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Original Research Article

INTRACRANIAL MENINGIOMAS: CORRELATIONS BETWEEN MR IMAGING CHARACTERISTICS AND HISTOPATHOLOGY

[1]Dr. Balaji S Pai, [2]Dr. Sandesh Khandelwal, [3]Dr. Gurupadappa, [4]Dr. Vishwanatha Narayana, [5]Dr. Raghu Patil

[1]Department of Neurosurgery, BMC&RI, Bangalore, Karnataka, India
[2]Department of Neurosurgery, LN Medical College, Bhopal, Madhya Pradesh, India
[3]Department of Neurosurgery, KIMS, Hubballi, Karnataka, India
[4]Department of Neurosurgery, Karnataka Institute of Medical Sciences, Hubballi, Karnataka, India
[5]Department of Radiodiagnosis, PMSSY, BMC&RI, Bangalore, Karnataka, India

Corresponding Author:
Dr. Vishwanatha Narayana (drvishhubli@gmail.com)

Abstract

Context: Contrast enhanced MRI scans with addition of arterial and venous sequences are the most important studies to evaluate Intracranial Meningiomas. MRI is being utilized to determine the histological subtypes and biologic behavior of meninigiomas.
Aims: Aim of the study is to correlate the MRI imaging characteristics with histopathology.
Settings and Design: This is a prospective study in a tertiary neurosurgical teaching institute.
Methods and Material: The prospective study done to correlate the relationship between MRI characteristics and histopathological features in 120 surgically verified intracranial meninigiomas.

Statistical analysis: Continuous variables are presented as Mean (SD) and Categorical variables are summarized as frequencies (Percent). Chi-square/Fischer Exact test are used to test the association between variables. P value of 0.05 or less is considered statistically significant.

Results: Majority of the meningioma appears Isointense (70.8%) on T1 and hyper intense (45.8%) on T2 weighted images. Tumours with T2 hypo intense on MRI predominantly are of Fibroblastic on histopathology (20/36, 55.6%) Tumours with T2 hyper intense on MRI predominantly Meningothelial 22/55, 40%), and Transitional (16/55 29.1%) subtypes.
Conclusions: The signal intensity of MRI may be useful in the preoperative characterization of meningiomas. T2 weighted images are helpful in predicting the histopathological subtypes, vascularity and consistency The tumors which appear hypo intense on T2 weighted images are predominantly fibroblastic and hyper intense tumors are of Meningothelial and transitional subtypes.

Keywords: Magnetic resonance imaging, meningiomas, meningothelial, fibroblastic

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Introduction

Meningiomas account for approximately 35% of all primary intracranial tumors and most common extra axial lesion encountered in neuroimaging [1-3]. The progress in meninigiomas treatment mirrors advances in neurosurgery [4]. Earlier plain roentgenograms and conventional angiography were utilized for the evaluation of intracranial meningiomas. Introduction of CT and MRI dramatically improved detection and accuracy of diagnosis. Contrast enhanced MRI scans with addition of arterial and venous sequences provide more useful information about the tumor features and surrounding anatomy. Imaging techniques like MRI, fMRI and somatostatin scintigraphy are being used to predict the histological subtypes and biologic behavior of meninigiomas. Several previous studies [5, 6, 7, 8, 9, 10, 11] utilized MRI tumor signal imaging characteristics for predicting the intraoperative tumor consistency, vascularity and histopathology. Tumor signals on T 1 weighted sequences were rather similar regardless of histopathological subtypes as majority of meninigiomas appear isointense to hypo intense on T1 weighted images. However, the tumors which appear hypo intense on T2 weighted images are predominantly fibroblastic and hyper intense tumors are of Meningothelial subtypes. Hence this study has been done to correlate MRI characteristics with histopathology.

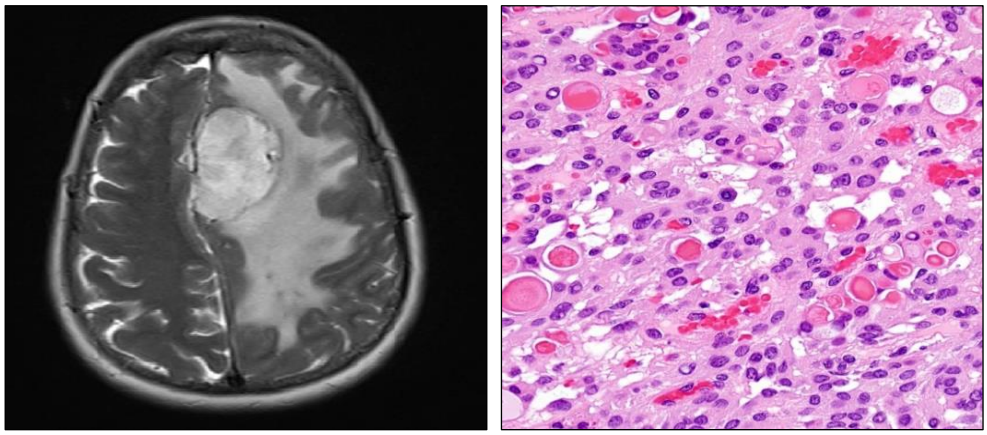

Fig 1

MRI T2 Sequence Showing T2 Hyperintense Left Frontal Parafalcine Meningioma and the Histopathological Features Suggestive of Meningothelial Subtype.

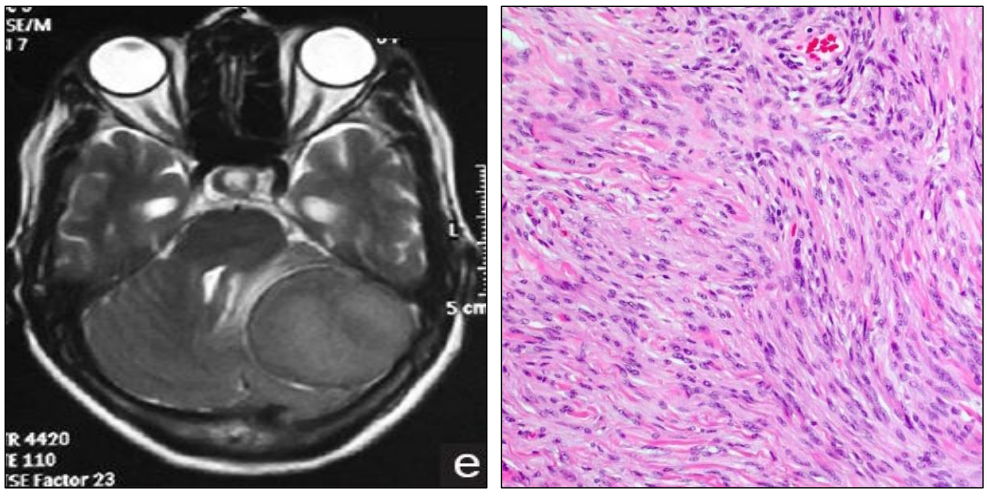

Fig 2

MRI T2 Sequence Showing T2 Hypointense Tentorial Meningioma and the Histopathological Features Suggestive of Fibroblastic Subtype.

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Subjects and Methods

The study was undertaken in the Department of Neurosurgery, BMC&RI from September 2016 to September 2018 after obtaining clearance from the Institute Ethical Committee. Informed consent was taken from all the patients. Preoperatively MRI imaging Characteristics of all Intracranial Meningiomas were reported by single radiologist and correlated with final histopathological report.

Results

The commonest location of tumor is Convexity 22.5% (27/120) followed by Parasagittal and parafalcine 19.16 % (Table 1).
The mean age of our patients was 46.54 years. Among males and females, it was 46 and 47 years respectively (Table 2).
Out of 120 patients, 49 (40.8%) were males and 71 (59.2%) were females. Male to Female ratios is1:1.4 (Table 3).
In our study majority of the meninigiomas appears Isointense (77.5%) on T1and hyper intense (45.8%) on T2 sequence (Table 4& 4A).
94.29% of Meningothelial type, 78.79% of transitional type & 65.38% of Fibroblastic & other histologic types of meningiomas including atypical ones were Isointense on T1 weighted sequence. This difference was statistically significant (p=0.018) (Table 4A).
65.71% of Meningothelial type, 51.52% of transitional type, 46.15% of other histologic types of meningiomas were Hyper intense and 76.92 % of Fibroblastic type were hypo intense on T2 weighted sequence. This difference was statistically significant (p<0.005) (Table 5 & 5A).
There was no significant association of Histopathology types with Gender and age group (Table 6 & 6A).

Table 1: Location distribution of patients studied

Location	No of Patients	Percentage
Convexity	27	22.5%
Parasagittal & Parafalcine	23	19.16%
Tuberculum sellae	21	17.5%
Sphenoid	10	8.3%
Olfactory	12	10%
Tentorial	20	16.6%
Intraventricular	2	1.6%
Middle fossa	1	0.8%
Foramen magnum	2	1.6%
Orbital	2	1.6%
Total	120	

Table 2: Age distribution of patients studied

Age group	No. of patients	Percent
21.00-30.00	12	10
31.00-40.00	30	25
41.00-50.00	30	25
51.00-60.00	34	28.3
61.00-70.00	12	10
71.00+	2	1.7
Total	120	100

	Mean (SD)	Median (IQR)	Minimum	Maximum
Age	46.54 (12.53)	47 (55-36.5)	21	85

Table 3: Gender distribution of patients studied

Gender	No. of patients	%
Female	71	59.2
Male	49	40.8
Total	120	100.0

Table 4: Histopathological types on T1 weighted images

Histopathology		T1 weighted image signal			Total (%)
		Hyperintense	Isointense	Hypointense	
Meningothelial		0 (0)	33 (94.3)	2 (5.7)	35 (100)
Transitional		0 (0)	26 (78.8)	7 (21.2)	33 (100)
Fibroblastic		0 (0)	17 (65.4)	9 (34.6)	26 (100)
Others	Atypical	0 (0)	11 (61.1)	7 (38.9)	18 (100)
	Clear cell	0 (0)	2 (100)	0 (0)	2 (100)
	Microcytic	0 (0)	1 (50)	1 (50)	2 (100)
	Anaplastic	0 (0)	1 (100)	0 (0)	1 (100)
	Angiomatoid	0 (0)	0 (0)	1 (100)	1 (100)
	Choroid	0 (0)	1 (100)	0 (0)	1 (100)
	Secretory	0 (0)	1 (100)	0 (0)	1 (100)
Total		0 (0)	93 (77.5)	27 (22.5)	120 (100)

Table 4A: Distribution of cases based on histopathology and signal intensity on T1 sequence

	Isointense	Hypo intense	Total	Chi Square test
Meningothelial	33 (94.29)	2 (5.71)	35 (100)	P=0.018
Transitional	26 (78.79)	7 (21.21)	33 (100)	
Fibroblastic	17 (65.38)	9 (34.62)	26 (100)	
Other types	17 (65.38)	9 (34.62)	26 (100)	
Total	93 (77.5)	27 (22.5)	120 (100)	

Table 5: Histopathological types on T2 weighted images

Histopathology		T2 weighted image signal			Total
		Hyperintense	Isointense	Hypointense	
Meningothelial		23 (65.7)	11 (31.4)	1 (2.9)	35 (100)
Transitional		17 (51.5)	11 (33.3)	5 (15.2)	33 (100)
Fibroblastic		3 (11.5)	3 (11.5)	20 (76.9)	26 (100)
Others	Atypical	6 (33.3)	4 (22.2)	8 (44.4)	18 (100)
	Clear cell	2 (100)	0 (0)	0 (0)	2 (100)
	Microcytic	2 (100)	0 (0)	0 (0)	2 (100)
	Anaplastic	0 (0)	0 (0)	1 (100)	1 (100)
	Angiomatoid	1 (100)	0 (0)	0 (0)	1 (100)
	Choroid	1 (100)	0 (0)	0 (0)	1 (100)
	Secretory	0 (0)	0 (0)	1 (100)	1 (100)
Total		55 (45.8)	29 (24.2)	36 (30)	120 (100)

Table 5A: Distribution of cases based on histopathology and signal intensity on T2 sequence

	Hyperintense	Isointense	Hypointense	Total	Fischer Exact test
Meningothelial	23 (65.71)	11 (31.43)	1 (2.86)	35 (100)	$p<0.005$
Transitional	17 (51.52)	11 (33.33)	5 (15.15)	33 (100)	

Fibroblastic	3 (11.54)	3 (11.54)	20 (76.92)	26 (100)	
Other types	12 (46.15)	4 (15.38)	10 (38.46)	26 (100)	
Total	55 (45.83)	29 (24.17)	36 (30)	120 (100)	

Table 6: Distribution of cases based on histopathology and Gender

	Female	Male	Total	Chi Square test
Meningothelial	20 (57.14)	15 (42.86)	35 (100)	
Transitional	19 (57.58)	14 (42.42)	33 (100)	
Fibroblastic	16 (61.54)	10 (38.46)	26 (100)	P=0.975
Other types	16 (61.54)	10 (38.46)	26 (100)	
Total	71 (59.17)	49 (40.83)	120 (100)	

Table 6A: Distribution of cases based on histopathology and age group

	Age group						Total	Fischer exact test
	21-30	31-40	41-50	51-60	61-70	71.00+		
Meningothelial	4 (11.43)	10 (28.57)	9 (25.71)	8 (22.86)	3 (8.57)	1 (2.86)	35 (100)	
Transitional	3 (9.09)	10 (30.3)	9 (27.27)	6 (18.18)	5 (15.15)	0 (0)	33 (100)	
Fibroblastic	2 (7.69)	6 (23.08)	7 (26.92)	8 (30.77)	2 (7.69)	1 (3.85)	26 (100)	p=0.839
Other types	3 (11.54)	4 (15.38)	5 (19.23)	12 (46.15)	2 (7.69)	0 (0)	26 (100)	
Total	12 (10)	30 (25)	30 (25)	34 (28.33)	12 (10)	2 (1.67)	120 (100)	

Discussion

In the present study most of the meningioma appears Isointense 77.5% (93/120) on T1and hyper intense 45.8% (55/120) on T2 sequence. Tumours with T2 hypo intense on MRI predominantly are of Fibroblastic on histopathology 76.9% (20/26). Tumours with T2 hyper intense on MRI predominantly Meningothelial 22/55, 40%), and Transitional (16/55 29.1%) subtypes. Various studies have been done [5, 6, 7, 8, 9, 10, 11] to correlate MRI characteristics findings with histopathology. F Maiuri *et al*. [5] examined the relationship between MRI and histopathological features in 35 surgically verified intracranial meninigiomas. He concluded that T 2 hyper intense tumors are usually soft, more vascular and more frequently of Meningothelial or angioblastic subtypes; hypo intense or hypo-isointense are more often fibroblastic and transitional subtype. AD Elster *et al.* [6] showed that markedly hypo intense (7/40) were predominantly of fibroblastic or transitional elements while markedly hyper intense meningioma (14/40) demonstrated predominance of syncytial or angioblastic elements. The varied MR appearance of meninigiomas has a clear histologic basis and crude prediction of pathologic subtype is possible in over three-fourths of cases. Karthigeyan *et al.* [10] concluded that T2 and FLAIR hypo intense imaging was associated with fibroblastic and psammomatous subtypes of meningiomas.

Conclusion

MRI T 2 signal intensity characteristics in intracranial meningiomas can be correlated with the histopathological subtypes that can predict the biological behavior of the tumors. Tumours that appear hyper intense on T2 are more of Meningothelial, transitional and angiomatous type because of their high water content and vascularity. They are more of softer in consistency and easily resectable. Tumors that appear Hypo intense on T2 are more of Fibroblastic subtype, more firm in consistency and requires more operating time.

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Conflicts of interest

There are no conflicts of interest.

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