



## Intra-Axial Neoplasms: Conventional Versus Advanced MRI

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### Abstract

**Introduction:** Brain tumors are the second leading cause of cancer related deaths in children and young adults, being common among all age groups. Diagnosis of intraxial brain tumors is very crucial since they are usually very advanced at the time of diagnosis. MRI, with the advent of advanced modalities such as Diffusion Weighted Imaging and Magnetic Resonance Spectroscopy, has gained an ever-increasing multifaceted role in the diagnosis of brain tumors. The role of conventional and advanced MRI in the diagnosis of intra-axial neoplasms need to be ascertained.

**Materials and Methods:** This is a prospective observational study undertaken over a period of two years on 52 patients evaluated by MRI with the aim to evaluate the characteristic MR findings of various intra-axial supratentorial neoplasms and to assess the additive role of advanced imaging in its diagnosis.

**Results:** The most commonly encountered neoplasm was high grade glioma followed by metastases. Diagnostic accuracy of MRI was 80.7% and upon addition of advanced imaging it was 94.2%.

**Conclusion:** Advanced MR imaging modalities should be mandatory for evaluation of intraaxial mass lesions.

**Keywords:** diffusion weighted, magnetic resonance perfusion, spectroscopy, enhancement.

### Introduction

Intracranial neoplasms are on the rise in recent times. Most brain tumors are not diagnosed until after symptoms appear and hence are usually advanced at the time of diagnosis. Early diagnosis of the tumors helps in effective management of the deadly disease and save life. This requires prompt exclusion of other conditions which can simulate

radiological appearance of space-occupying lesions like abscesses, demyelinating disease, encephalitis and vascular malformations<sup>(1)</sup>.

The most effective and common imaging tool for diagnosing supratentorial (located above tentorial attachment of brain) intraaxial (located within the brain parenchyma) brain tumors is Magnetic Resonance Imaging (MRI)<sup>(2)</sup>. Conventional MRI techniques include T1 and T2 Weighted imaging

with Gadolinium enhancement which provide anatomical localisation of the tumors. However, with this modality the distinction between various tumor types is not often possible.

Recently, with the advent of advanced MR imaging modalities such as Diffusion Weighted imaging, Spectroscopy and Perfusion imaging, MRI has gained an evolving multifaceted role in the accurate pre-operative evaluation with determination of histologic grade of tumors.

**Materials and Methods**

This was a Prospective Observational Study conducted on patients referred to the Dept. of Radiodiagnosis, VIMSAR, Burla, for diagnosis of suspected intracranial intraxial neoplasm. The study period was from October 2015 to September 2017 and all such patients of all ages and both sexes were included in the study.

The different types of MRI was performed on the patients including advanced MR imaging modalities such as Diffusion Weighted imaging, Spectroscopy and Perfusion imaging. The diagnostic Accuracy of different parameters of MRI was evaluated and correlated with biopsy.

**Results**

Fifty two patients were diagnosed with Supratentorial Intraaxial Neoplasms in the study period. The most commonly encountered neoplasm was Glioblastoma (4.6%) followed by Metastases. Males were more commonly involved.

**Table 1.** Demographic Profile of Patients with Supratentorial Intra-axial Neoplasms

Tumor	Age	Males	Females	Total
High Grade Astrocytic	15-79	12	6	18
Metastases	31-77	7	8	15
PNET	4-8	1	1	2
Low Grade Astrocytic	19-54	6	5	11
Ependymoma	17, 40	1	1	2
Lymphoma	58,66	2		2
Ganglioglioma	21	1		1
Astroblastoma	5		1	1
Total		30	22	52

High grade astrocytoma was most common intraaxial neoplasm in our study. It most often occurred within 15 to 79 years. It was more prevalent in males.

**Table 2.** Contrast Enhancement Pattern of Supratentorial Intraxial Neoplasms on MRI.

Tumor	No enhance ment	Hom ogenous	Inhomo genous	Ring-like/ Perip heral	Total
High Grade Glioma	3		5	10	18
Metastases		5		10	15
PNET			2		2
Low Grade Glioma	11				11
Ependymom a				2	2
Lymphoma		2			2
Ganglioglioma			1		1
Astroblasto ma			1		1
Total	14	7	9	22	52

Ring like enhancement was most often found in high grade gliomas, metastasis and ependymoma. Low grade gliomas did not show any enhancement in all cases. Ganglioglioma and astroblastoma demonstrated inhomogenous enhancement.

**Table 3.** ADC Values of selected neoplasms.

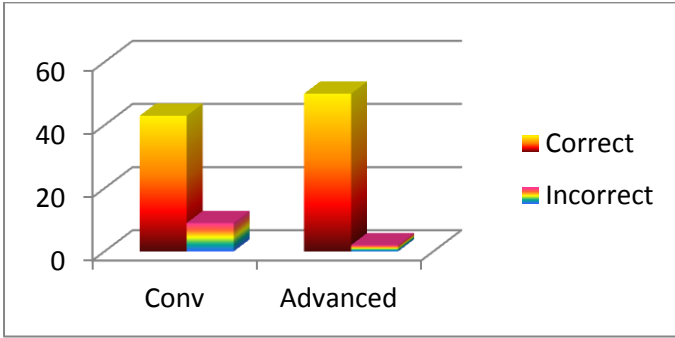
ADC	High Grade Glioma (x10 <sup>-3</sup> mm <sup>2</sup> /sec)	Low Grade Glioma (x10 <sup>-3</sup> mm <sup>2</sup> /sec)	Lymphoma (x10 <sup>-3</sup> mm <sup>2</sup> /sec)
Minimum	0.99	1.23	0.63
Mean	1.15	1.48	0.66

Lower ADC values were seen in lymphoma as compared to gliomas.

**Table 4.** MR Spectroscopy acquisition

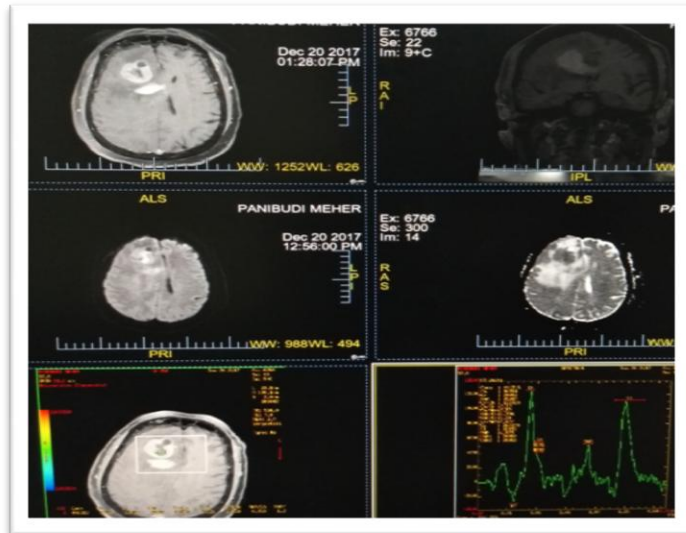
Tumor	Total	Cho/Cr > 1.8	Lactate elevation
High Grade Glioma	18	15	11
Low Grade Glioma	11	6	0

Lactate elevation was a consistent feature in high grade gliomas.

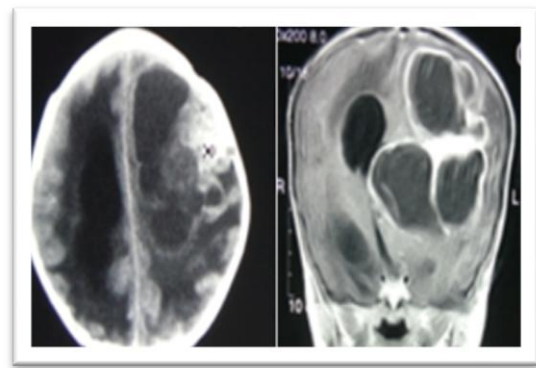


**Fig 1.** Comparison of Diagnostic Accuracy of Conventional and Advanced MRI.

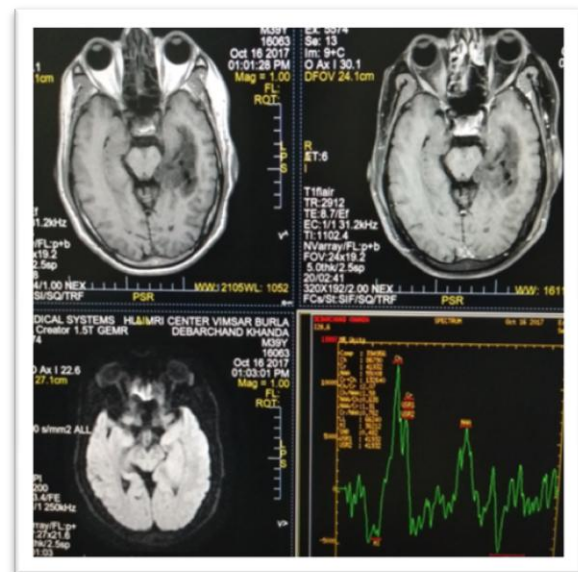
Gadolinium enhancement alone has low sensitivity and specificity in the evaluation of intraaxial neoplasms with difficult differentiation of various tumor types. Advanced MRI techniques helps in improving accuracy of diagnosis.



**Fig 2.** Image on upper row showing axial and coronal T1 post contrast- a heterogeneously enhancing right frontal lobe mass extending into the corpus callosum with surrounding edema. Middle row shows areas of diffusion restriction. Lower row - MRS of the lesion - elevated Choline, lipid lactate and diminished NAA peak. This was a case of glioblastoma multiforme.



**Fig 3.** Axial and coronal CT post contrast image showing a heterogenous solid cystic lesion solid part taking avid enhancement. Marked adjacent edema also evident.



**Fig 4.** Upper row showing heterogeneously hypointense lesion in left temporal lobe not taking enhancement on contrast administration. Lower row: No diffusion restriction; MRS - MI/Cr ratio >0.6.

**Discussion**

In T1 weighted images most tumors were hypointense (37(49.3%)) or isointense (28 (37.3%)). Mixed intensity was seen in 4 cases of High Grade Astrocytic tumors, all of which were hemorrhagic. Most of the tumors showed hyperintensity in T2 weighted MR images (46 (61.3%)). This was consistent with *Anna Zimny et al*<sup>(3)</sup>. Most of the lymphomas were hypointense in T2 weighted MRI which exactly corroborated to the study conducted by *Schwingel R et al*<sup>(4)</sup>.

Also 39 out of 52 patients (75%) revealed Gd enhancement.

Both Ependymomas diagnosed in our study were located adjacent to the cortical surface, which is characteristic according to *Schwartz TH et al*<sup>(5)</sup>. They showed complete ring like enhancement.

There was no significant enhancement in three out of 18 high grade gliomas. This was well correlated with *JN Scott et al* found upto one-third of cases of High Grade/Malignant Gliomas without enhancement on imaging<sup>(6)</sup>.

Patchy enhancement was evident in one Low Grade Glioma. According to *Johann Palud et al* diffuse low grade gliomas can rarely show patchy, heterogenous, faint enhancement<sup>(7)</sup>.

Among gliomas, high grade gliomas depicted lower ADC values than low grade gliomas. In comparison, 0.82+/- 0.3 and 1.15 +/- 0.3 were the min. ADC values for high and low grade gliomas respectively in a study by Osama et al (lower than our study) (8). This has been attributed to differences in MRI equipment and b values used. In the present study, lower ADC values were seen in lymphoma as compared to gliomas due to their higher cellularity.

A Cho/Cr ratio cut-off of 1.8 was used to distinguish between low grade and high grade gliomas. This, when combined with lactate peak led to a higher diagnostic accuracy for high grade gliomas (97%).

For low grade gliomas, MI/Cr ratios were used and values of 0.6 or more were encountered in 100% of the cases in keeping with studies by Bartha and Ruggieri PM et al<sup>(9,10)</sup>. In fact, the range of values obtained in the present study was more specific than that carried out by Ruggieri PM et al<sup>(10)</sup>.

MR perfusion values of r CBV (mean and range) calculated in case of gliomas demonstrated significantly higher values in case of high grade gliomas compared to low grade gliomas. This correlated well with a study by Hakyemez et al<sup>(11)</sup>.

Finally, the difference between the diagnostic accuracy of Conventional MRI alone and this when combined with advanced modalities for supratentorial intraaxial neoplasms, was found to be statistically significant (p <0.05).

## Conclusion

Advanced MRI modalities provide additional information which make MRI a comprehensive tool in conclusive diagnosis of Supratentorial Intraaxial Tumors. Advanced MR imaging is superior to Conventional MRI in the identification of the type of neoplasm and ascertaining its grade; when compared to Conventional imaging and hence, should be mandatory for evaluation of intraaxial mass lesions.

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