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ROLE OF MR SPECTROSCOPY IN THE EVALUATION OF ADULT INTRACRANIAL NEOPLASMS

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ABSTRACT

AIM: The aim of the study was to compare the efficacy of MR spectroscopy in predicting the histology of intracranial neoplasms and to correlate with WHO grading. **METHODS AND MATERIALS:** This prospective study was performed in 41 patients with intracranial tumours. The levels at TE 144ms and TE 35ms. were calculated within the tumor, the peritumoral region, and the contralateral normal appearing white matter .The ratios were calculated by dividing the maximum value in the tumor and in the peritumoral region by the value in the contralateral normal-appearing white matter. For statistical analysis Student independent t-test and ROC curve analysis was performed. **RESULTS:** The difference in the mean Cho/Cr, Cho/Naa and Lip/Lac ratios of high and low grade gliomas were statistically significant. Among all the parameters Cho/Cr was the best parameter to identify high-grade gliomas, >2.554 for Ch/Crt yielded 87.5 % sensitivity and 90 % specificity and a cut off of >1.595 for Ch/Crp yielded 87.5 % sensitivity and 90 % specificity.Similarly the difference in the mean Cho/Cr, Cho/Naa of high grade glioma and metastasis were statistically significant. Among all parameters identify high-grade gliomas, a cut off of > 1.53 for Ch/Crp yielded 87.5 % sensitivity and 77.8 % specificity. **CONCLUSION:** MRI spectroscopy showed very good diagnostic accuracy in grading glial tumors, as well as in the differentiation of GBM from metastasis.

KEYWORDS: Glioma Magnetic resonance imaging Spectroscopy Tumour.

INTRODUCTION

Primary brain tumors include tumors that originate from the tissues of the brain, or the brain's immediate surroundings. Primary tumors are categorized as glial (composed of glial cells) or non-glial (developed on or in the structures of the brain, including nerves, blood vessels and glands) and benign or malignant. Metastatic brain tumors include tumors that arise elsewhere in the body (such as the breast or lungs) and migrate to the brain, usually through the bloodstream.

In general, the role of MR imaging in the workup of intraaxial tumors can be broadly divided into tumour diagnosis and classification, treatment planning and post treatment surveillance. Advanced magnetic resonance imaging (MRI) techniques, such as MR spectroscopy, diffusion and perfusion MR imaging techniques can give important in vivo physiologic and metabolic information, complementing morphologic findings from conventional MRI in the clinical setting. The commonly used advanced MR imaging techniques include diffusion-weighted imaging, perfusion weighted imaging and MR spectroscopy.

Molecular imaging is largely experimental at this stage. Discrimination of extra-axial and intra-axial brain tumors is relatively easy with only anatomic imaging; however, the major diagnostic challenge is to reliably, noninvasively, and promptly differentiate various histological tumour types to avoid biopsy and follow- up imaging studies. Integration of diagnostic information from advanced MR imaging techniques can further improve the classification accuracy of conventional anatomic imaging1.

MR spectrosopy provides a means to characterize the metabolite profiles of tumoral and non-tumoral lesions in the brain. MR spectroscopic imaging (MRSI) or chemical-shift imaging (CSI), either 2D or 3D, obtains spectroscopic information from multiple adjacent volumes over a large volume of interest in a single measurement.

This study focuses on the role of the most commonly used advanced MR imaging technique-MR spectroscopy for the diagnosis and classification of the adult intracranial tumours.

AIMS AND OBJECTIVES

1. Comparing the efficacy of MR spectroscopy imaging technique with routine MR imaging technique in predicting the histology of intracranial neoplasms.
2. Determine the various indices obtained following post processing of MR data (Cho /Cr , Cho /Naa and Lip/Lac peaks) and correlate with WHO grading.

MATERIALS AND METHODS

This is a hospital based time bound prospective study, conducted between Oct 2012 to Aug 2014 over a period of 23 months in the Department of Radiodiagnosis and Imaging, Kasturba Medical College, Manipal. All the patients in whom intracranial neoplasms was suspected and who were conforming to the inclusion criteria were selected for the study. In each patient, spectroscopy parameters were calculated and relationship of these parameters with the final diagnosis was correlated.

Inclusion criteria

The study includes those adult patients whose final diagnosis is confirmed by histopathology in case of a tumor / known primary in case of metastasis. Patients must be previously untreated.

Exclusion criteria

Contraindication to perform MRI.
Histopathology proven non neoplastic lesions.

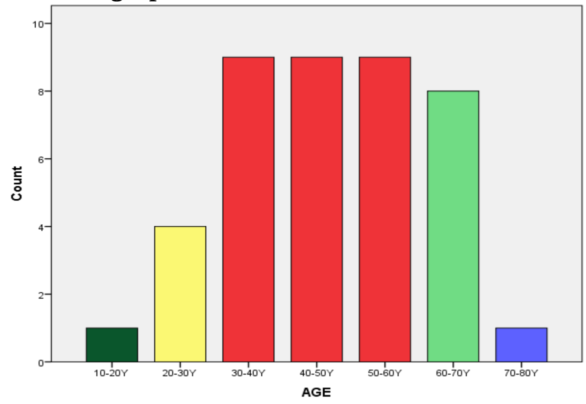
Statistical analysis

Statistical analysis was performed using SPSS 20 software to obtain the means of the spectroscopy parameters of various lesions. The means derived were further compared using student independent t-test to check the statistical significance in their difference. Receiver operating characteristic (ROC) curves were generated for the spectroscopy parameters which showed statistically significant difference to identify the cut off points that maximized the sensitivity and specificity for identifying each condition.

OBSERVATIONS AND RESULTS

The present study sample included 41 patients who suffered from intracranial neoplasms. 27 patients were males and 14 were females.

1. Demographic details

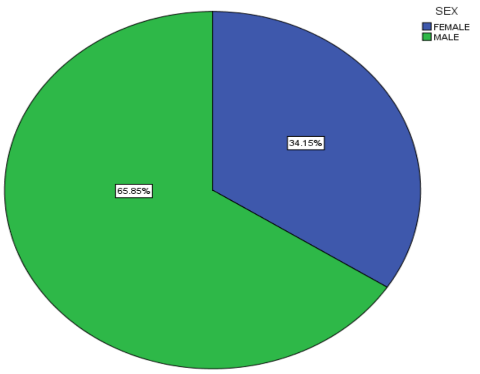


a) Age

Majority of the patients in the study were in the age group between 30 and 60 yrs age group. Minimum age was 19 yrs, Maximum age was 72 yrs. Mean age was 47.5 yrs.

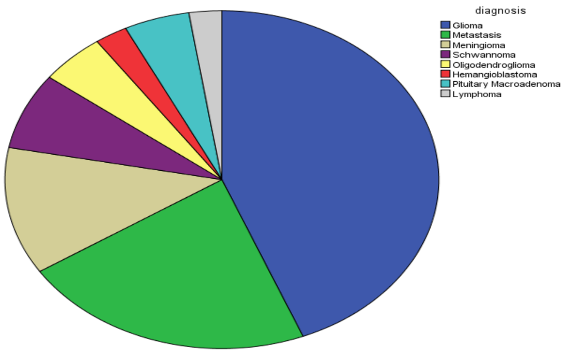
b) Sex

Male patients exceeded the female patients forming 65.9 % of the total population.



2. Frequencies of the lesions

Gliomas constituted the most common intracranial space occupying lesions accounting for 43.9 % of the cases. Out of 18 cases of glioma, 8 had high grade glioma out of which 7 were glioblastomamultiforme (grade IV) and 1 was anaplastic astrocytoma (grade III) and 10 had low grade glioma (WHO grade I &II) which showed minimal to no enhancement after contrast administration.

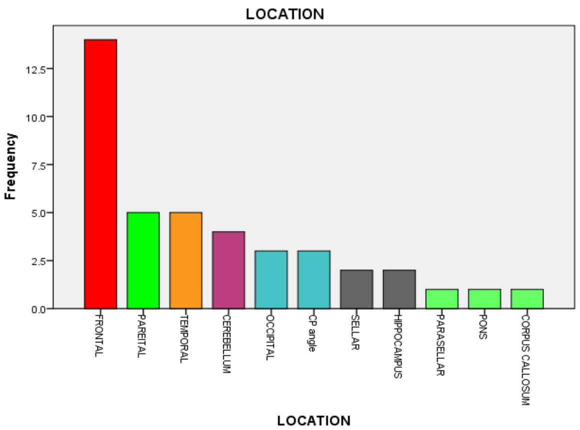


Metastasis was the second most common lesions accounting for a total of 9 cases out of which 4 were secondaries from bronchogenic carcinoma, 3 had breast carcinoma and 2 from the gastrointestinal tract. Meningiomas were the third most common lesions accounting for a total of 5 cases in which 4 were histopathologically typical meningiomas and 1 was atypical meningiomas.

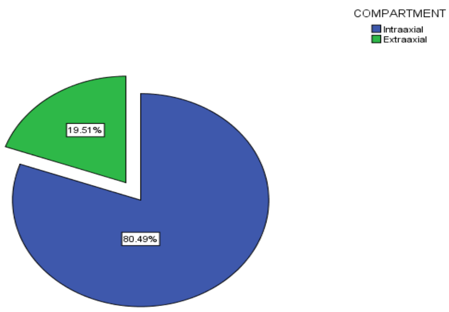
DIAGNOSIS	FREQUENCY
Low grade glioma	10
High grade glioma	08
Metastasis	09
Meningioma	05
Schwannoma	03
Oligodendroglioma	02
Pituitary macroadenoma	02
Lymphoma	01
Hemangioblastoma	01

3. MORPHOLOGICAL CHARACTERISTICS.

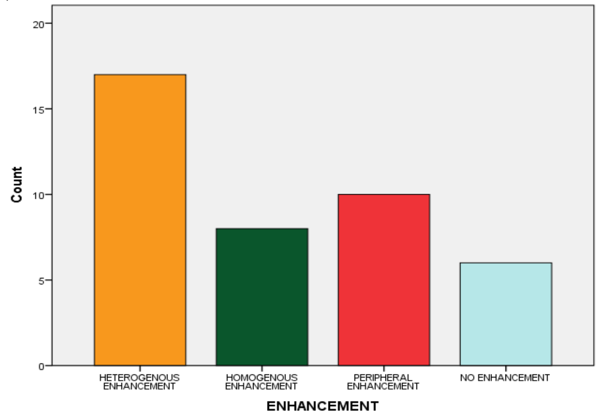
a) Location.



34.1% of the lesions were in the frontal lobe followed by 12.2% in parietal and temporal lobe, 7.3% in occipital region and the rest (22.1%) in the locations as shown in the bar chart. Intra-axial lesions constituted the majority accounting to 80.5% of the lesions.



b) Enhancement of the lesion.

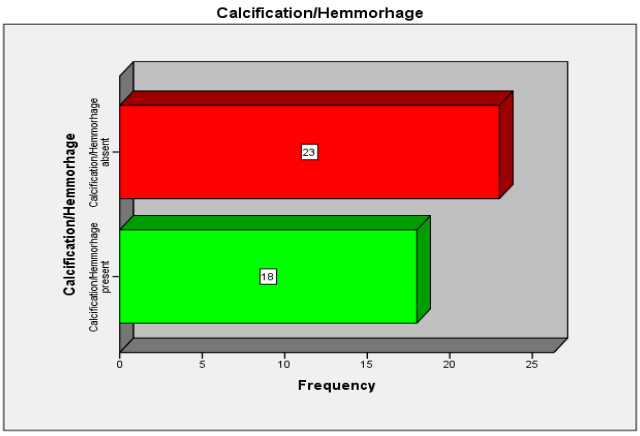


18 out of 41 lesions (41.5 %) showed heterogenous enhancement with majority in this group comprising of gliomas (7 lesions) followed by metastasis (4 lesions).

Peripheral enhancement was seen in 24.4% of the cases (10 out of 41 lesions) with the majority in this group constituted by gliomas (5 lesions),followed by metastasis(3 cases)

Homogenous enhancement was seen in 19.5% of the cases (08 out of 41 lesions) with majority being meningiomas (03 lesions) and schwannomas (02 lesions). 06 lesions (14.6 %) were non-enhancing and mostly included low grade gliomas(05 lesions) and oligodendroglioma(01 lesion)

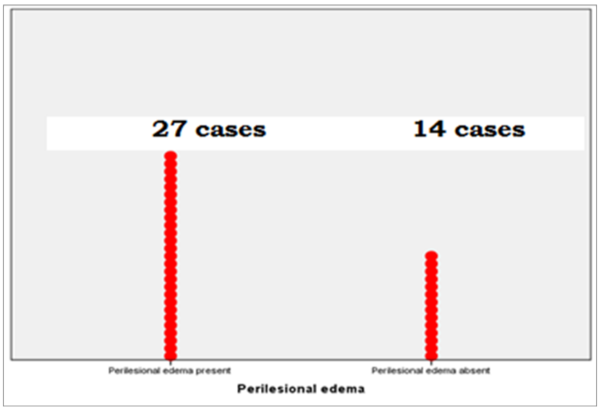
c) Presence of haemorrhage/calcifications.



Calcifications/Hemorrhage was seen in 18 cases (43.9 %) (6 cases of glioma, 4 cases of metastasis, 3 cases each of meningiomas and schwannoma and 1 case each of pituitary macroadenoma and oligodendroglioma). Rest of the lesions 23 cases (56.1 %) showed no calcifications/hemorrhage.

d) Presence of perilesional edema.

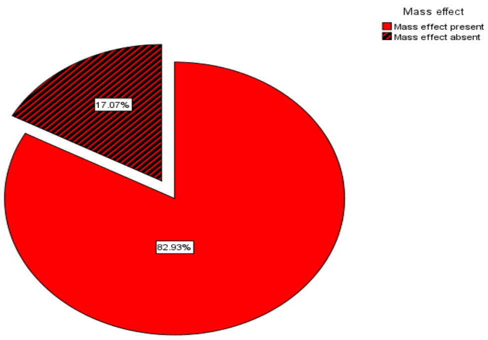
27 cases showed perilesional edema accounting to 65.9 % of the total cases. gliomas (14 cases) formed the majority showing perilesional edema followed by Metastasis (09 cases).



e) Presence of mass effect.

34 cases showed mass effect either in the form of midline shift or effacement of the adjacent sulci or supra/infratentorialherniations.

Gliomas (14 -7 low grade and 7 high grade lesions) and metastasis (07 lesions) were among the majority causing the maximum mass effect.



4. Statistical Analysis

Descriptive statistics of the mean, total number of cases (N), standard deviation, minimum and maximum values of Ch/Crt,Ch/Crp , Ch/Naat,Ch/Naap for various lesions were calculated. Using student independent t-test, a statistical analysis for comparing and characterizing the lesions with respect to the spectroscopy parameters was performed. The following set of lesions could be compared.

1. High grade and Low grade gliomas
2. High grade gliomas and Metastasis
3. High grade gliomas and Meningiomas
4. High grade gliomas and oligodendroglioma

Receiver operating characteristic (ROC) curves were generated to obtain the sensitivity and specificity for the spectroscopy parameters showing statistically significant difference in their means.

Statistical comparison of High grade and Low grade gliomas

The difference in the mean Ch/Crt,Ch/Crp of high grade and low grade gliomas were statistically significant ($P < 0.05$). No statistically significant difference found between the two with respect to mean Ch/Naat and Ch/Naap.

MR SPECTROSCOPY

To identify high-grade gliomas, a cut off of **>2.554** for Ch/Crt yielded 87.5 % sensitivity and 90 % specificity and a cut off of **>1.595** for Ch/Crp yielded 87.5 % sensitivity and 90 % specificity.

Statistical comparison of High grade gliomas and Metastasis

The difference in the mean Ch/Naap,Ch/Crp of high grade glioma and metastasis were statistically significant ($P < 0.05$).

MR SPECTROSCOPY

To identify high-grade gliomas, a cut off of > **1.53** for Ch/Crp yielded 87.5 % sensitivity and 77.8 % specificity and >**1.033** for Ch/Naap yielded 75 % sensitivity and 77.8 % specificity.

Statistical comparison of High grade glioma and Meningiomas

The difference in the mean Ch/Crp and Ch/Naap of high grade and meningiomas were statistically significant ($P < 0.05$). No statistically significant difference found between the two with respect to mean Ch/Crt, Ch/Naat was obtained.

Statistical comparison of High grade glioma and Oligodendroglioma

No significant difference in the perfusion parameters was obtained in our study. Major limitation was the small sample size for oligodendroglioma.

DISCUSSION

Advanced magnetic resonance imaging (MRI) techniques, such as MR spectroscopy, diffusion and perfusion MR imaging techniques can give important in vivo physiologic and metabolic information, complementing morphologic findings from conventional MRI in the clinical setting. MR spectroscopy (MRS) allows tissue to be interrogated for the presence and concentration of various metabolites and thereby clinicians can judge factors such as neuronal viability, neurotoxins, and membrane turnover within the volume of interest and thereby, the likely underlying pathology.[1,2,3]

The study comprised of 41 cases of intracranial neoplasms of which glioma (43.85%) constituted the most common lesion, followed by metastasis (21.9%) and meningiomas (12.1%). 27 patients were male and 14 were females. Most of the patients were between the age group of 30-60 yrs. Minimum age was 19 yrs, Maximum age was 72 yrs. Mean age was 47.5 yrs. MRSI provides estimates of the levels of cellular metabolites that may be relevant for evaluating the aggressiveness of tumors and for defining tumor burden.[4,5,6,7] Previous studies consisted of limited number of patients with variable acquisition methodology thereby restricting comparisons across different grades of tumors.[8,9] Nevertheless, MRSI has become an increasingly important method in the diagnostic workup of patients with glioma. Our study showed a significant difference in the values of Ch/Crp in differentiating high grade gliomas and low grade gliomas in agreement with Server etal.[10] By taking a cut off value of 1.595 for Ch/Crp we obtained a sensitivity of 87.5 % sensitivity and specificity of 90 %.No significant difference in the values of C/Naat and Ch/Naap was obtained in our study however Server etal[10] found a significant difference in Ch/Naat and Ch/Naap values. Mean Ch/Crp of metastasis and glioma in our study was 2.095±.618 and 1.347±.563 respectively . Meng law etal[11] showed a mean of 2.28±.1.24 and .76±.23 respectively. Fan etal[12] showed a mean of 2.65 ±.32 and 1.22 ±.38. No significant difference in the values of Ch/Crt and Ch/Naat was obtained. With regard to spectroscopy ,for comparison high grade glioma and meningioma, a cut off of > 1.595 for Ch/Crp yielded 87.5 % sensitivity and 100 % specificity and a cut off of > .675 for Ch/Naap yielded 87.5 % sensitivity and 100 % specificity for high grade glioma. No significant difference in the intratumoral ratio of metabolites was obtained. Peritumoral area was more significant. Two cases of oligodendrogliomas had showed high Cho/Crt and Cho/Naat ratios and no significant difference with respect to high grade gliomas.Once again small sample size was a major limitation. Oligodendroglioma is ambiguous on histopathology and also on MRS. The choline peak may be very highly elevated, creatine may be normal and lactate present, all features of a more malignant neoplasm, yet the prognosis is generally more favorable compared to an astrocytoma.[13] The Bland Altmann test was performed to determine the agreement between the two observers. There was significant agreement between the observers and also within the observer, concluding that there was no significant variation between the values of the spectroscopy parameters obtained and the values are repeatable and consistent.

REFERENCES

1. Covarrubias DJ, Rosen BR, Lev MH. Dynamic magnetic resonance perfusion imaging of brain tumors. Oncologist., 2004; 9: 528-537.
2. Castillo M, Kwock L, Mukherji SK. Clinical applications of proton MR spectroscopy. AJNR Am J Neuro-radiol., 1996; 17(1): 1-15.
3. Andrés Server Alonso .Advanced Neuroimaging in Brain Tumors: Diffusion, Spectroscopy, Perfusion and Permeability MR imaging for the evaluation of tumor characterization and surgical treatment planning. Doctoral Thesis, Section of Neuroradiology, Oslo University Hospital, 2011; 39-64.
4. Chang SM, Nelson S, Vandenberg S, Cha S, Prados M, Butowski N, McDermott M, Parsa AT, Aghi M, Clarke J, Berger M. Integration of preoperative anatomic and metabolic physiologic imaging of newly diagnosed glioma. J Neurooncol., 2009 May; 92(3): 401-15.
5. Saraswathy S, Crawford FW, Lamborn KR, Pirzkall A, Chang S, Cha S, Nelson SJ. Evaluation of MR markers that predict survival in patients with newly diagnosed GBM prior to adjuvant therapy. J Neurooncol., 2009 Jan; 91(1): 69-81.
6. Oh J, Henry RG, Pirzkall A, Lu Y, Li X, Catalaa I, Chang S, Dillon WP, Nelson SJ. Survival analysis in patients with glioblastoma multiforme: predictive value of choline-to-N-acetylaspartate index, apparent diffusion coefficient, and relative cerebral blood volume. J Magn Reson Imaging., 2004 May; 19(5): 546-54.
7. Pirzkall A, McKnight TR, Graves EE, Carol MP, Sneed PK, Wara WW, Nelson SJ, Verhey LJ, Larson DA. MR-spectroscopy guided target delineation for high-grade gliomas. Int J Radiat Oncol Biol Phys., 2001 Jul 15; 50(4): 915-28.
8. Chang SM, Nelson S, Vandenberg S, Cha S, Prados M, Butowski N, McDermott M, Parsa AT, Aghi M, Clarke J, Berger M. Integration of preoperative anatomic and metabolic physiologic imaging of newly diagnosed glioma. J Neurooncol., 2009 May; 92(3): 401-15.
9. Hakyemez B, Erdogan C, Ercan I, et al. High-grade and low-grade gliomas: differentiation by using perfusion MR imaging. ClinRadiol., 2005; 60: 493–502.
10. Andrés Server Alonso .Advanced Neuroimaging in Brain Tumors: Diffusion, Spectroscopy, Perfusion and Permeability MR imaging for the evaluation of tumor characterization and surgical treatment planning. Doctoral Thesis, Section of Neuroradiology, Oslo University Hospital, 2011; 39-64.
11. Law M, Yang S, Wang H, Babb JS, Johnson G, Cha S, Knopp EA, Zagzag D. Glioma grading: sensitivity, specificity, and predictive values of perfusion MR imaging and proton MR spectroscopic imaging compared with conventional MR imaging. AJNR Am J Neuroradiol., 2003 Nov-Dec; 24(10): 1989-98.
12. Q. Zeng, H. Liu, K. Zhang, C. Li, and G. Zhou, "Noninvasive evaluation of cerebral glioma grade by using multivoxel 3D proton MR spectroscopy," Magnetic Resonance Imaging, 2011; 29(1): 25–31,.
13. Khalid L, Carone M, Dumrongpisutikul N, Intrapiromkul J, Bonekamp D, Barker PB, Yousem DM. Imaging Characteristics of Oligodendrogliomas that Predict Grade. AJNR Am J Neuroradiol. 2012 Jan 19.13. Bulakbasi N, Kocaoglu M, Farzaliyev A, Tayfun C, Ucoz T, Somuncu I. Assessment of diagnostic accuracy of perfusion MR imaging in primary and metastatic solitary malignant brain tumors. AJNR Am J Neuroradiol., 2005 Oct; 26(9): 2187-99.