Original Article

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# Magnetic Resonance Imaging Evaluation of Supratentorial Tumors: A Hospital Based Descriptive Study

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## Abstract

**Background:** Brain tumors can be classified by location into supratentorial, infratentorial, and midline tumors. Magnetic resonance imaging (MRI) has earned recognition as the optimal screening technique for the detection of most intracranial tumors. MRI using spin echo, gradient echo, and combination of spin echo and gradient echo pulse sequences before and after intravenous administration of paramagnetic contrast agents provides inherently greater contrast resolution between structural abnormalities and adjacent brain parenchyma and has proved to be more sensitive in the detection of focal lesions of the brain.

**Methods:** A total of 40 patients with symptoms of intracranial pathology were subjected to MRI and those cases found to have supratentorial tumors and proven by histopathology were studied during the period from December 2012 to September 2014.

**Results:** The MRI features of 40 supratentorial tumors were reviewed, out of which 63% were found to be extra-axial tumors and 37% intra-axial tumors. About 27% were found to be glial tumors and 73% were found to be non-glial tumors. Astrocytomas and meningiomas formed majority of the glial and non-glial tumors, respectively. Astrocytomas were predominantly located in the frontoparietal and frontal lobes, whereas majority of meningiomas were located in bilateral cerebral convexities and parafalcine regions.

**Conclusion:** MRI proves to be a valuable modality of imaging in evaluating the characteristics, distribution, localizing, and assessing of the extent of various intra- and extra-axial tumors in the supratentorial region.

**Key words:** Brain tumors, Gliomas, Magnetic resonance imaging, Meningioma, Supratentorial tumors

## INTRODUCTION

The designation "brain tumors" is commonly applied to a wide variety of intracranial mass lesions that are distinct in their location, biology, treatment, and prognosis. Since many of these lesions do not arise from brain parenchyma, the more appropriate term would be "intracranial tumors." Majority of these tumors present with nonspecific complaints such as headache, stroke, like syndromes, or seizures. Often diagnosis is made or suggested initially by the findings on imaging studies. However, prognosis of these patients has improved considerably due to recent advances in diagnostic techniques, microsurgery and radiotherapy. Clinical evaluation, radiology and pathology play big roles in deciding the long-term prognosis.[1]

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Recent advances in imaging techniques have exploded into the horizon of using many different modalities such as magnetic resonance imaging (MRI), and computed tomography (CT) perfusion, positron emission tomography, and single photon emission CT. These imaging modalities have revolutionized the diagnosis and management of brain tumors.[2]

MRI has earned recognition as the optimal screening technique for the detection of the most intracranial neoplasms. MRI using spin echo, gradient echo, and combination spin echo and gradient echo pulsing

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sequences before and after intravenous administration of paramagnetic contrast agents provides inherently greater contrast resolution between structural abnormalities and adjacent brain parenchyma and has proved to be more sensitive in the detection of focal lesions of the brain. Moreover, the multiplanar capability of MR is very helpful to determine the anatomic site of origin of lesions and to demarcate extension into adjacent compartments and brain structures.[3]

The aim of the study is to evaluate the characteristics, distribution, localizing, and assessing the extent of various intra- and extra-axial tumors in the supratentorial region by MRI. This study will enable to develop an imaging method for evaluation of supratentorial tumors and also help in prognosis and treatment.

## MATERIALS AND METHODS

A hospital based descriptive study was conducted on 40 patients with histologically proven cases. This study was done in Department of Radio-diagnosis and Imaging of Vydehi Institute of Medical Sciences and Research Centre in a period of 2-year from December 2012 to September 2014. Patients with tumors other than supratentorium, patients with claustrophobia, cardiac pacemakers, and cochlear implants were excluded from the study.

MRI scan was performed on 1.5 Tesla Philips Achieva. Conventional Spin Echo sequences like axial T1, T2 and fluid-attenuated inversion recovery (FLAIR), coronal T2, sagittal T1, postcontrast SE T1 axial, sagittal and coronal: Diffusion-weighted imaging (DWI), multivoxel PRESS spectroscopy MRI images were evaluated for location, consistency, hemorrhage, necrosis, margins, edema, contrast enhancement, and any additional features of the tumors. Pre-operative diagnosis was compared with post-operative pathological diagnosis.

Topographically, tumors were divided into supratentorial and infratentorial and classified into intra- and extra-axial. Radiological diagnosis was based on topography of the lesion, characterization into intra versus extra parenchymal location; morphological analysis for the presence of secondary changes adjacent to the lesion was sought. The WHO classification based on histopathology was done.

## OBSERVATION AND RESULTS

In our study of 40 cases, we had 11 (27%) glial tumors (low grade glioma, high grade glioma, astrocytoma, and glioblastoma multiforme [GBM]) and 29 (73%) non-glial tumors (meningioma, pituitary macroadenoma, and craniopharyngioma, metastasis, pineocytoma, and dysembroblastic neuroepithelial tumor respectively. Among the glial tumors, astrocytomas were the most commonglial tumors (5 of 11 cases) and meningiomas were the most common non-glial tumors (14 of 29 cases) (Figures 1 and 2).

### Astrocytoma

We observed that 8/40 (20%) the cases had astrocytomas with mean age of 31.6 ± 4.7 years and male:female ratio of 5:3. Most of the cases presented with convulsions 5/8 followed by headache and ataxia 4/8 and had the initial clinical diagnosis of intra cranial space occupying lesions (ICSOL) in 4/8 patients and epilepsy in 2/8 patients (Table 1). Most of the patients on MRI were isointense to hypointense on T1-weighted images (T1WI) and were

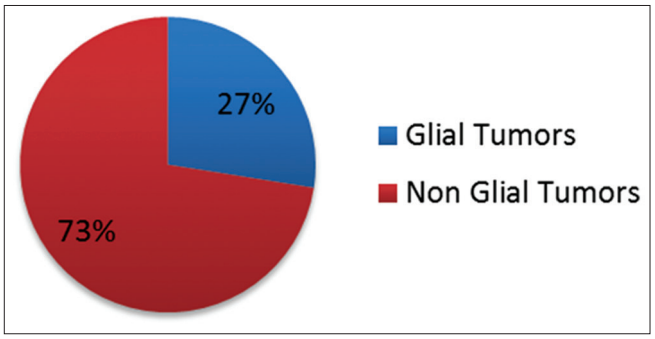


**Figure 1: Classification of the tumors based on cell of origin**

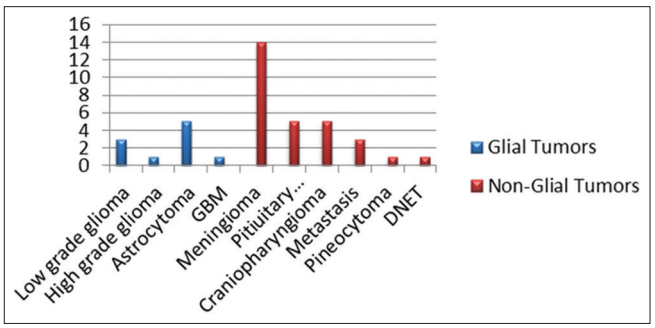


**Figure 2: Distribution of glial and non-glial tumors (*n*=40)**

**Table 1: Clinical parameters of astrocytoma tumors**

| Clinical findings | *n*=8 |
|---|---|
| Age (years)* | 31.7±4.7 |
| Gender (male:female) | 5:3 |
| Vomiting | 3 (37.5%) |
| Headache | 5 (62.5%) |
| Convulsions | 7 (87.5%) |
| Hemiplegia/paresis | 0 (0%) |
| Ataxia | 4 (50%) |
| Blurring of vision | 0 (0%) |
| ICSOL | 4 (50%) |
| Epilepsy | 2 (25%) |

*Value express as mean±SD, SD: Standard deviation, ICSOL: Intra cranial space occupying lesions

homogenously hyperintense on T2-weighted images (T2WI). On FLAIR 6 of 8 cases were hyperintense and the remaining were hypointense. Perilesional edema was evident in most of the cases but there was no contrast enhancement or calcification. DWI showed no restriction. On MR spectroscopy (MRS), there was elevated choline with reversal of choline creatine ratios (7/8) and low N-acetyl aspartate (NAA) peak (Table 2 and Figure 3).

### Meningioma

We observed that 14/40 (35%) the cases had meningioma with mean age of 50.07 ± 3.7 years and male:female ratio of 6:8. Most of the cases presented with a headache 9/14 and convulsions 6/14 followed by hemiplegia 4/14 and ataxia 3/14 and had the initial clinical diagnosis of ICSOL in 7/14 patients (Table 3). Most of the patients on MRI were isointense to hypointense on T1WI and isointense to hyperintense T2WI; mostly variable signal intensities were noted. On FLAIR the lesions were hyperintense and all the cases showed contrast enhancement. Perilesional edema and contrast enhancement was evident in all the cases. On DWI, restriction was observed in all the cases. On MRS, there was an elevated NAA, CHO, glutamate, and CR peak with no lactate peak observed. All the observed tumors were benign meningiomas and hence most of the tumors on MRS NAA and creatine peaks were observed. Two of the fourteen cases showed lipid peak, which was suggestive of necrosis (Table 4 and Figure 4).

**Table 2: MRI characteristics of astrocytoma tumors**

| Sequences | | *n*=8 |
|---|---|---|
| T1W | Hypointense | 8 (100%) |
| T2W | Hyperintense | 8 (100%) |
| FLAIR | Hyperintense | 6 (75%) |
| | Hypointense | 2 (25%) |
| DWI | No restriction | 8 (100%) |

MRI: Magnetic resonance imaging, T1W: T1-weighted, T2W: T2-weighted, FLAIR: Fluid-attenuated inversion recovery, DWI: Diffusion-weighted imaging

| Additional findings | |
|---|---|
| Peri-lesionaledema | 5 (75%) |
| Necrosis | 0 (0%) |
| Bone erosion | 3 (37.5%) |
| Hydrocephalus | 0 (0%) |
| Contrast enhancement | 0 (0%) |

### Craniopharyngioma

We observed that 4/40 (10%) the cases had craniopharyngioma with mean age of 30.0 ± 7.1 years and male:female ratio of 3:1. Most of the cases presented with headache 3/4 and ataxia 3/4 and had the initial clinical diagnosis of ICSOL in 4/4 patients (Table 5).

Most of the patients on MRI were isointense on T1W sequences and hypointense on T2W sequences. On FLAIR, the lesions were hyperintense. Significant heterogeneous contrast enhancement was evident in one case and cystic degeneration was evident on all the cases. DWI showed restriction in all the cases (Table 6).

**Table 3: Clinical parameters of meningioma tumors**

| Clinical findings | *n*=14 |
|---|---|
| Age (years)* | 50.07±3.7 |
| Gender (male:female) | 6:8 |
| Vomiting | 3 (21.4%) |
| Headache | 9 (64.3%) |
| Convulsions | 6 (42.9%) |
| Hemiplegia/paresis | 4 (28.6%) |
| Ataxia | 3 (21.4%) |
| Blurring of vision | 0 (0%) |
| ICSOL | 7 (50%) |
| Epilepsy | 0 (0%) |

*Value express as mean±SD, SD: Standard deviation, ICSOL: Intra cranial space occupying lesions

**Table 4: MRI characteristics of meningioma tumors**

| Sequences | | *n*=14 |
|---|---|---|
| T1W | Hypointense | 5 (35.7%) |
| | Isointense | 9 (64.3) |
| T2W | Hyperintense | 6 (42.9%) |
| | Isointense | 8 (57.1%) |
| FLAIR | Hyperintense | 14 (100%) |
| DWI | Restriction | 14 (100%) |

MRI: Magnetic resonance imaging, T1W: T1-weighted, T2W: T2-weighted, FLAIR: Fluid-attenuated inversion recovery, DWI: Diffusion-weighted imaging

| Additional findings | |
|---|---|
| Peri-lesional edema | 14 (100%) |
| calcifications | 5 (35.7%) |
| necrosis | 2 (14.3%) |
| Bone erosion | 7 (50%) |
| Hydrocephalus (compressive) | 4 (28.6%) |
| Contrast enhancement | 14 (100%) |

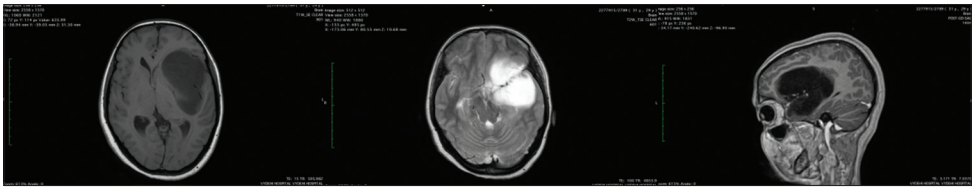

**Figure 3: Axial T1-weighted (T1W), T2-weighted (T2W) and sagittal T1W postcontrast low grade glioma. A well-defined left frontotemporal homogenously enhancing T1W and T2W cystic lesion with no enhancement on T1W sagittal section**

### Pituitary Macroadenoma

We observed that 4/40 (10%) the females cases had pituitary macroadenoma with mean age of 27.3 ± 5.7 years. Most of the cases presented with headache 4/4 and vomiting, ataxia 3/4 and had the initial clinical diagnosis of ICSOL in 4/4 patients (Table 7 and Figure 5).

Most of the patients on MRI were isointense on T1W sequences and isointense on T2W sequences. On FLAIR, the lesions were isointense. Calcifications, necrosis and bone erosion was evident in all the cases (3 of 4 cases) and all the cases showed heterogeneous intense contrast enhancement (Table 8 and Figure 5).

### Metastasis

We observed that 3/40 (7.5%) the male cases had metastasis with mean age of 49.8 years. Most of the cases presented with headache, vomiting, and ataxia. We had 3 cases on cerebral metastases, which were seen in all male patients and seen in the age group of 40-55 years. Patients presented with symptoms of headache, paresis, and vomiting (Table 9).

Most of the patients on MRI were isointense to hypointense on T1W sequence and hyperintense on T2W sequence. On

**Table 5: Clinical parameters of craniopharyngioma tumors**

| Clinical findings | *n*=4 |
|---|---|
| Age (years)* | 30.0±7.1 |
| Gender (male:female) | 3:1 |
| Vomiting | 2 (50%) |
| Headache | 3 (75%) |
| Convulsions | 0 (0%) |
| Hemiplegia/paresis | 1 (25%) |
| Ataxia | 2 (50%) |
| Blurring of vision | 3 (75%) |
| ICSOL | 4 (100%) |
| Epilepsy | 0 (0%) |

*Value express as mean±SD, SD: Standard deviation, ICSOL: Intra cranial space occupying lesions

**Table 6: MRI characteristics of craniopharyngioma tumors**

| MRI sequences | | *n*=4 |
|---|---|---|
| T1W | Isointense | 4 (100%) |
| T2W | Hypointense | 4 (100%) |
| FLAIR | Hyperintense | 4 (100%) |
| DWI | restriction | 4 (100%) |

MRI: Magnetic resonance imaging, T1W: T1-weighted, T2W: T2-weighted, FLAIR: Fluid-attenuated inversion recovery, DWI: Diffusion-weighted imaging

| Additional findings | |
|---|---|
| Cystic areas | 4 (100%) |
| Bone erosion (sella) | 4 (100%) |
| Hydrocephalus | 0 (0%) |
| Contrast enhancement | 1 (25%) |

**Table 7: Clinical parameters of pituitary macroadenoma tumors**

| Clinical findings | *n*=4 |
|---|---|
| Age (years)* | 27.3±5.7 |
| Gender (male:female) | 0:4 |
| Vomiting | 2 (50%) |
| Headache | 4 (100%) |
| Convulsions | 1 (25%) |
| Hemiplegia/paresis | 0 (0%) |
| Ataxia | 0 (0%) |
| Blurring of vision | 3 (75%) |
| ICSOL | 4 (100%) |
| Epilepsy | 0 (0%) |

*Value express as mean±SD, SD: ICSOL: Intra cranial space occupying lesions

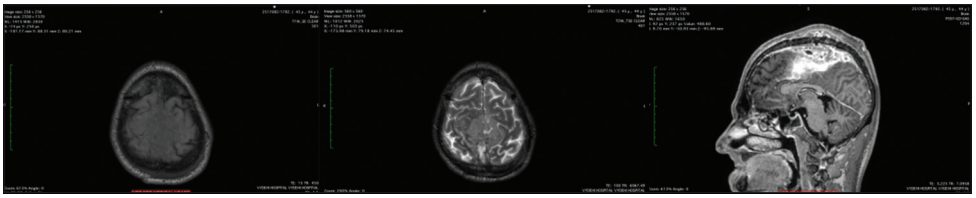

**Figure 4: Axial T1-weighted images (T1WI), T2-weighted images and sagittal postcontrast T1WI. Meningioma. An extra-axial midline heterogeneous lesion with post contrast enhancement, the lesion is isointense on T2 and T1W sequences with cystic areas within s/o necrosis noted in the high parietal region with perilesional edema predominantly in the left cerebral hemisphere**

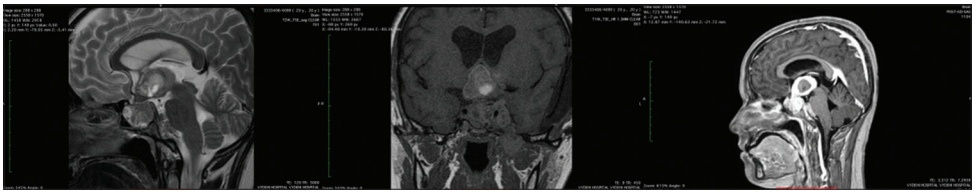

**Figure 5: Axial T2-weighted, coronal T1-weighted (T1W) and postcontrast T1WI images of pituitary macroadenoma. Large well defined intensely and homogenously enhancing sellar- suprasellar mass lesion compressing third ventricle with obstructive hydrocephalus, compressing and elevating optic chiasm, invading left cavernous sinus with encasement of left internal carotid artery and invasion of skull base on left side as described above, s/o pituitary macroadenoma**

FLAIR, the lesions were hyperintense. There was intense enhancement following contrast administration. Pattern of Contrast enhancement observed was uniform and ring enhancing. On MRS, the lesion showed elevated choline, lactate and lipid peaks. As a result of hypercellular tumoral activity, choline peak was observed in all the 3 cases. Lipid peak was observed in 1 case with necrosis. DWI showed no restriction (Table 10 and Figure 6).

## DISCUSSION

### Astrocytoma

Astrocytomas are a heterogeneous group of tumors that arise from the glia. We observe that 8/40 (20%) cases had astrocytomas with mean age of 31.6 ± 4.7 years and male:female ratio of 5:3. They are reported to be most common type of intra-axial supratentorial brain tumors and account for 60% of all intracranial neoplasms in the pediatric population as reported by Poussaint.[4]

The clinical presentation of patients with an astrocytoma varies on the basis of the location and aggressiveness of the tumor. In the present study, most of the cases presented with convulsions (5/7) followed by headache and ataxia (4/7) and had the initial clinical diagnosis of ICSOL in (4/7) patients and epilepsy in (2/7) patients. Gupta, reported that signs and symptoms may be nonspecific such as headache, nausea, and seizures. Low-grade tumors typically cause minimal neurologic deficits because of the lack of tissue destruction, and patients can present with generalized seizures. Patients with more aggressive tumors may present with complex partial seizures and neurologic deficit.[5] All the studied cases were fibrillary astrocytoma Grade II in the present study. Lesions were seen either in frontal 3/7 or frontoparietal lobes 4/7. Histologically, they are reported by Louis *et al*.,[6] to vary from low- to high-grade and are classified according to their histopathology pattern, biologic behavior, and genetic characterization. They also reported that this group of tumors includes diffuse astrocytoma, pleomorphic xanthroastrocytomas (PXA), subependymal giant-cell astrocytoma (SEGA), anaplastic astrocytoma, GBM, and pilocytic astrocytoma. They also reported that low-grade astrocytoma (WHO Grades I and II) were more common than high-grade astrocytomas and include pilocytic astrocytoma, SEGA, PXA, and diffuse astrocytoma. Anaplastic astrocytomas

**Table 8: MRI characteristics of pituitary macroadenoma**

| MRI sequences | | *n*=4 |
|---|---|---|
| T1W | Isointense | 4 (100%) |
| T2W | Hyperintense | 4 (100%) |
| FLAIR | Isointense | 4 (100%) |
| DWI | Restriction | 4 (100%) |

MRI: Magnetic resonance imaging, T1W: T1-weighted, T2W: T2-weighted, FLAIR: Fluid-attenuated inversion recovery, DWI: Diffusion-weighted imaging

| Additional findings | |
|---|---|
| Calcifications | 3 (75%) |
| necrosis | 2 (50%) |
| Bone erosion (sella) | 3 (75%) |
| Hydrocephalus | 1 (25%) |
| Contrast enhancement | 4 (100%) |

**Table 9: Clinical parameters of metastatic tumors**

| Clinical findings | *n*=3 |
|---|---|
| Age (years) | 49.3±5.3 |
| Gender (male:female) | 3:0 |
| Vomiting | 2 (66.7%) |
| Headache | 3 (100%) |
| Convulsions | 0 (0%) |
| Hemiplegia/paresis | 3 (100%) |
| Ataxia | 0 (0%) |
| Blurring of vision | 3 (100%) |

**Table 10: MRI characteristics of metastatic tumors**

| Sequences | | *n*=3 |
|---|---|---|
| T1W | Isointense | 2 (66.7) |
| | Hypointense | 1 (33.3) |
| T2W | Hyperintense | 3 (100) |
| FLAIR | Hyperintense | 3 (100) |
| DWI | No restriction | 3 (100) |

MRI: Magnetic resonance imaging, T1W: T1-weighted, T2W: T2-weighted, FLAIR: Fluid-attenuated inversion recovery, DWI: Diffusion-weighted imaging

| Additional findings | |
|---|---|
| Perilesional edema | 3 (100%) |
| Hydrocephalus | 1 (33.3%) |
| Contrast enhancement | 3 (100%) |

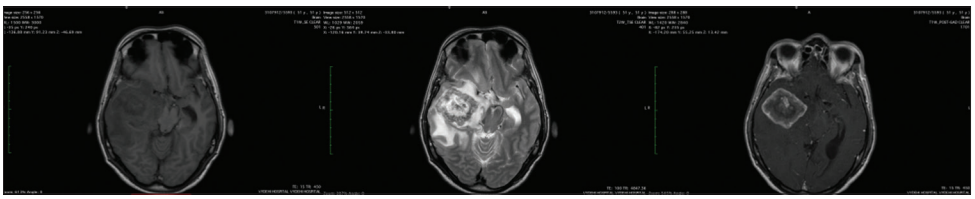

**Figure 6: Axial T1-weighted (T1W), T2-weighted (T2W) and postcontrast T1W images of cerebral metastases. Well-defined T1W hypointense, T2W hyperintense lesion in the right temporal region with significant perilesional edema and intense ring enhancement of the lesion on T1W postcontrast**

are considered Grade III because of histologic evidence of malignancy, and GBMs are classified as Grade IV because of their aggressive behavior and fatal outcome.[7]

Most of the patients in the present study were hypointense on T1W and hyperintense on T2W. Poussaint reported that the imaging characteristics of astrocytomas also vary depending on the grade of malignancy.[4] Gupta, reported that they can be solid and cystic and have calcification in up to 20% of cases,[5] but this was not observed in present study which may be because of small sample size.

On imaging, Smirniotopolous *et al*. reported that diffuse astrocytomas are most often characterized by a homogeneous infiltrating, ill-defined white matter mass that is relatively hypointense to gray matter on T1WI, appears hyperintense on T2WI, and shows no enhancement.[8] This observation is in conformity with the observations in the present study. In the present study, tumors are homogeneously hyperintense on FLAIR imaging in 6 out of 8 patients. Salzman *et al*., reported that these tumors are homogeneously hyperintense on FLAIR imaging and usually do not restrict on DWI. Peritumoral edema and hemorrhage are rare and higher-grade lesions should be suspected if enhancement is noted.[9] On MRS, there was elevated choline, low NAA peak and elevated CHO: CR ratios (7/8). MRS findings are nonspecific, showing elevated choline and low NAA levels similar to findings in many other tumors.

### Meningioma

Verheggen and Mahmood *et al*.,[10,11] reported that meningiomas constitute approximately 20% of all intracranial tumors and are easily diagnosed using routine MR imaging. In the present study, we observed that that 14/40 (35%) the cases had meningioma with mean age of 50.07 ± 3.7 years and male:female ratio of 6:8. Furthermore Mahmood *et al*.,[11] reported that malignant and atypical meningiomas, although relatively uncommon and accounting for approximately 7.2% and 2.4% of all meningiomas, respectively,[10,11] were associated with less favorable clinical outcomes because they are more prone to recurrence and aggressive growth.[12]

In the present study, we did not observe any malignant meningioma among the studied patients. According to the WHO classification of meningiomas, those meningiomas with low-risk of recurrence and aggressive growth are classified as WHO Grade I.[12] The Grade I classification includes the most common types of meningioma (fibrous or fibroblastic, transitional or mixed, and meningothelial) and the following benign subtypes: Psammomatous, angiomatous, microcystic, secretory, lymphoplasmacyte-rich, and metaplastic.[12]

Most of the patients on MRI were isointense on T1W, T2WI and hyperintense on FLAIR. On MRS, there was elevated CHO (10/14), glutamate (10/14) and creatinine (7/14) peaks. Perilesional edema and contrast enhancement was evident in all the cases. MRS does not play a significant role in diagnosis but can help distinguish meningiomas from mimics. DWI showed restriction.[12]

In the present study, calcification was noted in 5/14 patients. Louis *et al*.,[6] reported that these meningiomas with abundant psammoma bodies form irregular calcified and occasionally ossified masses. The decreased diffusion constant may relate to the paramagnetic properties of calcium. It is reasonable to postulate that a densely calcified mass would create a cellular environment in which the presence of this mineral would change the normal translational movement of water molecules across membranes.

### Craniopharyngioma

In the present study, we observe that 4/40 (10%) the cases had craniopharyngioma with mean age of 30.0 ± 7.1 years and male:female ratio of 3:1. Bunin *et al*.,and Haupt *et al*. reported that distribution by age is bimodal with the peak incidence in children at 5-14 years and in adults at young to middle age group.[13,14]

In the present study, most of the cases presented with headache (3 of 4 cases) and ataxia (3 of 4 cases) and had the initial clinical diagnosis of ICSOL in 4/4 patients.

Jagannathan and Karavitaki[15,16] reported that symptoms develop insidiously and there is often a delay of 1-2 years between symptom onset and diagnosis. They also reported that usual symptoms on presentation as headaches, nausea, and vomiting either from mass effect from the tumor itself or from secondary hydrocephalus caused by obstruction of the Foramen of Monro, the third ventricle or the aqueduct of sylvius. Classically, a bitemporal hemianopia from inferior chiasmatic compression but alternatively patients may have a homonymous hemianopia, optic atrophy with papilledema.

The classical appearance of a craniopharyngioma is of a sellar/suprasellar mass partly solid, partly cystic calcified mass lesion. In the present study, we observed all the cases in sellar or suprasellar region. Rossi *et al*.,[17] reported that these tumors occur in the suprasellar (75%), supra and infrasellar (20%) and infrasellar (5) regions. The suprasellar tumors may be subdivided into further groups depending on their relationship to the third ventricle and the optic chiasm.[18]

MRI with and without contrast will, accurately delineate the extent of the tumor and, in particular, its involvement

with the hypothalamus. Rossi *et al*., reported that magnetic resonance angiography is useful in not only delineating the course of the vessels, which can be through the tumor, but also to help differentiate a tumor from a possible vascular malformation.[17] It is the investigation of choice to plan the surgical approach. In the present study, most of the patients on MRI were isointense on T1W, hypointense on T2W and hyperintense on FLAIR. Calcification and necrosis was evident in all the cases.

### Pituitary Macroadenoma

In the present study, we observe that 4/40 (10%) the females cases had Pituitary adenoma with mean age of 27.3 ± 5.7 years. Most of the cases presented with headache 4/4 and vomiting ataxia 3/4 and had the initial clinical diagnosis of ICSOL in 4/4 patients. Wolffenbuttel *et al*.[17] reported that the clinical features of pituitary adenoma vary depending on the location and size of the tumor and its secretory capability. Pituitary adenomas typically appear during early adulthood, and no sex predilection is known. The symptoms of functioning tumors are related to the specific hormone the tumor produces.[19,20]

Currently, MRI is the examination of choice for sellar and parasellar pathologies due to its superior soft tissue contrast, multiplanar capability, and lack of ionizing radiation. In the present study, most of the patients on MRI were isointense on T1W and T2W. Calcification and necrosis and bone erosion was evident in all the cases (3 of 4 cases) and all the cases showed contrast enhancement.

On MRI, Suzuki *et al*.[21] reported that pituitary macroadenoma on T1W MRIs are typically isointense to grey matter and larger lesions are often heterogeneous and vary in signal intensity due to areas of cystic changes/necrosis/hemorrhage. On contrast enhancement the lesion demonstrates moderate to bright enhancement. On T2W MRIs the lesions demonstrate isointense signals to grey matter. On FLAIR, the lesions were hyperintense. These observations are similar to present study.

### Metastasis

Brain metastases occur in 15-40% of patients with cancer,[22,23] Many of whom are asymptomatic. Certain malignancies are often associated with brain metastases, including cancers of the lung, breast, skin, colon, pancreas, testes, ovary, cervix, renal cell carcinoma, and melanoma.[22,23] Although many case reports of intracranial metastatic disease from various other cancers exist. In the present study, we observed that 3/40 (7.5%) the females cases had metastasis with mean age of 49.8 years.

The detection of brain metastases is important for initial staging of patients with systemic malignancy. In the present study, Most of the cases presented with headache and vomiting ataxia (3 of 3 cases) and had the initial clinical diagnosis of ICSOL in 3 out of 3 patients. In some cases, Silvestri *et al*., reported that the presence of brain metastases comes to clinical attention through new neurological signs and symptoms, and imaging is therefore indicated in such patients.[24] Soffietti *et al*., reported that symptoms may include headache, seizure, syncope, focal neurological deficit, or papilledema.[22,23] Metastatic disease can involve different compartments of the central nervous system. The most common, metastatic disease affects the skull and/or brain parenchyma. Metastases can also involve the leptomeninges and pachymeninges.[25] In the present study, the tumors were seen in temporal or parietal lobes.

MRI is a sensitive screening test for brain metastasis. It is also useful to further evaluate mass lesions found on NECT to refine the differential diagnosis. In the present study, most of the patients on MRI were isointense on T1W and hyperintense on T2W.

On MRI, Chen *et al*., reported that metastases are usually isointense or hypointense on T1, hyperintense on T2, and exhibit avid enhancement.[26] Some metastases, such as melanoma, are T1 hyperintense due to the paramagnetic effects of melanin. Hemorrhagic metastases may also demonstrate T1 signal hyperintensity, depending on the age of hemorrhage. DWI usually demonstrates facilitated diffusion (i.e., bright on apparent diffusion coefficient map), rather than diffusion restriction. This is comparable to the present study. Vasogenicedema can be substantial, and is unrelated to lesion size. Hakyemez *et al*.,[25] found a significantly increased ratio of vasogenicedema to contrast enhancing lesion size in metastases compared with high grade primary brain tumors, although metastases may display little or no vasogenicedema. Small cortically based metastases may not demonstrate any visible edema, and must therefore be looked for carefully.[27]

Gadolinium contrast enhancement is vital to detect small metastases. Balériaux and Healy *et al*., have documented the utility of contrast in the detection of additional lesions compared with noncontrast studies.[28-30] In these studies, contrast administration improved diagnostic confidence. Contrast administration is also important to distinguish non-neoplastic white matter disease from metastases.

## CONCLUSION

Proton MRS is a useful tool to distinguish whether a brain mass is neoplastic or non-neoplastic, but has not been shown to reliably distinguish metastasis from high-grade primary glial neoplasm such as glioblastoma.[31] in the

present study, on MRS, most of the cases showed elevated choline peak. Necrosis and contrast enhancement was evident in all the cases.

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