Study of the Diagnostic Value of Magnetic Resonance Imaging in Brain Lesions

Mohamed Yousef[1, 2], Mohammed Salih[3,4], Qurain Turki Alshammari[5], Bushra Abdel Malik[5], Saddig Jastaniah[2,6]

[1]College of Medical Radiologic Sciences, Sudan University of Science and Technology, Khartoum, Sudan.
[2]Batterjee Medical College, Department of Radiological Science, Jeddah, Saudi Arabia.
[3]College of Radiologic Technology, The National Ribat University, Khartoum Sudan
[4]Department of Diagnostic Radiology, Royal Care International Hospital, - Khartoum, Sudan
[5]Hail University, College of Medical Applied Sciences, Department of Diagnostic Radiology Sciences, Hail – KSA.
[6]Department of Diagnostic Radiology Faculty of Applied Medical Sciences, King Abdul-Aziz University, KSA
mohamed.yousef@bmc.edu.sa

Abstract: The high morbidity and mortality associated with Intracranial Space Occupying Lesions necessitate their early diagnosis to plan the intervention that is required. This study was carried out to study the value of Magnetic Resonance in brain lesions, it was a descriptive retrospective, and a prospective cross-sectional study was done at the National Ribat University and Department of Diagnostic Radiology, Royal Care International Hospital, Khartoum, Sudan included 250 patients 163)65%) of them were males and 87 (35%) were females, with general conditions with brain lesions. It was done using Data collection sheet including (age, gender, and site of lesions, clinical findings of the MRI of the brain and the MRS findings). The results of this study revealed that majority of the patients were in the 6th decade (64%), Malignancy was the most common lesion (46%), gliomas (18%) and the most involved area was the parietal lobe (15%). Various types of brain tumors were revealed, and malignant tumors showed increased Cho/Cr peaks with NAA remain unchanged, the increased Cho/Cr and Cho/NAA ratio also noted with glioma. It concluded that Diagnosis of benign and malignant brain tumors and differentiating them from other focal intra-cranial lesions based on imaging procedures alone is still a challenging problem, combination of proton MRS and conventional MRI protocol can provide valuable additive information helping in tissue characterization of intra-cranial tumors leading to improved diagnosis and thus reducing biopsies, the result of the study was in line with previous studies**.**

[Yousef M, Salih M, Alshammar Q T, Abdel Malik B, Jastaniah S. **Study of the Diagnostic Value of Magnetic Resonance Imaging in Brain Lesions.** *Life Sci J* 2017;14(12):25-30]. ISSN: 1097-8135 (Print) / ISSN: 2372-613X (Online). http://www.lifesciencesite.com. 5. doi:10.7537/marslsj141217.05.

Keywords: Diagnostic Value, Magnetic Resonance Imaging, Brain Lesions

1. Introduction

Brain tumors comprise some of the most malignant tumors known to affect human beings and are refractory to all modalities of treatment.

The number of the cases of tumors in the central nervous system in Norway included 1067. Of this group, 367 have malignant tumors, [(1)] according to the Norwegian Cancer Registry. Malignant brain tumors are the leading cause of death from solid tumors in children and the third-leading cause of cancer-related death in patients aged 15 to 34 years old [(2,3)]. Brain metastases are the most common complication of systemic cancer, with estimated incidence rates of 8.3 to 11 cases per100 000 populations [(4)].

The standard of neuroimaging for brain tumor evaluation is anatomy-based MRI with iv contrast ([5,6)].

MRS is a non-invasive qualitative and quantitative analysis of some metabolites within the brain [(7)]. Recent advances have been made through the use of multivoxel techniques and metabolite maps, which allow assessment of both the entire volume of the lesion and the surrounding normal-appearing brain tissue. Recent studies suggest the utility of this technique in making a specific diagnosis, determination of histological grade treatment [(8).]

Advanced MRI techniques have already become indispensable to the neurosurgeon. Brain tumor clinical review boards cannot function without extensive discussion of perfusion and spectroscopic data. Preoperative knowledge is intra-operative power for the neurosurgeon.

That power will only grow with the evolution of advanced MRI techniques [(9)].

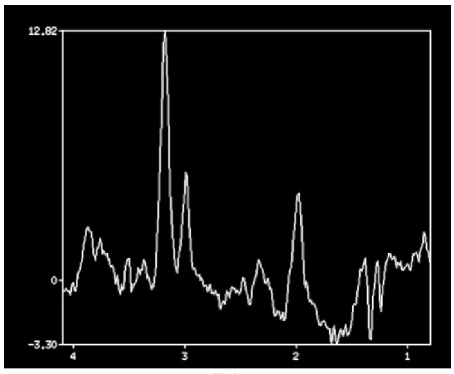
To differentiate between malignant, benign tumors, N-acetylaspartate (NAA), Choline, Creatine, lactate/lipid, and alanine ratios were significant. Increase in lipid and alanine could distinguish metastases and meningiomas from other tumors. Increase in the lactate level correlated with the degree of malignancy [(10)].

This study aimed to describe the spectrum of Magnetic Resonance Spectroscopy in brain lesions

and to show its diagnostic importance in differentiating neoplastic and non-neo plastic and other intracerebral lesions.

2. Material and Methods

(A)



(B)

Fig (1): (A) T1 axial with contrast and show the enhanced lesion (B) Spectrum curve of above lesion and shows high Cho peak

2.1 Subjects

This study was d in the Department of Diagnostic Radiology, Royal Care International Hospital during the period from April 2015to July 2017, and Sudan. It was a cross-sectional comparative study. Data was collected with the help of a Performa including name, gender, site of lesions, clinical findings of the MRI of the brain and the MRS. Included 250 patients 163)65%) Male and 87 (35%) female, with general conditions with brain lesions

2.2 Study protocols (Techniques)

MRS studies were performed using 1.5 Tesla Toshiba whole-body MR systems. Routine brain MRI was performed in 3 orthogonal planes, including at least T1, T2, and fluid-attenuated inversion recovery (FLAIR) weighted images. Fig (1) shows that sample of the study.

2.3 Statistical analysis

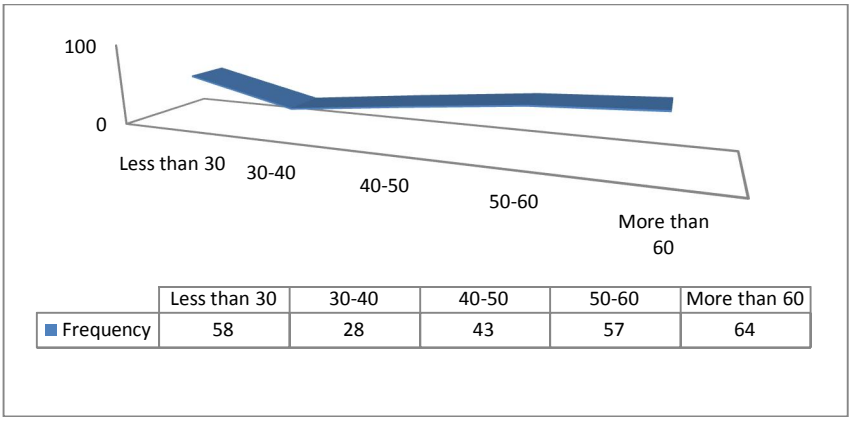
Continuous data are presented as the mean ± standard deviation (SD) and compared using the *t*-test. Categorical data were expressed as percent frequencies, and differences between proportions were analyzed using the chi-square test. Statistical correlation between variables was tested using the Pearson's product-moment coefficient of correlation (r). All tests of significance were two-tailed and a p-value < 0.05 was considered statistically significant. All analyses were performed using SPSS version12. Statistical software (SPSS Inc., Chicago, Illinois).

2.4 Ethical issues:

Approval for this study was obtained from RCIH, and Verbal consent was taken from the participants.

3. Results

The sample size in this study was 250 patients who attended radiology department in RICH and investigated by MRS for evaluation of intracerebral lesions which distribute the participants into three subgroups, and detailed results are shown in the tables and figures below.



	Less than 30	30-40	40-50	50-60	More than 60
Frequency	58	28	43	57	64

Fig 1: shows the Age classes, frequency.

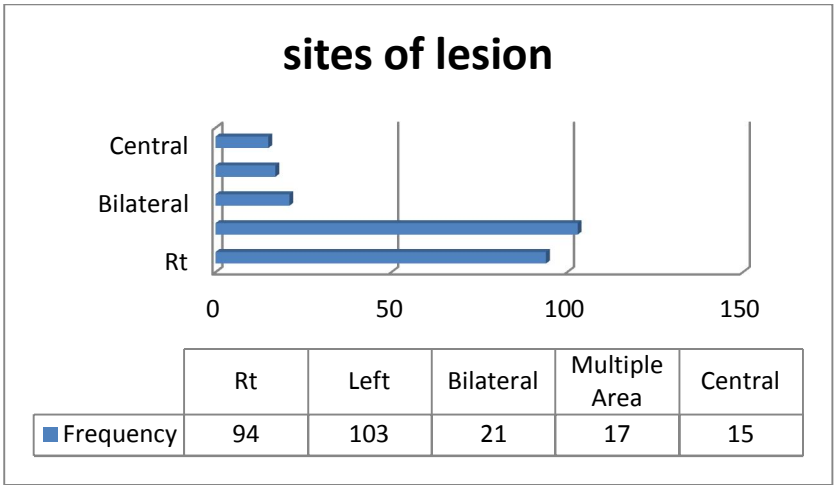


Fig 2: sites of lesion

Table 1- shows Gender frequency.

Gender	Frequency	Percent	Cumulative Percent
Male	163	65.2	65.2
Female	87	34.8	100.0
Total	250	100.0	

Table 2: MRI Findings

	Frequency	Percent	Cumulative Percent
Fronto-Parietal lesion	13	5.2	5.2
Occipital-Parietal lesion	13	5.2	10.4
Thalamic Basal Ganglia signal changes	32	12.8	23.2
Parietal lesion	38	15.2	38.4
Tempro-Parietal lesion	21	8.4	46.8
Occipital subcortical lesion	9	3.6	50.4
Frontal lesion	33	13.2	63.6
Brain Stem lesion	27	10.8	74.4
Cerebellar lesion	12	4.8	79.2
Periventricular enhancing lesions	7	2.8	82.0
Temporal lesion	30	12.0	94.0
Intra-Ventricular lesion	2	.8	94.8
Fronto-Temporal lesion	7	2.8	97.6
CPA lesion	6	2.4	100.0
Total	250	100.0	

Table 3: MRS Findings

	Frequency	Percent	Cumulative Percent
Malignancy	116	46.4	46.4
Inflammatory process	27	10.8	57.2
Meningioma	11	4.4	61.6
Glioma	45	18.0	79.6
Granuloma	11	4.4	84.0
Normal brain metabolites ratios	22	8.8	92.8
Ischemic infarct (Stroke)	12	4.8	97.6
Mitochondrial disease	4	1.6	99.2
Early sub-acute BG hematoma	2	0.8	100.0
Total	250	100.0	

Table 4: Chemical Analysis * MRS Findings Cross tabulation

	MRS Findings									
	Malignancy	Inflammatory process	Meningioma	Glioma	Granuloma	Normal brain metabolites ratios	Ischemic infarct (Stroke)	Mitochondrial disease	Early sub-acute BG hematoma	Total
High Cho/Cr, Cho/NAA Ratio (Low NAA peak)	116	0	0	0	0	0	0	0	0	116
High Cho/Cr ratio, Normal NAA peak, High lipid/ lactate peak	0	27	0	0	0	0	0	0	0	27
Raised Cho, low Cr and NAA, and a peak of alanine	0	0	11	0	0	0	0	0	0	11
High Cho/Cr and Cho/ NAA ratio with lipid lactate peak	0	0	0	45	0	0	0	0	0	45
Increased lipid-lactate, reduced NAA and only mild increase in the Cho/Cr ratio	0	0	0	0	11	0	0	0	0	11
Normal Curves (No significant metabolites changes)	0	0	0	0	0	22	0	0	0	22
Raised of Cho with reduction of NAA and lactate peak	0	0	0	0	0	0	12	0	0	12
High signal peak of lactate, mild increase in Cho/ Cr ratio, and normal NAA	0	0	0	0	0	0	0	4	0	4
Raised lactate and lipid peaks, No changes in the NAA peak. No significant reversal of the Cho/ Cr ratio	0	0	0	0	0	0	0	0	2	2
Total	116	27	11	45	11	22	12	4	2	250

4. Discussions

This study aimed to assess the role MRS in brain lesions, to explain the importance of MRS in distinguishes from other brain lesions

The maximum number of patient in the present study was in the 6th decadein contrast with the finding of Bhavesh R Goyani1 et al. [11]

The gender ratio of the present study was found to be quite comparable with the study conducted by B. Shah et al. [12]. Some male patients were more in both the studies. 3:2 M: F ratios in the present study agree with the research done by Sohail K et al. et al. [13].

In this study, Malignancy was the most common MRI finding in 46% patients followed by Gliomas 19% in contrast with the finding of Bhavesh R Goyani1 et al. [11].

The present study results are consistent with those of previous reports [14-19]

The current study showed that similar appearance of tissues on conventional MR images might have different spectral characteristics. Abnormal metabolites levels were found in a range of biopsy specimens, and this is consistent with two studies conducted by Leclerc et al. and Kennedy et al. [23]

The manner of using MRS for patient management guidance depends on clinical situations, In this study comparison of MRS with biopsy taken as gold standard

In this study, the most common site of these lesions was parietal lobe as shown in (Table 2). Cases of various types of brain tumor were included in this part of the study, and most of them were malignant which showed increased Cho/Cr peaks, and NAA unchanged, so the increased Cho/Cr and Cho/NAA ratio noted with glioma (Table 4). This result was in line with previous studies [5].

In present study Single-voxel proton MRS have been used for the assessment and grading of brain tumors. [21].

This study revealed parameters that characterize the tumor type or malignancy which in most of the previous reports failed to find spectroscopic parameters which characterize the tumor type [22].

However, these researchers concluded that the malignancy of gliomas could not be estimated [23].

Also, some previous reports have shown raised of Cho/Cr and Cho/NAA ratios in the tumor area compared to the standard area, [24].

5-Conclusion

- MR Spectroscopy is a highly sensitive tool for any brain lesions.
- The most common hemisphere to be involved was the parietal lobe regardless of the entity of the brain lesions.
- Malignancy was the most common lesion.
- MRS non-invasive method for diagnosing brain tumors.
- MR spectroscopy can play the main role to improve diagnostic accuracy in the differentiation of circumscribed brain lesions.
- Finally, our study had a few limitations, it's a single center study, owing to the unavailability of the newly introduced technique MRS in the other diagnostic centers, the second limitation is unavailability of the histopathological results for comparison, as many of our patients don't have the operations yet.
- For better patient care, MRS should be done routinely in patients with brain lesions.

Corresponding Author:
Dr. Mohamed Yousef
[2]Batterjee Medical College, Department of Radiological Science, Jeddah, Saudi Arabia
E-mail: mohamed.yousef@bmc.edu.sa

References

1. Cancer Registry of Norway. Cancer in Norway 2008. Ref Type: Report.
2. Mechtler L. Neuroimaging in neuro-oncology. Neurol Clin. 2009 Feb;27(1):171-201.
3. Jemal A, Siegel R, Ward E, Murray T, Xu J, Thun MJ. Cancer statistics, 2007. CA Cancer J Clin. 2007 Jan-Feb;57(1):43-66.
4. Newton HB, Malkin MG. Overview of brain tumor epidemiology. In: Newton HB, Jolesz FA (eds) Handbook of neuro-oncology neuroimaging. Elsevier, New York, 2008 pp 3-8.
5. Gerstner ER, Sorensen AG, Jain RK, Batchelor TT. Advances in neuroimaging techniques for the evaluation of tumor growth, vascular permeability, and angiogenesis in gliomas. Curr Opin Neurol.2008 Dec;21(6):728-35.
6. Sorensen AG, Batchelor TT, Wen PY, Zhang WT, Jain RK. Response criteria for glioma. Nat Clin Pract Oncol. 2008 Nov;5(11):634-44.
7. Leclerc X, Huisman TA, Sorensen AG. The potential of proton magnetic resonance spectroscopy ((1) HMRS) in the diagnosis and management of patients with brain tumors. Curr Opin Oncol. 2002 May;14(3):292-8.
8. Law M. MR spectroscopy of brain tumors. Top Magn Reson Imaging. 2004 Oct;15(5):291-313.
9. Golfinos JG, Tessler LE, Kelly PJ. Advanced MRI for brain tumors: a neurosurgical perspective. Top Magn Reson Imaging. 2004 Oct;15(5):337-9.
10. Majos C, Julia-Sape M, Alonso J, Serrallonga M, Aguilera C, Acebes JJ, et al. Brain tumor classification by proton MR spectroscopy: comparison of diagnostic accuracy at short and long TE. AJNR American journal of neuroradiology. 2004;25(10):1696-704. Epub 2004/12/01.
11. Bhavesh R Goyani1, Bhagwati V Ukani, Parth Naik, Hinal Bhagat Mahesh K Vadel, Rakesh Sheth, A Study on Role of Magnetic RESONANCE IMAGING (MRI) IN INTRACRANIAL SPACE OCCUPYING LESIONS, NJMR | Volume 5 | Issue 1 | Jan – March 2015.
12. Shah B. et al.: CT evaluation of primary brain tumors 1993.
13. Leclerc X, Huisman TA, Sorensen AG. The potential of proton magnetic resonance spectroscopy [H-MRS] in diagnosis and management of patients with brain tumors. Curr Opin Oncol 2002; 14: 292-8.
14. Neff B, Willcox T, Sataloff R. Intralabyrinthine schwannomas. Otol Neurotol 2003; 24: 299-307.
15. Alexander Lin et al.; Efficacy of proton magnetic resonance spectroscopy in neurological diagnosis and neuro -therapeutic decision making, NeuroRx, Vol 2, issue 2, 197-214.
16. Franklyn A H et al.; H MR spectroscopy of brain tumors and masses; NMR Biomed 2003;16:123-131 .
17. Sergio L R et al., Proton magnetic resonance spectroscopy: clinical applications in patients with brain lesions; Sao Paulo Med 2003;121(6) 254-259.
18. Moller-Hartman W et al.; Clinical application of proton magnetic resonance in diagnosis of intracranial mass lesions; Neuroradiology 2002;44:371-378 .
19. Majós C et al.; Proton MR spectroscopy improves discrimination between tumor and pseudotumoral lesion in solid brain masses. (PubMed); AJNR Am J Neuroradiol. 2009 Mar;30(3):544-51. Epub 2008 Dec 18.
20. Kennedy RJ and others. Intralabyrinthine schwannomas" diagnosis, management, and a new classification system. Otol Neurotol 2004; 25:166-7.

21. Bulakbasi N, Kocaoglu M, Ors F, Tayfun C, Ucoz T. Combination of single-voxel proton MR spectroscopy and apparent diffusion coefficient calculation in the evaluation of common brain tumors. AJNR Am J Neuroradiol 2003; 24:225-233.
22. Shimizu H, Kumabe T, Tominaga T, et al. Noninvasive evaluation of malignancy of brain tumors with proton MR spectroscopy. AJNR Am J Neuroradiol 1996; 17:737-747.
23. Kugel H, Heindel W, Ernestus R-I, Bunke J, du Mensil R, Friedmann G. Human brain tumors: spectral patterns detected with localized H-1 MR spectroscopy. Radiology 1992; 183:701–709.
24. Fulham MJ, Bizzi A, Dietz MJ, et al. Mapping of brain tumor metabolites with proton MR spectroscopic imaging: clinical relevance. Radiology 1992; 185:675-686.

12/10/2017