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A PROSPECTIVE STUDY TO FIND OUT ROLE OF MRI IN EVALUATION OF BRAIN TUMOURS & THEIR HISTOPATHOLOGICAL CORRELATION

Pharmacology

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ABSTRACT

Background: Brain tumors are not a very common disease, but they are among the most fatal cancers. Not only malignant but benign tumor could also lead to death due to mass effect on vital structures. Access to these tumors is difficult and MRI could be helpful in determining anatomical location of tumors and distinction of malignant from benign.**Objective:** The present study was done to identify and characterize various brain tumors using magnetic resonance imaging techniques and to identify histopathological correlation of MRI findings. **Materials and Methods:** The present prospective observational study was carried out on selected 50 patients referred for MRI scan of brain with a clinical suspicion of brain tumor in the Department of Radiology, GMC, Azamgarh for a period of 6 months from September 2020 to February 2021. MRI scan of brain was performed in all cases. Patients who were operated were followed for histopathological diagnosis. The histopathological reports were compared with MRI findings. All these information's were collected in pre-designed structured data collection sheets. The collected data were compared and analyzed by SPSS software version 15. **Results:** Results of 50 patients were analyzed. 31 (62%) were Male whereas 19 (38%) Patients were female. Majority of Patients were in the Age group of 30-39 (34%). Most common presenting symptoms was headache accounting 15 (9.69%). Most common site for tumor involvement was Right cerebral hemisphere 19 (38%). 74% patients had Malignant lesion while 26% had benign lesion. Glioblastomamultiforme was most commonly observed malignant lesion accounting for 17 (34%) while Meningioma was most commonly observed benign lesion accounting for 04 (8%). **Conclusion:** MRI is useful modality and study of choice in the diagnosis of brain tumors because of its high sensitivity and specificity especially after the use of contrast. MRI thus can be regarded as an important imaging modality in the diagnosis of tumor.

KEYWORDS

Tumor, Magnetic Resonance Imaging, Histopathology, Malignant, Benign

INTRODUCTION

Brain tumors are not a very common disease, but they are among the most fatal cancers. De Angelis et al.[1] reported an incidence of less than 1 h in the western population but life expectancy for an individual can be one year or even less for the most aggressive brain tumors. The causes of brain cancer are still largely unknown, the only environmental risk factors which could be identified so far, are exposure to certain chemicals or ionizing radiation.[2]

Early detection of brain tumors is difficult because the brain is covered by the skull and brain tumors do not exhibit very specific clinical symptoms. In general, three different categories of symptoms for brain tumors can be distinguished.[3]

1. Increased cranial pressure can lead to headache, vomiting and altered states of consciousness.
2. Cognitive and behavioral impairment, personality or emotional changes can be attributed to brain dysfunction.
3. Symptoms of irritation like absences, fatigue or seizures can be observed.

However, all these symptoms are not specific for brain tumors only. Therefore, diagnosis usually starts with an interrogation of the patient for medical history and symptoms. If a brain tumor is suspected, imaging plays a central role. Currently, different modalities of magnetic resonance images (MRI) are state of the art for noninvasively diagnosing brain tumors.[1]

Magnetic resonance imaging (MRI) is a non-invasive 3D imaging technique, which offers good soft tissue contrast. 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.[3]

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.[4] MRI for brain tumor studies makes use of different modalities to visualize different regions of the tumor. This is necessary because not all the sub-compartments of a brain tumor can be distinguished from one modality only. However, despite the crucial role of imaging, a definitive diagnosis can only be confirmed by histological examination of tumor tissue samples, which have been obtained by biopsy or surgery.[5] The present was done to assess the effectiveness of MRI for the evaluation of brain tumor and its comparison with histopathological findings. It also elucidate the accuracy, sensitivity, specificity of MRI in detection of brain tumor.

AIM & OBJECTIVES

1. To identify and characterize various brain tumors using magnetic resonance imaging techniques.
2. To identify and characterize various brain tumours using histopathological diagnosis and histopathological correlation of MRI findings.
3. To study location, extent & involvement of key structure by brain tumour and tumour like conditions.

MATERIAL AND METHODS

The present prospective observational study was carried out on consecutively selected 50 patients ranging from 25-90 years of age referred for MRI scan of brain with a clinical suspicion of brain tumor in the Department of Radiology, Government Medical College, Azamgarh for a period of 6 months from September 2020 to February 2021 after commencement of Institutional Ethics Committee Approval.

At first all the patients were evaluated by detail history and clinical examination with special emphasis on nervous system. Subsequently MRI scan of brain was performed in all cases. Patients who were operated were followed for histopathological diagnosis. The histopathological reports were collected thus, were compared with MRI findings. All these information's were collected in pre-designed structured data collection sheets.

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 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.

Statistical Analysis

Descriptive statistical analysis has been carried out in the present study. Results on categorical measurements are presented in number (%). Chi-square test has been used to find the significance of study parameters on categorical scale between two or more groups. P value <0.05 were considered statistically significant.

RESULTS

The main objective of the study was to establish the diagnostic usefulness of MRI in detection of brain tumor. A total number of 50 patients who were clinically suspected, having brain tumor was included consecutively in this study. Following result was obtained during the study period.

- During the study Period, a total of 50 Patients underwent MRI to find out cerebral tumor and it was observed that 31 (62%) were Male whereas 19 (38%) Patients were female. Similarly, it was observed that at majority of Patients were in the Age group of 30-39 (34%) followed by Age group of 40-49 (11%) while Patients with age group of <30 was minimum 3(6%). as represented in Table no 1. In our study at government hospital $x2$ was 9.62, d.f was 3 and p value was 0.7214, which indicates that there was no association between age group and gender.

Table 1: Gender wise Age group distribution of Patients with Cerebral Tumor (n=50)

GOVERNMENT HOSPITAL			
Age group(years)	Patients		Total (%)
	Male (%) (n=31)	Female (%) (n=19)	
<30	02 (6.45)	01 (5.26)	03 (6)
30-39	11 (35.48)	06 (31.57)	17 (34)
40-49	07 (22.58)	04 (21.05)	11 (22)
50-59	05 (16.12)	04 (21.05)	09 (18)
60-69	04 (12.90)	02 (10.52)	06 (12)
>70	02(6.45)	02 (10.52)	04 (8)
Total	31 (100)	19 (100)	50 (100)
Grand Total (%)	**62**	**38**	**100**
$x2$= 9.62	d.f =3 p= 0.7214	(Mean ± SD: 39.26±8.33)	

- During the study Period on analyzing cases according to the presenting symptoms Gender wise it was observed that, most common presenting symptoms was headache accounting 15 (9.69%) followed by Fever 11 (7.27%), Nausea/vomiting 10 (16.96%) while least presenting symptoms was weakness 01 (3.63%) as represented in Table no 2. In our study at government hospital $x2$ was 6.835, d.f was 3 and p value was 0.0105 which indicates that there was association between age group and gender.

Table 2: Distribution of cases according to the presenting symptoms (n=50)

GOVERNMENT HOSPITAL				
S.No	Type of Symptoms	Patients		Total (%) (n=50)
		Male (%) (n=31)	Female (%) (n=19)	
1.	Seizures	03 (25.53)	01 (24.59)	04 (23.63)
2.	Nausea/Vomiting	06 (20.12)	04 (14.75)	10 (16.96)
3.	Focal neurological deficit	02 (13.82)	02 (13.11)	04 (12.72)
4.	Vision Problems	01 (8.51)	01 (14.75)	02 (10.30)
5.	Headache	09 (11.70)	06 (8.19)	15 (9.69)
6.	Fever	08 (8.51)	03 (6.55)	11 (7.27)
8.	Ataxia	02 (6.38)	01 (4.91)	03 (5.45)
9.	weakness	00 (3.19)	01 (4.91)	01 (3.63)
Grand Total (%)		31 (100)	19 (100)	50 (100)
$x2$= 6.835		d.f =3	*p =0.0105	

- In our study distribution of lesions according to site were analyzed and it was observed that most common site was Right cerebral hemisphere 19 (38%) followed by Left cerebral hemisphere 12 (24%), Bilateral cerebral hemispheres 07 (14%) while least commonly involved site was Intraventricular 01 (2%) as depicted in Table no 3. In our study at government hospital $x2$ was 6.835 and p value was 0.997 which indicates that there was no association between age group and gender.

Table 3: DISTRIBUTION OF LESIONS ACCORDING TO SITE (n=50)

GOVERNMENT HOSPITAL			
Site	Patients		Total (%) (n=50)
	Male (%) (n=31)	Female (%) (n=19)	
Right Cerebral Hemisphere	11 (35.48)	08 (42.10)	19 (38)
Left Cerebral Hemisphere	08 (25.80)	04 (21.05)	12 (24)
Bilateral Cerebral Hemispheres	04 (12.90)	03 (15.78)	07 (14)
Cerebellum	02 (6.45)	02 (10.52)	05 (10)

Sellar/Parasellar	03 (9.67)	01 (5.26)	04 (8)
Brainstem	1 (3.22)	01 (5.26)	02 (4)
Intraventricular	01 (3.22)	00 (0.00)	01 (2)
Total (%)	31 (100)	19 (100)	50 (100)
Grand Total (%)	**62**	**38**	**100**
$x2$= 6.835		*p value=0.997	

- In our study out of 50 patients distribution of types of lesions were analyzed and the study reports revealed that 74% patients had Malignant lesion, 26% had benign lesion while patients in the age group of 30-39 had maximum lesion i.e 17(34%) followed by age group of 40-49 had 11 (22%) & 50-59 had 09 (18%) lesion as depicted in Table no 4.

Table no 4: Distribution of types of lesions

GOVERNMENT HOSPITAL				
Age group(years)	**Patients**		**Benign (%) (n=13)**	**Malignant (%) (n=37)**
	Male (%) (n=31)	**Female (%) (n=19)**		
<30	01 (3.22)	02 (10.52)	01 (7.69)	02 (5.40)
30-39	09 (29.03)	08 (42.10)	03 (23.07)	14 (37.83)
40-49	08 (25.80)	03 (15.78)	04 (30.76)	07 (18.91)
50-59	06 (19.35)	03 (15.78)	02 (15.38)	07 (18.91)
60-69	04 (12.90)	02 (10.52)	02 (15.38)	04 (10.81)
>70	03(9.67)	01 (5.26)	01 (7.69)	03 (8.10)
Total	31 (100)	19 (100)	13 (100)	37 (100)
Grand Total (%)	**62**	**38**	**26**	**74**
$x2$= 6.90	d.f =6	*p= 0.0254		

- In our study on distributing lesions based on histopathology the study reports revealed that 74% patients had Malignant lesion of which Glioblastomamultiforme was most commonly observed malignant lesion accounting for 17 (34%) followed by Metastasis 10(20%) while Anaplastic astrocytoma was least commonly observed malignant lesion accounting for 03 (6%). Similarly 26% patients had benign lesion of which Meningioma was most commonly observed benign lesion accounting for 04 (8%) followed by Low grade glioma 03(6%) while Arachnoid cyst & Choroid plexus papilloma were least commonly observed benign lesion accounting for 01 (2%). as depicted in Table no 5.

Table no 5: Distributions of lesions based on histopathology

Type of lesion	**Patients**		**Total no. of case (%) (n=50)**
	Male (%) (n=31)	**Female (%) (n=19)**	
I. Malignant (n=37)			
Glioblastomamultiforme	11 (35.48)	06 (31.57)	17 (34)
Metastasis	07 (22.58)	03 (15.78)	10 (20)
Lymphoma	03 (9.67)	04 (21.05)	07 (14)
Anaplastic astrocytoma	02 (6.45)	01 (5.26)	03 (6)
II. Benign (n=13)			
Meningioma	03 (9.67)	01(5.26)	04 (8)
Low grade glioma	02 (6.45)	01 (5.26)	03 (6)
Pituitary adenoma	00 (0.00)	01 (5.26)	02 (4)
Arachnoid cyst	01 (3.22)	01 (5.26)	01 (2)
Tuberculoma	01 (3.22)	01 (5.26)	02 (4)
Choroid plexus papilloma	01 (3.22)	00 (0.00)	01 (2)
Total (%)	31 (100)	19 (100)	50 (100)
$x2$= 7.26	d.f =5	p= 0.5914	

DISCUSSION

The diagnostic approach to neurological problems has undergone significant change with the introduction of MRI has proven to be an excellent technique for visualization of the brain tumor. Magnetic Resonance Images can be acquired with equal clarity in any orientation, axial, sagittal, coronal, image, artifacts from bone are absent with MRI. MRI is the imaging modality of the choice brain tumor.[5]

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.

In our study out of 50 patients who underwent MRI to find out cerebral tumor, it was observed that 31 (62%) were Male whereas 19 (38%) Patients were female which was similar to the findings of Ahmad et al who reported 63% of male patients in their study reports.[7] In this study the mean age of the patient was 39.26±8.33 years of age which was contradictory to the findings of Mulkens et al. who studied tumor of CNS & reported mean age to be 54 years.[8] Similarly, our study results reported that majority of patients were in the age group of 30-39 (34%) followed by age group of 40-49 (11%) while Patients with age group of <30 was minimum 3(6%) which was almost similar to the findings Haque S et al who reported middle aged person to be more affected with brain tumors.[9]

Our study results revealed that, most common presenting symptoms was headache accounting 15 (9.69%) followed by Fever 11 (7.27%), Nausea/vomiting 10 (16.96%) while least presenting symptoms was weakness 01 (3.63%). These findings were in accordance with the findings of Ahmad et al & Taghipour Zahir SH et al who reported headache as the most common presenting symptoms in their study.[7,10] However our findings was in contradiction to the study results of Haque S et al who reported tinnitus as the common presenting symptoms in their study.[9]

Our study results revealed that most common site involvement was Right cerebral hemisphere 19 (38%) followed by Left cerebral hemisphere 12 (24%), Bilateral cerebral hemispheres 07 (14%) while least commonly involved site was intraventricular 01 (2%). Not much of the study were found which described the site involvement of tumors, however a study done by Ahmad et al also revealed similar findings to our study showing most common site involvement as Right cerebral hemisphere.[7]

The study reports revealed that 74% patients had Malignant lesion, 26% had benign lesion while patients in the age group of 30-39 had maximum lesion i.e 17(34%) followed by age group of 40-49 had 11 (22%) & 50-59 had 09 (18%) lesion which was almost similar to the findings of Ahmad et al who reported 66% cases as malignant in their study reports[7] & was contradictory to the findings of Taghipour Zahir SH et al who reported 90% cases as malignant in their study results.[10]

In our study Glioblastomamultiforme was most commonly observed malignant lesion accounting for 17 (34%) followed by Metastasis 10(20%) while Anaplastic astrocytoma was least commonly observed malignant lesion accounting for 03 (6%). Similarly Meningioma was most commonly observed benign lesion accounting for 04 (8%) followed by Low grade glioma 03(6%) while Arachnoid cyst & Choroid plexus papilloma were least commonly observed benign lesion accounting for 01 (2%). These findings were in accordance to the findings of Trivedi et al who reported glioma as commonest lesion in their study reports. There is wide variation in different types of diagnosis made in different study results.

CONCLUSION

Brain lesions biopsy with pathological reports have a high value in diagnosis of tumors, but sometimes that the biopsy specimens are scanty or acceptability to the tumor is difficult. So, MRI scan could be very helpful for pathologists to report their diagnosis.

Diagnosis of tumours might not always require brain biopsy, which is an invasive procedure that would otherwise be required to establish the final diagnosis. MRI 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. MRI findings of the present study correlated well the histopathological results. It can therefore be concluded that MRI is useful modality and study of choice in the diagnosis of brain tumors because of its high sensitivity and specificity especially after the use of contrast. MRI thus can be regarded as an important imaging modality in the diagnosis of tumor.

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 brain tumor.

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