Original Research Article

Magnetic resonance imaging of supra tentorial tumors: Correlation with histopathology

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Abstract

Background: 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". Advances in MR spectroscopy have expanded the horizon of MR imaging and have opened new avenues for further characterization of histological and biochemical composition of brain tumors. Still grading the malignancy on MR imaging technique is far from perfect. Our study aims to use routine sequences for evaluation of intracranial tumors. The histologic picture can often be predicted with a high degree of accuracy if the age of the patient, the exact tumor location and the imaging characteristics are taken into consideration. **Methodology:** A cross-sectional study was conducted in the Dept. of Radiology, NRI Medical College, Guntur from Nov-2014 to Sep-16 with the sample size of 67 subjects who attended with the symptoms and willing to participate in the study. **Results and Conclusion:** 1.The study shows that MRI is one of the best modality in identifying the supratentorial tumors. 2. MRI gains its importance in differentiating and characterizing individual tumors using an array of sequences like T1W, T2W, DWI and FLAIR along with the aid of MR spectroscopy technique. 3. MRI plain and contrast study with the addition of multi voxel spectroscopy helps the radiologist to locate, characterize the lesion as well as examine the areas to which it has extended and provide very important and useful information to neurosurgeons to decide the surgical and medical treatment plan required in each case. 4. Emerging technique like DWI has been described in the evaluation of cystic tumors. In addition, tumors such as lymphoma and DN*Et al*so demonstrate decreased diffusion, adding valuable information to the radiologist when formulating a differential diagnosis of a cerebral mass lesion. There are also growing applications using DWI in differentiating tumors such as glioblastoma, primary cerebral lymphoma, and metastasis. 5.In the armamentarium of non – invasive techniques, MRI becomes the mainstay of investigation from the view point of accuracy and safety. 6. Thus with this study we have developed a strategy for evaluation of supra tentorial brain tumors using T1,T2 weighted images, FLAIR, DWI,GRE, Post contrast T1 images and also multi voxel spectroscopy which resulted in better histopathological correlation.

Key Words: MRI, Supra Tentorial Tumors, Histopathology.

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INTRODUCTION

Magnetic resonance imaging (MRI) was introduced into clinical medicine in 1981, and in short time since then it has assumed a role of unparallel importance in diagnostic imaging. MR Imaging has become an indispensable tool in the evaluation of intracranial masses. The multiplanar capability of MRI is very helpful to determine the anatomic site of origin of lesions and to demarcate extension into adjacent compartments and brain structures. Although MRI provides many necessary details regarding nature and extent of tumor more parameters are needed to determine the type and grade of malignancy of tumor. Advances in MR spectroscopy have expanded the horizon of MR imaging and have opened new avenues for further characterization of histological and biochemical composition of brain tumors. Still grading the malignancy on MR imaging technique is far

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from perfect. Despite its excellent soft tissue visualization and variety of imaging sequences, conventional MRI presents limitations regarding certain tumor properties, such as infiltration and grading. The inability to detect infiltrating cells beyond the tumoral margin and to accurately define the grade of the tumor impedes surgical resection and the post-surgical treatment procedure. Hence, biopsy remains the gold standard, although it might provide histopathological information about a limited portion of the lesion and not necessarily about the whole neoplastic tissue. Present study aims to use routine sequences for evaluation of intracranial tumors. The histologic picture can often be predicted with a high degree of accuracy if the age of the patient, the exact tumor location and the imaging characteristics are taken into consideration. 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". The term "tumor" is used to include both neoplastic and non-neoplastic mass lesions, and should be considered in its broadest sense to simply indicate a space-occupying mass[1,2]. Radiological diagnosis is based on:

1. Topography of the lesion
2. Characterization into intra V/s extra parenchymal location
3. Morphology analysis and
4. Presence of secondary changes adjacent to the lesion.

AIMS AND OBJECTIVE

The aim of the study is to evaluate supra tentorial tumors in a group of 67 patients who were referred to Department of Radiodiagnosis and to correlate the MR imaging findings with Histopathological report.

Objectives

- To study the distribution of various supratentorial neoplasms.
- To study MRI features of supratentorial neoplasms
- To develop imaging strategy for evaluation of supratentorial tumors.
- To correlate the MRI findings with Histopathological report.

Place of study: This study was conducted in the Department of Radio-Diagnosis at NRI General Hospital, Chinakakani, Guntur in 67 patients who were referred clinically to the Department of Radiology with clinical symtoms suggestive of supratentorial intra cranial space occupying lesions.

Duration of study: The duration of study was from November 2014 to September 2016.

Sample size and Type of Study: 67 patients who presented with clinical symptoms suggestive of supratentorial intra cranial space occyping lesion were included in my study. Prospective observational study was performed.

Inclusion Criteria: All patients above 18 years of age, who are clinically suspected to have supratentorial tumors are imaged and then operated and have a histopathology report are included in the study.

Exclusion Criteria

- Those patients who are not operated are excluded.
- Supratentorial pathology and sympatomatology due to infections
- Pediatric age group
- Congenital malformations
- Trauma or cerebrovascular accidents will be excluded.
- Patients with pacemakers, aneurysmal clips and claustrophobia were excluded from the study.

Examination Technique: Patients from November 2014 to September 2016 who were referred clinically to the Department of Radiology, NRI general hospital with clinical symptoms suggestive of supratentorial intracranial space occupying lesions are imaged. MR imaging was performed with a clinical 1.5T Signa Excite system (General electrical medical systems, Milwaukee, USA). A dedicated eight channel high resolution head coil was used.

MRI BRAIN: Protocol

- T1 Axials.
- T2 Axials.
- FLAIR Axials.
- DWI with ADC Mapping
- GRE Axials.
- MR Spectroscopy
- Post Contrast T1 Axials.

Study Parameters being Monitored

1. Clinical features and clinical diagnosis
2. MRI BRAIN - evaluation of characteristics of supra tentorial brain tumors, their distribution, assessing the extent of lesion, imaging morphology and presence of secondary changes within and adjacent to the lesion such as perilesional edema, necrosis, calcifications, hemorrhage and post contrast enhancement of the lesion.
3. Comparing the MR Imaging diagnosis with Histopathology report.

RESULTS

Age and Sex Distribution: Out of 67 subjects, 13 (19.4%) were in the age group 20-30 years, 14 (20.9%) were in the age group 31-40 years, 13 (19.4%) were in the age group 41-50 years, 19 (28.4%) were in the age group 51-60 years, 5 (7.5%) were in the age group 61-70 years, 3 (4.4%) were in the age group 71-50 years. 35 (52.2%) of the subjects were male and 32 (47.8%) were female.

Glial tumors distribution: Out of 67 subjects, 27 (40.3%) were had Glial tumors, remaining 40 (59.7%) were had Non Glial tumors. Out of 27 Glial tumor subjects, 2 (18.5%) were had Low grade Glioma (Oligodendroglioma), 2 (7.4%) were had High grade Glioma, 11 (40.8%) were had Astrocytoma, 9 (33.3%) were had Glioblastoma multiforme. Out of 40 non Glial tumor subjects, 25 (62.5%) were had Meningioma, 5 (12.5%) were had Metastases, 1 (2.5 %) were had DNET, 1 (2.5 %) were had NHL, 4 (10%) were had Pituitary macroadenoma, 4 (10 %) were had Craniopharyngioma,

Clinical Presentation: 49.3% of the subjects had Vomiting, 73.1% of the subjects had Headache, 40.3% of the subjects had Convulsions, 16.4% had Hemiplegia/paresis, 16.4% had Ataxia and 11.9% had Blurring of Vision.

Astrocytoma Tumors: We observed that 11/67 (16.4%) of the cases had Astrocytomas, with mean age of 31.7 ±4.7 years and male : female ratio of 7:4. Most of the cases presented with convulsions(7/11) followed by headache and ataxia (5/11) and had the initial clinical diagnosis of ICSOL in (4/11) patients and epilepsy in (2/11) patients.Most of the patients on MRI were Hypointense on T1W and Hyperintense on T2W. On MR spectroscopy, there was elevated choline, low NAA peak and elevated CHO: CR ratios (10/11). DWI showed no restriction in 8 out of 11 cases and 3 out of 11 cases showed diffusion restriction. Peri-lesional edema was evident in all the cases but there was no contrast enhancement or calcifications.

Meningioma Tumors: We observed that 25/67 (37.3%) cases had Meningioma with mean age of 50.07 ±3.7years. Most of the cases presented with headache, convulsions and vomiting. On MRI most of the patients were hypointense on T1W and isointense on T2W.DWI showed restriction in most of the cases (24/25). On contrast administration there is enhancement in all the cases (25/25). MR spectroscopy showed elevated choline/creatine ratio. On DWI, restriction was seen. Peri-lesional edema and contrast enhancement was evident in all the cases.

Craniopharyngioma Tumors: We observed that 4/67 (5.9%) cases had Craniopharyngioma, with mean age of 30 ±7.1 years. Most of the cases presented with headache (3/4) and vomiting (2/4) and had the initial clinical diagnosis of ICSOL in (4/4) patients. On MRI most of the patients were isointense on T1W and hypo on T2W. Contrast enhancement and cystic degeneration was evident on all the cases. DWI showed restriction in all the cases. MR spectroscopy revealed non specific findings.

Pituitary macroadenoma Tumors: We observed that 4/67 (5.9%) 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 (3/4) and had the initial clinical diagnosis of ICSOL in (4/4) patients. On MRI most of the patients were isointense on T1W and T2W. Calcifications, necrosis and bone erosion was evident in 3 of 4 cases and all the cases showed contrast enhancement.

Metastatic Tumors: We observed that 5/67 (7.4%) cases had Metastasis with mean age of 49.8 years and male to female ratio of 3:2. Most of the cases presented with headache, vomiting and ataxia (5/5) and had the initial clinical diagnosis of ICSOL in (5/5) patients. On MRI most of the patients were iso intense on T1W, some are hypointense on T1 and hyper-intense T2W. On MR spectroscopy, Showed elevated choline peak. DWI showed no restriction. All the cases showed contrast enhancement. Calcification, necrosis and bone erosion was not evident in all the cases. However Hydrocephalus was seen in 33% cases. Out of 67, 88% of the subjects had single lesions, remains 12% were two or more lesions.

Table 1: Correlation of MRI diagnosis with Histopathological diagnosis

Tumor	MRI Diagnosis	Histopathology	%
Glial Tumors	27	24	88.9
Metastases	5	4	80.0
Meningioma	25	23	92.0
Pituitary macroadenoma	4	4	100.0
Craniopharyngioma	4	4	100.0
NHL	1	1	100.0
DNET	1	1	100.0
Total	**67**	**61**	**91.0**

DISCUSSION

Astrocytoma: Astrocytomas are a heterogeneous group of tumors that arise from the glia. In our present study, observed that 11/67 (16.4%) the cases had Astrocytomas with mean age of 31.7±4.7 years and male: female ratio of 7:4. They are reported to be most common type of intraaxial supratentorial brain tumors and account for 60% of all intracranial neoplasms as reported by Poussaint TY *et al* 2001.[3] 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 7/11 followed by headache and ataxia 5/11 and had the initial clinical diagnosis of ICSOL in 4/11 patients and epilepsy in 2/11 patients. In our study the histological variants observed were, diffuse fibrillary astrocytoma (7/11), Pleomorphic astrocytoma (2/11) and anaplastic astrocytoma (2/11). They are reported by Louis DN *et al* 2007[4], to vary from low to high grade and are classified according to their histopathology pattern, biologic behavior, and genetic characterization. Most of the patients in the present study, were hypointense on T1W and hyperintense on T2W. Gupta N *et al* 2010[5] reported that, they can be solid and cystic and have calcification in up to 20% of cases[4] but this was not observed in present study which may be because of small sample size. In the present study, peri-lesional edema was evident in all the cases but there was no contrast enhancement or calcification. Although most malignant gliomas have peritumoral edema, enhancement, and necrosis, these characteristics are reported by Panigrahy A 2009, to be absent in some high-grade tumors, making the classification and grading of tumors on conventional imaging sometimes unreliable. On imaging, Smirniotopolous J. *et al*[6] 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 T1-weighted images, appears hyperintense on T2-weighted images, and shows no enhancement.[7] This observation is in conformity with the observations in the present study. In the present study, tumor are homogeneously hyperintense on FLAIR imaging in 10 out of 11 patients. Maia AC Jr, *et al* 2005 reported that on perfusion MRI, rCBV is relatively low as seen in other low-grade tumors.[8] MRS findings are nonspecific, showing elevated choline and low NAA levels similar to findings in many other tumors. Meningioma: Verheggen R, and Mahmood A *et al* reported that meningiomas constitute approximately 20% of all intracranial tumors[9] and are easily diagnosed using routine MR imaging. In the present study we observed that that 25/67 (37.3%) cases had Meningioma with mean age of 50.07 ±3.7years with a male to female ratio of 10:15. Furthermore Mahmood A *et al* reported that, malignant and atypical meningiomas, although relatively uncommon and accounting for approximately 7.2% and 2.4% of all meningiomas, respectively[9], are associated with less favorable clinical outcomes because they are more prone to recurrence and aggressive growth. 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.[9] 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.[7] On MRI most of the patients were hypointense on T1W and isointense on T2W. DWI showed restriction in most of the cases (24/25). On contrast administration there is enhancement in all the cases (25/25). MR spectroscopy showed elevated choline/creatine ratio, elevated CHO (17/25), Glutamite (16/25) and CR (13/25) peaks. Peri-lesional edema was evident in all the cases. In the present study calcification was noted in 5/25 (20%) patients.

Craniopharyngioma: In the present study, we observe that 4/67 (5.9 %) the cases had Craniopharyngioma with mean age of 30.0 ± 7.1 years and male: female ratio of 3:1. Bunin GR[10,] and Haupt R *et al*[11] 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. In the present study, 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. Jagannathan J[12] and Karavitaki N[13] *et al* reported that usual symptoms on presentation are: headache, 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. The classical appearance of a craniopharyngioma is of a sellar/suprasellar partly solid, partly cystic calcified mass lesion. In the present study we observed all the cases in sellar or supra-sellar region. Rossi A *et al*[14] reported that these tumors occur in the suprasellar (75%), supra and infra sellar (20%) and infrasellar (5%) regions. Magnetic resonance imaging (MRI) with and without contrast will, accurately delineate the extent of the tumor and, in particular, its involvement with the hypothalamus. Rossi A *et al* [14] reported that Magnetic resonance angiography (MRA) is useful to not only delineate the course of the vessels, which can be through the tumor, but also to help differentiate a tumor from a possible vascular malformation.[14]. 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 most of all the cases[14].

Metastasis: Brain metastases occur in 15-40% of patients with cancer,[15] many of whom are asymptomatic. Intracranial metastases may be either parenchymal or extraaxial. Extra-axial metastasis may be epidural, dural or leptomeningeal. Epidural metastases are nearly always

associated with adjacent osseous metastases with spread to the epidural space. 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,[16] although many case reports of intracranial metastatic disease from various other cancers exist. In the present study, We observe that 5/67(7.4%) cases had Metastasis with mean age of 49.3 ± 5.3 years. The male: females ratio of 3:2 in our study. 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 (5 /5) and had the initial clinical diagnosis of ICSOL in 5 / 5 patients. Ishimaru H *et al*[17] reported that symptoms may include headache, seizure, syncope, focal neurological deficit, or papilledema. In the present study, most of 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 in order to refine the differential diagnosis. In the present study, most of the patients on MRI were iso intense on T1W and hyper intense T2W.

On MRI, Chen XZ *et al*[18] reported that metastases are usually iso or hypointense on T1, hyperintense on T2, and exhibit avid enhancement. Some metastases, such as melanoma, are T1 hyperintense due to the paramagnetic effects of melanin. Haemorrhagic 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 (ADC) map), rather than diffusion restriction. This is comparable to the present study. Vasogenic edema can be substantial, and is unrelated to lesion size. Hakyemez B *et al*[19] found a significantly increased ratio of vasogenic edema to contrast enhancing lesion size in metastases compared with high-grade primary brain tumors, although metastases may display little or no vasogenic edema. Small cortically based metastases may not demonstrate any visible edema, and must therefore be looked for carefully. Gadolinium contrast enhancement is vital to detect small metastases. Balériaux D and Healy ME *et al* [20] have documented the utility of contrast in the detection of additional lesions compared with noncontrast studies. In these studies, contrast administration improved diagnostic confidence. Contrast administration is also important to distinguish nonneoplastic white matter disease from metastases. Proton MR Spectroscopy 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[21]. In the present study, On MR spectroscopy, most of the cases showed elevated choline peak. Calcification and necrosis and bone erosion was not evident in all the cases and all the cases showed contrast enhancement.

CONCLUSION

1. The study shows that MRI is one of the best modality in identifying the supratentorial tumors.
2. MRI gains its importance in differentiating and characterizing individual tumors using an array of sequences like T1W, T2W, DWI and FLAIR along with the aid of MR spectroscopy technique.
3. MRI plain and contrast study with the addition of multi voxel spectroscopy helps the radiologist to locate, characterize the lesion as well as examine the areas to which it has extended and provide very important and useful information to neurosurgeons to decide the surgical and medical treatment plan required in each case.
4. Emerging technique like DWI has been described in the evaluation of cystic tumors. In addition, tumors such as lymphoma and DN*Et al*so demonstrate decreased diffusion, adding valuable information to the radiologist when formulating a differential diagnosis of a cerebral mass lesion. There are also growing applications using DWI in differentiating tumors such as glioblastoma, primary cerebral lymphoma, and metastasis.
5. In the armamentarium of non – invasive techniques, MRI becomes the mainstay of investigation from the view point of accuracy and safety.
6. Thus with this study we have developed a strategy for evaluation of supra tentorial brain tumors using T1,T2 weighted images, FLAIR, DWI,GRE, Post contrast T1 images and also multi voxel spectroscopy which resulted in better histopathological correlation.

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