Original Article

DOI: 10.17354/ijss/2015/523

Brain Space Occupying Lesions by Magnetic Resonance Imaging: A Prospective Study

Bulabai Karpagam[1], V Vadanika[2]

[1]Associate Professor, Department of Radiology, SRM Medical College Hospital and Research Institute, Kattankulathur, Kanchipuram, Tamil Nadu, India, [2]Resident, Department of Radiology, SRM Medical College Hospital and Research Institute Kattankulathur, Kanchipuram, Tamil Nadu, India

Abstract

Introduction: During the last few years, the role of magnetic resonance imaging (MRI) as a diagnostic tool in neuroradiology is well-established. With advanced MRI techniques such as perfusion, diffusion, and spectroscopy, it is now possible to differentiate between various intracranial lesions.

Aim: The aim of present study was to data analysis of brain space occupying lesions (SOL) evaluated by MRI and with histopathological correlation of patients presented with various clinical symptoms.

Materials and Methods: The study was performed on a whole body system at 1.5 Tesla MRI, using a dedicated head coil. Multiplanar T1- and T2-weighted, diffusion, gradient images, using spinecho sequences, post contrast study, and proton magnetic resonance spectroscopy were performed in all cases on single and multivoxels chemical shift imaging. All cases were correlated with histopathology and by follow-up studies after management.

Result: Study was done for a period of 1-year in patients of varying clinical symptoms subjected for MRI. SOL due to infective etiology was noted high in the age group of 10-30 years and neoplasm among 30-50 years. While glioma is the most common malignant tumor followed by matastasis and meningeoma among benign lesions as noted in previous literature. Tuberculoma was the most common lesion in the infective etiology. MRI-aided in characterizing and diagnosing uncommon lesions and tumor mimicking lesions.

Conclusion: No significant difference in 5 noted in occurrence when compared with previous study data of major brain SOL. Recent advanced MRI tests aids in characterization and narrowing differential diagnosis for brain lesions, for definitive diagnosis still histologic tissue evaluation is needed for uncommon and tumors with atypical presentation. Limitation of the study is the small group of patients, hence for image evaluation, the incidence and prevalence of rare tumors requires larger group study analysis.

Key words: Brain, Tumefactive demyelination, Tumors

INTRODUCTION

Distributions of tumor types vary substantially by age group and among the developing/developed countries. Data from several national cancer registries support differences in the epidemiology of brain tumors in children versus adults. High-grade glioma (30.5%) and meningioma (29.4%) are the most common types of adult primary brain tumors (data taken from the Swedish cancer registry). Males also generally have higher rates of primary malignant brain tumors while females have higher rates of non-malignant tumors, primary meningiomas.[1] During the last few years, the role of magnetic resonance imaging (MRI) as a diagnostic tool in neuroradiology is well-established. With advanced MRI techniques such as perfusion, diffusion, and spectroscopy, it is now possible to differentiate between various intracranial lesions. The differential diagnosis of intra cerebral necrotic tumors and the cerebral abscess is frequently difficult on conventional MRI as both can present as ring enhancing lesions.[2] The necrotic component of brain tumor (glioblastoma multiforme [GBM] and metastases) show marked hypo intensity on diffusion-weighted image (DWI) due to

Access this article online

IJSS

www.ijss-sn.com

Month of Submission : 09-2015
Month of Peer Review : 10-2015
Month of Acceptance : 11-2015
Month of Publishing : 11-2015

Corresponding Author: Dr. Bulabai Karpagam, Department of Radiology, SRM Medical College Hospital and Research Institute, Kanchipuram, Tamil Nadu, India. Phone: +91-9894777929. E-mail: karaso1987@yahoo.com.

increased free water. The DWI must allow differentiation between necrotic tumors and cerebral abscess.[3] The diffusion restricted signal helps in glioma grading on the basis of increasing tumor cellularity. Magnetic resonance spectroscopy (MRS) is highly sensitive in differentiating low-grade from high-grade gliomas, perilesional tumor infiltration and more specific in characterizing abscess with lipid/lactate, amino acid peaks. Provides additional information over conventional study to differentiate extra axial tumors as meningeoma with alanine peak. Not only the common tumors are well-differentiated by MRI, but also space occupying lesions (SOL) of infective etiology, rare tumors, tumor mimicks as tumefactive demyelinating lesions and congenital lesions prevalence and imaging features are diagnosed by MRI.[4]

MATERIALS AND METHODS

The present study consisting of 53 cases of intracranial SOL for a period of 1-year attended our department for MRI evaluation for varying clinical symptoms. Among this, 50 were SOL and 3 were lesions resembling a tumor. It was a prospective study using descriptive analysis by SPSS software not applying test data analysis. The study was performed on a whole body system at 1.5 Tesla. Diagnosis of intracranial mass was confirmed by biopsy or postoperative histopathological examination, cerebrospinal fluid findings supplemented by follow-up MRI study as per clinical requirement. MRI by multiplanar T1- and T2-weighted, diffusion, gradient images, using spin echo sequences, were obtained in all the patients. For all cases, contrast study and proton MRS by single (PRESS) and multivoxel chemical shift imaging MRS was performed on 1.5 Tesla scanner (SEIMENS MAGNETOM) using 8 channel head coil with TR 2000, TE 31/144/288 with flip angle 90°. DWI is typically performed using at least two b values (e.g., b = 0 s/mm^2 and other b values from 0 to 1,000 s/mm^2) to enable meaningful interpretation.

RESULT ANALYSIS

The highest incidence of patients in the present study was found in 21-30 and 41-50 years group (16%) Table 1. Brain SOL was more common in male (64%) and in was female of 36% Table 2, which was similar as illustrated by previous study reports. Brain SOL occurs in intra axial and extra axial locations. In Table 3 shows 68% of intra axial lesions and 32% of extra axial lesions, which includes meningioma (the most common benign and extra axial neoplasm) 5th nerve schwanoma and pituitary adenoma. Intracranial SOL subjected for MRS and diffusion weighted series showed 20 cases of glioma (40%) with the highest incidence of low-grade gliomas (24%) and 8 (16%) were high-grade gliomas shows more than 50%. While low-grade gliomas (12) including ependymoma, pilocytic astrocytoma showed either no contrast enhancement (33%) or mild (in 66%) enhancement noted. Pyogenic abscess (1) and tubercular abscess (1) showed ring enhancement. All 5 cases of tuberculoma showed enhancement of variable degree. In the case of gliomas, MRS by NAA/choratio proved helpful in differentiating low-grade from high-grade gliomas with mean value in high-grade glioma is 0.28 and low-grade glioma 0.66 suggest a significant decrease in NAA and a significant increase in choline which is a marker of cell proliferation. Moreover, all cases included in this study were either surgically or by biopsy proved. Among 5 cases of metastasis 2 of known primary (carcinoma breast and lung) and 5 cases of tuberculoma were followed periodically with treatment.

Table 1: Distribution of intracranial mass lesions according to age

Patient age	No. of patients	Percentage
0-10	5	10
11-20	6	12
21-30	8	16
31-40	7	14
41-50	8	16
51-60	4	8
61-70	7	14
71-80	4	8
81-90	1	2
Total	50	100

Highest incidence of patients in present study was found in 21-30 and 41-50

Table 2: Distribution of intracranial mass lesions according to sex

Sex	No. of patients	Percentage
Male	32	64
Female	18	36
Total	50	100

Table 3: Distribution of intracranial mass lesions according to location

Location	No. of patients	Percentage
Intra axial	34	68
Extra axial	16	32
Total	50	100

Present study showed more incidence of intra axial lesions (68%)

DISCUSSION

Patients with brain SOL presented with one or more symptoms that include seizures, increased intracranial pressure, or localized neurologic deficits such as weakness, motor problems, and aphasia. Brain SOL has wide spectrum of lesions such as infective, vascular, and benign and malignant neoplasm. Infective lesions include granulomatous lesions and pyogenic abscess. Common benign lesions are predominently extra axial such as meningeomas, pituitary adenoma, schwanoma and less common tumors as epidermoid, and hemangioma chordoma. Glioma and metastasis are the common malignant neoplasms of the brain. Multiple lesions denote metastasis or infective etiology, whereas multifocal glioma are rare, and in present study 92% of SOL were solitary and 4 of 50 cases were only multiple (2) metastasis and (2) tuberculoma (Table 4). Among 53 cases, 50 were SOL in the present study group, 3 were tumor-like lesions (Table 5) and 40% was glioma as compared with of 80% by Ostrom *et al.*[5] Low-grade gliomas including oligodendoglioma, astrocytoma, and ependymoma constitute 15-18%,[6] which was 24% in our study. In the largest stereotactic brain biopsy series, the most common intra axial brain masses were high-grade primary neoplasms 36%, low-grade primary neoplasms (33%), metastases (8%), demyelinating and inflammatory conditions 3%, and abscesses 1% by Al-Okaili *et al.*,[2] which is variable with our analysis of meningeoma of 16% and infective and metastasis of significant in number 10% each. High-grade gliomas have low survival rate, as GBM represents the most common type of glioma as by other studies,[2,5,7] it was falling next to low-grade in our series.

Tumors of the central nervous system are graded according to WHO, are graded based on standard histopathological features as atypical cells, mitoses, endothelial proliferation, and necrosis. Grades I and II gliomas were taken together as low-grade, and Grades III and IV were considered high-grade gliomas. On contrast MRI study, some astrocytomas and virtually all oligodendrogliomas do not contrast enhance, and even the high-grade astrocytomas that do contrast enhance frequently show enhancement in only a portion of the tumor. Because these tumors have abnormal T2 transverse relaxation time that is difficult to distinguish from surrounding edematous but otherwise normal brain tissue (Figure 1). MRS was useful in the perilesional spread of the tumor infiltration in high-grade gliomas and recurrent tumors.[8] In present study, 8 cases of low-grade gliomas (66.66%) and all case of high-grade gliomas (100%) showed pathological spectra not limited to contrast enhancing area. On MRS Naa/ch ratio was significantly lower and ch/cr ratio was significantly higher in high-grade gliomas than in low-grade gliomas.

Meningiomas occur at a rate of 7.8 per 100,000 per year, but only 25% are believed to be symptomatic.[9] Meningiomas typically appear as extra axial lesions, and the presence of a dural tail aids in the diagnosis. While meningeomare present 16% in the present study as compared to 33% incidence of brain tumors by Wiemels *et al.*[10] Among 8 cases of meningeoma, 1 case of malignant meningeoma occurred in male (Figure 2) rest of 7 were noted in the female. Computed tomography can help evaluate bone involvement and the presence of calcifications, which can be seen in 30% of benign meningiomas[10] but are rare in malignant meningiomas. Although benign tumors showed perilesional edema, it was much more in malignant meningiomas. Meningiomas could be differentiated from schwannomas by the presence of alanine in the former. All cases of meningeoma showed moderated to intense enhancement with T2 hypointensity; diffusion restricted

Table 4: Distribution according to number of intracranial mass lesions

Number of lesions	No. of patients	Percentage
Single	46	92
Multiple	4	8
Total	50	100

Present study found more incidence of solitary as compared to multiple lesions (92%)

Table 5: Distribution according to histopathalogy of intracranial mass lesions

Type	No. of patients	Percentage
Low-grade glioma	12	24
High-grade glioma	8	16
Metastases	5	10
Meningioma	8	16
Schwannoma	1	2
Pyogenic abscess	1	2
Tubercular abscess	1	2
Medulobla stoma	2	4
Piueoblastoina	1	2
Tuberculoma	5	10
Pituitary macroadeuoma	6	12

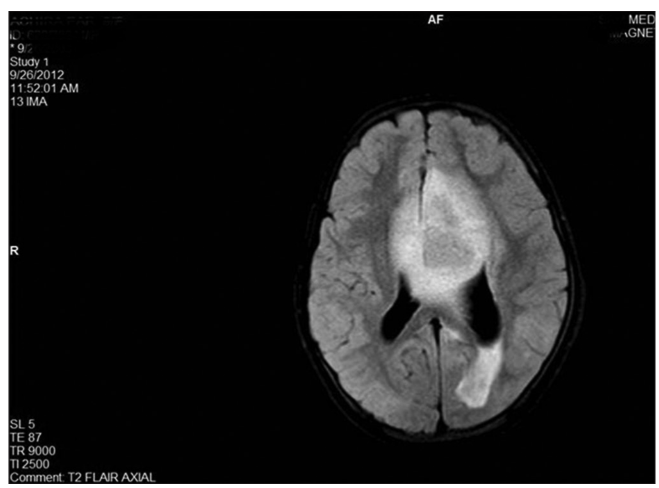

Figure 1: Glioma in the frontal lobe appears hyperintense on T2 series that is difficult to distinguish from surrounding edematous but otherwise normal brain tissue

signal and Ch, Alanine peak on MRS. All metastases and meningiomas (100%) showed pathological spectra limited to contrast enhancing area in our study. Pituitary macro adenoma (6 cases) (Figure 3) also showed increased Ch peak. Lactate and lipid peak was noted on all extra axial tumors including 8th nerve schwanoma (Figure 4). However, no significant MRS or diffusion features noted for pineoblastoma (Figure 5) where anatomical localization and enhancement features aided in diagnosis.

Metastasis to the brain occurs in 20-40% of known primary tumors and the most common (40%) intracranial tumor in adults. Lung, breast, and melanoma are the most common primary tumors to metastasize to the brain. Most commonly, the metastatic disease affects the skull or brain parenchyma and also involve the meninges.[11] In present study, 2 out of 5 cases were multiple lesions (Figure 6) with disproportionate perilesional edema showed mild to moderate contrast enhancement. A single case of solitary

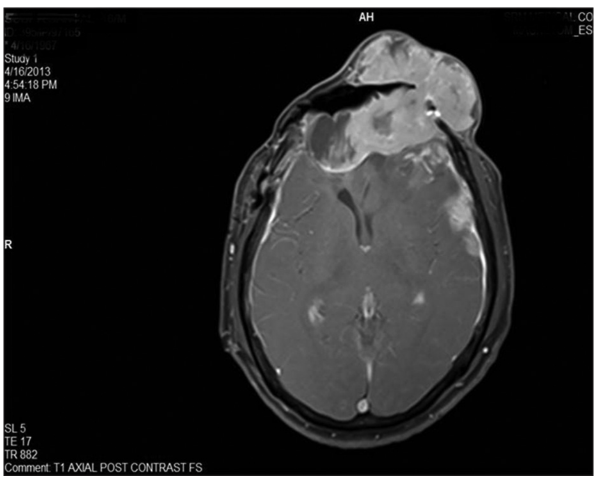

Figure 2: Case of recurrent malignant meningeoma shows intense enhancement with areas of necrosis, perilesional edema, and meningeal enhancement

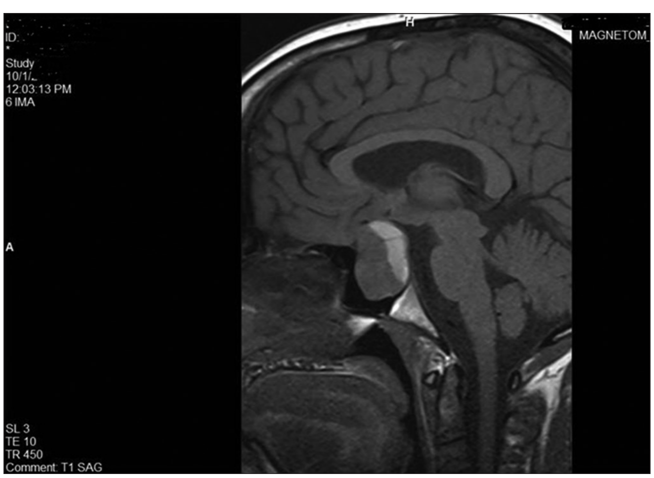

Figure 3: Pituitary macro adenoma with mixed signal intensity with figure of eight

Figure 4: Posterior fossa lesion with central necrosis with mild enhancement of the solid component in a case of 8th nerve schwanoma

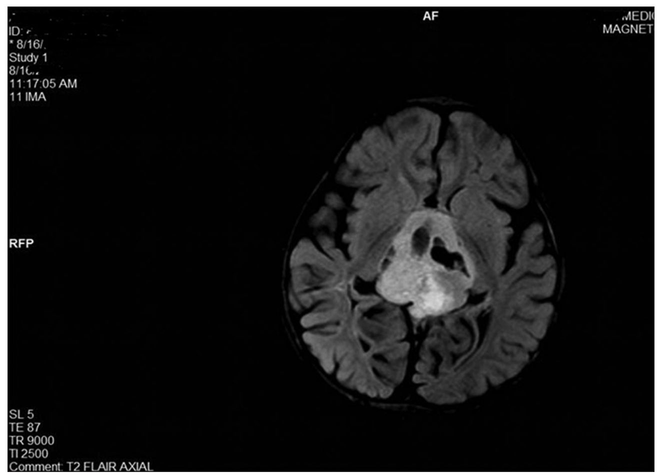

Figure 5: Pinealoblastoma with calcification, intense enhancement and necrosis with no characteristic study pattern on magnetic resonance spectroscopy

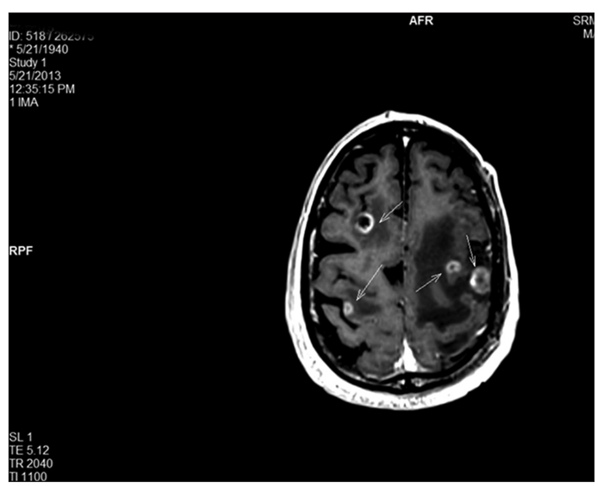

Figure 6: Multiple ring enhancing lesion with perilesional edema without diffusion restricted signal and elevated ch/cr ratio denoting multiple metastasis

metastasis showed necrosis and was not able to differentiate from glioblastoma on with MRS, which showed elevated ch/cr (4), lipid/lactate (4) peaks with NAA/Cho > 1 in peritumoral edema.

Non-neoplastic lesions including intracranial abscess, granuloma, phakomatosis, and tumefactive demyelination can cause a diagnostic dilemma. 3 cases of brain lesions of the present study were mimicking brain SOL, as tumefative demyelination (2 lesions), phakomatosis (1 lesion). Tubercular and pyogenic abscess showed ring enhancement with lactate/lipid peak and diffusion restricted signal. Tumefactive demyelination diseases, of multiple sclerosis, acute disseminated encephalomyelitis may present as tumor-like lesions on imaging. By MRI abscess displaying solitary or multiple focal areas of signal alteration with peripheral ring enhancement. Among 2 cases of abscess, in present study, 1 case (tuberculus abscess) showed multiple lesions widening the spectrum to include metastasis as well. Both showed irregular, incomplete open ring enhancement with central necrosis closely resembling glioblastoma causing difficulty in differentiating. MRS in tumefactive demyelination showed a reduction of NAA and increased in choline and lipids, and elevation of lactate due to ischemia.[12] However, these resonance spectra are not specific, and they may resemble brain tumors or even tuberculoma.

CONCLUSION

Detailed information of brain lesions by MRI aid in diagnosing and management. More over, Noninvasive recent advanced MRI techniques plays a major role in characterization and narrowing differential diagnosis for brain lesions, still for definitive diagnosis histologic tissue evaluation is needed for uncommon and lesions with the atypical and overlapping presentation. Limitation of the study is the small group of patients, hence for image evaluation, the incidence and prevalence of rare and tumors like lesions require larger group study analysis in future which forms one-third of brain SOL.

REFERENCES

1. Bondy ML, Scheurer ME, Malmer B, Barnholtz-Sloan JS, Davis FG, Il'yasova D, *et al.* Brain tumor epidemiology: Consensus from the brain tumor epidemiology consortium. Cancer 2008;113 7 Suppl:1953-68.
2. Al-Okaili RN, Krejza J, Wang S, Woo JH, Melhem ER. Advanced MR imaging techniques in the diagnosis of intraaxial brain tumors in adults. Radiographics 2006;26 Suppl 1:S173-89.
3. Gigineishvili D, Gigineishvili T, Tsiskaridze A, Shakarishvili R. Incidence rates of the primary brain tumours in Georgia – A population-based study. BMC Neurol 2014;14:29.
4. Larjavaara S, Mäntylä R, Salminen T, Haapasalo H, Raitanen J, Jääskeläinen J, *et al.* Incidence of gliomas by anatomic location. Neuro Oncol 2007;9:319-25.
5. Ostrom QT, Bauchet L, Davis FG, Deltour I, Fisher JL, Langer CE, *et al.* The epidemiology of glioma in adults: A "state of the science" review. Neuro Oncol 2014;16:896-913.
6. Surawicz TS, McCarthy BJ, Kupelian V, Jukich PJ, Bruner JM, Davis FG. Descriptive epidemiology of primary brain and CNS tumors: Results from the Central Brain Tumor Registry of the United States, 1990-1994. Neuro Oncol 1999;1:14-25.
7. Li WB, Tang K, Chen Q, Li S, Qiu XG, Li SW, *et al.* MRI manifestions correlate with survival of glioblastoma multiforme patients. Cancer Biol Med 2012;9:120-3.
8. Horská A, Barker PB. Imaging of brain tumors: MR spectroscopy and metabolic imaging. Neuroimaging Clin N Am 2010;20:293-310.
9. Glen HJ. Stevens clinical application of diffusion weighted MR imaging: A review. Neuroradiology 2006;16:705-10.
10. Wiemels J, Wrensch M, Claus EB. Epidemiology and etiology of meningioma. J Neurooncol 2010;99:307-14.
11. Fink KR, Fink JR. Imaging of brain metastases. Surg Neurol Int 2013;4 Suppl 4:S209-19.
12. Gavra M, Boviatsis E, Stavrinou LC, Sakas D. Pitfalls in the diagnosis of a tumefactive demyelinating lesion: A case report. J Med Case Rep 2011;5:217.

How to cite this article: Karpagam B, Vadanika V. Brain Space Occupying Lesions by Magnetic Resonance Imaging: A Prospective Study. Int J Sci Stud 2015;3(8):123-127.

Source of Support: Nil, **Conflict of Interest:** None declared.