

PICTORIAL REVIEW OF MENINGIOMA ON MRI WITH LITERATURE REVIEW

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ABSTRACT

The commonest non-gliar, extra-axial tumor of central nervous system (CNS) is meningioma. Although it is the most common tumor with some typical features that represent it as benign tumor and differentiate it from other brain tumors; but not all meningiomas exhibit these features. Some meningiomas show certain features that represent their atypical/malignant nature while some present at atypical location. The imaging appearances along with different locations have immense importance radiologically in providing a roadmap for management either with surgery alone or combined with radiotherapy and for assessing the expected post-surgical outcome by its location, site of dural attachment, extent of peritumoral edema, brain invasion by loss of tumor-brain interface, displacement of neurovascular bundle, post contrast enhancement pattern and diffusion restriction. MRI is the imaging modality of choice for detecting aforementioned radiological features due to superior soft tissue contrast. So, this pictorial review illustrates the common as well as uncommon locations with typical and atypical/malignant features of meningioma on MRI.

Introduction

The commonest extra-axial, non-gliar, intracranial tumors in adults are meningiomas with incidence of 80.3/1000000 people.¹ There is a high ratio of meningioma in women than men (2:1), being more common in reproductive years which had led down the basis for many studies. One of the studies show relative risk of 2.48 in premenopausal women who were hormone users (oral contraceptives) then with non-hormone user's post-menopausal women.² Meningiomas are mostly slow growing tumors arising from the arachnoid cap cells. According to WHO classification of brain tumors, meningiomas are classified into Grade I (benign), Grade II (atypical) and Grade III (malignant).³

MRI features and different locations of Meningiomas:

The cross-sectional imaging modalities like CT and MRI provide a non-invasive track to evaluate menin-

giomas. But owing to superior soft tissue contrast resolution of MRI, it remains on the top of investigations for detecting and characterizing the meningiomas.⁴

The locations of meningioma is variable, can be found anywhere along external regions of brain or in intraventricular location, but frequent locations are cerebral convexities, olfactory groove in anterior cranial fossa (Fig.1,7), parasagittal regions (Fig.3,6), tentorium cerebelli (Fig.4), sphenoid wing (Fig.9), cerebello-pontine angles. Along with this, few meningiomas occurs in less typical locations like diploic space and orbital cavity (Fig.2).⁵ However, 1% of meningiomas are ectopically located in extra-dural locations like mandible and temporal bones.⁴

On MRI, meningiomas have some characteristics appearances including well marginated mass lesion with hypointense to isointense signals on T1WI and isointense to hyperintense on T2WI showing homo-

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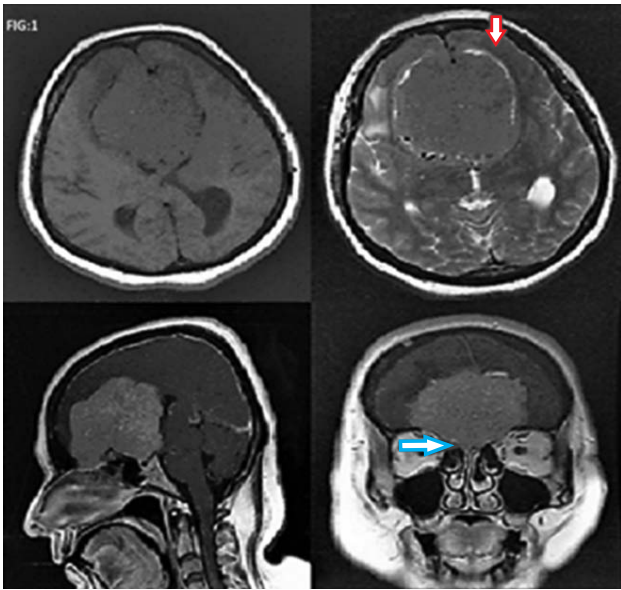


Figure 1: OLFACTORY GROOVE MENINGIOMA

MRI Brain of 65 years old male; Axial T1 and T2, post-Gd sagittal and coronal images showing a well defined extra axial lesion in the anterior cranial fossa along olfactory groove and planum sphenoidale (blue arrow), returning isointense signals on T1 and T2 with homogenous post-Gd enhancement. It is showing CSF cleft sign and displacement of vessels (red arrow).

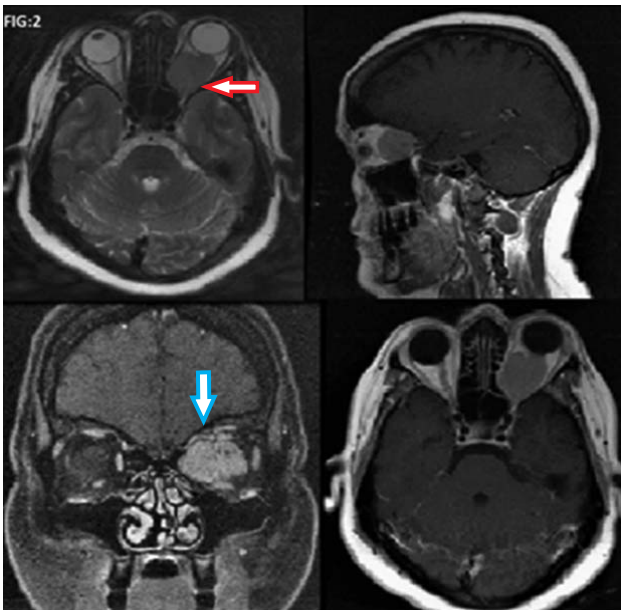


Figure 2: LEFT OPTIC NERVE SHEATH MENINGIOMA

MRI Brain of 35 years old female; axial T2 and axial, coronal and sagittal post-Gd images showing retrobulbar intraconal fusiform lesion involving left orbital cavity returning T2 isointense signals with homogenous post contrast enhancement. It is closely approximating the ipsilateral optic nerve with intact fat planes representing tram track sign on axial section (red arrow) and doughnut sign on coronal section (blue arrow). It is causing mild proptosis and also infiltrating medial rectus muscle with thinning of lamina papyracea and posteriorly extending upto orbital apex.

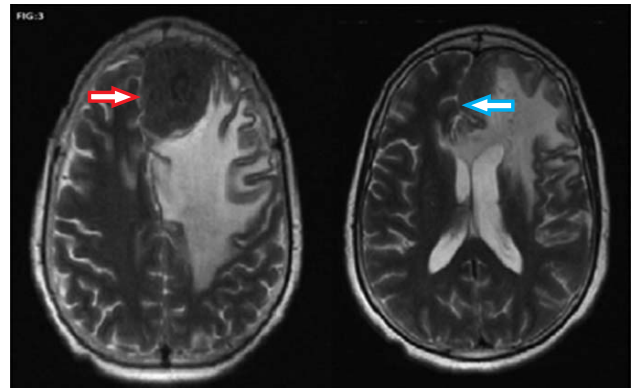


Figure 3: LEFT PARA SAGITTAL MENINGIOMA

MRI Brain of 55 years old female; axial T2WI showing an extra axial lesion in left frontal lobe in parasagittal location (red arrow) returning T2 isointense to hypointense signals causing mass effect with contralateral midline shift (blue arrow) and significant perilesional edema.

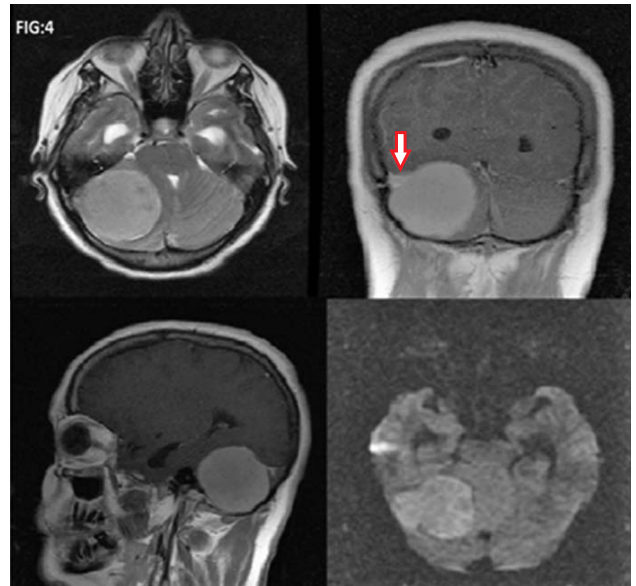


Figure 4: RIGHT TENTORIAL MENINGIOMA

MRI Brain of 50 years old female; axial T2, coronal and sagittal post Gd images and axial DWI showing a well-defined extra axial lesion adjacent right cerebellopontine angle with CSF cleft and dural tail signs attached to right tentorium (red arrow). It is returning T2 isointense signals and showing homogeneous post contrast enhancement with diffusion restriction. It is causing mass effect over brain stem and fourth ventricle resulting in obstructive hydrocephalus.

geneous post contrast enhancement (Fig.1,8).⁵ But not all meningiomas exhibit these typical findings, some may show atypical feature like cystic component due to necrosis / degeneration and heterogeneous post contrast enhancement (Fig.6,7). Few imaging features have a high predictive value in assessing malignant meningioma from benign entity like hetero-

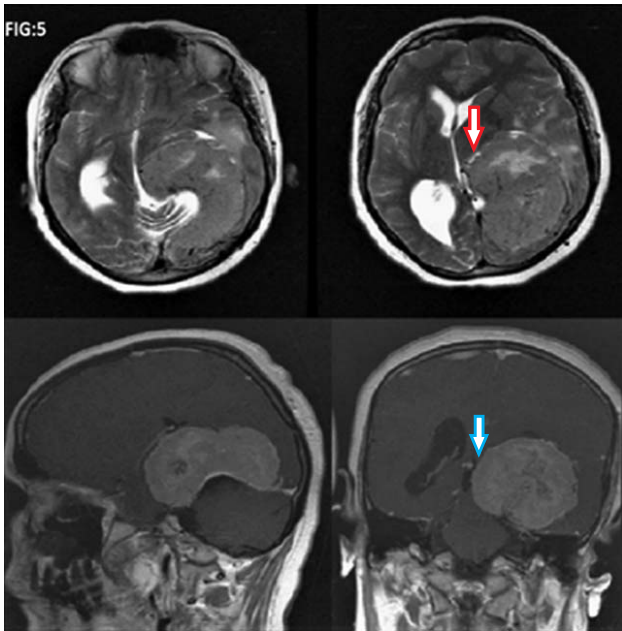


Figure 5: LEFT SUPRATENTORIAL MENINGIOMA

MRI Brain of 28 years old female; axial T2 as well as coronal and sagittal post-Gd images showing meningioma in left supratentorial location with CSF cleft (red arrow) and dural tail signs returning T2 isointense to intermediate signals with internal areas of necrosis. It is causing significant mass effect over thalamus and brainstem causing midline shift, uncal herniation (blue arrow), ipsilateral lateral ventricular effacement and contralateral ventricular dilatation.

geneous texture (Fig.6), enhancement of capsule, irregular interface between brain and tumor (Fig.10) and significant peritumoral edema (Fig.7,10).¹ Few studies have shown that an irregular shape of meningioma, diffusion restriction on DWI sequence and low on ADC maps (Fig.10), invasion and destruction of surrounding skull, encasement of vessels and distortion of surrounding cortical grey matter with loss of fat planes between primary tumor and brain parenchyma (Fig.10) play a significant role in assessing brain invasion by meningiomas and in discriminating the atypical/malignant meningiomas from benign entity. So, these features should be evaluated to differentiate between benign and atypical/malignant variety as it has immense importance in management like radiation therapy along with resection of primary tumor and in assessing the expected recurrence rate of tumor.⁶⁻⁹

John Varlotto et al⁸ used vascularity index in his study to determine the benign and atypical/malignant meningiomas on the basis of enhancement pattern. He compared the vascularity of primary mass (meningioma) with surrounding dural venous sinuses especially superior sagittal sinus as well as with

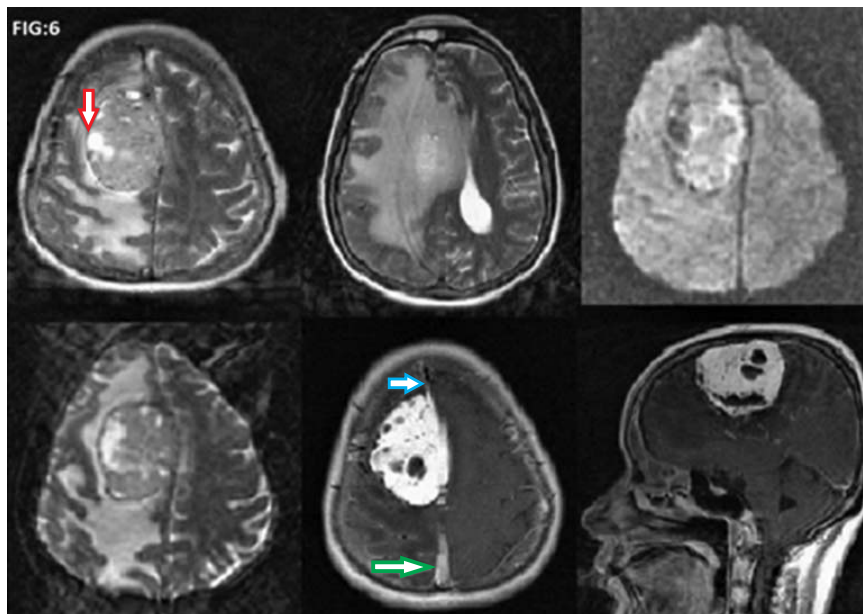


Figure 6: RIGHT PARASAGITTAL / PARAFALCINE MENINGIOMA WITH CYSTIC COMPONENT

MRI Brain of 42 years old female; axial T2, DWI and ADC as well as axial and sagittal post-Gd images showing a meningioma in right para falcine location with atypical features, returning T2 heterogeneously intermediate signals with cystic component (red arrow) and showing heterogeneous intense post contrast enhancement more than superior sagittal sinus (green arrow) and diffusion restriction. It is representing a small enhancing dural tail (blue arrow). It is causing significant compression effect over lateral ventricle and causing midline shift associated with significant perilesional edema.

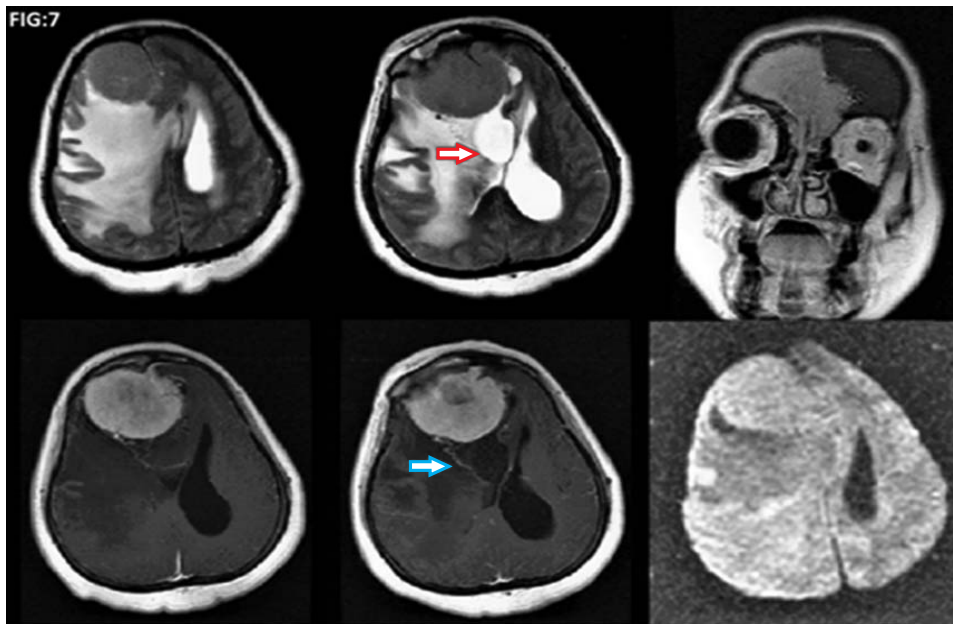


Figure 7: OLFACTORY GROOVE MENINGIOMA WITH PERITUMORAL CYST

MRI Brain of 37 years old female; axial T2 and DWI, as well as axial and coronal post-Gd images showing a meningioma involving olfactory groove, planum sphenoidale, sulcus chiasmaticus, anterior clinoid process extending into bilateral ethmoid sinuses. It is also showing attachment with anterior falx and crossing to the left cerebral hemisphere involving bilateral frontal lobes. It is returning T2 isointense signals with cystic component (red arrow) and showing heterogeneous post contrast enhancement with prominent vascular supply (blue arrow). It is associated with significant compression effect over lateral ventricle and causing midline shift with marked perilesional vasogenic edema.

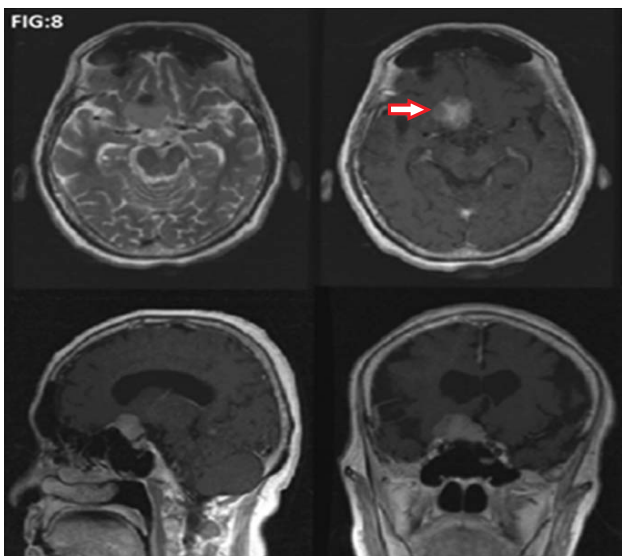


Figure 8: SUPRA SELLAR BENIGN MENINGIOMA

MRI Brain of 70 years old female; axial T2, as well as axial, coronal and sagittal post-Gd images showing a meningioma in supra sellar, right parasellar region and planum sphenoidale. It is returning T2 intermediate signals and showing moderate post contrast enhancement (red arrow) without significant edema and intact tumor-brain interface representing benignity of tumor. It is extending into right cavernous sinus and encasing the ipsilateral internal carotid artery superomedially. Superiorly it is compressing the optic chiasma and inferiorly abutting the roof of sphenoid sinus.

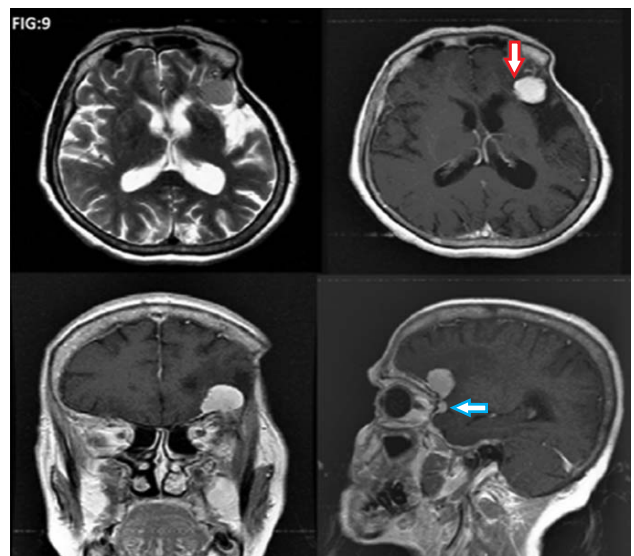


Figure 9: RECURRENT MENINGIOMA ALONG ROOF OF LEFT ORBIT

MRI of 60 years old female with past history of brain surgery for meningioma; Axial T2 and axial, coronal and sagittal post Gd images. Recurrence of meningioma is seen along roof of left orbit (red arrow) extending into frontotemporal region as well as involving part of greater wing of sphenoid. It is returning T2 isointense signal and showing homogeneous post contrast enhancement. Another new developed meningioma is seen adjacent to it (blue arrow). Post-surgical changes are seen in fronto-temporo-parietal bones and soft tissues.

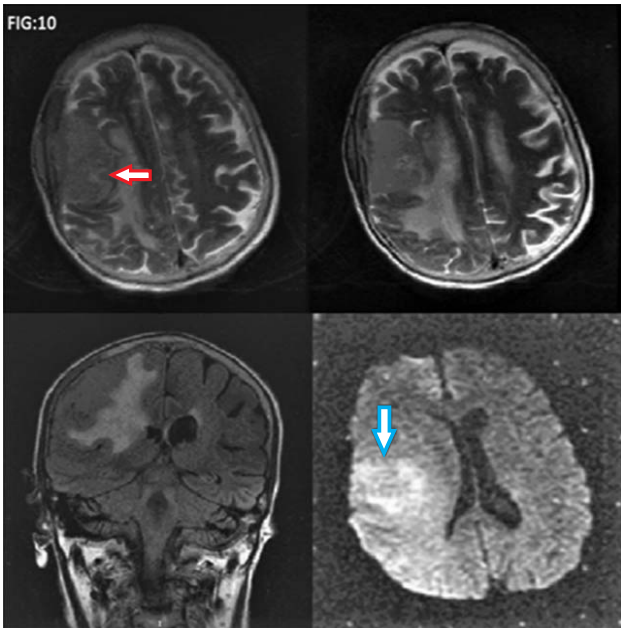


Figure 10: MENINGIOMA ALONG RIGHTFRONTOPARIETAL BONE (CEREBRAL CONVEXITY)

MRI Brain of 60 years old male; axial T2 and DWI, as well as coronal FLAIR images showing meningioma along right frontoparietal region with atypical features like partial disruption of tumor-brain interface (red arrow) and significant vasogenic edema with diffusion restriction (blue arrow). It is compressing ipsilateral lateral ventricle and associated with hyperostosis of right frontoparietal bone.

pituitary gland and graded them in 1-4 in order of degree of tumor enhancement. Vascularity 1 show the low enhancement compared to the dural sinuses, especially the superior sagittal sinus (Fig.8) represent benignity of tumor in contrary to Vascularity 4 which show intense tumor enhancement with high signal compared to the superior sagittal sinus (green arrow) represent atypical/malignant nature of tumor (Fig.6).

Conflict of Interest: None

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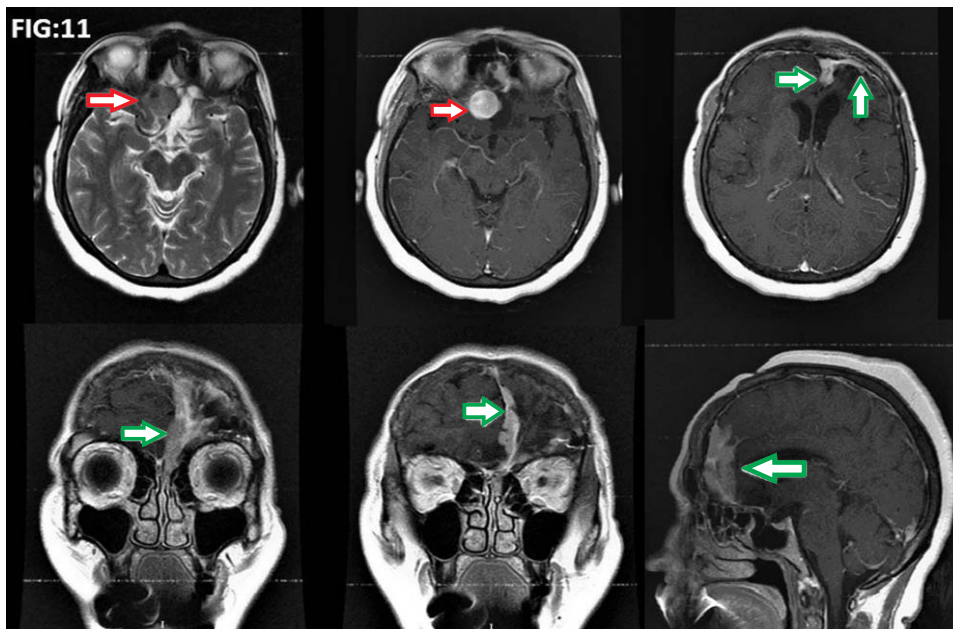



Figure 11: MENINGIOMA EN PLAQUE AND RIGHT PARAFALCINE

MRI Brain of 40 years old female; axial T2 as well as axial, sagittal and coronal post-Gd images showing meningioma along right parafalcine region of frontal lobe returning T2 isointense signals with homogeneous post contrast enhancement (red arrow) and causing midline shift. Enhancing nodular dural thickening is seen along falx cerebri and left frontal lobe representing meningioma en plaque (greenarrow).

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