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Research Article

ROLE OF MR SPECTROSCOPY IN EVALUATION OF INTRA-AXIAL BRAIN TUMORS

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Plexus Papilloma, Metastasis.

ABSTRACT

Background and purpose: To determine magnetic resonance spectroscopy (MRS) characteristics of intraaxial tumours, to assess MRS reliability in glioma grading and discrimination between different histopathological types of tumours and to determine the infiltrative nature of the tumour.

Results: The tumours showed decreased NAA and Cr contents and a high Cho signal. The Lac-Lip signal was high in grade III astrocytomas, glioblastomas, medulloblastoma and choroid plexus papilloma. Reports that Cho/Cr ratio and cho/NAA ratio increases with glioma's grade whereas NAA/Cr decreases were confirmed with histopathological correlation. Diffuse infiltrative astrocytomas compared to anaplastic astrocytoma and glioblastomas, had a statistically significantly greater ml/Cr ratio.

Conclusions: MR spectroscopy is as a reliable method for glioma grading. It is useful in discrimination between WHO grade II and grade III, IV astrocytomas as well as other intraaxial brain tumors. The spectroscopic MR measurements in the peritumoral region 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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INTRODUCTION

Objectives

- To determine biochemical markers of intraaxial brain tumors using MR spectroscopy.
- To evaluate role of MR spectroscopy in determining the infiltrative nature of the intra axial brain tumors.

METHODOLOGY

All patients referred to the department of Radio diagnosis with clinically suspected brain tumors in a period of 1 years from Nov 2015 to November 2016 were subjected for the study.

Hospital based descriptive study with sample size of 30 cases.

METHODS

Equipment and Technique Used: The MRI scan was performed MR PHILIPS ACHIEVA 1.5 T.

SENSE coils was used for acquisition of images.

Study Definition

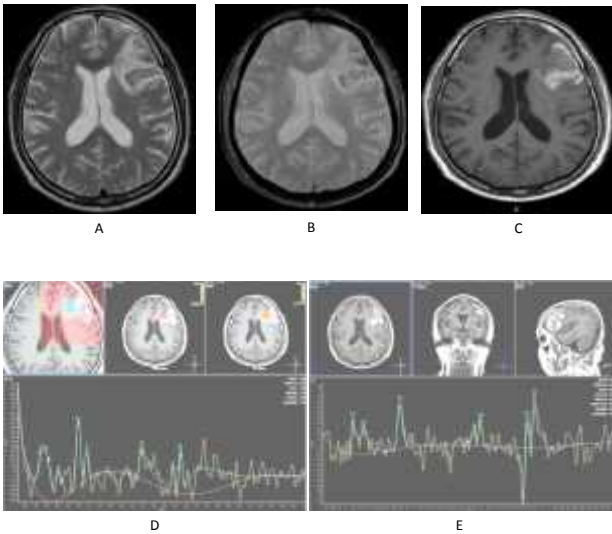
MR spectroscopy is used as diagnostic test for diagnosing intraaxial brain tumors. An increase choline peak at 3.2ppm, myoinositol peak at 3.6ppm, lipid peak at 0.9-1.4ppm, lactate peak at 1.3ppm and reduced NAA peak at 2.0ppm, creatinine peak at 3.0, 3.9ppm was considered significant for diagnosing brain tumors. We reported brain tumor as high grade if there was increase in choline/creat ratio of more than 2.3, choline/NAA ratio of more than 1.9, reduced NAA/creatinine of less than 1.5.

We reported brain tumors as low grade if choline/creatinine ratio was less than 2.3, this value was used as a threshold value in order to increase the specificity of detecting brain tumors. Astrocytoma tumors were divided as low grade and high grade by using threshold value for myoinositol/creatinine ratio of 0.82 +/- 0.25 for low grade tumors and 0.33 +/- 0.16 for high grade tumors.

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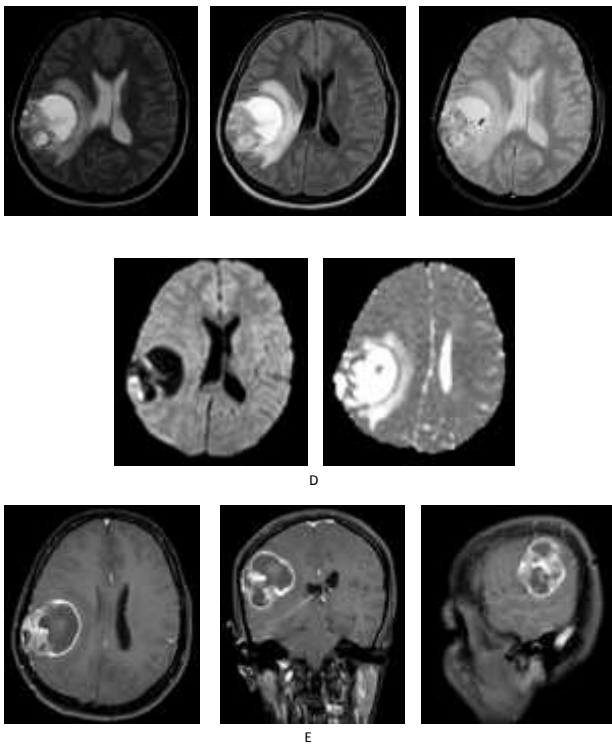
Case 1: 60 year old referred with seizures



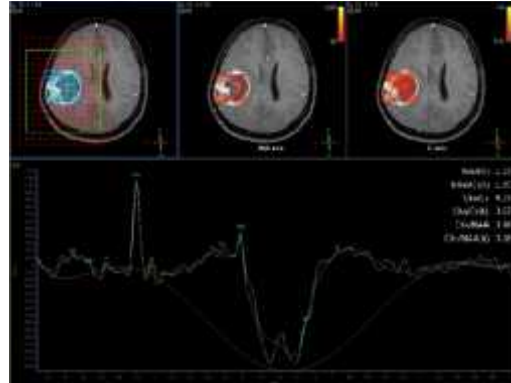
- A. T2 TSE AXIAL shows gyral hyperintensity seen involving left fronto temporal lobe with white matter edema causing sulcal effacement.
- B. T2 FFE AXIAL shows multifocal areas of blooming suggestive of petechial hemorrhages.
- C. T1W GADO AXIAL shows gyral enhancement in left fronto temporal lobe.
- D. 2D PRESS 144 and choline maps; shows raised choline, reduced NAA peaks, increased choline/NAA and choline/creat ratios in the perilesional white matter edema suggestive of perilesional infiltration.
- E. SV PRESS 144 shows raised choline, reduced NAA peaks, lipid inversion, increased choline/NAA and choline/creat ratios in the enhancing portion of the lesion.

The case was finally diagnosed as gliomatosis cerebri.

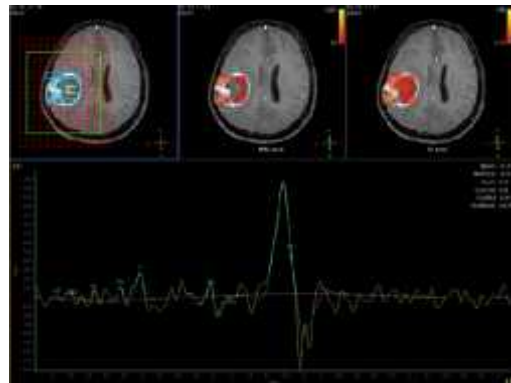
Case 2: 28 years old referred for seizures and loss of consciousness.



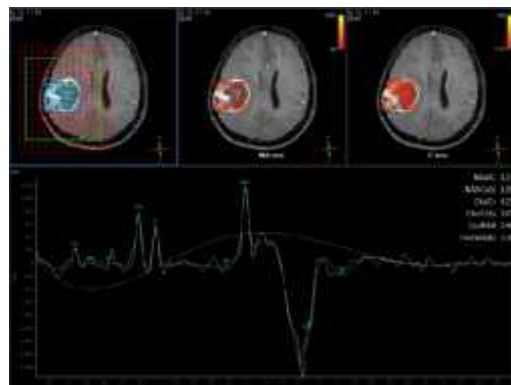
- A. T2W TSE AXIAL, B. FLAIR AXIAL, C. T2W FFE (GRE) AXIAL
- D. DWI, shows large cortical based heterogenous solid and cystic lesion in right parietal lobe causing calvarial erosion. The cystic component is not suppressing on FLAIR. Perilesional white matter edema is noted in T2W/FLAIR. The solid portion of mass shows foci of diffusion restriction. On gradient there are multiple scattered foci of blooming probably due to calcific specks.
- E. T1W GADO AXIAL, CORONAL, SAGGITAL, shows ring enhancing lesion with intense enhancement of solid portion of the mass.



F



G

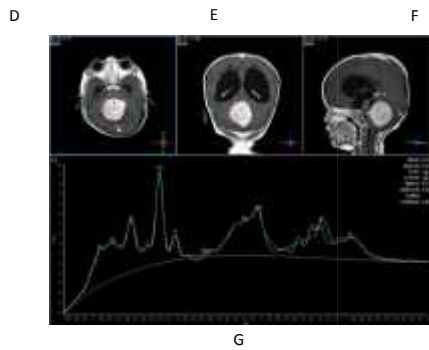
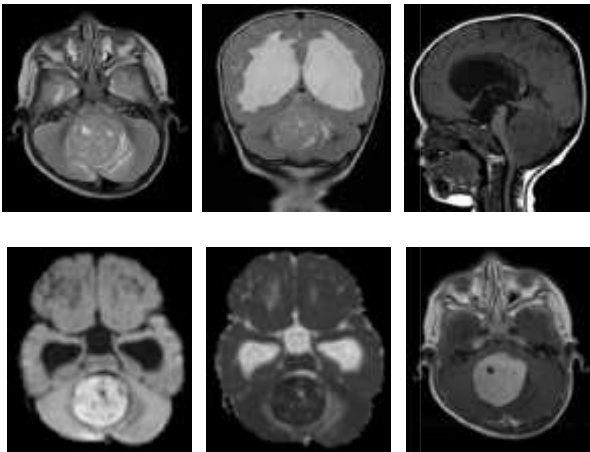


H

- F. 2D PRESS 144 Multivoxel Spectroscopy On Solid Portion, shows increased choline peak, reduced NAA, reduced creat, increased cho/creat, cho/NAA ratios and reduced NAA/creat ratio.
- G. 2D PRESS 144 MVS ON NECROTIC PORTION, shows a large lactate peak and inversion of lipid peak depicting as necrotic component.
- H. 2D PRESS MVS ON PERILESIONAL EDEMA show increased choline peak and increased cho/creat ratio suggestive of infiltrative spread. There is NAA peak due to voxel contamination of normal brain.

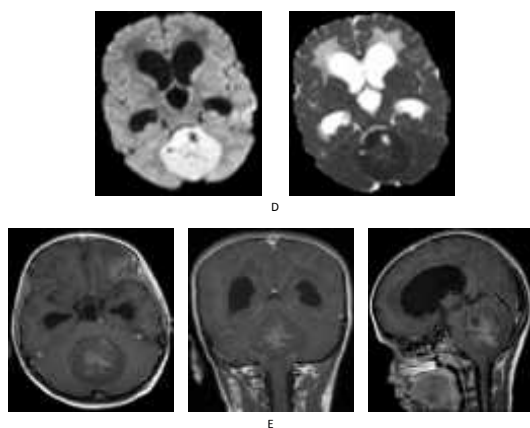
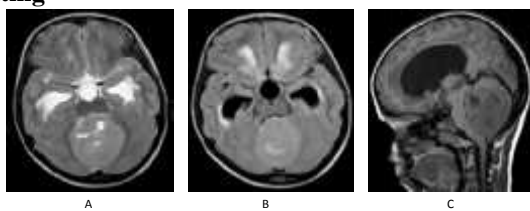
The case was diagnosed as oligodendroglioma.

Case 3. 11month old infant, female referred for signs and symptoms of raised intracranial tension.

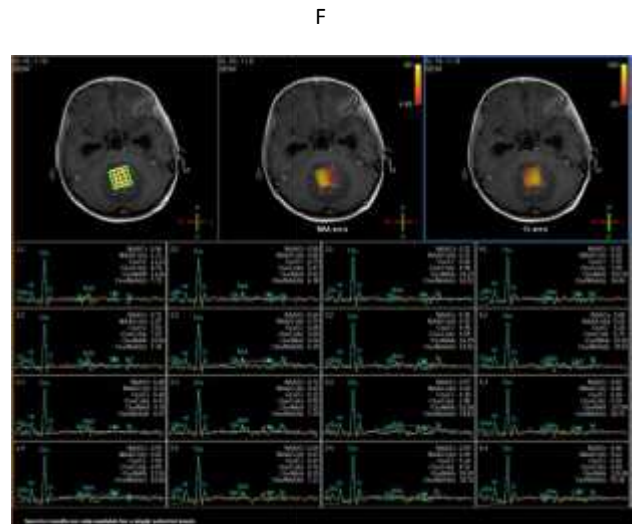
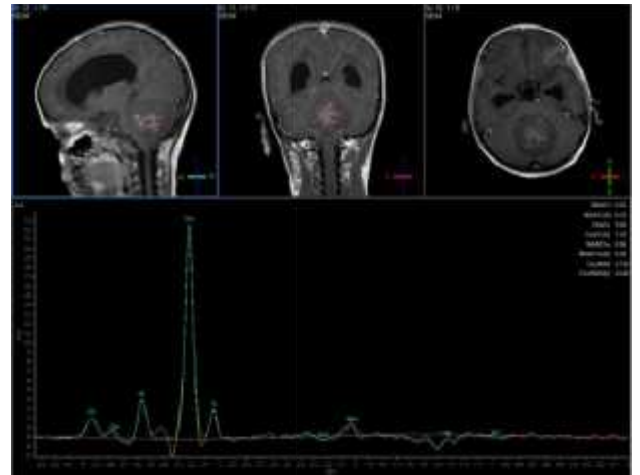


- A&B. T2W TSE AXIAL AND CORONAL,
- C. T1W SAGITTAL shows T1 isointense and T2 hyperintense large mass lesion with lobulated smooth margins is seen in the 4th ventricle involving the mid and lower 4th ventricle. Internal few cystic changes are seen. Mass expands the 4th ventricle grossly .Cerebellum is stretched out.
- D. DWI and E. ADC shows diffusion restriction
- F. T1W GADO AXIAL post contrast scan shows diffuse homogenous intense contrast enhancement with internal small non enhancing areas.
- G. SV PRESS 31 single voxel Spectroscopy shows elevated choline, reduced NAA and reduced creat peaks. Increased cho/creat and cho/NAA ratios.Reduced NAA/creat ratio. This was diagnosed as ependymoma.

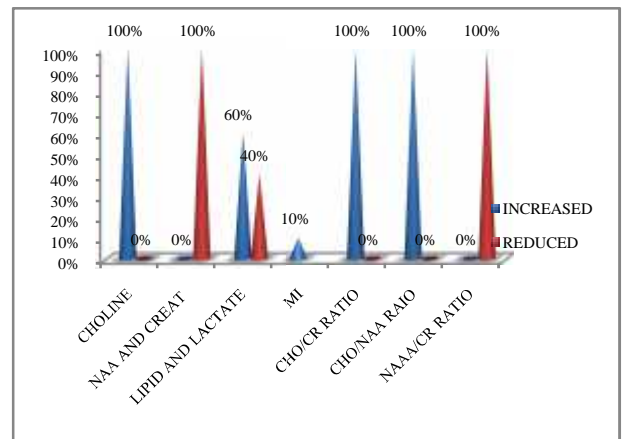
Case 4. 8 year old girl referred with headache and vomiting



- A. T2W TSE AXIAL
- B. FLAIR AXIAL
- C. T1 SAGITTAL shows midline large oval sized mass lesion with central cystic lesion. The mass appears isointense to grey matter on T1WI and hyperintense on T2WI. Cysts are not suppressed on FLAIR.
- D. ADC, E.ADC shows diffusion restriction
- E. T1W GADO axial, coronal and sagittal shows central patchy moderate enhancement.

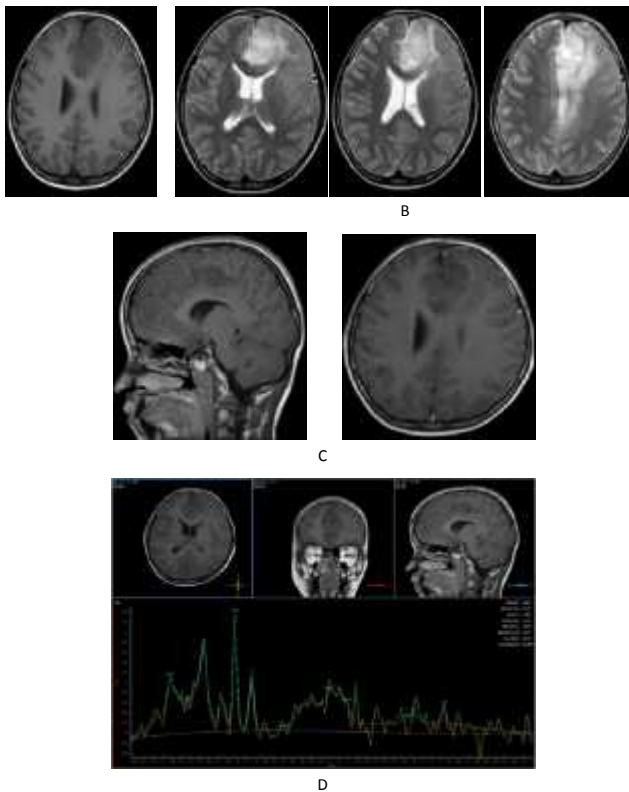


- F. SV PRESS 144 single voxel spectroscopy,
- G. 2D PRESS 144 multi voxel spectroscopy shows high choline peaks, low NAA and low creat peaks. Choline/NAA ratios and choline/creat ratios are increased. NAA/creat ratio is reduced. Case was diagnosed as medulloblastoma.



Graph-1 Bar diagram showing distribution of sample based on MRSPECTROSCOPY findings of intraaxial brain tumors.

Case 5: 14 year old referred with headache, seizures and cognitive impairment.



- A. T1W AXIAL
- B. T2 series show poorly defined T1 hypo and T2 hyperintensity lesion is seen in left frontal lobe.
- C. T1 GADO sagittal and axial images show no contrast enhancement.
- D. SV PRESS 31 single voxel spectroscopy at short TE show elevated choline, reduced NAA and creat peak. ml peak. Increased cho/creat, cho/NAA, ml/creat ratios and reduced NAA/creat ratio. This was case of diffuse infiltrating astrocytoma or grade 2 glioma.

From the above findings it can be inferred that all brain tumors i.e., 100% showed increased choline peak, choline/creatinine and choline/NAA ratios. And absent or reduced NAA, creatinine peaks and reduced NAA/creatinine ratio. In 60% of cases there is lipid and lactate peak. In 10% myoionositol peak.

Table 1 Distribution of Cases Based on Mri Diagnosis In Correlation With Histopathological Diagnosis

Sl. No.	Intraaxial brain tumor	Histopathological diagnosis	Mri diagnosis
1.	GBM (Grade 4)	11	12
2.	High Grade Glioma (Grade 3)	2	3
3.	Low Grade Glioma (Grade 2)	3	2
4.	Oligodendroglioma	2	1
5.	GliomatosisCerebri	2	2
6.	Ependymoma	2	1
7.	Medulloblastoma	2	2
8.	Metastasis	1	1
9.	Choroid Plexus Papilloma	1	1
10.	Lymphoma	1	1
11.	Neurocytoma	-	1
	TOTAL	27	27

From the above table it can be inferred that for diagnosing intraaxial brain tumor, MRI with MR spectroscopy has 100% diagnostic accuracy in diagnosing gliomatosiscerebri, medulloblastoma, metastasis and choroid plexus papilloma. Whereas diagnostic accuracy of 96.3% were observed in diffuse infiltrative astrocytoma, oligodendroglioma and

ependymoma. A diagnostic accuracy of 92.59% is observed in lymphoma. A diagnostic accuracy of 88.89% is observed in glioblastoma multiformae and anaplastic astrocytoma.

DISCUSSION

All GBM showed intense enhancement, anaplastic astrocytoma showed moderate enhancement, and diffuse infiltrative astrocytoma cases had minimal enhancement. Oligodendroglioma, ependymoma and one case of gliomatosiscerebri showed intense enhancement whereas the other case of gliomatosiscerebri showed mild enhancement. Our findings are in agreement with study conducted by [R Felix, W Schörner et al.](#)⁶²

Diffuse infiltrative astrocytoma are grade 2 astrocytomas. There were three patients with diffuse astrocytoma in our study. Two of them were seen in the age group of 11-20years and another case was of 47 year old. Our findings were similar to study done [Mauricio Castilloa et al](#)¹⁶.

Anaplastic astrocytomas are grade 3 astrocytomas. Two patients with anaplastic astrocytoma were evaluated in our study. One was seen in a child of 11years and one in an adult of 37years. Our findings were similar to study done by [Magalhaes A, Godfrey W et al](#)⁶³ and [Mauricio Castilloa et al.](#)¹⁶

GBM are grade 4 astrocytomas. 12 patients with Glioblastomamultiformae were evaluated in our study. All GBM cases were found in adults between 3rd to 8thdecade.Two cases of GBM did not correlate on histopathology. They were diagnosed as lymphoma and anaplastic astrocytoma on histopathology. However we found a diagnostic accuracy of 88.89%. Significant association between MR spectroscopy findings and histopathological findings. Our study was similar to study done by [Magalhaes A, Godfrey W et al](#)⁶³ and [Mauricio Castilloa et al.](#)¹⁶

Oligodendrogial tumors can be low grade/ grade 2 oligodendroglioma or grade 3 anaplastic oligodendroglioma based on WHO grading system. In our study we evaluated two patients with oligodendroglioma, one of which was misdiagnosed as GBM on MRI. Both were histopathologically proven as anaplastic oligodendroglioma. Both the tumors were found in adults in 2nd and 4th decade. We got specificity of 100% and sensitivity of 50%. Diagnostic accuracy of 96.3%. Our study is in agreement with the study done by [Spampinato MV, Smith JK, Kwock L et al.](#)²⁵

Gliomatosiscerebri can be either grade 2 or grade 3. We had two patients with gliomatosiscerebri, they were in 3rd and 6th decade. Our study is in agreement with previous studies done by [Mohana-Borges et al](#)⁶⁵, [Galanaud D et al](#)⁶⁶ and [Peretti-Viton P et al.](#)⁶⁷

Ependymoma has been graded as grade 2. We had one patient with ependymoma and another misdiagnosed as neurocytoma which on histopathology was diagnosed as ependymoma. Both the patients were of paediatric age group below 10 years.Our study shows similar results obtained in study done by [Fouladi M et al.](#)⁶⁸

We had two patients with metastasis. They were in 4th and 7th decade. Histopathology was not done in one. We got diagnostic accuracy of 100%. our study is in agreement with study done by [Law M, Cha S, Knopp EA, et al.](#)²⁴.

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