



Role of MRI Imaging in Evaluation of Typical & Atypical Meningiomas

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ABSTRACT

Magnetic resonance imaging (MRI) with contrast is the modality of choice for diagnosis as well as for predicting the success of its complete removal of meningiomas. Magnetic resonance imaging findings of 40 cases of intracranial meningiomas diagnosed in our institute were studied. Objective of this study was to describe typical and atypical locations and findings of intracranial meningiomas on magnetic resonance imaging with imaging characterization of atypical meningioma corresponding to their WHO grading or histological subtypes.

Materials and Methods : Study was conducted at Department of Radiodiagnosis & Imaging, New civil hospital, Surat from August 2015 to July 2016 over a period of 12 months. 40 patients of intracranial meningiomas of 10-70 years' age group were studied.

Result : A higher incidence noted in females. Most of the tumours are solitary with supratentorial location being most common - the cerebral convexities along parasagittal location/falx. Other locations are sphenoid ridge, posterior fossa, olfactory groove and parasellar region. Majority were typical (WHO grade I) in 90.1%, only 6.8% were atypical (WHO grade II) whereas 3.1% were Anaplastic subtype (WHO grade III). Most of the tumours showed low signal on T1- (64%) and high signal on T2- (65%) and FLAIR (72%) weighted images. After contrast administration, 71% of the tumours presented intense and 29% showed moderate and heterogenous enhancement. Areas of vasogenic oedema around the tumours were seen in 36% of the cases. Twenty four percent of the cases showed bone infiltration, and the dural tail sign was seen in 65% of the tumours.

Conclusion : The diagnosis of meningioma is usually obvious on CT or MRI scanning except when it presents in unusual locations and with atypical imaging characteristics as seen with atypical meningiomas WHO grade II or III.

KEYWORDS : Atypical meningiomas, Anaplastic meningioma, Magnetic Resonance Imaging (MRI), WHO grading

INTRODUCTION:

Meningiomas are the most common non-glial extraaxial primary tumours of the central nervous system (CNS), accounting for between 18 to 21% of all intracranial tumours. Meningiomas originate from arachnoid meningotheial (cap cells) of the arachnoid villi which are usually located along dural venous sinuses. The majority of meningiomas are spontaneous and of unknown aetiology, although recognised risk factors include previous exposure to radiation, trauma, genetic disorders. Multiple meningioma is typically associated with Neurofibromatosis type 2 and Multiple Meningiomatosis syndrome.

They are more common in women, although Grade II & III shows male preponderance. Mostly benign and usually have distinct appearance on histology and imaging but rarely may be atypical or malignant classified WHO Grade II & III.

Magnetic resonance imaging (MRI) with contrast is the modality of choice for diagnosis of meningiomas providing superior contrast differentiation and usually the ability to differentiate between intra- and extra-axial lesions.

MATERIALS AND METHODS:

The protocol was approved by Ethics Committee and written informed consent was obtained from each patient. Research study was conducted at Department of Radiodiagnosis & Imaging, New civil hospital, Surat from August 2015 to July 2016 over a period of 12 months. 40 patients of intracranial meningiomas of 10-70 years' age group were studied and the MRI findings were correlated with intraoperative findings and histopathological diagnosis in operated cases. All MR imaging examinations were performed with MAGNETOM Essenza 1.5 Tesla MRI Scanner from SIEMENS at AatmaJyoti MRI Centre, New Civil Hospital, Surat with standard scanning protocol.

RESULTS:

Out of forty patients, 62% were females and 38% were males. Most of them were solitary except one where multiple (three) meningiomas noted in a patient with neurofibromatosis and Multiple meningiomatosis syndrome. The most common sites of occurrence is supratentorial (90%) involving cerebral parasagittal location/falx (27%), convexities (19%), sphenoid ridge (17%), posterior fossa (10%), olfactory groove (8%) and others accounting for 19%.

Most common presenting symptom was headache followed by symptoms related to brain compression like hemiparesis, cranial nerve

palsies and visual field defects due to compression effect of meningiomas based on their location. Majority were typical (WHO grade I) in 90.1%, only 6.8% were atypical (WHO grade II) whereas 3.1% were Anaplastic subtype (WHO grade III).

DISCUSSION:

Meningiomas are well-circumscribed globular or lobulated (Globose) or flat sheet like (en plaque) dural-based tumours clearly demarcated from the brain.

The typical MRI signal intensity characteristics consist of iso to slight hypointensity relative to grey matter on the T1-weighted sequence and iso to moderately hyperintensity relative to grey matter on the T2 sequence. After contrast administration on T1 contrast sequence meningiomas typically show avid, homogeneous enhancement found in 71% cases. Rest of the 29% of cases showed peripheral, heterogenous enhancement due to calcifications, nonenhancing cystic and necrotic areas. Adjacent bony changes, hyperostosis noted in 20% of cases, as though better demonstrated in CT than MRI.



Fig A. T2WI shows an isointense convexity meningioma. Central hyperintensity is where dural vessels enter the mass

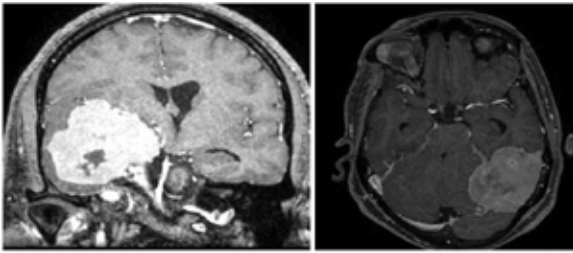


Fig B. Sphenoid wing meningioma and Posterior fossa meningioma

On spectroscopy - meningiomas shows increased choline peak with significant reduction in the NAA and creatine levels, small alanine peak.

The typical radiological signs of extraaxial location are better identified on MRI, although not specific, more frequently observed in meningiomas than in other extra-axial lesions. These signs are the following.

There is white matter buckling of the underlying brain parenchyma. Dural tail sign - enhancement of the dura infiltrating away from the lesion is seen in majority of cases. Other differential diagnoses to consider for dural tail sign are extra-axial metastases (leptomeningeal metastases), tuberculosis and sarcoid.

Cerebrospinal fluid cleft sign – T1 low signal intensity(SI), T2 high SI line in between mass and brain parenchyma seen mainly in typical cases whereas atypical meningiomas infiltrates into brain parenchyma with loss of CSF cleft.

Pial vascular structures interposed between the tumour and the brain surface.

Differential diagnosis of extraaxial lesions are: Dural metastases, granuloma (T. B, Sarcoid), idiopathic hypertrophic pachymeningitis, extramedullary haematopoiesis, etc.

Atypical or less frequent radiological features:

Atypical meningioma is classified as WHO grade II whereas malignant meningiomas as WHO grade III meningiomas. Atypical meningiomas including choroid and clear cell subtypes exhibits increased mitotic activity with increased cellularity and prominent nucleoli. A MIB-1 labelling index > 4 is typical.

Anaplastic variety is WHO grade III meningioma shows imaging triad of extracranial mass, osteolysis and “mushrooming” of intracranial tumor. This includes papillary and rhabdoid subtypes.

Large amount of edema uncommon, both mild and severe oedema noted in ten cases (33.3%).⁷

Calcifications noted in 30% of cases, it may be peripheral or central, small punctate or large conglomerate.

Haemorrhagic areas were noted in three cases. Diffusion restriction noted in two cases. Cystic or nonenhancing areas noted in four cases.

Meningiomas associated with complications such as dural sinus invasion noted in five cases, significant mass effect on surrounding arteries, cranial nerves, ventricular system and brainstem noted in fifteen cases.

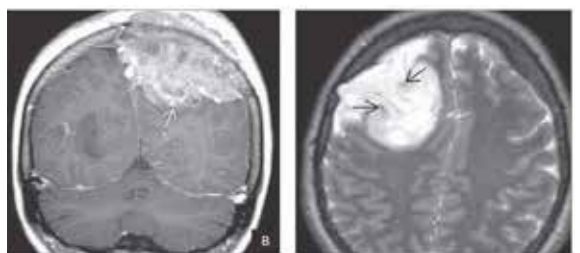


Fig C. Coronal T1 C+ scan in the same patient shows the transdural, transcranial invasive tumor . No border between

neoplasm and brain is discernible. WHO grade III (malignant) meningioma was the histopathologic diagnosis. T2WI in another patient with anaplastic (malignant) meningioma shows “mushroom” configuration

CONCLUSION:

The diagnosis of meningioma is usually obvious except when it presents in unusual locations and with atypical imaging characteristics.

MRI is the modality of choice for diagnosis as well as for predicting the success of its complete removal by providing information about their location, dural attachment site, severity of oedema and displacement of critical neurovascular structures; which is useful for planning operative approach and affects outcome.

Imaging features reported to suggest atypical or malignant nature of meningiomas are haemorrhage, cystic change, restricted diffusion on DWI and osteolysis.

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