

MRI EVALUATION OF EPILEPSY WITH CLINICAL CORRELATION

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ABSTRACT

BACKGROUND

Epilepsy is a chronic disorder characterized by a spontaneous tendency for recurrent seizures. An epileptic seizure is a clinical manifestation of abnormal, excessive neuronal activity arising in the grey matter of the cerebral cortex. Epilepsy is one of the most common conditions to be evaluated by MRI.

METHODS

This is Hospital Based Prospective Observational study, conducted in the department of radio-diagnosis, NSCB Medical College and Hospital in conjunction with MP MRI and CT Scan Centre, Jabalpur. This study comprised of a total of 150 patients clinically diagnosed as seizures disorder who had undergone MRI examination.

RESULTS

Cases were divided according to the age ranging from < 1 to 91 years with presenting complaint of seizures. Maximum number of patients was males and in the age group of 16-30 years. MR examination had abnormal findings in 92 out of 150 patients (62%), of which majorly was infective granuloma (35.86%), infarct with gliosis (19.56%), tumours (13.04%), congenital (5.4%), Mets (4.3%), sinus thrombosis (3.2%); miscellaneous causes were 18.47%. GTCS was the most common type with 132 (88%) involving generalized, absence and myoclonic; patients were predominantly males 84 (63.6%), between the age group of 16-30 years.

CONCLUSIONS

From the present study it was noted that MRI is a very efficient tool in diagnosing the aetiology of epilepsy. Identification of the exact location of the epileptogenic focus is of great help from neurosurgical point of view. Diagnosing and characterizing the abnormalities with great accuracy by MRI not only helps in preoperative cases but also helps to evaluate the post-operative status. It is non-invasive and there is no exposure to ionizing radiation.

KEYWORDS

MRI, Epilepsy, Seizure, Epileptogenic Focus.

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BACKGROUND

Epilepsy is a chronic disorder characterized by a spontaneous tendency for recurrent seizures. An epileptic seizure is a clinical manifestation of abnormal, excessive neuronal activity arising in the grey matter of the cerebral cortex. This can take a variety of forms, depending on the origin and the propagation of this pathological activity.

Approximately 50 million people currently live with epilepsy worldwide. The estimated proportion of the general population with active seizures or epilepsy at a given time is between 4 and 10 per 1000 people. However, some studies

in low and middle income countries suggest that the proportion is much higher, between 7 and 104 per 1000 people.

The diagnosis of epilepsy depends on the clinical history, supportive EEG and imaging findings.

Magnetic resonance imaging (MRI) has increased substantially the ability to detect causes of seizure disorders, to plan medical or surgical therapy, and to prognosticate the outcome of disorders and therapy. However, MRI must be performed with techniques that will maximize the detection of potentially epileptogenic lesions.

MRI with other functional imaging modalities including PET and SPECT has also been proven valuable in localization of structural and functional alteration. The role of MR in epilepsy surgery in identifying the epileptogenic focus, also lies in its ability to depict topographic relationships between epileptogenic lesion and the eloquent regions of brain.¹

The magnetic resonance imaging (MRI) appearance of the various histologic substrates of epilepsy and the clinical role of MRI in symptomatic epilepsy are reviewed. MRI is

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used clinically to identify potential surgical candidates among patients with epilepsy.

The evaluation of seizures is a common indication for magnetic resonance (MR) imaging. MR imaging is clearly more sensitive imaging technique, particularly in the detection of early disease important to obtain an accurate history, especially regarding the onset and nature of the seizures, from the referring clinician as the specific MR imaging technique used depends on the specific type of seizures the patient has. New-onset seizures in an adult require the acquisition of routine T1- and T2- weighted images, as well as gadolinium-enhanced images.

METHODS

This Hospital based Prospective observational study was conducted on 150 patients, who were referred to the Radiodiagnosis department of NSCB Medical College and Hospital in conjunction with MP MRI and CT scan centre Jabalpur (M.P.) from 1st March 2017 to August 2018. All patients of any age and sex who had undergone MRI with strong clinical suspicion of epilepsy were taken as study subjects. All patients with Contraindications to MRI studies, Claustrophobia or anxiety disorders exacerbated by MRI and Inability to provide consent.

Permission from the Ethical Institute Committee was obtained prior to the study and informed consent of study subjects was taken before MRI was done.

The patients details documented in predesigned proforma. All the patients underwent MRI scanning on 1.5T GE SIGMA MRI Scanner.

Imaging Protocol

Our "Epilepsy Protocol" consisted of the following sequences.

- T1 and T2 Weighted Sequences - Two Orthogonal Planes.
- T2 FLAIR Sequence
- Diffusion Weighted Imaging (DWI)
- GRE T2 Sequence.
- T2 Coronal Oblique Perpendicular to Long Axis of Hippocampus.
- 3D magnetization Prepared Rapid Gradient Echo (MPRAGE) Gadolinium Enhanced T1 Weighted images to be done if indicated on non-contrast MRI Findings.

Imaging Parameters

- Axial, Coronal & Sagittal SE: TI-weighted image SE/SE/FRFSE T2-weighted image with FOV of 24 x 24 cm.
- Axial & Coronal T2 FLAIR image with FOV of 24 x 24 cms.
- Axial, DW image with FOV of 28 x 22 cms.
- Coronal T2 GRE image with FOV 22 x 20 cms.
- Coronal oblique T2-weighted image with FOV 26 x 26 cms.
- Coronal 3D MPRAGE image with FOV 22 x 16.5 cms with TR = 22 / 25 & TE = 7.3.

- A general application of TE = 15/20 and TR = 300/700 for Sagittal / Axial SE TI - weighted image.
- TE = 90/105 and TR = 3000/6100 for sagittal / Axial / Coronal / SE / FSE / FRFSE T2 - weighted image.
- TE = 80/95 and TR = 8002 for Coronal / Axial T2 FLAIR sequence.
- TE - 20 and TR = 640/1000 for Coronal GRE sequence.
- Slice thickness of 5 mm in Sagittal Coronal & Axial planes with 1 mm gap was used in T1W, T2W, FLAIR, DW & GRE sequences.
- Slice thickness of 3 mm in Oblique Coronal plane with 1 mm gap was used in T2W sequence.
- Slice Thickness of 2.2 mm in Coronal plane with 1 mm gap was used in MPRAGE Sequence.

The MR imaging of brain was recorded in single coated imaging film.

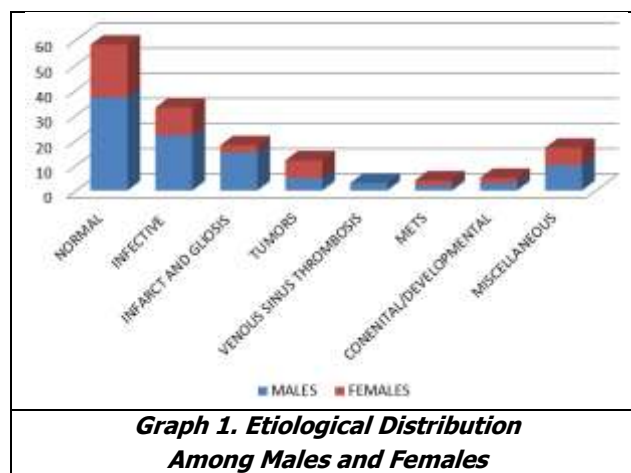
RESULTS

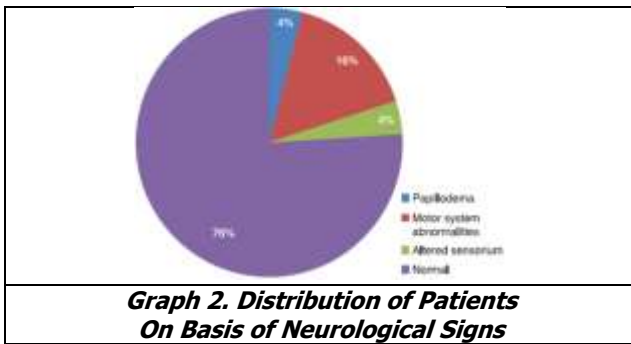
MRI Diagnosis	No. of Patients	Percentage
Infective	33	35.86%
Infarct with Gliosis	18	19.56%
Tumours	12	13.04%
Mets	4	4.34%
Venous Thrombosis	3	3.26%
Congenital	5	5.40%
Miscellaneous	17	18.47%

Table 1. Distribution of Abnormal MRI Patients

Sex	Partial Seizure (16)	Generalized Seizure (134)
Male	13(72.22%)	84.(63.63%)
Female	5(27.77%)	48(36.36%)
Total	18	132

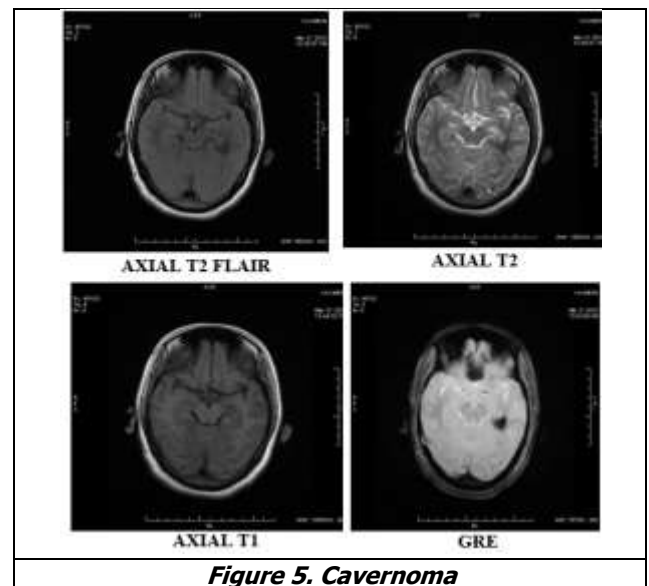
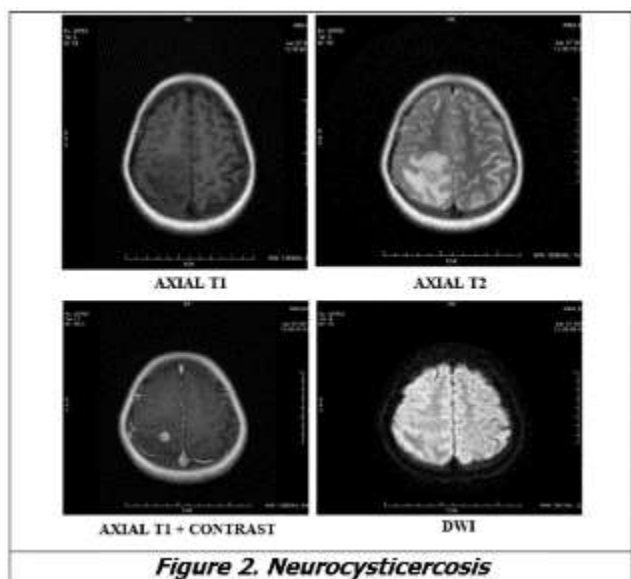
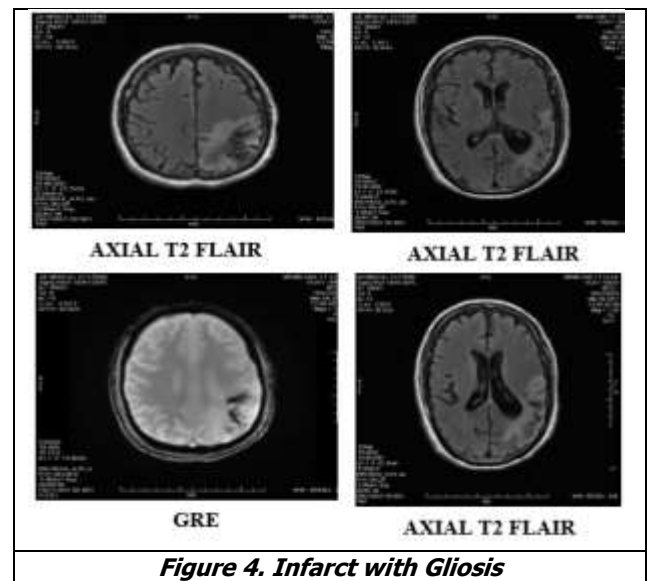
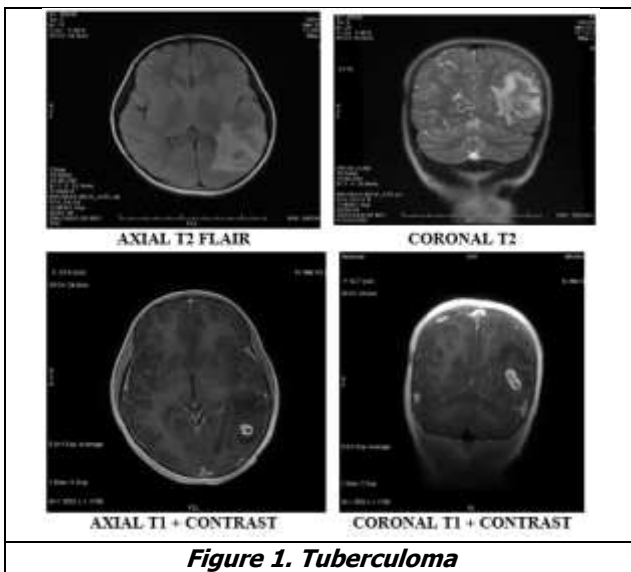
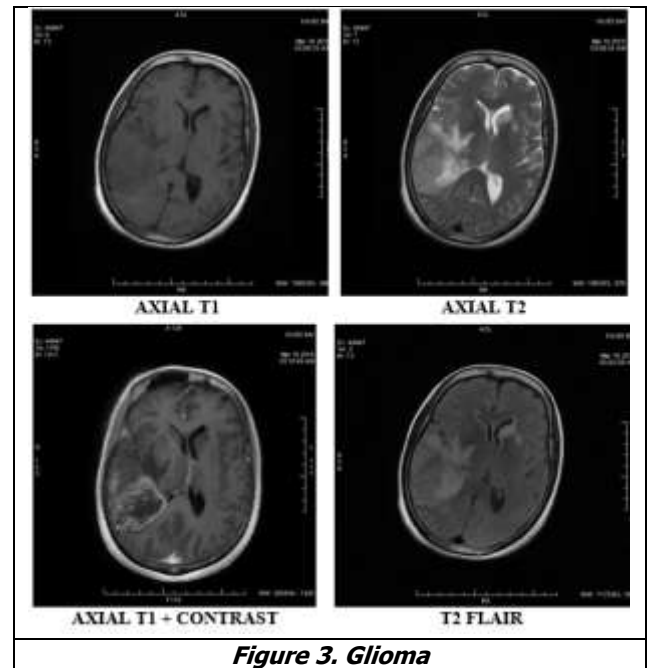
Table 2. Distribution According to Sex of The Seizure Patients





Clinical Diagnosis	No. of Patients	Percentage
GTCS	122	81.33%
Absence	3	2%
Myoclonic	7	4.6%
Simple Partial Seizure	9	6%
Complex Partial Seizure	8	5.33%
Simple With Sec Generalization	1	0.6%

Table 3. Distribution of Patients on The Basis of Clinical Diagnosis of Seizures



DISCUSSION

In our Hospital based Prospective observational study of 150 patients with clinical diagnosis of seizures irrespective of age and sex were chosen but under the criteria laid down by ILAE 1981.

The clinical history of patients was taken individually; proforma was filled accordingly, involving the CNS examination.

Distribution of Patients

The age of patients was from <1 year to 91 year, with male being the dominant in number of males comprising of 97 (65%) and females 53 (35%).

Spectrum of Diagnosis on MR Imaging

The MR examination had an abnormal findings in 92 out of 150 patients (62%), of which majorly constituted by infective granuloma (35.86%), infarct with gliosis (19.56%), tumors (13.04%), congenital (5.4%), Mets (4.3%), sinus thrombosis (3.2%); miscellaneous causes were of (18.47%), rest 58(38%)were normal.

Infective Granuloma Tuberculoma

Sixteen patients showed the evidence of having tuberculoma on the MR imaging.

Features of the lesions were, well defined, along the basal cisterns, rim enhancing, often conglomerated with thick wall, with central hypo-intensities and peripheral hyper-intensities on T2 imaging. The lesions showed on MRS elevated lactate, lipid peak.

Wasay M, Kheleani BA, Moolani MK, Zaheer J, Pui M, Hasan S, Muzaffar S, Bakshi R, Sarawari AR et al.² One hundred patients (43 men) were identified. The age range was 1 to 75 years (mean = 30 y). The number of lesions ranged from 1 to > 100 (mean = 4.5 lesions/patient). Thirty-one patients had solitary lesions, whereas 69 had multiple lesions.³

Neurocysticercosis

Sixteen patients showed the evidence of neurocysticercosis (NCC). All the stages of the NCC was seen in the patients, comprising of ring enhancing lesions in the cerebral hemispheres.

The lesions showed choline peak in the patients, who had MRS done.

Seven patients had shown single ring enhancing lesions with appearance of cyst within cyst, with others showing cystic signals with multiple intraparenchymal lesions of different stages.

Tushar B. Patil, Madhuri M. Paithankar.⁴ Studied 40 patients with probable diagnosis of NCC and concluded that 72% patients showed one lesion, 27% with multiple lesions and common site was parietal lobe (4%).

A 2-4-mm scolex can be seen in nearly 50% of cases.

Cerebral Abscess

One patient showed evidence of space occupying lesion in right posterior high parietal lobe with perilesional edema with low signal intensity on T2WI with peripheral hyper-intensity on T1WI. The lesion showed rim enhancement on contrast. Restriction noted on diffusion weighted images and MRS shows high lactate, lipid peak.

Data from recent studies suggest that diffusion-weighted (DW) imaging is more sensitive than conventional MR imaging in distinguishing brain abscesses and cystic tumors.⁵

Infarct with Gliosis

Eighteen patients showed gliotic changes on MR imaging of which three were females and remaining fifteen were males. Etiological classification consists of arterial of three, venous were of three, only findings of gliosis were of twelve which had history of gliosis.

Three patients showed features of chronic infarct arterial in one of them in temporal lobes, other fronto-parietal, other in parietal lobes.

Three patients showed features of venous infarct, all of them were males.

Twelve of them showed features of old infarct with gliosis and gliosis as their main findings.

Four of the patients showed encephalomalaciatic changes with the prior history of trauma, infarct and remote stroke.

In the patients more than 50% showed gliotic changes in elderly

Danier C. et al.,⁶ conducted prospective cohort study of early onset of seizures in 661 stroke patients and concluded that infarcts involving cerebral cortex, the Rewash high risk of early stroke in water shed infarcts (23%) than territorial strokes (5.3%).

Early-onset seizures typically occur during the first days as simple focal seizures without secondary generalization. Late-onset seizures (three times more often than early-onset seizures) have a peak incidence between 6 months and 2 years after a stroke and are more frequently complex focal seizures with or without secondary generalization; (Bladin et al. 2000).⁷

Brain Tumours

Twelve cases of brain tumours of different aetiologies, comprising five of Glioma, which had two were of high, low each, one of well differentiated glioma itself, with mean age of >50 yrs.

Four case of Meningioma of which three were newly diagnosed case of Meningioma and one was recurrent case.

Three cases of intra axial SOL, Astrocytoma and benign lesion of Arachnoid Cyst.

The generalized features of Glioma were: Hypo-intense on T1WI and Hyper- intense on both T2WI and FLAIR sequences.

On MRS showed choline peak and no contrast enhancement. Mild perilesional restriction with mass effect seen.

The mean age of presentation according to the study was 40 years, similar to the mean age of presentation of low grade astrocytomas is 39 years of age Okamoto et al. 2004.⁸

Four cases of Meningioma were seen, three out of four were seen in females of mean age fourth decade.

MR imaging features included well defined extra axial, enhancing, dural broad based with dural tail sign, showing Hyper-intensity on T2WI and homogenous contrast enhancement. The lesion showed in almost all cases of compressing underlying cerebral parenchyma.

Preoperative seizures were observed in 29.2% of 4709 patients with supratentorial meningioma (Greenberg H, Chandler WF, Sandler HM. Brain tumours. Oxford University Press, USA, 1999).⁹

Developmental Malformations

Five of our patients showed congenital or developmental findings on MR imaging of which three were males, two were females of various diagnosis, Right Hemimegacephaly, Type 1 Lissencephaly, Type 1 Arnold Chiari Malformation, Joubert Syndrome and Epidermoid in Right CP angle. The presentations as seizures has been seen from birth, below or less than 1 year with ongoing drugs, with drugs being regular course the frequency of seizures showed decrease in interval and duration.

- Bilateral cerebral hemisphere appear grossly abnormal in outline with few shallow cortical sulci and shallow bilateral sylvian fissures giving an appearance of hour glass /figure-8 configuration. The cortex is markedly thickened measuring 6 mm. Mild enlargement of bilateral ventricles noted with maximum diameter at level of atrium measuring 16 mm on the right side and 17 mm on left side. Finding are consistent with disorder of neural migration and cortical development type-1 lissencephaly.
- Confluent areas of T2 and FLAIR hyper-intensities are noted in bilateral cerebral hemisphere white matter predominantly location appearing hypo-intense on T1W suggesting hypomyelination.
- Inferior vermis appear hypo-plastic with mega cisterna magna communicating with prominent fourth ventricle through slit like opening consistent with Dandy-Walker variant.

Type 1 Lissencephaly showed Agyria/pachygyria in cerebral lobes. Cell sparse zone between a thin outer layer cortex and a thick inner layer of grey matter.

The cortex is markedly thickened measuring 12-20 mm (rather than the normal 3-4 mm).

Two-layered cortex Forman et al. 2005¹⁰ Onset of epilepsy is usually between 3 and 12 months, but may be later. Mortality exceeds 50% by 10 years and few children live longer than 20 years. (Common associated malformations include rounded hippocampi, enlarged posterior portions of the lateral ventricles, flat anterior portion of the corpus callosum, and very variable hypoplasia of the cerebellum, especially the midline vermis.

In the Right Hemimegacephaly showed features of enlargement of right cerebral hemisphere with cortical thickening involving right frontal lobe without restriction.

Shorvon SD, Andermann F, Guerrini R. The Causes of Epilepsy, Common and Uncommon Causes in Adults and Children. Cambridge Univ Pr. (2011).¹¹

Hemimegalencephaly or unilateral megalencephaly is a congenital disorder in which there is hamartomatous overgrowth of all or part of a cerebral hemisphere.¹²

Miscellaneous

Under the heading of miscellaneous, which comprises of total seventeen cases of which mainly involves namely, two cases of HIE, three cases of ADEM, one case of PVL, one case of arterio venous malformation cavernoma.

Villani F, D' Incerti L, Granata T et-al. Epileptic and imaging findings in perinatal hypoxic-ischemic encephalopathy with ulegyria.¹³

The features of ADEM (Acute disseminated encephalomyelitis) are regions of high signal on T2WI, in the region of subcortical, thalami and brainstem. On contrast enhancement showed the enhancement at the edges of inflammation, giving arc pattern of enhancement.

The diagnosis of ADEM is made after considering clinical features consisting of prior vaccination, viral infection.

Follow up MRI showed complete resolution of the findings.

Wong AM, Simon EM, Zimmerman RA et al.¹⁴ Acute necrotizing encephalopathy of childhood: correlation of MR findings and clinical outcome.

Cavernoma features are well defined non enhancing altered signal intensity lesion which appears hyper-intense on T2WI/FLAIR images with adjacent hypo-intense rim, iso to hypo-intense on T1WI images and showing blooming on GRE images in Left temporal periventricular region. Up to 40% of patients with cavernomas present with epileptic seizures Awad and Jabbour 2006.¹⁵

Periventricular white matter hyperintensity is noted in our case.

Among PVL, complex focal and seizures are most common (Humphreys et al. 2007).¹⁶ There is a correlation between the grade of periventricular leukomalacia on MRI, the presence of other radiologic abnormalities, the risk of epilepsy, and the type of epilepsy syndrome.

Venous Sinus Thrombosis

Three patients showed MRI features of cerebral venous sinus thrombosis in our study; all the three cases were males.

Two patients showed superior sagittal sinus thrombosis and one revealed left transverse sinus thrombosis. Out of three cases, two patient showed haemorrhagic infarct with thrombus and one patient showed extension of thrombus in to superficial cortical vein with focal gyral oedema.

CONCLUSIONS

MRI is much more diagnostically valuable and it is the appropriate neuroimaging study in seizure disorder.

It has been proven beyond doubt that MRI is the most meaningful procedure in the diagnosis, treatment and follow-up of patients with inflammatory and parasitic lesions of the brain such as cysticercosis, tuberculoma, brain abscess, and encephalitis. MRI gives more precise localization of lesions and subsequently, this is of immense help to both clinicians as well as neurosurgeons in their attempt to achieve a faster and more accurate method of discovering the nature of the pathologies.

As seizure disorder is associated with morbidity, the accurate diagnosis of the seizures is crucial for finding the effective management to avoid relapse of seizures.

Diagnosing and characterizing the abnormalities with great accuracy by MRI not only helps in preoperative cases but also helps to evaluate the post-operative status. It is non-invasive and absence of exposure to ionizing radiation is an added advantage. However, experience and understanding of the principles are essential for accurate diagnosis.

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