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SIGNIFICANCE OF MRI IN THE EVALUATION OF EPILEPSY PATIENTS

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ABSTRACT:

Background/Aims: Recurrent seizures that are not brought on by a sudden systemic or neurological injury are the hallmark of epilepsy, a chronic illness.¹The clinical manifestation of aberrant, excessive neuronal activity originating in the cerebral cortex's grey matter is an epileptic seizure.²

A paroxysmal change in neurologic function brought on by abnormally high neuronal electrical activity is known as a seizure.¹ The superior soft tissue contrast of MR imaging, which permits a detailed representation of anatomy and eliminates the beam-hardening artefact in the basal brain that is present with CT, has made it the most valuable and diagnostically valuable tool for preoperative localization of epileptogenic focus. Additionally, MR imaging allows for multiplanar imaging.¹

Material and methods:

A prospective study was carried out at the Radiodiagnosis Department at Dhiraj Hospital, SBKS MI&RC, Vadodara, Gujarat. All individuals who had clinical symptoms and indicators of epilepsy and were sent to the Department of Radio-Diagnosis. The MRI scanner used for the study was the Siemens. Using the 1.5T SIEMENS MAGNETOM-ESSENZA system, MRI scans were performed on each subject. The study aimed to include a minimum of 100 cases; however, there is potential to include more cases based on availability throughout the study time. 220 cases in all were examined.

Results: In our study 220 patients who were clinically diagnosed of epilepsy were undergone MRI examination of the brain. The MRI findings were normal in 100(45.4%) cases and revealed spectrum of abnormalities in 120(54.5%) cases. The common abnormalities were cerebral infarction with gliosis (22.2%), infections –NCC (8.6%) and tuberculoma (2.7%), cerebral atrophy (7.2%), venous thrombosis (3.6%), developmental malformations (3.1%), cavernomatous malformations (1.8%), glioma (1.82%), meningioma (1.3%), tuberous sclerosis (0.9%), viral encephalitis findings (0.4 %) and AV malformation (0.4%)were among the abnormal findings.

Conclusion:

We conclude that MRI plays a significant role in patients presenting with epilepsy with MRI epilepsy protocol to confirm or rule out any organic or developmental lesions. In our study, it was observed that most common neuroimaging abnormalities associated were cerebrovascular diseases & infections. Most common age group in our study was 16-30 years with male predominance.

Key words: MRI. EVALUATION, EPILEPSY

INTRODUCTION:

Recurrent seizures that are not brought on by a sudden systemic or neurological injury are the hallmark of epilepsy, a chronic illness.¹ The clinical manifestation of aberrant, excessive neuronal activity originating in the cerebral cortex's grey matter is an epileptic seizure.²

A paroxysmal change in neurologic function brought on by abnormally high neuronal electrical activity is known as a seizure.¹

The prevalence of epilepsy is estimated to be 5 to 10 people per 1000, whereas the incidence is between 0.3 to 0.5%.³

In clinical practice, doctors frequently deal with the examination of patients who are presenting with seizures.

Numerous neuro-radiological examinations are available to help diagnose and determine the cause of the lesion. These include skull x-rays, CT, MRI, EEG, Pneumocephalography, CSF analysis, and carotid angiography.⁴

The superior soft tissue contrast of MR imaging, which permits a detailed representation of anatomy and eliminates the beam-hardening artifact in the basal brain that is present with CT, has made it the most valuable and diagnostically valuable tool for preoperative localization of epileptogenic focus. Additionally, MR imaging allows for multiplanar imaging.¹

It has also been demonstrated that co-registration of MRI with other functional imaging modalities, including as PET and SPECT, is beneficial in locating structural and functional alterations. In addition to helping to identify the epileptogenic focus during epilepsy surgery, magnetic resonance imaging (MR) can show the topological correlations between the epileptogenic lesion and the expressive brain areas.¹

The purpose of the research investigation that follows is to investigate the range and aetiology of MRI findings in individuals who have been diagnosed with epilepsy.

AIMS & OBJECTIVES:

1. To identify brain abnormalities that may be connected to the aetiology of epilepsy.
2. To investigate the range of MRI results in epilepsy patients.
3. To investigate the causes of epilepsy.
4. To identify which imaging abnormalities epilepsy patients most frequently have.

METHODOLOGY:

MRI scans were performed on 220 individuals who had a clinical impression of epilepsy between August 2022 and July 2023 (One year).

Study site: Dhiraj Hospital, SBKS MI&RC, Vadodara, Gujarat.

Study type: Prospective Study.

All individuals who had clinical symptoms and indicators of epilepsy and were sent to the Department of Radio-Diagnosis. The MRI scanner used for the study was the Siemens. Using the 1.5T SIEMENS MAGNETOM-ESSENZA system, MRI scans were performed on each subject. The study aimed to include a minimum of 100 cases; however, there is potential to include more cases based on availability throughout the study time. 220 cases in all were examined.

Inclusion criteria :

- Based on clinical information, patients with epilepsy who were referred for an MRI brain scan were chosen.

- All patients presenting with epilepsy.
- Cases were included irrespective of sex / age.

Exclusion criteria :

- Patients with pacemakers, metallic implants, aneurysmal clips, etc. are contraindications to MRI tests.
- Claustrophobia or anxiety disorders exacerbated by MRI.
- Inability to provide consent.

Duration of study – 1 year.

Every patient's clinical history was noted. Each patient completed a thorough proforma and had the following investigations:

Routine investigations

- CBC, DLC, TLC, Urine routine examination, ESR.
- Serum creatinine, Sugar, Blood urea.

Special investigations: MRI Brain (Plain / contrast).

Materials :

- Whole body MRI scanner SIEMENS 1.5Telsa
- Contrast media Gadolinium (Gadobenate Meglumin)
- Emergency drugs like Inj. Dexamethasone, Avil, Adrenaline etc.
- Syringes 5ml, 10ml & 20ml.

Various details of MRI findings were studied as under –

- Any lesion present
- Site
- Signal intensity
- Surrounding edema
- Any hemorrhage
- Atrophy
- Infarction
- Mass effect
- Contrast enhancement / enhancing lesions
- Calcification
- Developmental malformations
- Hydrocephalus.

RESULTS:**TABLE 1: AGE & GENDER WISE DISTRIBUTION**

Age in years	Male	Female	Total	Percentage
<1	3	4	7	3.2
1-15	17	20	37	16.8
16-30	42	27	69	31.3
31-45	32	21	53	24
46-60	17	10	27	12.2
>60s	14	13	27	12.2
Total	125(56.8%)	95(43.1%)	220	

Maximum number of patients were in the age group of 16-30 years.(31.3%).

Sex ratio : Male : Female – 1.3:1

Male predominance was noted.

TABLE 2: DISTRIBUTION OF PATIENTS BASED ON MR DIAGNOSIS

MR diagnosis	No. of patients	Percentage
Normal study	100	45.4
Infarct with Gliosis	49	22.2
NCC	19	8.6
Atrophy	16	7.2
Venous thrombosis	08	3.6
Developmental malformation	07	3.1
Tuberculoma	06	2.7
Glioma	04	1.8
Cavernoma	04	1.8
Meningioma	03	1.3
Tuberous sclerosis	02	0.9
Viral encephalitis	01	0.4
AV malformation	01	0.4

There were atrophic and infarct alterations in four patients. Infarcts and thrombosis coexisted in two instances.

45.4% of the 100 patients had normal testing results. Of the patients with epilepsy, infarct with gliosis was the most often seen MR abnormality (49 individuals, or 22.2%).

When a patient presents with epilepsy, the most prevalent MR diagnosis in 57% of cases is related to cerebral vascular causes, which include venous thrombosis, arterio-venous malformation, and infarct with gliosis.

TABLE 3: PERCENTAGE OF ABNORMAL MR DIAGNOSIS

Total	Normal	Abnormal	Percentage
220	100	120	54.54

TABLE 4 : DISTRIBUTION OF ABNORMALITIES GENDER WISE DISTRIBUTION

Male	Female	Total
65(54.16%)	55(45.83%)	120(100%)

TABLE-5 DISTRIBUTION OF ABNORMALITIES IN VARIOUS AGE GROUPS

MR diagnosis	< 1 years	1-15 years	16-30 Years	31-45 years	46-60 years	>60 years	Total
Infarct with gliosis	3	2	5	7	14	18	49
NCC	0	4	11	4	0	0	19
Atrophy	0	0	3	7	6	0	16
Venous thrombosis	0	0	6	1	0	1	8
Developmental Malformation	2	2	2	0	1	0	7
Tuberculoma	0	2	0	3	0	1	6
Glioma	0	0	0	2	2	0	4
Cavernoma	0	0	0	4	0	0	4
Meningioma	0	0	1	2	0	0	3
Tuberous sclerosis	0	2	0	0	0	0	2
Viral Encephalitis	0	1	0	0	0	0	1
AV malformation	0	0	1	0	0	0	1
Total	5	13	29	30	23	20	120

Ages 31 to 45 were the most prevalent age group to exhibit MR abnormalities (25%).

TABLE 6: LOCATIONS OF NCC IN MR SCANS

Location	Number
Cerebral hemispheres	
Frontal lobe	8
Parietal lobe	1
Temporal lobe	1
Occipital lobe	3
Multiple (cerebral hemispheres & other intracranial sites)	6
Total	19

Most frequently, NCC was discovered in the frontal lobes.

TABLE 7: INVOLVEMENT OF SINUSES IN VENOUS THROMBOSIS PATIENTS

Involvement of sinuses	Number
Superior sagittal sinus involvement	4
Right transverse & sigmoid sinuses	2
Left transverse & sigmoid sinuses	2
Total	8

The superior sagittal sinus was the most often affected sinus in venous thrombosis cases.

DISCUSSION:

Out of 220 patients, 120 had MR examinations (54.5%) which revealed pathological findings. These included NCC (8.6%), atrophy (7.2%), venous thrombosis (3.6%), tuberculoma (2.7%), gliomas (1.8%), meningioma (1.3%), tuberous sclerosis (0.9%), gliomas with gliosis (22.2%), tubes with gliosis (2.2%), and AV malformation (0.4%). Gliosis-related cerebral infarcts:

An MRI analysis of 49 individuals (22.2%) showed evidence of cerebral infarction.

Eight of the 49 patients had an infarct in their frontal and occipital lobes, which was determined based on diffusion limitation, slight oedema, and the effacement of nearby sulci.

One patient out of 49 had characteristics of a parietal lobe subacute hematoma, exhibiting hyperintensity on the T1, T2, and FLAIR sequences. T2WI and FLAIR images reveal a hypointense narrow ring around the lesion. There was perilesional oedema.

Eleven individuals had chronic ischemic alterations with gliosis in the fronto-parietal lobes, and one patient had abnormalities in the right fronto-parietal, temporo-occipital lobe related to cystic encephalomalacia.

Fifteen patients had bilateral periventricular hyperintense lesions on T2 and FLAIR, along with small chronic ischemia lesions in deep white matter that were unrestricted on diffusion sequences.

In deep gray matter nuclei of ten patients, there were ancient, small gliotic regions.

MRA abnormalities, such as cerebral arterial branch narrowing, were seen in two individuals.

Danier C. et al. found that there was a higher probability of early stroke in watershed infarcts (23%) compared to territorial strokes (5.3%) in their prospective cohort analysis of early start of seizures in 661 stroke patients.

NEUROCYSTICERCOSIS- Nineteen individuals exhibited symptoms consistent with neurocysticercosis (NCC). Each patient showed many ring-enhancing lesions in the cerebral hemispheres and the parenchymal type of NCC. T1 hypointense and T2 hyperintense contents are seen in lesions. Perilesional oedema was seen in few lesions. Cystic signals and eccentric specks inside lesions are observed in the majority of frontal lobe lesions. Every patient had a choline peak on MRS. Four patients showed several intraparenchymal lesions of varying stages, while fifteen patients had few ring-enhancing lesions along with perilesional oedema.

CEREBRAL ATROPHY- Cerebral atrophy was seen in 16 cases. Atrophic alterations, mostly affecting bilateral frontal and temporal lobes with periventricular leukomalacia changes, were seen in 12 cases. Two patients presented with bilateral cerebellar hemisphere cortex, subcortical atrophic alterations and a persistent stroke in the left corona radiata with gliosis and widespread cerebral atrophy. The hippocampal cortical atrophic alterations were seen in two cases.

VENOUS SINUS THROMBOSIS- In our investigation, eight individuals had cerebral venous sinus thrombosis-related MRI findings. Four individuals had superior sagittal sinus thrombosis; two patients also had involvement in the left sigmoid sinus and the other two in the right transverse and sigmoid sinuses. Of the four instances, two patients had haemorrhagic infarcts with thrombus, and one patient had localized gyral oedema along with thrombus extension into the superficial cortical vein. Two individuals had thrombosis in both the left transverse and sigmoid sinuses, whereas the other two patients had thrombosis in both the right transverse and sigmoid sinuses. Two patients in our research had a history of puerperium, and two patients had used oral contraceptives in the past.

DEVELOPMENTAL MALFORMATIONS- A total of seven individuals exhibited characteristics associated with developmental malformations. Polymicrogyria with thicker cortex was seen in three cases. Lissencephaly was present in two patients: frontal & parietal lissencephaly in one patient, and lissencephaly in the frontal and temporal lobes in another. Hippocampal globular and vertical orientation was seen in one case. Heterotopic gray matter was seen in one case.

TUBERCULOMA- An MRI scan revealed that six patients had tuberculoma. The lesions were conglomerate, rim-enhancing, and well-defined, with thick walls that varied in size. The lesions had increased lactate and lipid peak on MRS and perilesional oedema.

GLIOMA- An MRI for four patients showed glioma. There were four patients with lesion locations: the right parietal lobe, the left frontal lobe, the right parieto-occipital area, and the right frontal region.

The characteristics of MR are: On T1WI, the lesions were hypointense; on T2WI and FLAIR sequences, they were hyperintense. There was a little mass impact along with minor perilesional limitation. In every case, MRS revealed an increased choline peak. There was no contrast enhancement in two lesions. The aforementioned characteristics pointed to low-grade glioma, and both patients were sent to more advanced facilities. The contrast enhancement was absent in the necrotic portions of the other two individuals. The aforementioned characteristics point to high-grade glioma, and both patients were sent to more advanced facilities.

CAVERNOMA- Four patients had well-defined localized non-enhancing lesions with full hypointense rims on gradient echo sequences in the right temporal area in one patient and haemorrhagic signal intensities in the subcortical white matter of the right frontal lobe in three others.

MENINGIOMA- In frontal convexity, three individuals had meningioma-like characteristics. In one instance, the right frontal convexity showed well pronounced extra axial, increasing SOL. There was mild cortical neighbouring hyperostosis seen at the edge of the lesion, which had a Dural base and a Dural tail. A comparable lesion in the right intersphenoid area was seen in another case. Similar lesions in the cerebellopontine angle cistern were seen in another case.

TUBEROUS SCLEROSIS- MR neuroimaging was performed on two patients who had been clinically diagnosed with the disease. One patient's results showed several poorly defined areas of altered signal intensity affecting different areas of the cortex and subcortical white matter of both cerebral hemispheres, suggesting cortical and subcortical tubers. Subependymal nodules around both lateral ventricles were seen in one case.

Barkovich used MRI to examine seven individuals with a clinical history of tuberous sclerosis. He found that the lesions were hypointense on T2 WI and hyperintense on T1 WI in parenchymal nodular and subependymal linear lesions. concluded that, in cases where tuberous sclerosis is clinically suspected in infancy, an MRI should not be postponed and that, when detected early in infancy, MRI can aid in the earliest possible identification of the condition. Consequently, parents will receive counseling and patients will receive proper professional care.⁵

VIRAL ENCEPHALITIS- MR characteristics of a single patient with viral encephalitis were observed. These features included bilateral basal ganglia with hyperintense signals on T2W & FLAIR images, while T1W pictures showed hypointense signals.

It was demonstrated by Kamini et al. that MRI is useful in the diagnosis of viral encephalitis. In 17 of the 18 cases, the most prevalent and noticeable characteristic was involvement of the insular cortex. Three individuals exhibited unilateral involvement of the basal ganglia and thalamus. Abnormal T2/FLAIR hyperintensities with diffusion limitation were seen bilaterally in the thalami, basal ganglia, and midbrain in individuals with Japanese encephalitis.⁶

CONCLUSION:

In clinical practice, assessing a patient who presents with epilepsy is a frequent challenge. A crucial part of evaluating individuals with epilepsy is MR imaging.

Determining the exact aetiology of epilepsy is essential to developing a successful treatment plan. Research has demonstrated that MRI is a very sensitive and specific method of determining the underlying pathophysiology in epilepsy. High spatial resolution, superior intrinsic soft tissue contrast, the capacity to image in several planes, and the absence of ionizing radiation make magnetic resonance imaging (MR) a flexible diagnostic tool for seizure patients.

In addition to identifying particular epileptogenic substrates, MR imaging also establishes a course of therapy and makes prognostic predictions. Subtle structural abnormalities associated with epilepsy can be identified by using proper imaging procedures and doing a thorough assessment of the pictures.

In order to assess the range of results, different etiologic reasons for epilepsy, and the most frequent imaging anomaly, 220 individuals with a clinical impression of epilepsy were subjected to magnetic resonance imaging.

The primary etiological causes in our investigation were cerebral infarct with gliosis (22%), NCC (8.6%), and atrophy (7.2%). Other factors included neoplasms, developmental abnormalities, tuberculomas, venous thrombosis, cavernoma, and tuberous sclerosis respectively. Gliosis-associated cerebral infarct was the most prevalent abnormality.

With its better neuroimaging capabilities and zero radiation exposure, magnetic resonance imaging (MR imaging) may be the initial test of choice for conditions such as epilepsy, acute cerebrovascular illness with seizures, developmental cortical abnormalities, and vascular malformations. It has outstanding capacity to detect small lesions as well as their location, size, and quantity of discoveries.

Therefore, we draw the conclusion that MRI is important for patients who come with epilepsy so that any organic or developmental abnormalities may be ruled out or confirmed using the MRI epilepsy procedure.

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