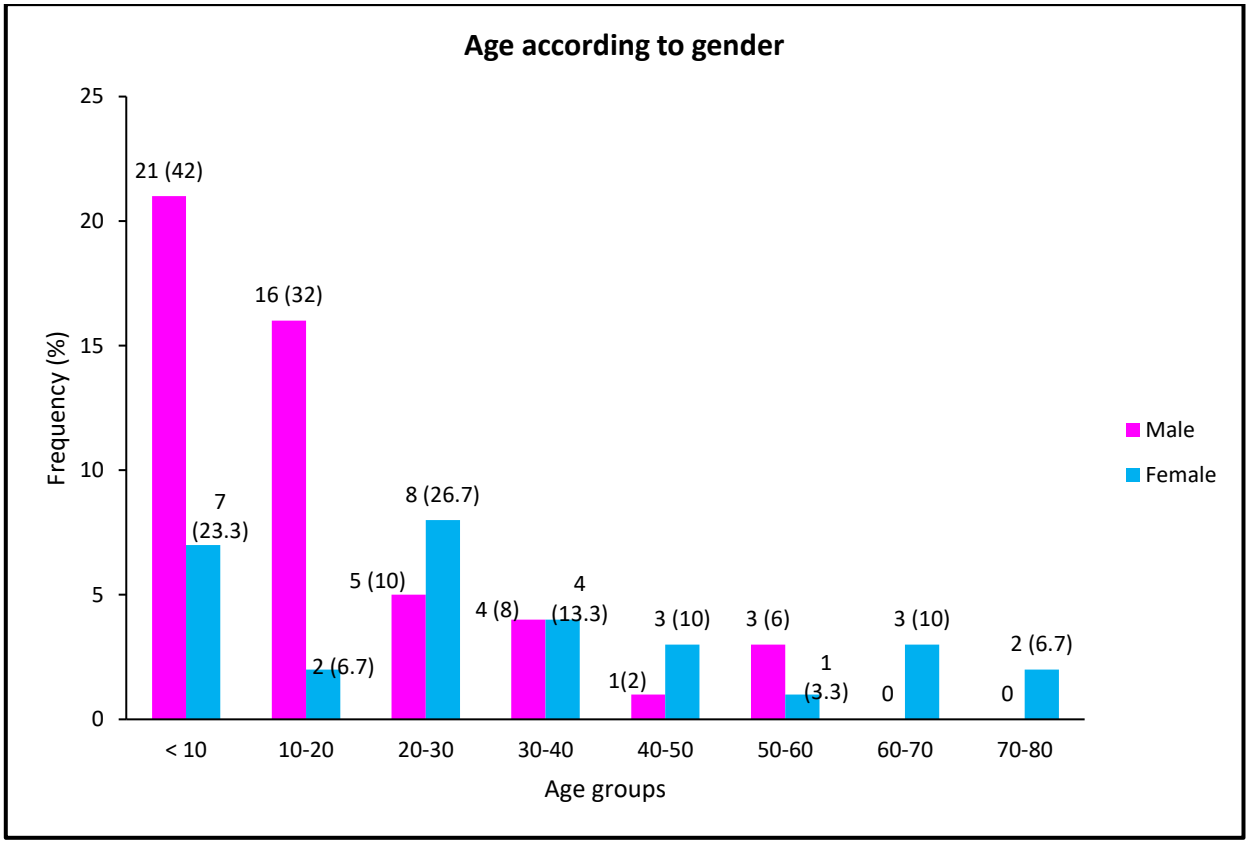
- For example, individuals who are less than 10 years old make up 35% of the total population, those who are between 10 and 20 years old make up 22.5%, and so on.

SUMMARY

- The population consists of 80 individuals in total.
- The largest age group is "< 10", making up 35% of the population.
- The age group "10-20" is the next largest, making up 22.5% of the population.
- Other age groups have smaller proportions, with "70-80" being the smallest at 2.5%

Table 4: Age according to gender

		Gender			
		Male		Female	
		n	%	n	%
Age groups	< 10	21	42	7	23.3
	10-20	16	32	2	6.7
	20-30	5	10	8	26.7
	30-40	4	8	4	13.3
	40-50	1	2	3	10.0
	50-60	3	6	1	3.3
	60-70	0	0	3	10.0
	70-80	0	0	2	6.7



EXPLANATION

❖ **Males**:

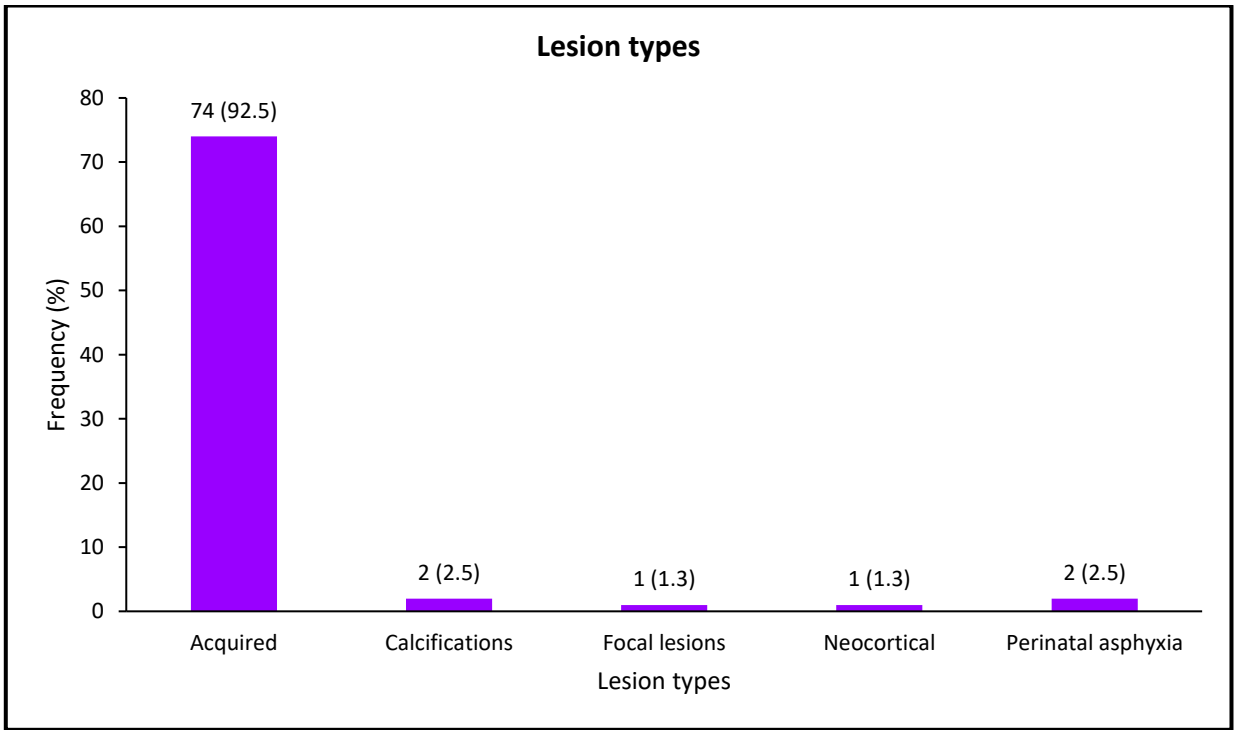
- The largest proportion of males is in the "< 10" age group (42%).
- No males are in the "60-70" and "70-80" age groups.
-

❖ **Females**:

- The largest proportion of females is in the "20-30" age group (26.7%).
- The "< 10" age group also has a significant proportion of females (23.3%).

Table 5: Lesion type

		Frequency	%
Lesion type	Acquired	74	92.5
	Calcifications	2	2.5
	Focal lesions	1	1.3
	Neocortical	1	1.3
	Perinatal asphyxia	2	2.5



EXPLANATION

Lesion Type: This column represents different categories of lesions.

- "Acquired" refers to lesions that develop after birth due to various causes.
- "Calcifications" are deposits of calcium salts within tissues.
- "Focal lesions" are localized areas of damage or disease within an organ.
- "Neocortical" refers to lesions located in the neocortex of the brain.
- "Perinatal asphyxia" refers to brain damage due to lack of oxygen around the time of birth.

Frequency: This is the count of occurrences for each lesion type.

- For example, there are 74 occurrences of acquired lesions.

Percentage (%): This shows the proportion of each lesion type in relation to the total number of lesions, expressed as a percentage.

- For example, acquired lesions make up 92.5% of the total lesions.

SUMMARY

- The total number of lesions is 80.
- The majority of the lesions (92.5%) are acquired.
- Calcifications and perinatal asphyxia each account for 2.5% of the lesions.

- Focal lesions and neocortical lesions each account for 1.3% of the lesions.

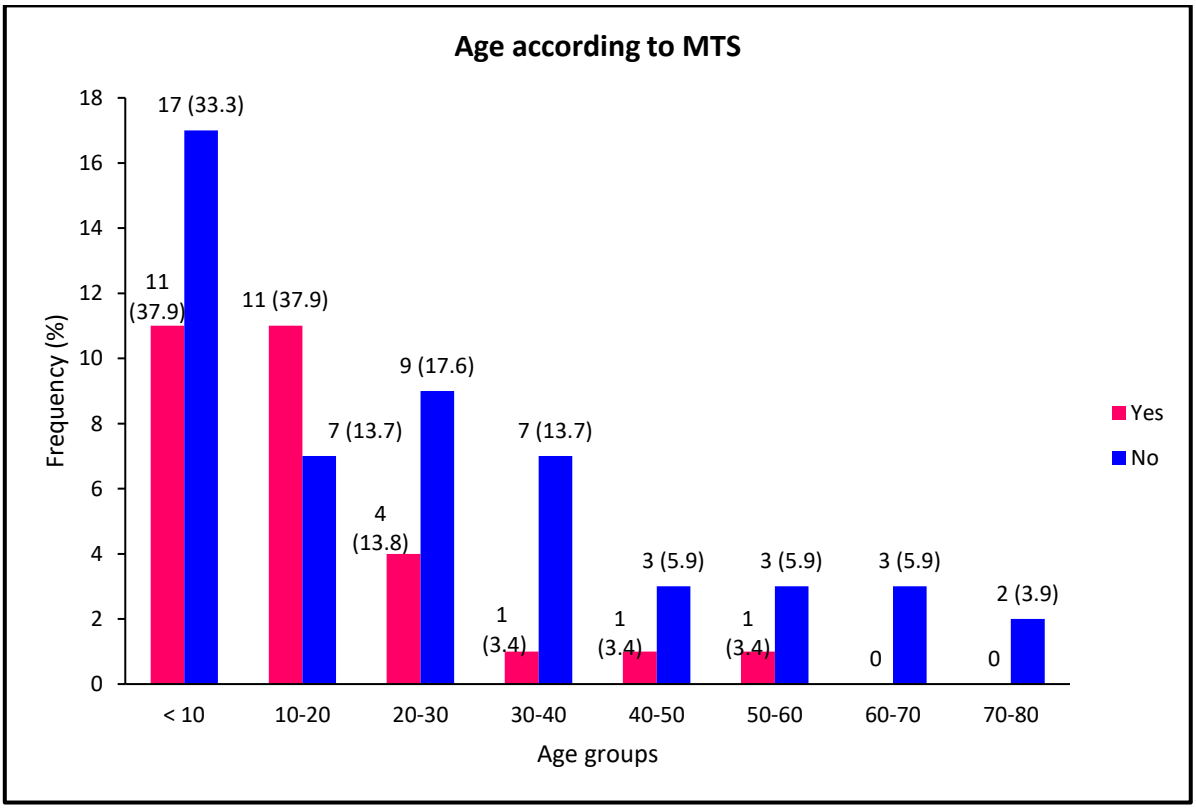
Table 6: MTS

		Frequency	%
MTS	Yes	29	36.3
	No	51	63.7

Table 7: Association between MTS and age groups

		MTS				Likelihood ratio	p value
		Yes		No			
		n	%	n	%		
Age groups	< 10	11	37.9	17	33.3	12.12	0.097
	10-20	11	37.9	7	13.7		
	20-30	4	13.8	9	17.6		
	30-40	1	3.4	7	13.7		
	40-50	1	3.4	3	5.9		
	50-60	1	3.4	3	5.9		
	60-70	0	0	3	5.9		
	70-80	0	0	2	3.9		

The Likelihood ratio test was used to find the association between MTS and age groups. There was no association ($p > 0.05$) between MTS and age groups. [Table – 7]



SUMMARY

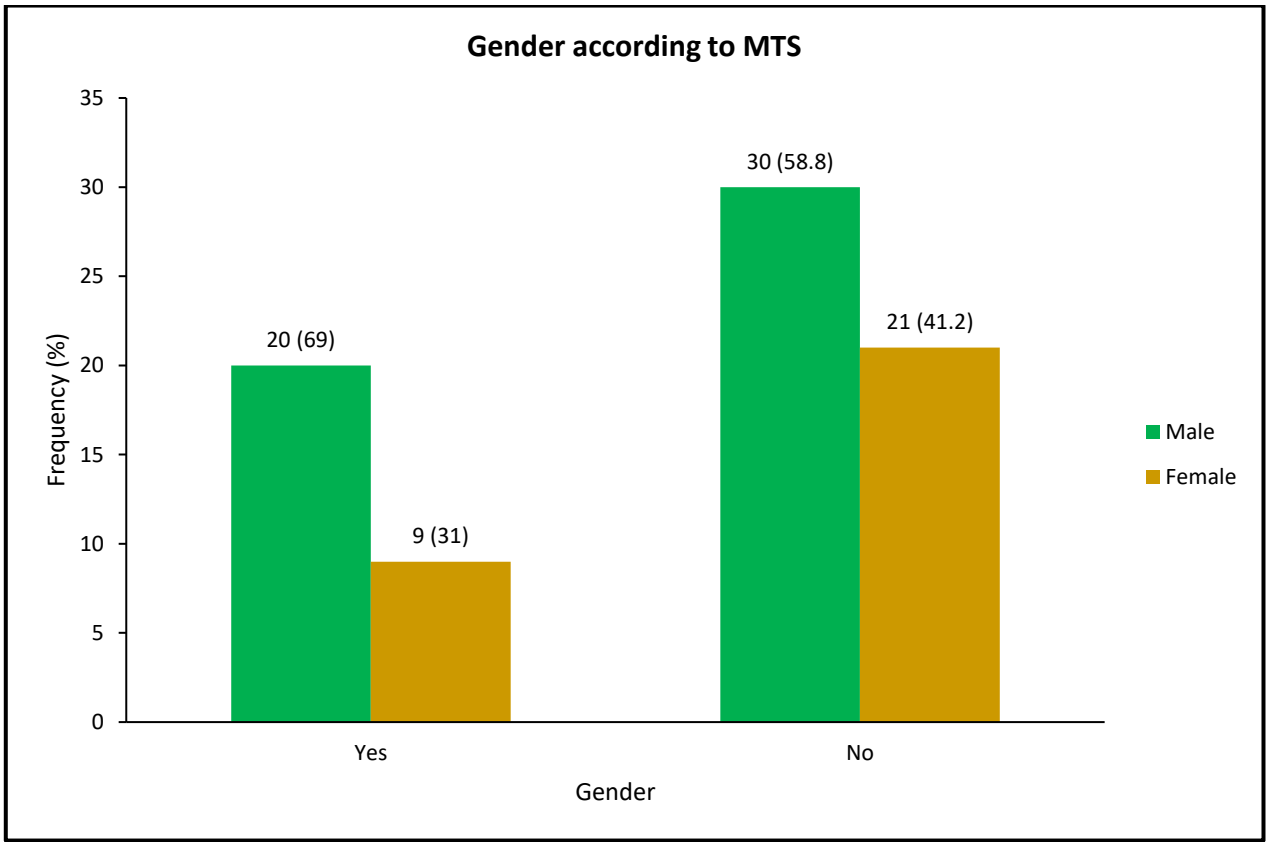
Age Groups with Higher MTS Presence: The < 10 and 10-20 age groups have the highest percentages of individuals with MTS (both at 37.9%).

Age Groups with Lower MTS Presence: The 60-70 and 70-80 age groups have no individuals with MTS.

Table 8: Association between MTS and gender

		MTS				Chi square	p value
		Yes		No			
		N	%	n	%		
Gender	Male	20	69.0	30	58.8	0.81	0.368
	Female	9	31.0	21	41.2		

The Chi square test was used to find the association between MTS and gender. There was no association ($p > 0.05$) between MTS and gender. [Table – 8]



SUMMARY

Gender Analysis: Among males, 69% of those with MTS have MTS, compared to 58.8% of those without MTS.

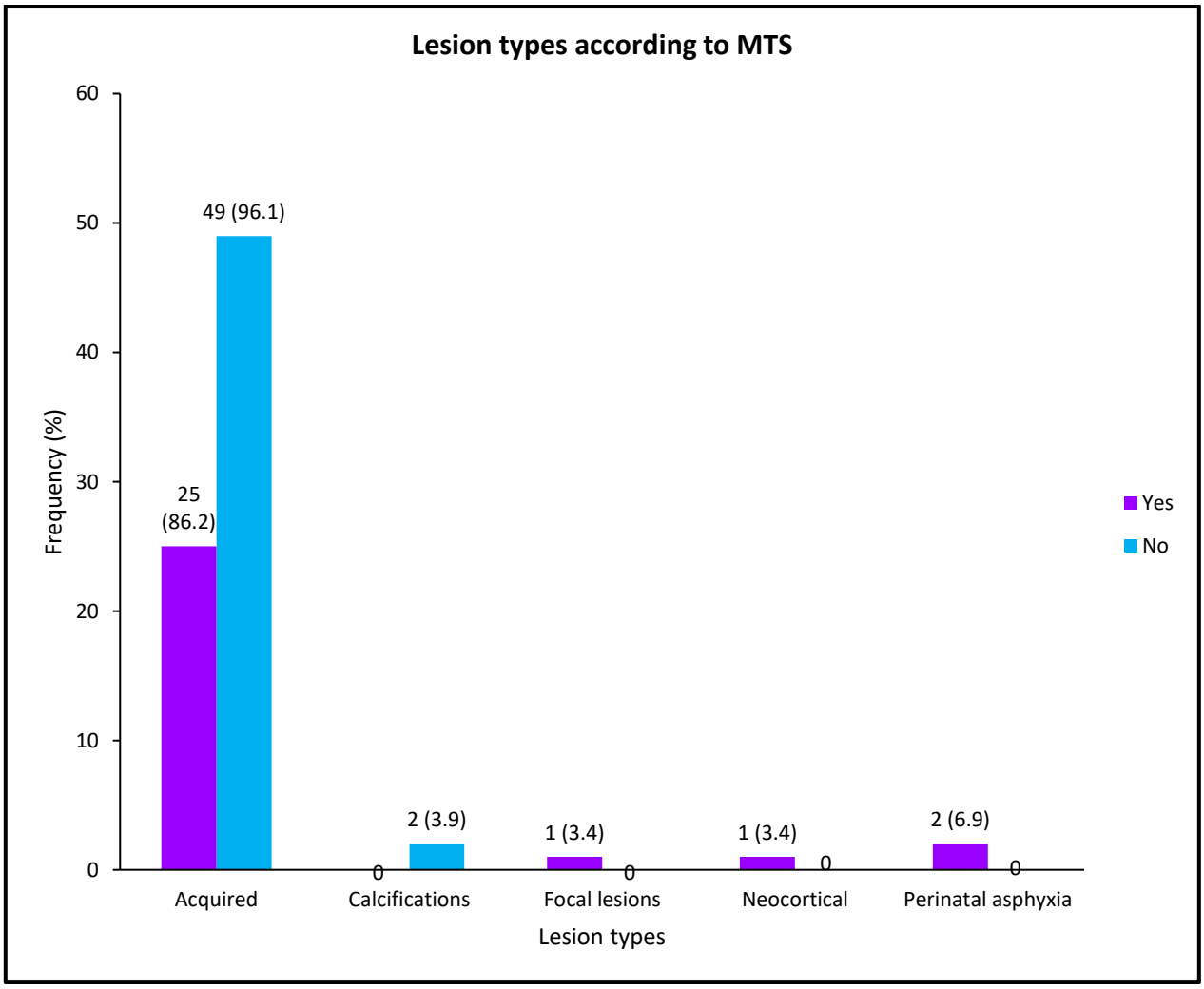
Statistical Significance: The Chi-square test result (0.81) and the p-value (0.368) indicate that there is no statistically significant association between being male and having MTS. The results suggest that gender does not significantly affect the likelihood of having MTS in this dataset.

Table 9: Association between MTS and lesion types

		MTS				Likelihood ratio	p value
		Yes		No			
		n	%	n	%		
Lesion type	Acquired	25	86.2	49	96.1	10.12	0.039*
	Calcifications	0	0	2	3.9		
	Focal lesions	1	3.4	0	0		
	Neocortical	1	3.4	0	0		
	Perinatal asphyxia	2	6.9	0	0		

(* Significant)

The Likelihood ratio test was used to find the association between MTS and lesion types. There was an association ($p < 0.05$) between MTS and lesion types. [Table – 9]



SUMMARY

Acquired Lesions:

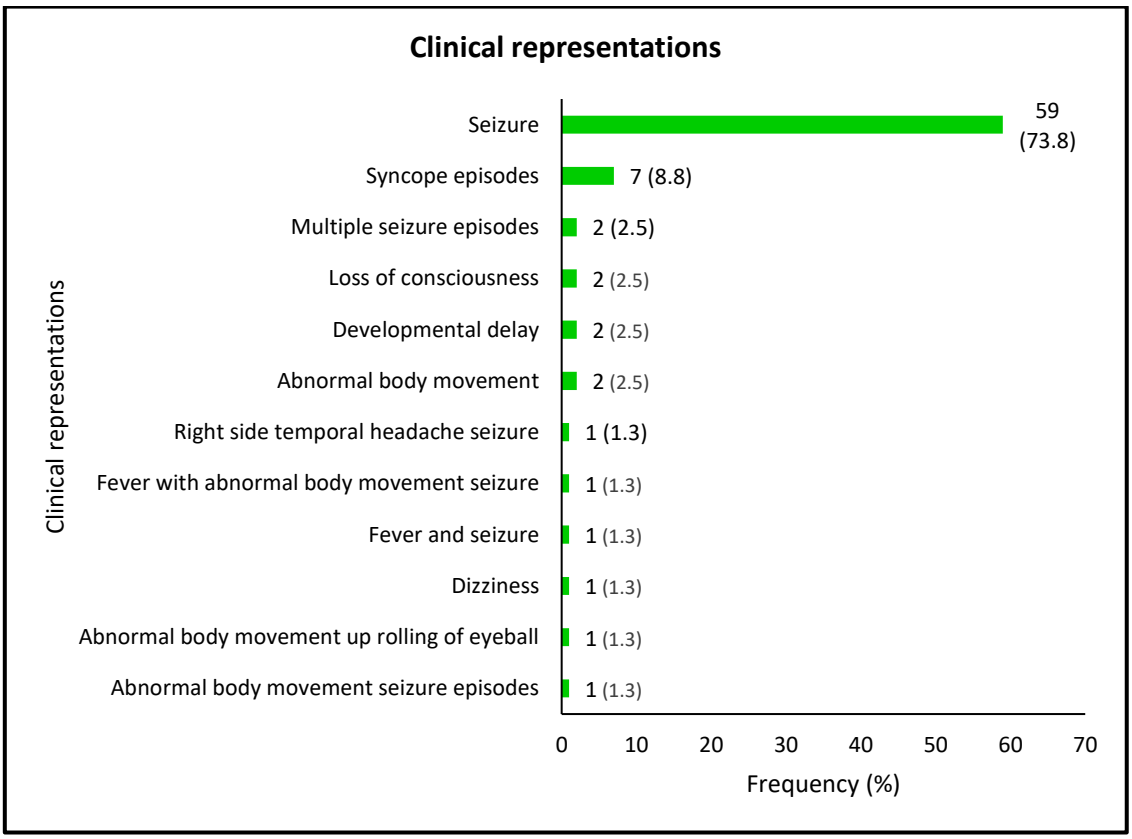
- A high percentage of individuals with MTS have acquired lesions (86.2%), but an even higher percentage of individuals without MTS also have acquired lesions (96.1%). Despite this, the overall association between lesion type and MTS is statistically significant.

Calcifications, Focal Lesions, Neocortical Lesions, Perinatal Asphyxia:

- None of the individuals with MTS have calcifications.
- There are small percentages of individuals with focal lesions (3.4%), neocortical lesions (3.4%), and perinatal asphyxia (6.9%) among those with MTS, while none of these lesions are present in individuals without MTS.

Table 10: Clinical representations

Clinical representations	Frequency	%
Abnormal body movement	2	2.5
Abnormal body movement seizure episodes	1	1.3
Abnormal body movement up rolling of eyeball	1	1.3
Developmental delay	2	2.5
Dizziness	1	1.3
Fever and seizure	1	1.3
Fever with abnormal body movement seizure	1	1.3
Loss of consciousness	2	2.5
Multiple seizure episodes	2	2.5
Right side temporal headache seizure	1	1.3
Seizure	59	73.8
Syncope episodes	7	8.8



EXPLANATION

Seizure:

- The most common clinical presentation, observed in 59 individuals, accounting for 73.8% of the population. This indicates that seizures are a predominant symptom in this group.

Syncope episodes:

- The second most common presentation, observed in 7 individuals (8.8%). Syncope episodes refer to temporary loss of consciousness usually related to insufficient blood flow to the brain.

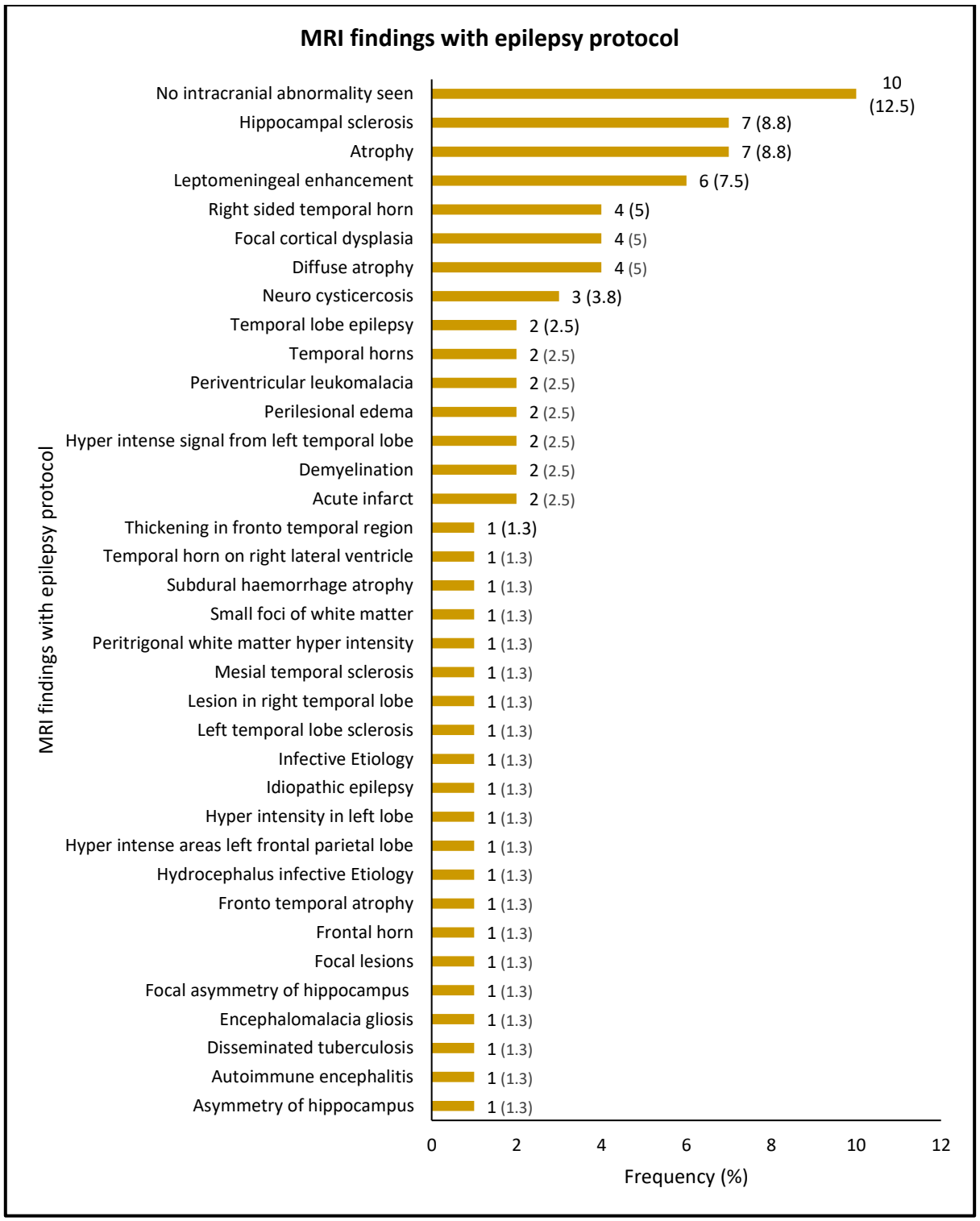
Other symptoms:

- Symptoms like "Abnormal body movement," "Developmental delay," "Loss of consciousness," and "Multiple seizure episodes" each have a frequency of 2, representing 2.5% of the population for each symptom.
- Symptoms like "Abnormal body movement seizure episodes," "Abnormal body movement up rolling of eyeball," "Dizziness," "Fever and seizure," "Fever with abnormal body movement seizure," and "Right side temporal headache seizure" each have a frequency of 1, representing 1.3% of the population for each symptom.

Table 11: MRI findings with epilepsy protocol

MRI findings with epilepsy protocol	Frequency	%
Acute infarct	2	2.5
Asymmetry of hippocampus	1	1.3
Atrophy	7	8.8
Autoimmune encephalitis	1	1.3
Demyelination	2	2.5
Diffuse atrophy	4	5
Disseminated tuberculosis	1	1.3
Encephalomalacia gliosis	1	1.3
Focal asymmetry of hippocampus	1	1.3
Focal cortical dysplasia	4	5
Focal lesions	1	1.3
Frontal horn	1	1.3
Fronto temporal atrophy	1	1.3
Hippocampal sclerosis	7	8.8
Hydrocephalus infective Etiology	1	1.3
Hyper intense areas left frontal parietal lobe	1	1.3
Hyper intense signal from left temporal lobe	2	2.5
Hyper intensity in left lobe	1	1.3
Idiopathic epilepsy	1	1.3
Infective Etiology	1	1.3
Left temporal lobe sclerosis	1	1.3
Leptomeningeal enhancement	6	7.5
Lesion in right temporal lobe	1	1.3
Mesial temporal sclerosis	1	1.3
Neuro cysticercosis	3	3.8
No intracranial abnormality seen	10	12.5
Perilesional edema	2	2.5

Peritrigonal white matter hyper intensity	1	1.3
Periventricular leukomalacia	2	2.5
Right sided temporal horn	4	5
Small foci of white matter	1	1.3
Subdural haemorrhage atrophy	1	1.3
Temporal horn on right lateral ventricle	1	1.3
Temporal horns	2	2.5
Temporal lobe epilepsy	2	2.5
Thickening in fronto temporal region	1	1.3



Explanation

- **Variety of Findings**: The data demonstrates a wide range of MRI findings associated with epilepsy, including atrophy, sclerosis, lesions, hyperintensity, and other abnormalities.
- **Common and Rare Findings**: While some findings, like atrophy and hippocampal sclerosis, are relatively common, others are less frequently observed.
- **Diagnostic Importance**: These MRI findings are crucial for diagnosing and understanding the underlying causes of epilepsy in individuals, aiding in treatment planning and management.

STATISTICAL ANALYSIS

The collected data were summarized by using the Descriptive Statistics: frequency, percentage; mean and S.D. The Chi square or Likelihood ratio test was used to find the association between the variables. The p value < 0.05 was considered as significant. Data were analyzed by using the SPSS software (SPSS Inc.; Chicago, IL) version 29.0.10.

DISCUSSION

Numerous studies have shown that the preoperative diagnosis of both mesial temporal sclerosis and epileptogenic temporal lobe tumors is best done noninvasively with MR imaging. Mesial temporal sclerosis describe a lesion characterized by neuronal loss and gliosis involving principally the hippocampus and amygdala, or both, but occasionally extending to other mesial temporal structures or even throughout the temporal lobe, and leading to generalized atrophy and gliosis.

Frequency and Distribution of MRI Findings:

- **No Intracranial Abnormality Seen**: This finding is the most frequent, observed in 12.5% of the study population.
- **Atrophy and Hippocampal Sclerosis**: Both atrophy and hippocampal sclerosis are common findings, each observed in 8.8% of the population. These findings are significant as they are indicative of structural changes in the brain that may contribute to epileptic activity.
- **Leptomeningeal Enhancement**: This finding, observed in 7.5% of the population, suggests inflammation or infection involving the meninges, which can be associated with epilepsy.
- **Focal Cortical Dysplasia and Diffuse Atrophy**: These findings, observed in 5% of the population each, highlight the presence of structural abnormalities that may contribute to epileptogenesis.
- **Variety of Findings**: The data reveals a wide variety of MRI findings associated with epilepsy, including structural abnormalities such as infarcts, asymmetry of the hippocampus, focal cortical dysplasia, and demyelination. Additionally, infectious etiologies such as disseminated tuberculosis and neurocysticercosis were also observed, highlighting the diverse range of potential causes of epilepsy.

Clinical Implications:

Diagnostic Challenges: MRI findings play a crucial role in the diagnosis and management of epilepsy. They provide valuable insights into the underlying structural abnormalities or pathologies that may be contributing to the development of seizures. Identification of specific MRI findings, such as hippocampal sclerosis or focal cortical dysplasia, can help clinicians tailor treatment strategies, including the selection of appropriate anti-seizure medications or consideration for surgical intervention.

Treatment Considerations: Identification of specific MRI findings can inform treatment strategies, such as surgical intervention for focal cortical dysplasia or hippocampal sclerosis, or targeted medical management for conditions like autoimmune encephalitis or neurocysticercosis.

Prognostic Significance: Certain MRI findings, such as hippocampal sclerosis, may have prognostic implications for treatment response and long-term outcomes in individuals with epilepsy.

Research Directions:

- **Further Investigation**: The data highlights the need for further research to elucidate the relationship between specific MRI findings and epileptogenesis, as well as the impact of these findings on treatment outcomes and prognosis.
- **Advanced Imaging Techniques**: Advances in imaging technology, such as high-resolution MRI and functional imaging modalities, may provide additional insights into the structural and functional changes associated with epilepsy.

Limitations:

- It's important to acknowledge that MRI findings represent structural abnormalities visible on imaging and may not always correlate directly with clinical manifestations or seizure control.
- The interpretation of MRI findings requires expertise and careful consideration of clinical context to avoid overdiagnosis or misinterpretation of incidental findings.

Conclusion:

In conclusion, the discussion of MRI findings with an epilepsy protocol highlights the diverse range of structural abnormalities associated with epilepsy and underscores the importance of MRI in the diagnostic evaluation and management of individuals with seizures. Effective utilization of MRI findings can aid in accurate diagnosis, localization of seizure foci, and optimization of treatment strategies for individuals with epilepsy. MRI is a mandatory investigation for diagnosis and treatment of epilepsy. The relentless progress in imaging and machine learning techniques will continue to push the boundaries of lesion visibility and to provide increasingly sophisticated predictors of clinical outcomes for the benefit of people with epilepsy.

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