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ORIGINAL ARTICLE

EVALUATION OF BRAIN TUMOURS BY MRI TECHNIQUES AND THEIR HISTOPATHOLOGICAL CORRELATION

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HOWTOCITETHISARTICLE:
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ABSTRACT: This study was conducted on thirty patients of brain tumors diagnosed on CT scan/ Conventional MRI. It was performed in the Department of Radiological and PET Imaging, Institute of Nuclear Medicine and Allied Sciences (INMAS), Brig S. K. Mazumdar Marg , Lucknow road, Delhi. Out of thirty patients, 19 patients (63.33%) were male and 11 patients (36.66%) were female. Their ages ranged from 22 to 63 years. The most common presenting symptom was headache followed by seizures. MRI is a powerful tool for evaluation and characterization of brain tumors because of its superior soft tissue contrast and multiplanar capabilities. All these patients underwent routine MRI sequences, including T1W, T2WI and FLAIR sequences. Histopathological correlation was obtained in all the patients to serve as the gold standard. Out of thirty patients selected for this study, twenty cases were found to be malignant and ten cases were benign on histopathological evaluation. Majority of malignant lesions were glioblastomamultiforme. Amongst benign cases, majorities were meningioma, one was a granulomatous lesion and one was a benign cystic lesion. On conventional MRI sequences, including T1, T2 and FLAIR, there was significant overlap between appearances of benign and malignant lesions in their intensity on various sequences. Moreover, it has got no prognostic value in follow up of patients after therapy.

KEYWORDS: Brain tumor, M R I, Histopathological correlation.

INTRODUCTION: Magnetic resonance imaging is a non-invasive method of mapping of internal structure of the body, which completely avoids the use of ionizing radiation and provides multiplanar imaging with good spatial resolution. It is the modality of choice for detection & characterization of CNS pathology. Conventional MRI acquires signal mainly from the difference in relaxation properties of free water protons. Thus, sensitivity in depicting lesion is high, but pathological specificity is not good. Although qualitative interpretation of basic brain tumour MRI (including T2-weighted images and gadolinium [Gd]-enhanced T1-weighted images), remains the backbone of brain tumour imaging, in a significant number of cases, these techniques fail to allow confident and correct differential diagnosis, grading, and monitoring of brain tumour.[1] The identification of a tumoural mass and the assessment of its size and vascularization are best achieved with X-ray CT and MRI, while biochemical imaging can provide additional information that is crucial for tumour classification, differential diagnosis and follow-up.[2]

AIMS AND OBJECTIVES:

- To identify and characterize various brain tumors using magnetic resonance imaging techniques.
- To identify and characterize various brain tumours using histopathological diagnosis and histopathological correlation of MRI findings.

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MATERIAL AND METHODS: The present study was conducted in the Department of Radiological Imaging & Department of PET Imaging of Institute of Nuclear Medicine and Allied Sciences (INMAS), Brig S K MazumdarMarg, Timarpur, Delhi-110054 after taking necessary approval from the Institutional Ethics Committee.

PATIENTS: A total of 30 patients were included in the study after taking written informed consent. Patients taken up for study were cases of brain tumors diagnosed on conventional MRI or CT scan. Patient selection was made from the patients coming for MRI in the Department of Radiological Imaging. A thorough clinical history was taken and relevant physical examinations were done. All the routine blood investigations were carried out including renal function tests.

All patients with brain tumours diagnosed on CT scan / Conventional MRI coming in our department were chosen for the study. Patients were explained about the procedures to be carried.

Patients were then followed during their management by the referring surgeons and results of histopathology of tumour tissues were collected. The histopathological diagnosis was considered as the 'gold standard' in this study.

STUDY DESIGN: Diagnostic accuracy study.

FOLLOWING ELIGIBILITY CRITERIA WERE FOLLOWED: All age groups and both sexes were included.

INCLUSION CRITERIA:

1. Patients provisionally diagnosed with brain tumour by CT/MRI.
2. Tumour size at least 1.5 cm in greatest axial dimension on CT/MRI**.**

EXCLUSION CRITERIA:

1. All patients of known renal pathology.
2. Life expectancy of < 3 months.
3. Absolute or Relative contraindication to MRI and PET-CT.
4. Pregnant or lactating patients.

MRI: MRI data were being collected using a Siemens Magnetom Skyra 3.0 T scanner (Siemens Healthcare Germany) using a 20-channel head coil. An 18-20G intravenous cannula was put in the antecubital vein and connected to a pressure injector. History of any previous intervention, surgery, metallic implants, pacemaker or any other ferromagnetic material was taken. Adequate comfort of the patient was ensured to minimize patient motion during the examination.

THE IMAGING PROTOCOL AND PARAMETERS WERE AS FOLLOWS:

CONVENTIONAL MR PROTOCOL: The MR protocol included the following sequences: a 3-plane localizer; T1WI (TR/TE/TI: 2000/12/859) in axial plane; FLAIR images (fluid-attenuated inversion-recovery images; TR/TE/TI: 9000/81/2500) in axial & coronal planes; and T2WI (TR/TE: 5600/100) in axial, coronal & sagittal planes. Following contrast administration, T1weighted images were obtained in axial, sagittal and coronal planes. All sequences were obtained with a 220 mm field of

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view and an interpolated 256 x 256 matrix. Slice thicknesses were 5 mm for axial images and 4 mm for sagittal and coronal images with a 1 mm intersection gap.

DATA QUANTITATION: Morphologic analysis was performed by conventional MRI techniques using following features:

i. Signal contrast with respect to normal brain parenchyma.
ii. Tumour size, shape, margins, internal architecture & extent of perifocal edema.
iii. Indirect tumour signs (compression syndrome, midline shift etc.)

Three-dimensional regions of interest (ROIs) were drawn manually on non-interpolated DW images in all lesions and additional normal tissue regions. ROIs used to be slightly smaller than the actual lesions in order to avoid partial-volume effects. Areas of necrotic tissue, as identified from the morphologic and contrast-enhanced images, were avoided.

Proton magnetic resonance spectroscopy was analyzed for the presence of 5 different metabolite peaks. These are the choline (Cho), creatine (Cr), N-acetylaspartate (NAA), lactate, and lipid. Tumours, especially primary brain tumours show a very specific pattern in elevation of choline and loss of N-Acetyl Aspartate peaks. Cho/Cr and Cho/NAA ratio were also calculated. In general the higher grade gliomas tend to exhibit higher Cho/Cr and Cho/NAA ratios.

Lesions were localized on PET-CT and ROI were drawn well within the lesions which generated standardized uptake values for the lesion with FDG uptake.

Based on the above parameters, the lesions were categorized as benign or malignant. A prospective diagnosis of malignant lesion was made based on morphological characteristics, PWI (rCBV tumour), ADC values, Values of NAA, Cho & Cr with Cho/Cr and Cho/NAA ratios and SUV on PET images.

OBSERVATION AND RESULTS: A total of 30 patients with brain tumours (referred to the MRI department of INMAS, Delhi-54) were included in the present study. Detailed MRI examination using conventional MRI sequences was performed on these patients. PET correlation was obtained in patients suspected to have malignancy on MRI evaluation. The patients were classified according to various parameters:

AGE DISTRIBUTION: Age of the patients ranged from 22 to 63 years. The youngest patient was 22 years old and the oldest patient was 63 years old. Amongst 30 patients studied, 22 patients were between 30-49 years age group.

Age Group	Number of cases	Percentage
< 30 years	2	6.67
30-39 years	11	36.67
40-49 years	11	36.67
> 50 years	6	20.00
Total	**30**	**100**

TABLE 1: AGE DISTRIBUTION IN 30 STUDY CASES

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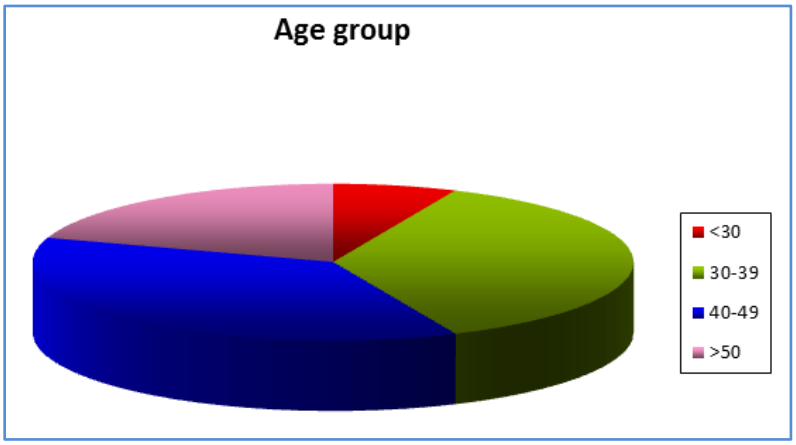


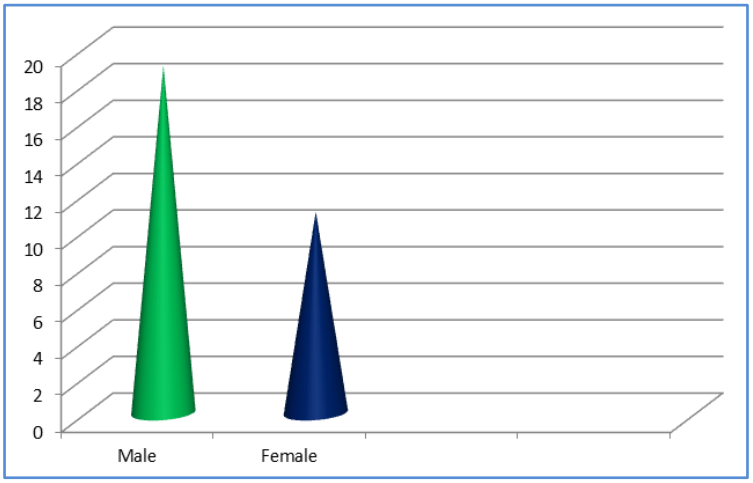
Graph 1

SEX DISTRIBUTION: Amongst 30 patients studied, 19 patients were male and 11 patients were female.

In the study, the majority of the patients were males comprising about 63.33%.

SEX	NO.OF PATIENTS	PERCENTAGE
Male	19	63.33%
Female	11	33.66%
Total	**30**	**100%**

TABLE 2: SEX WISE DISTRIBUTION OF PATIENTS IN 30 STUDY CASES



Graph 2

SYMPTOMS: All the patients of the study group presented with headache as the main complaint. Patients also presented with seizures (60%), unexplained nausea and vomiting (40%). Majority of the patients presented with a combination of headache and seizures. Few patients presented with

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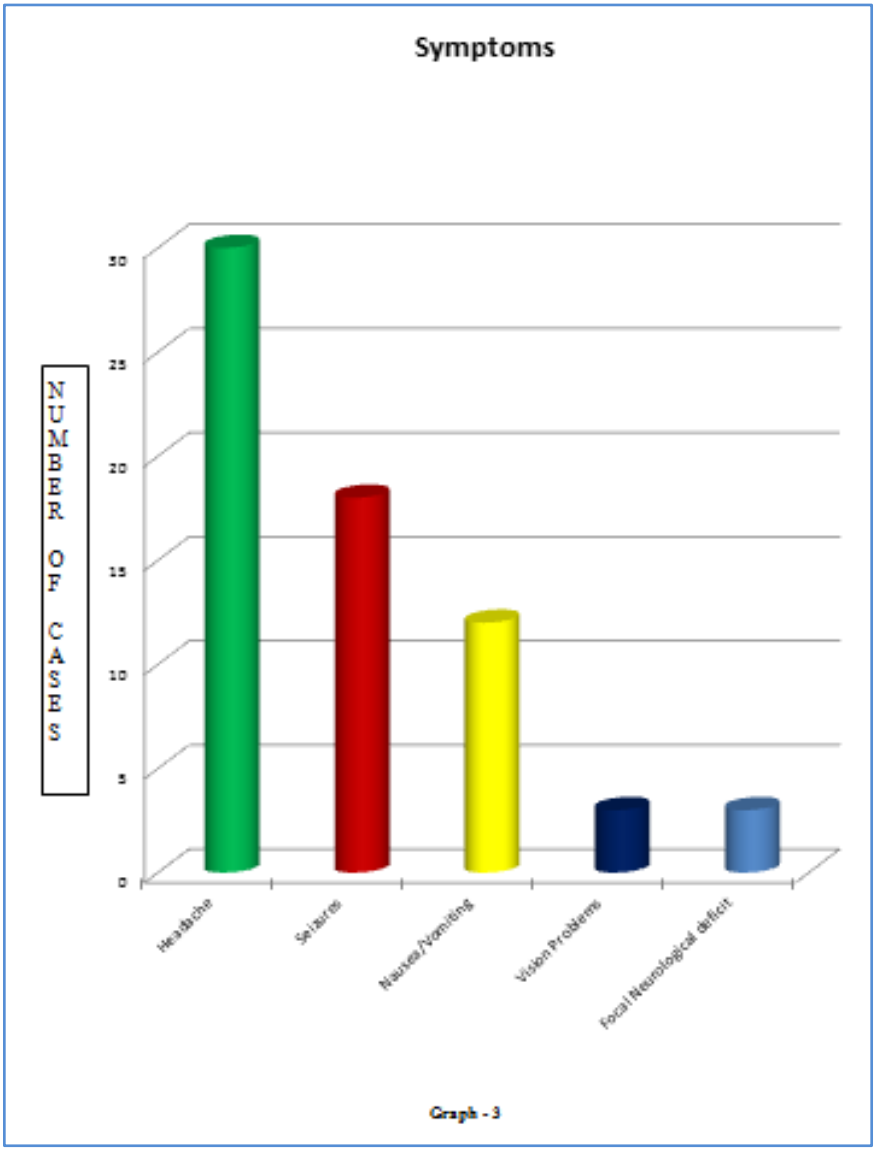
focal neurological deficit (10%) and vision problems (10%). The distribution of patients on the basis of presenting complaints is as follows.

Symptoms	Number of cases	Percentage
Headache	30	100
Seizures	18	60
Nausea/Vomiting	12	40
Focal neurological deficit	3	10
Vision Problems	3	10

TABLE 3: SIGN AND SYMPTOMS IN 30 STUDY CASES



Graph 3: Distribution of lesions according to site

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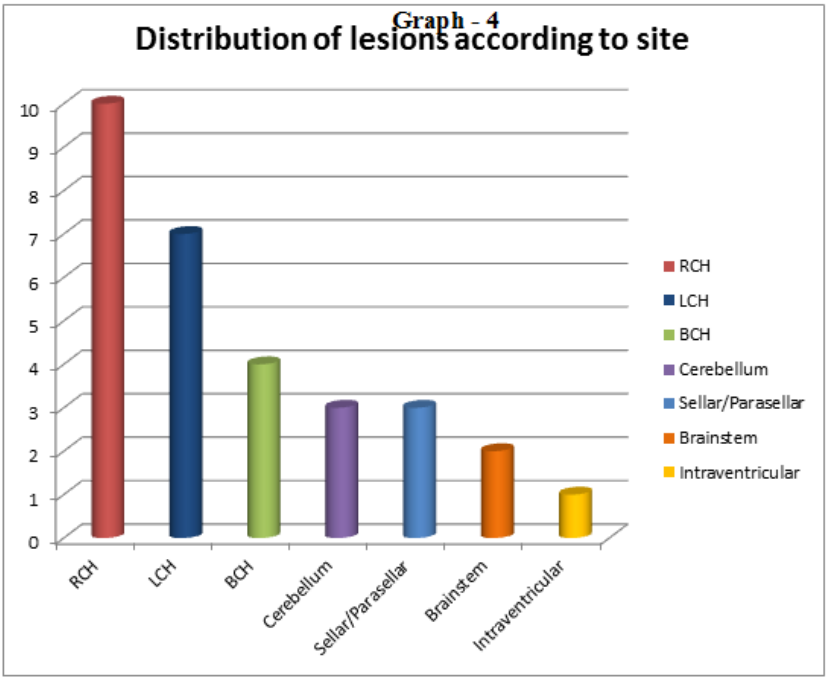
The majority of lesions (33.33%) were situated in right cerebral hemisphere and most of them were malignant in nature.

Site	Number of cases	Percentage
Right Cerebral Hemisphere	10	33.33
Left Cerebral Hemisphere	7	23.33
Bilateral Cerebral Hemispheres	4	13.33
Cerebellum	3	10
Sellar/Parasellar	3	10
Brainstem	2	6.66
Intraventricular	1	3.33
Total	**30**	**100**

TABLE 4: DISTRIBUTION OF LESIONS ACCORDING TO SITE IN 30 STUDY CASES



Graph 4

Age Group	Benign	Malignant
Less than 30 years	1(10%)	1(5%)
30-39 years	5(50%)	6(30%)
40-49 years	4(40%)	7(35%)
More than 50 years	0(0%)	6(30%)
Total	**10(33.33%)**	**20(66.67%)**

TABLE 5: DISTRIBUTION OF LESIONS IN VARIOUS AGE GROUPSIN 30 STUDY CASES

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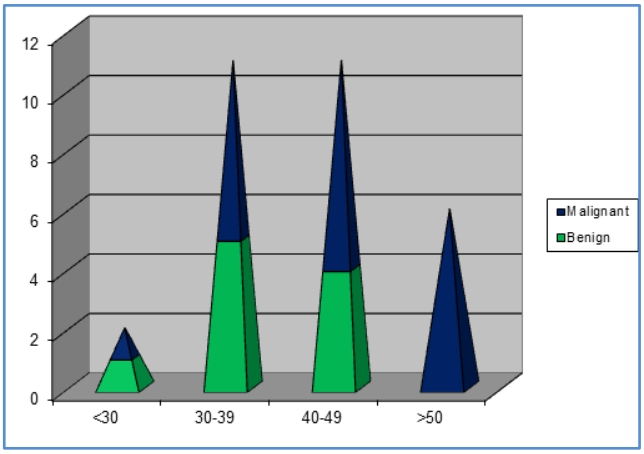


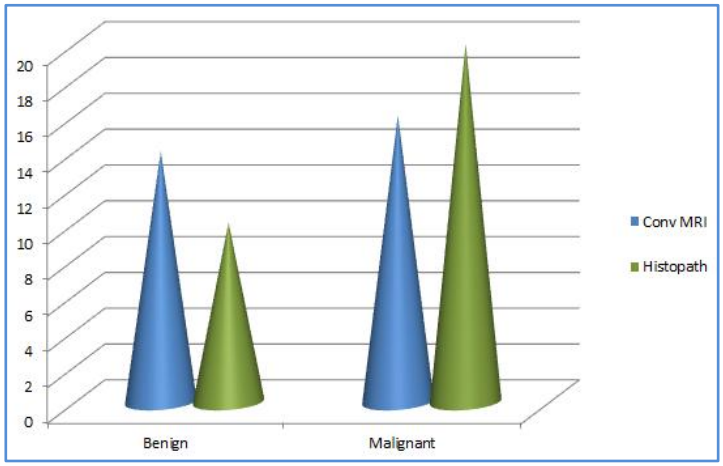
Graph 5

Sex	Benign	Malignant
Female	6 (60%)	5(25%)
Male	4(40%)	15(75%)
Total	**10(100%)**	**20 (100%)**

TABLE 6: DISTRIBUTION OF LESIONS IN VARIOUS SEX GROUPS IN 30 STUDY CASES

Type of lesion	Conventional MRI	Histopathology
Benign	14	10
Malignant	16	20

TABLE 7: CATEGORIZATION OF LESIONS BASED ON MORPHOLOGIC CRITERION ALONE ACCORDING TO CONVENTIONAL MRI



Graph 6

Ten lesions were benign with themajority being meningioma. Rest of the twenty lesions.

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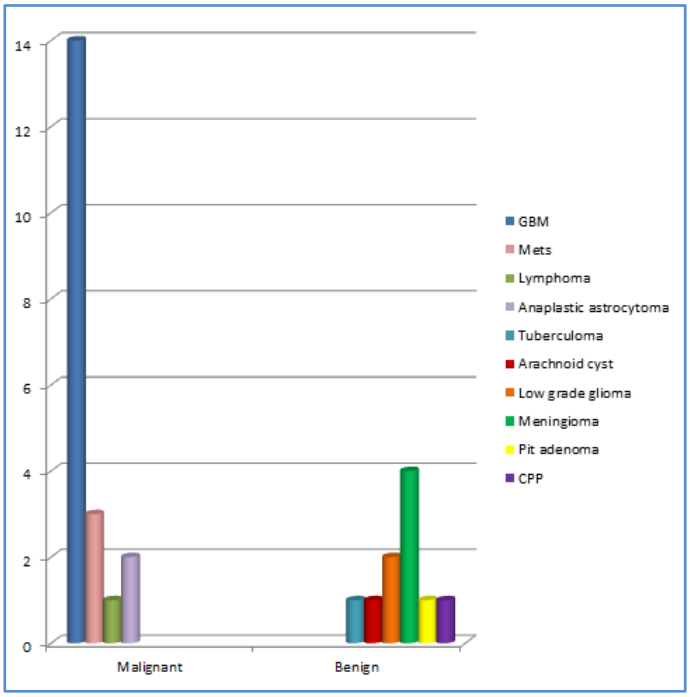
HISTOPATHOLGICAL EXAMINATION	Number of cases	Percentage
Benign	10	33.33%
Malignant	20	66.66%
Total	**30**	**100%**

TABLE 8: HISTOPATHOLOGICAL DIAGNOSIS IN 30 STUDY CASES

Type of lesion	Number of cases	Percentage
I – Malignant	**20**	**66.66**
a) Glioblastomamultiforme	14	46.66
b) Metastasis	3	10
c) Lymphoma	1	3.33
d) Anaplastic astrocytoma	2	6.66
I – Benign	**10**	**33.33**
a) Meningioma	4	13.33
b) Low grade glioma	2	6.66
c) Pituitary adenoma	1	3.33
d) Arachnoid cyst	1	3.33
e) Tuberculoma	1	3.33
f) Choroid plexus papilloma	1	3.33

TABLE 9: DISTRIBUTION OF LESIONS ON HISTOPATHOLOGY IN 30 STUDY CASES



Graph 7

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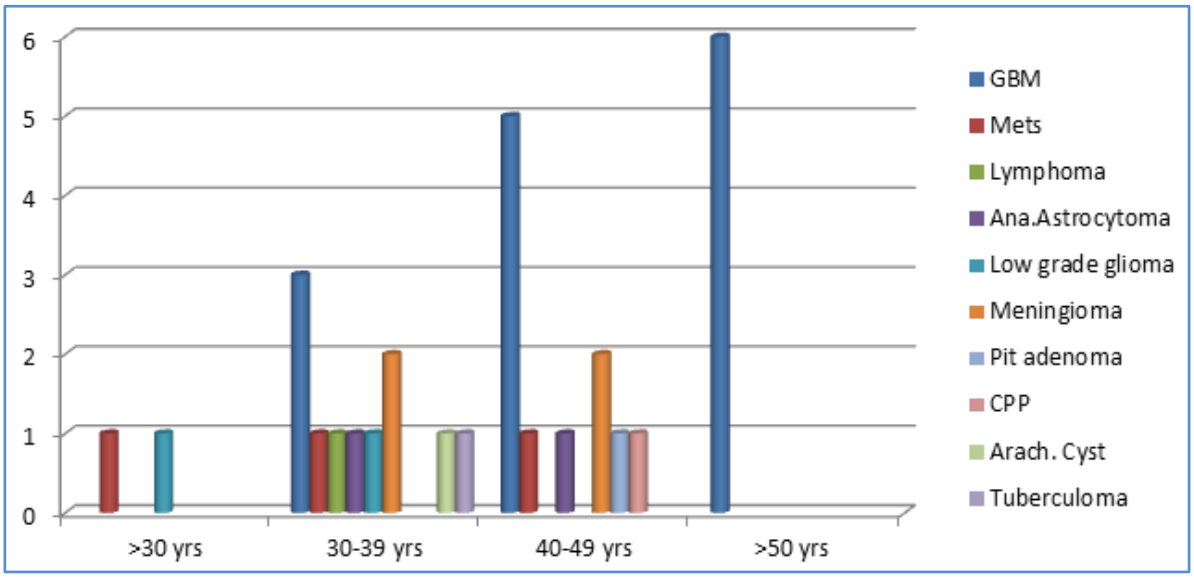
Age	Malignant				Benign					
	GBM	Mets	Lymphoma	Ana. Astrocytoma	Low grade glioma	Meningioma	Pit adenoma	CPP	Arach. Cyst	Tuberculoma
<30 yrs		1			1					
30-39 yrs	3	1	1	1	1	2			1	1
40-49 yrs	5	1		1		2	1	1		
>50 yrs	6									

TABLE 10: DISTRIBUTION OF VARIOUS LESIONS IN DIFFERENT AGE GROUP



Graph 8

Age	Malignant				Benign					
	GBM	Mets	Lymphoma	Ana. Astrocytoma	Low grade glioma	Meningioma	Pit adenoma	CPP	Arach. Cyst	Tuberculoma
Male	11	2	1	1	1			1	1	1
Female	3	1		1	1	4	1			

TABLE 11: DISTRIBUTION OF VARIOUS LESIONS IN DIFFERENT SEX GROUP IN 30 STUDY CASES

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Fig: 1A **Case of left frontal glioblastoma multiforme crossing the midline**

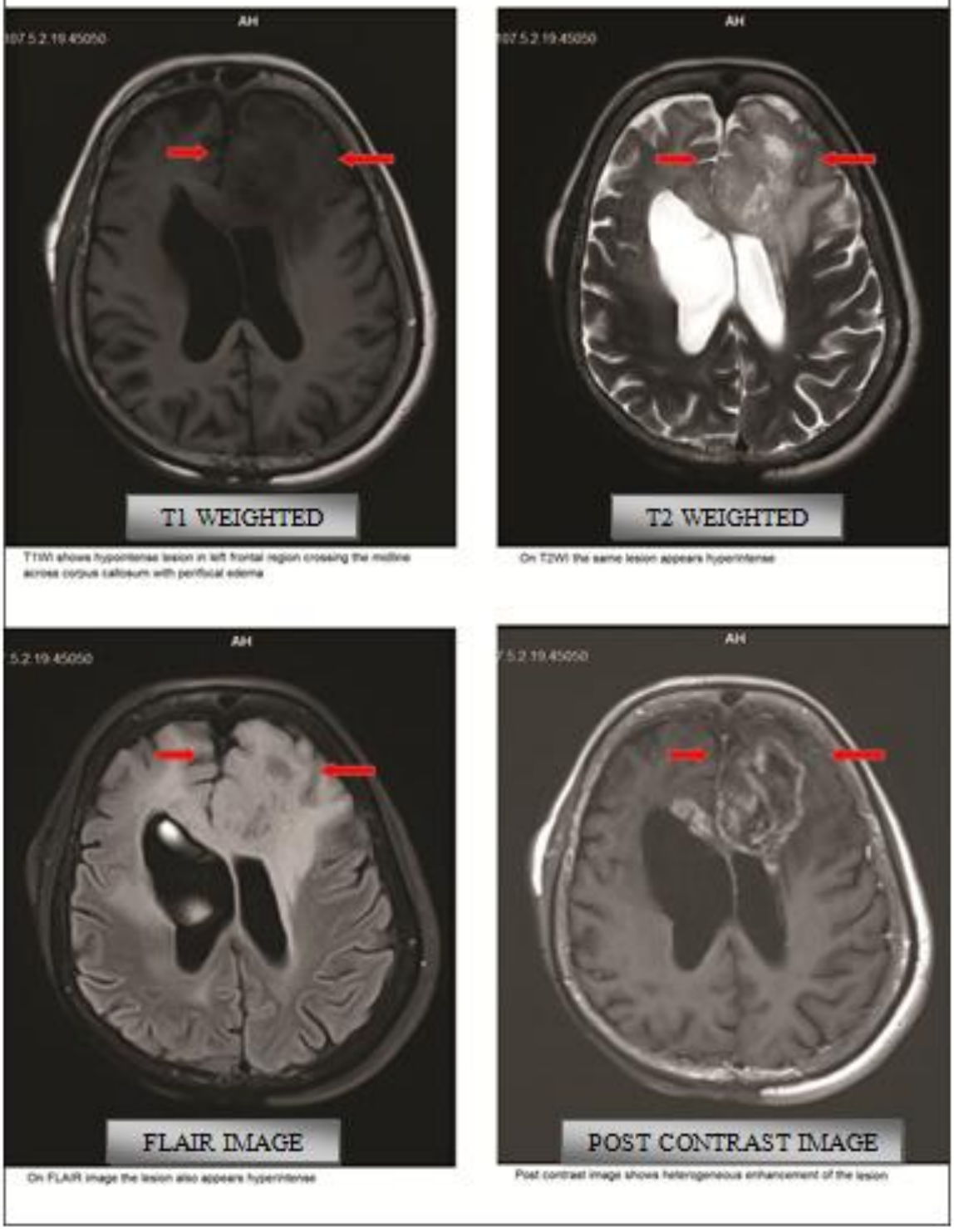

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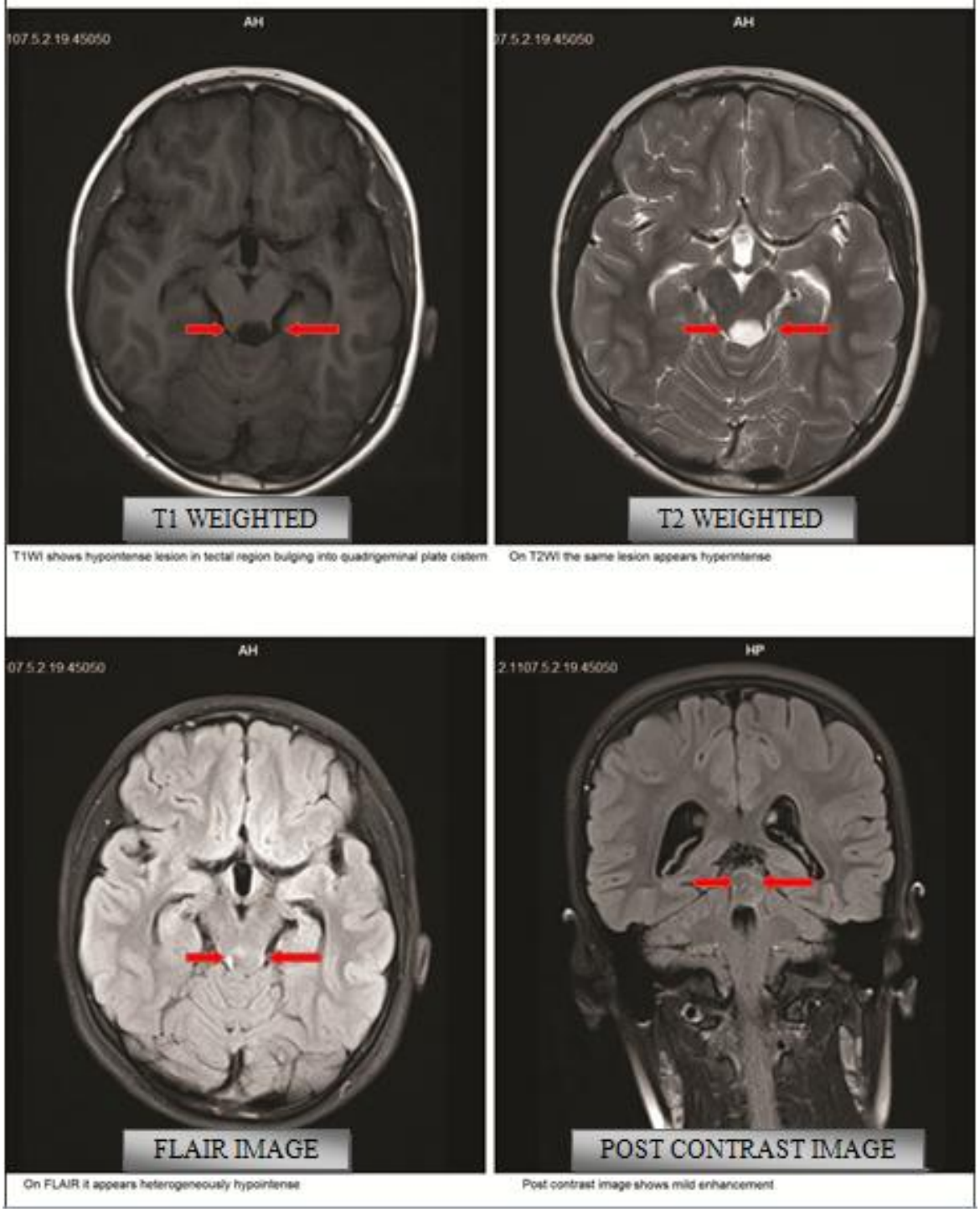
Fig: 4A. **Case of low grade glioma involving the brain stem**



T1WI shows hypointense lesion in tectal region bulging into quadrigeminal plate cistern

On T2WI the same lesion appears hyperintense

On FLAIR it appears heterogeneously hypointense

Post contrast image shows mild enhancement

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DISCUSSION: MRI has several benefits over CT scan in the evaluation of brain tumours, including its multiplanar capabilities, ionizing radiation free imaging, better visualization and characterization of tumour, detection of recurrence and differentiation of recurrence from radiation induced changes. The present study evaluates the role of novel magnetic resonance techniques in the evaluation and characterization of brain tumours. Thirty cases of brain tumours were analyzed in this study.

The age of the patients in this study ranged from 22 to 63 years. The youngest patient who was 22 years old presented with headache and nausea/vomiting. Twenty two patients (73%) belonged in the 30-50 years age group and formed the majority in the study group. All the patients had a chief complaint of headache.60% (n=18) of the patients presented with complaint of seizures, 40% (n=12) of the patients presented with complaint of nausea/vomiting, 10% (n=3) presented with focal neurological deficit and 10 %(n=3) presented with vision problems. Any neoplasm can have lethal consequences if it is located in a critical region, as when a benign meningioma, by compressing the medulla, causes cardiorespiratory arrest.[4]

Few of the patients had other comorbid conditions like diabetes, hypertension or coronary artery disease. None of the patients had any renal pathology or reaction to any medication as per past history. There was no adverse reaction observed in any of the patients after Gadolinium contrast administration.

Histipathology is considered to be the gold standard for final diagnosis and management. Out of the thirty cases in the present study, twenty cases were malignant in nature and ten cases were benign. Out of the benign cases, four were meningiomas, two were low grade glioma, one was pituitary macroadenoma, one was choroid plexus papilloma, one was granulomatous lesion and one was arachnoid cyst. The majority of malignant cases were glioblastomamultiforme (n=14), followed by metastases (n=3), anaplastic astrocytoma (n=2) and lymphoma (n=1).The anaplastic Astrocytoma (WHO grade III) often evolves from a well-differentiated precursor lesion of the type just described, a sequence in which losses of hetrozygosity involving chromosomes 10q and 19q (among others) as well as deletions affecting genes that encode p16 and other cell cycle regulators are implicated.[5]

Magnetic resonance evaluation of thirty patients with brain tumours was done. The lesions could be detected on conventional MRI sequences in all the patients. 46.67% (n=14) of the lesions had ill-defined margins, 46.67% (n=14) of the lesions had well defined margins and 6.66% (n=2) had lobulated margins on conventional T1 and T2WI. The majority of the lesions appeared hypointense on T1WI & appeared predominantly hyperintense on T2 weighted and FLAIR sequences. Perilesional edema was moderate to marked in malignant and inflammatory lesions whereas it was mild to absent in benign lesions.

Although magnetic resonance imaging including novel techniques like diffusion, spectroscopy and dynamic contrast enhancement studies are not routinely carried out for evaluation of brain tumours, they were found to be of value in discrimination between benign and malignant pathologies. Using magnetic resonance techniques, greater level of diagnostic confidence can be achieved and thus avoiding unnecessary biopsies which significantly reduce patient morbidity and mortality In some tumours, this benefit might preclude brain biopsy, which is an invasive procedure that would otherwise be required to establish the final diagnosis. It also helps to avoid delay in initiating tumour therapy as well as the progress of the treatment. Although expensive and time-consuming, the novel MRI techniques should, wherever available, be performed in addition to conventional MRI sequences in the evaluation of brain tumours and tumour-like lesions.

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SUMMARY: In the present study, thirty patients in the age range of 22 to 63 years of age were included after being diagnosed to be having a brain tumour on CT scan or conventional MRI. All these patients underwent routine MRI sequences, including T1W, T2WI and FLAIR sequences. Histopathological correlation was obtained in all the patients to serve as the gold standard.

In some tumours, this benefit might preclude brain biopsy, which is an invasive procedure that would otherwise be required to establish the final diagnosis. It also helps to avoid delay in initiating tumour therapy as well as the progress of the treatment. Although expensive and time-consuming, the novel MRI techniques should, wherever available, be performed in addition to conventional MRI sequences in the evaluation of brain tumours and tumour-like lesions.

CONCLUSION: This study was conducted on thirty patients of brain tumours diagnosed on CT scan/ Conventional MRI. It was performed in the Department of Radiological and PET Imaging, Institute of Nuclear Medicine and Allied Sciences (INMAS), Brig S.K. Mazumdar Marg, Lucknow road, Delhi.

Out of thirty patients, 19 patients (63.33%) were male and 11 patients (36.66%) were female. Their ages ranged from 22 to 63 years. The most common presenting symptom was headache followed by seizures.

In some tumours, this benefit might preclude brain biopsy, which is an invasive procedure that would otherwise be required to establish the final diagnosis. It also helps to avoid delay in initiating tumour therapy as well as the progress of the treatment. Although expensive and time-consuming, the novel MRI techniques should, wherever available, be performed in addition to conventional MRI sequences in the evaluation of brain tumours and tumour-like lesions. MRI is a powerful tool for evaluation and characterization of brain tumours because of its superior soft tissue contrast and multiplanar capabilities.

With advent of high field magnets and stronger gradients, the imaging times have reduced considerably along with superior spatial and temporal resolution. This has brought MRI to the forefront in diagnostic imaging of brain tumours. This may contribute not only to more precise diagnosis on MRI but also to more planning for treatment of cystic brain metastases.[3]

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