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Original Research Article

Role of MR Spectroscopy in Evaluation of Intraaxial Brain Tumours

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Conflict of interest: Nil

Abstract:

Background: Intra-axial brain masses constitute a major neurological health burden and represent a diverse group of pathological entities that pose considerable diagnostic and therapeutic challenges.

Methods: The study was carried out at the Department of Radiodiagnosis, Sardar Patel Medical college & Associate group of Hospitals, Bikaner, Rajasthan from October 2024 to October 2025 with aim to evaluate role of MR spectroscopy in intraaxial brain tumors.

Results: Analysis of spectra of 60 patients with intraaxial brain tumors was done; 22 with GBM, 4 with anaplastic astrocytoma, 6 with diffuse infiltrative astrocytoma, 4 with oligodendroglioma, 4 with gliomatosis cerebri, 4 with ependymoma, 4 with medulloblastoma, 2 with metastasis, 2 with choroid plexus papilloma and 2 with lymphoma. 6 other tumors were not histopathologically correlated.

Conclusion: we can conclude that for glioma grading, Magnetic Resonance Spectroscopy can be used as a trustworthy method. It is useful in discrimination between WHO grade II and grade III, IV astrocytomas as well as other intraaxial brain tumors such as gliomatosis cerebri, ependymoma, medulloblastoma, oligodendroglioma, lymphoma, metastasis and choroid plexus papilloma. Our study also demonstrates that spectroscopic MR measurements in the region surrounding the tumor can be used to demonstrate differences in solitary metastases and high-grade gliomas and also peritumoral infiltrative nature of certain intraaxial brain tumor.

Keywords: MR Spectroscopy, Astrocytomas, Ependymoma.

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Introduction

Intra axial brain masses are a significant health problem and present several imaging challenges. These lesions include primary neoplasm (high and low grade), secondary (metastatic) neoplasm, lymphoma, tumefactive demyelinating lesions, abscesses and encephalitis. We are witnessing a shift in imaging from merely providing anatomical information towards providing information about tumor physiology. [1-2] Imaging plays an integral role in intracranial tumor management. Magnetic resonance (MR) imaging in particular has emerged as the imaging modality most frequently used to evaluate intracranial tumors, and it continues to have an ever expanding, multifaceted role. In general, the role of MR imaging in the workup of intraaxial tumors can be broadly divided into tumor diagnosis and classification, treatment planning, and post treatment surveillance. In addition to conventional MR imaging techniques, a variety of advanced techniques have found their place in clinical practice or are the subject of intense research. [3-4] These advanced techniques offer

more than the anatomic information provided by the conventional MR imaging sequences. They generate physiologic data and information on chemical composition. The current advanced techniques include perfusion imaging, diffusion-weighted imaging (including diffusion tensor imaging), MR spectroscopy, blood oxygen level–dependent (BOLD) imaging, and the largely experimental molecular imaging. Magnetic resonance spectroscopy allows the non-invasive measurement of selected biological compounds in vivo. [5-6] Proton spectroscopy has been recognized as a safe and noninvasive diagnostic method that, coupled with magnetic resonance imaging techniques, allows for the correlation of anatomical and physiological changes in the metabolic and biochemical processes occurring within previously determined volumes in the brain. Magnetic resonance spectroscopy (MRS) provides information about the possible extent and nature of changes on a routine MRI scan by analyzing the presence and/or ratio of tissue metabolites such as NAA, creatine, choline, and lactate etc.

Materials and Methods

The study was carried out at the Department of Radiodiagnosis, Sardar Patel Medical college & Associate group of Hospitals, Bikaner, Rajasthan from October 2024 to October 2025 with aim to evaluate role of MR spectroscopy in intraaxial brain tumors.

Source of Data: Patients with clinical features suggestive of intra cranial space occupying lesion referred for MRI study to the Department of the Radiodiagnosis, Sardar Patel Medical college & Associate group of Hospitals, Bikaner, Rajasthan were included in study. The MRI was done on the advice of the referring doctor and no patient was made to undergo MRI for the sole purpose of this study.

Study Period: 12 months.

Study Design: Observational cross sectional non interventional study

Inclusion Criteria: The study includes

- All patients with clinical features suggestive of intra cranial space occupying lesion.
- All patients with incidentally diagnosed intraaxial brain tumor by CT.

Exclusion Criteria: The study will exclude

- Cases with benign lesions after histopathology confirmation.
- Patient having history of claustrophobia.
- Patient having history of metallic implants insertion, cardiac pacemakers and metallic foreign body in situ.
- Patient clinically unstable.

Sampling and Sample Size: The study is time bound study with sample size of 60 cases.

Data Acquisition: Patients with clinically suspected intra cranial lesion referred for MRI study, underwent the examination after contraindications for MRI were excluded and consent was taken. All the MRI scans in this study were performed using Philips Ingenia 3.0 T MRI scanner.

Statistical Analysis: In Microsoft excel, data was entered and data sheet and analysis was done. Descriptive statistics, frequencies and proportions were calculated and tabulated. Sensitivity, specificity, negative predictive value, positive predictive value and diagnostic accuracy to test the validity of MR Spectroscopy with respect to histopathological examination were calculated. Fisher exact test was the test of significance for categorical data. $p < 0.05$ was considered as statistically significant.

Results

In the study, it was observed that majority of the patients with intra-axial brain tumors were between 31 to 40 years of age. They constitute 20% of total study sample. The youngest patient was 10 months old and the oldest was 78 years old female. Majority i.e. 73.33% of the patients with intraaxial brain tumors were males. It is evident that there is male preponderance in intraaxial brain tumors. 73.33% of the patients were having intraaxial brain tumors in supratentorial location. It was observed that most common location for intraaxial brain tumor is supratentorial.

Table 1: Distribution of Cases Based on MRI Diagnosis in Corelation with Histopathological Diagnosis

Sl. No.	Intraaxial Brain Tumor	Histopathologi CAL Diagnosis	MRI Diagnosis
1.	GBM (Grade 4)	22	24
2.	High Grade Glioma (Grade 3)	4	6
3.	Low Grade Glioma (Grade 2)	6	4
4.	Oligodendroglioma	4	2
5.	Gliomatosis Cerebri	4	4
6.	Ependymoma	4	2
7.	Medulloblastoma	4	4
8.	Metastasis	2	2
9.	Choroid Plexus Papilloma	2	2
10.	Lymphoma	2	2

11.	Neurocytoma	-	2
	Total	**54**	**54**

Table 2: Sensitivity, Specificity, PPV, NPV and Diagnostic Accuracy of Brain Tumor Diagnosed in MRI in Correlation with Histopathological Diagnosis

Sl. No.	Brain tumor	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
1.	Glioblastoma Multiforme	90.91%	87.5%	83.33%	93.33%	88.89%
2.	Anaplastic Astrocytoma	33.33%	95.83%	50%	92%	88.89%
3.	Diffuse Infiltrative Astrocytoma	100%	96%	66.67%	100%	96.3%
4.	Oligodendroglioma	50%	100%	100%	96.15%	96.3%
5.	Gliomatosis Cerebri	100%	100%	100%	100%	100%
6.	Ependymoma	50%	100%	100%	96.15%	96.3%
7.	Medulloblastoma	100%	100%	100%	100%	100%
8.	Metastasis	100%	100%	100%	100%	100%
9.	Choroid Plexus Papilloma	100%	100%	100%	100%	100%
10.	Lymphoma	0%	96.15%	0%	96.15%	92.59%

Discussion

In our study observed that majority of the patients with intra-axial brain tumors were between 31 to 40 years of age. They constitute 20% of total study sample. The youngest patient was 10 months old and the oldest was 78 years old female. 73.33% of the patients with intraaxial brain tumors were males. It is evident that there is male preponderance in intraaxial brain tumors.

Similar male predominance has been reported in several previous neuroimaging studies.

Musawar et al [7] In their study, mean age of patients was 40.88±11.47 years. There were 69.3% male and 30.7% female patients.

In our study the majority of intra-axial brain lesions in the present study were located in the supratentorial region, accounting for 44 cases, indicating a clear predominance of supratentorial involvement. Infratentorial lesions were comparatively fewer, with 12 cases identified. This distribution highlights the higher frequency of intra-axial tumors occurring in the supratentorial compartment of the brain. The observed pattern is consistent with previously reported literature on intracranial tumor localization. [7]

Conclusion

On the basis of MRS alone, accurate grading of gliomas may be difficult. Combining MRS with conventional and other advanced MR imaging techniques, grading becomes more precise.

Some features of tumors on conventional MRI (e.g. contrast enhancement, surrounding edema, signal heterogeneity, necrosis, hemorrhage and midline crossing) suggest a high grade. MRS is complementary and helpful for glioma grading. High grade gliomas demonstrate marked elevation of Cho, decreased NAA and presence of Lactate and Lipid. Myoinositol is raised in low grade gliomas and reduced with increasing grades of tumors.

From our study we can conclude that for glioma grading, Magnetic Resonance Spectroscopy can be used as a trustworthy method. It is useful in discrimination between WHO grade II and grade III, IV astrocytomas as well as other intraaxial brain tumors such as gliomatosis cerebri, ependymoma, medulloblastoma, oligodendroglioma, lymphoma, metastasis and choroid plexus papilloma. Our study also demonstrates that spectroscopic MR measurements in the region surrounding the tumor can be used to demonstrate differences in solitary metastases and high-grade gliomas and also peritumoral infiltrative nature of certain intraaxial brain tumor.

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