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Original Research Article

A study on role of magnetic resonance imaging in the evaluation of intracranial neoplastic lesions

Shekavva Halli*, Vinod Hegde

Department of Radiodiagnosis, Srinivas Institute of Medical Sciences and Research Centre, Mangalore, Karnataka, India

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***Correspondence:**
Dr. Shekavva Halli,
E-mail: shakuntalahalli15@gmail.com

ABSTRACT

Background: Neoplastic central nervous system (CNS) lesions are a heterogeneous group of diseases with a variable outcome that reflects the precision of diagnosis and the delivery of optimal and specific treatment. CNS imaging has a pivotal role in directing management decisions. In the present study, cases of either clinically suspected intracranial neoplastic lesions or already diagnosed cases of neoplastic lesions were studied by cross sectional imaging of magnetic resonance imaging (MRI).
Methods: In this prospective study, 30 cases of intracranial neoplastic lesions were studied by 1.5T Siemens Essenza MR scanner over a period of 6 months. Imaging findings were evaluated and tabulated.
Results: Total 30 cases of in intracranial neoplastic lesions were studied aged between 12 to 87 years (17 men and 13 women). Most common presenting complaint was headache. Solitary lesions were present in 21 patients (70%) and multiple lesions in 9 patients (30%). 80% of the lesions were supratentorial, 13.3% were infratentorial and 6.6% were seen in both infra and supratentorial region. 76.6% were intra-axial and 23.3% were extra-axial. Metastasis were the most common neoplastic lesions; glial tumors are the second most common neoplastic lesions. Meningiomas were the most common benign tumors. Mass effect and perilesional edema were the most common associated findings.
Conclusions: MRI is the first line of investigation for diagnosis and evaluation of intracranial neoplastic lesions with reasonable degree of diagnostic accuracy. Neuroimaging in combination with clinical findings can be helpful in early diagnosis and timed intervention.

Keywords: Intracranial neoplastic lesions, Magnetic resonance imaging, Tumours

INTRODUCTION

The imaging and clinical management of patients with brain tumor continue to evolve over time and now heavily rely on physiologic imaging in addition to high-resolution structural imaging. Imaging remains a powerful noninvasive tool to positively impact the management of patients with brain tumor. The high morbidity and mortality associated with intracranial neoplastic lesions necessitates their early diagnosis so as to plan the required intervention.[1]

In the present study, cases of either clinically suspected intracranial neoplastic lesions or already diagnosed cases of neoplastic lesions were studied by cross sectional imaging by magnetic resonance imaging (MRI).

With the introduction of computed tomography (CT) and MRI scanning, imaging of intracranial neoplastic space occupying lesion has acquired a new dimension whereby excellent anatomical detail in axial, sagittal and coronal planes as well as tumoral tissue characterization has become possible. Advantages of MRI over CT are MRI helps to know exact nature of lesion, to know whether diffuse or focal, to know residual tumor or recurrence.[1] The

medulloblastoma has a variable and nonspecific appearance in adults and should always be considered in the differential diagnosis of a mass in the posterior fossa. Cerebellar medulloblastoma most frequently occurs during childhood, when it accounts for about 15% of all brain tumors, this neoplasm is uncommon in adults.[2]

Most brain neoplasms found in very young children are very large and extensive. This may be related to the fact that they are frequently diagnosed late. Early diagnosis is often difficult due to a prolonged clinically silent course. The interval between the onset of first symptoms and the definitive diagnosis of a brain tumor varies considerably, from 1 month up to 16 months.[3]

Brain tumor diagnosis consists of tumor detection, segmentation, and classification processes. Brain tumor detection techniques are mainly used to identify MRI images of tumors from a database, which is considered a basic and obvious process. However, brain tumor segmentation techniques are used for localizing and isolating different tumor tissues inside MRI images. Furthermore, brain tumor classification techniques are used to classify abnormal images as malignant or benign tumors. These three hybrid methods and techniques present useful information to radiologists and aid in the understanding of MRI information required for diagnosis. Significant work in the field of brain tumor diagnosis has been conducted by many researchers over the past several decades. Both tumor segmentation and classification methods have been proposed. The clinical acceptance of diagnosis methods has depended on the degree of user supervision and the simplicity of computation.[4]

MR imaging is the standard technique for visualizing and characterizing intracranial neoplastic lesions, with superior sensitivity compared with alternative modalities. Diagnosis and treatment planning are routinely based on conventional MR imaging, such as T2-weighted imaging, FLAIR, and T1 unenhanced FSE or GRE.[5]

MRI is highly sensitive to pathologic alterations of normal parenchyma and has been an important diagnostic tool in the evaluation of intracranial tumors. MRI allows an accurate determination of lesion location, extent, mass effect, atrophy, and subacute or chronic hemorrhage within the lesion, and an accurate distinction between a vascular structure and adjacent parenchyma.[6] MRI plays a major role in the diagnosis, grading, treatment and treatment response assessment of brain tumours and other intracranial lesions. Conventional MRI provides the anatomical and structural details of lesions in the neuraxis.[7]

The CNS manifestations either neoplastic or non-neoplastic occur in up to 15–20% of patients with NF-1. Malignancies occur up to four to six times more common in patients with NF-1 than in the general population. Patients with NF-1 are 2.25 to 3.26 times more likely to have vascular disease.[8] Modern neuroimaging is critical to the clinical management of patients with brain tumor.[9]

Ongoing research in brain tumor imaging attempts to develop, validate, and clinically implement advanced neuroimaging techniques that can aid in the diagnosis and identification of any disease factors or clinically relevant risk factors specific to each patient, the selection and implementation of the appropriate treatment targeting the unique biology of the individual tumor, and the detection of early treatment failure and any early or late onset therapy related complications.[10] The numerous new entities or variants appeared in the literature in the last few years suggest that the complex morphologic spectrum of CNS neoplasms is far from being completely delineated.[12] As experience with magnetic resonance (MR) of the brain accumulates, so does the evidence of its superiority over computed tomography (CT) in the detection of many cerebral abnormalities.[14]

Aims and objectives

The aim of the study was to describe various imaging characteristic features of intracranial neoplastic lesions in MRI.

METHODS

In this study, 30 cases of intracranial neoplastic lesions were studied in the department of radiodiagnosis and imaging, Srinivas Institute of Medical Sciences and Research Centre, Mangalore. The study was conducted over a period of 6 months from January 2022 to June 2022. Informed consent was taken from all the patients. The cases were investigated by imaging to determine the intracranial neoplastic lesions.

The investigation was carried out by using 1.5 Tesla MRI scanner (Seimens-Magnetom Essenza Dot) at department of radiodiagnosis, Srinivas Institute of Medical Sciences and Research Centre, Mukka, Mangalore. T1, T2, FLAIR and Susceptibility precontrast sequences followed by intravenous (IV) injection of 0.1 ml/kg body weight of gadopentate dimeglumine; postcontrast sequences were taken.

Various imaging characteristic features of intracranial neoplastic lesions in magnetic resonance imaging were evaluated. Tumor location, size, contour, margins, perilesional edema, calcification, necrosis, adjacent bony exostosis/hyperostosis and mass effects were evaluated.

A semi-structured questionnaire was prepared and demographic and clinical data like age, sex were noted. Symptoms and various morphological characters of intracranial neoplastic lesions were studied. All data were entered in Microsoft excel for statistical analysis. All statistical analysis was performed using statistical package for the social sciences (SPSS) software. A clinical-

radiological correlation and confirmation of radiological diagnosis was done by biopsy/surgery whenever possible to minimize patient follow up.

Inclusion criteria

All patients with suspected intracranial neoplastic lesions and already diagnosed cases of neoplastic lesions.

Exclusion criteria

Patients with infectious lesion, cysts, intraparenchymal hematoma and infarcts.

RESULTS

A total of 30 cases of intracranial neoplastic lesions were studied during the stipulated time frame, aged between12 years to 87 years (17 men and 13 women). When we looked into the gender distribution of the cases in male percentage was predominant which was 56.6% whereas female comprising 43.3% of the cases. Most common presenting complaint was headache which was 50% of the cases followed by seizures which was in 20% of the cases and in remaining cases loss of consciousness was present in 16.6%, altered sensorium was present in 13.3% of cases.

When we looked in the number of lesions, we found that solitary lesions were present in 21 patients (70%) and multiple lesions in 9 patients (30%). While assessing the location of the tumor we found that 80% of the lesions were in supratentorial region, 13.3% were in infratentorial region and 6.6% were seen in both infra and supratentorial region. In this study we found that 76.6% were intra-axial tumors and 23.3% were extra-axial tumors.

Table 1 presents the data on type on intracranial neoplastic lesions, in this study we found that metastasis were the most common neoplastic lesions which were seen in 7 patients and it was in 23.3% of the cases; glioblastoma multiforme are the second most common neoplastic lesions found in 6 patients which was in 20% of the cases; meningioma are the third most common neoplastic lesions found in 5 patients in our study which was in 16.6% of the cases. Pituitary macroadenoma, schwannoma and central neurocytoma was found in 2 cases each. Medulloblastoma, oligodendroglioma, hemangioma, choroid plexus papilloma, pilocystic astrocytoma, Lhermitte's-duclos syndrome found in 1 patient each.

Table 2 presents the data on associated MRI findings; perilesional edema which was found in 11 patients, it was in 36.6% of the cases and mass effect was found in 8 patents it was in 26.6% of the cases, these two were the most common associated findings. Other associated findings found in our study were necrosis which was present in 5 patients, hemorrhage was found in 4 patients and calcification was found in 2 patients.

Table 1: Intracranial neoplastic lesion types.

Intracranial neoplastic lesions	Numbers of cases (%)
Metastases	7 (23.3)
Glioblastoma multiforme	6 (20)
Meningioma	5 (16.6)
Pituitary macroadenoma	2 (6.6)
Schwannoma	2 (6.6)
Medulloblastoma	1 (3.3)
Oligodendroglioma	1 (3.3)
Hemangioma	1 (3.3)
Choroid plexus papilloma	1 (3.3)
Pilocytic astrocytoma	1 (3.3)
Lhermitte's-duclos	1 (3.3)

Table 2: Associated MRI findings.

MRI findings	Frequency (%)
Edema	11 (36.6)
Mass effect	8 (26.6)
Necrosis	5 (16.6)
Hemorrhage	4 (13.3)
Calcification	2 (6.6)

Table 3 presents the data on location of the tumors in the lobes or regions of the central nervous system; most commonly involved lobe was parietal lobe in 10 patients which was in 33.3% of the cases, followed by frontal lobe in 5 patients which was in 16.6% of the case; in 3 patients temporal lobe was involved; multiple lobes were involved in 6 patients. Other regions involved were intraventricular in 1 patient, central region in 1 patient and infratentorial in 4 patients.

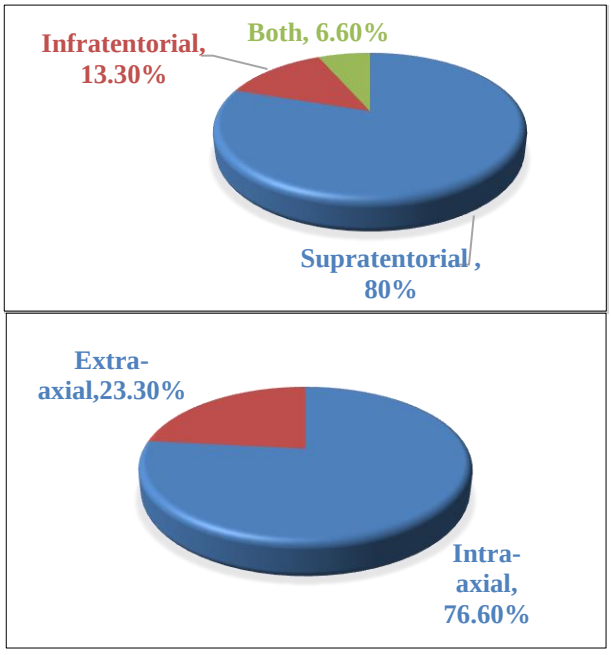

Figure 1: Location of tumor.

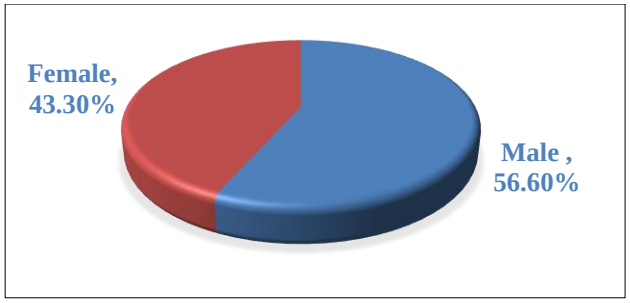

Figure 2: Gender distribution of cases.

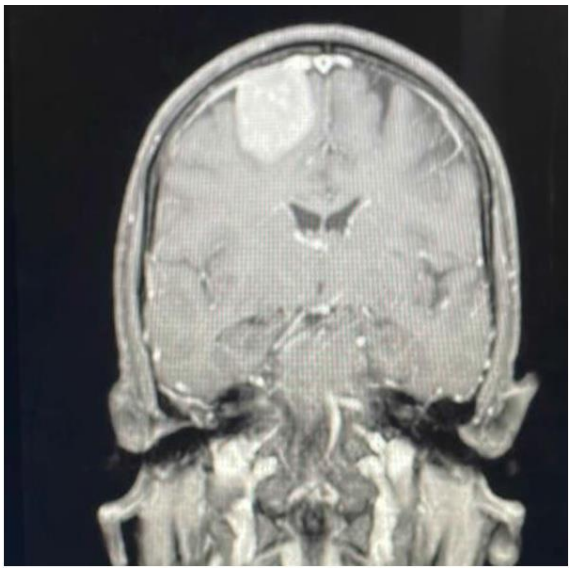

Figure 3: Coronal T1 post contrast image shows well defined extra axial lesion in the right parietal convexity with dural tail sign-meningioma.

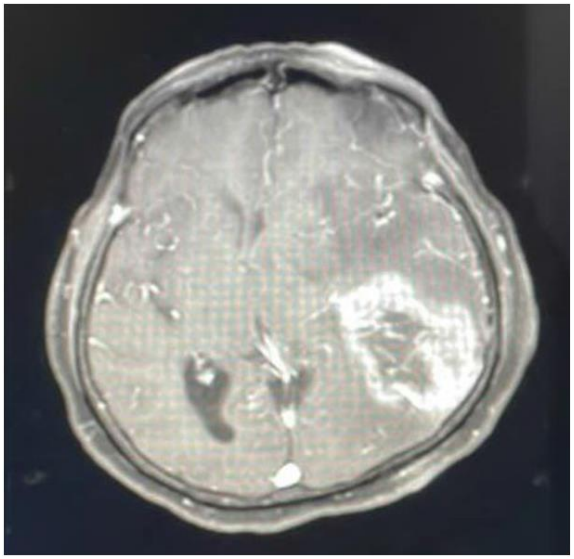

Figure 4: Axial T1 post contrast image of MRI brain shows a lesion predominantly in the left parietal region with thick irregular ring enhancement, perilesional edema and mass effect-glioblastoma multiforme.

Table 3: Hemispheric/regional involvement of Intracranial neoplastic lesions.

Lobe/region involved	Frequency (%)
Parietal	10 (33.3)
Frontal	5 (16.6)
Temporal	3 (10)
Multiple lobes	6 (20)
Intraventricular	1 (3.3)
Central	1 (3.3)
Infratentorial	4 (13.3)

Table 4 presents the data on clinical presentations of the cases, headache was most common complaint which was present in 50% of the cases, seizures in 20% of the cases, loss of consciousness in 16.6% of the cases and altered sensorium in 13.3% of the cases.

Table 4: Clinical presentation of cases.

Presentation	Frequency (%)
Headache	50
Seizures	20
Loss of consciousness	16.6
Altered sensorium	13.3

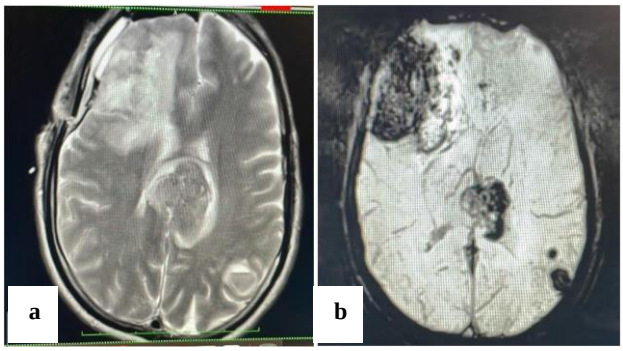

Figure 5: (a) Axial T2WI shows multiple hyperintense lesions in right frontal, lateral ventricle and left parietal regions-multiple metastases to brain from malignant melanoma; (b) Axial SWI shows multiple areas of blooming in right frontal, lateral ventricle and left parietal regions-multiple metastases to brain from malignant melanoma.

DISCUSSION

Our results indicate similar pattens regarding the patient age as in the study conducted by Goyani et al and Snyder et al.[1,11] More number of patients belonged to the age group between 31-40 years i.e. in 4th decade. Regarding gender distribution our results are comparable with the study conducted by Goyani et al, Snyder et al and Tadmor et al in these studies males were more than the females.[1,4,11]

In clinical presentation most of the cases presented with complaint of headache which was in 50% of the cases

similar findings reported in a study by Goyani et al 51.42% and Snyder et al 55.4%.[1,11] Second most common presenting complaint was seizures which in 20% of the cases comparable with the study conducted by Bhavesh Goyani et al 32.85% and Snyder et al 23.76%.[1,11] Another most common presenting complaint reported in our study was altered mental status 13.3% comparable with the study conducted by Goyani et al and Snyder et al 50.49%.[1,11]

Our study revealed the majority of intracranial neoplastic lesions diagnosed are metastatic lesions which accounted for 23.3% of cases which was in accordance with the previously published data like Essig et al 33%, Black 25% and Mayr et al.[11,13,17] Glioblastoma multiforme comprised 20%, meningiomas comprise 16.6% similar to study conducted by Essig et al these are benign, slow growing tumors that may be asymptomatic or cause seizures and headaches, they are found in the parasaggital and suprasellar region, along the sphenoid ridge, and over the cerebral convexities.[11]

In this study, other intracranial neoplastic lesions revealed are pituitary macroadenoma, schwannoma and central neurocytoma 6.6% each similar to study conducted by Essig et al.[11] Medulloblastoma, oligodendroglioma, hemangioma, choroid plexus papilloma, pilocytic astrocytoma and Lhermitte's-duclos syndrome in 3.3% each. As discussed in a study by Behin et al, pilocytic astrocytomas develop in children and young adults and are frequently located in the optic tracts, hypothalamus or basal ganglia, and the posterior fossa (cerebellum and brainstem).[16] On imaging, they are well circumscribed, contrast-enhancing tumours, similar findings note in our study.

In the present study, edema was the most common MRI finding in 36.6% patients followed by mass effect in 26.6%. similar findings reported in a study by Goyani et al.[1] The incidence of brain tumors with necrosis in the present study was found to be 18.57% similar to 18.5% by Goyani et al.[1] Hemorrhage in 13.3% of patients similar to study conducted by Michael et al and calcification in 6.6% of cases.[15]

Intracranial neoplastic lesions are solitary lesions mainly as reported in a study by Snyder et al similarly in our study 70% of cases had solitary lesions.[11] Gliomas are rarely multicentric, but may be mistaken for metastases when multiple lesions are present. The symptoms produced by intracranial neoplastic lesions are due to local effects because they do not metastasize, with the exception of medulloblastomas. Medulloblastomas are malignant, aggressive tumors arising from the fourth ventricle or cerebellum in children and young adults. They metastasize via the subarachnoid space and may present with signs of spinal cord compression.

Limitations

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

MRI is the most sensitive modality in the diagnosis and characterization of intracranial neoplastic lesions. Metastasis were the most common intracranial neoplastic lesions followed by glioblastoma multiforme and meningioma. Most common presenting symptom was headache. Edema was the most common associated MRI finding. Most of the lesions were solitary, most common hemisphere to be involved was the parietal lobe and most of the tumors located in supratentorial region.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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