

Cyst with an Enhancing Nodule: An Atypical Presentation of Angiomatous Meningioma

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ABSTRACT

Angiomatous meningioma is a rare and histologically distinct subtype of meningioma, comprising fewer than 3% of all meningiomas, that poses a significant diagnostic challenge due to its deceptively aggressive radiological appearance. Unlike the majority of World Health Organisation (WHO) Grade 1 meningiomas, this subtype frequently demonstrates imaging characteristics more commonly associated with high-grade or malignant intracranial neoplasms, including cystic degeneration, an enhancing mural nodule, disproportionate peritumoral oedema, and mass effect with midline shift, features that can readily mislead the treating clinician toward a presumptive diagnosis of a more sinister lesion. We present the case of a 51-year-old male with a two-year history of progressive headache and a three-month history of personality change characterised by episodic rage and expressive dysphasia, in whom neuroimaging demonstrated a large right frontal cystic lesion with an intensely enhancing nodule adherent to the falx cerebri and surrounding oedema. Gross total resection was achieved via right frontal craniotomy at Simpson Grade I, and histopathological analysis confirmed the diagnosis of angiomatous meningioma, WHO Grade 1, characterised by a predominance of vascular channels with interspersed meningothelial cells. This case underscores the importance of including angiomatous meningioma in the differential diagnosis of cystic intracranial lesions with enhancing mural nodules, particularly when attached to dural structures, and highlights that radical surgical resection remains both the diagnostic and therapeutic cornerstone, carrying an excellent long-term prognosis.

Keywords: Cystic meningioma, Enhancing nodule, Falx meningioma, Peritumoral oedema

CASE REPORT

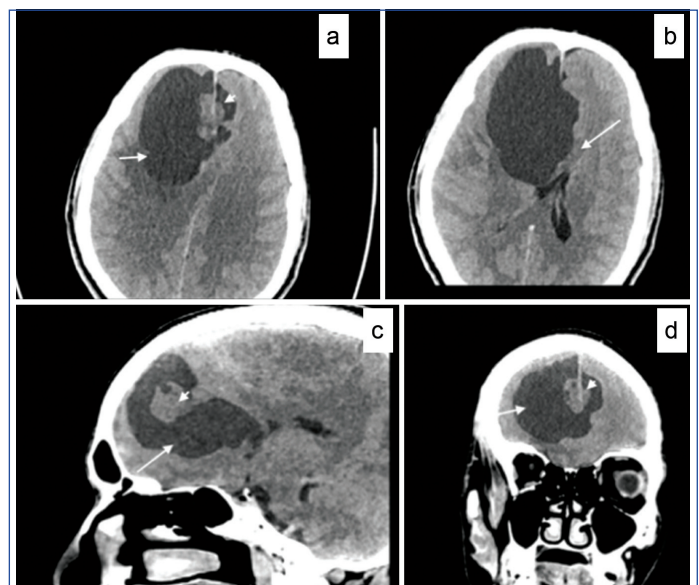
A 51-year-old right-handed male presented to the neurosurgery outpatient department with a two-year history of progressive headache and a three-month history of personality changes. He had no significant past medical history, no family history of intracranial neoplasms, and was not on any regular medications. There were no known drug allergies.

On neurological evaluation, the patient demonstrated difficulty retrieving words and names (anomia) and episodic behavioural dysregulation, manifesting as bouts of rage, likely attributable to right frontal involvement. On general neurological examination, the patient was alert and oriented. Muscle power was 5/5 in all four limbs. Cranial nerve examination was unremarkable. Pronator drift was positive on the left side, indicating a subtle upper motor neuron deficit. Gait was normal. No papilloedema was noted on fundoscopy.

Contrast-Enhanced CT (CECT) Brain [Table/Fig-1]: A well-defined cystic lesion was identified in the right frontal region, extending across the midline via the anterior falx to the left side. The lesion was extra-axial. A heterogeneously enhancing solid component, measuring 8×6×6 mm, was identified within the cystic lesion, adherent to the falx, and more prominent on the right side. Minimal perilesional oedema was present. The mass effect was evidenced by a left sided midline shift and compression of the frontal horns of both lateral ventricles (right > left). Additionally, [Table/Fig-1b] (arrow) shows subfascial herniation from right to the left side.

Contrast-enhanced MRI (CEMRI) Brain [Table/Fig-2]: MRI confirmed a cystic extra-axial right frontal lesion that mildly extended to the left across the anterior falx. The cystic component was hyperintense on T1-weighted imaging, isointense on T2-weighted imaging, and suppressed on FLAIR sequences, consistent with proteinaceous fluid or modified CSF. The solid mural nodule (8×6×6 mm) appeared mildly hypointense on T2-weighted imaging and hyperintense on FLAIR, with intense post-contrast enhancement.

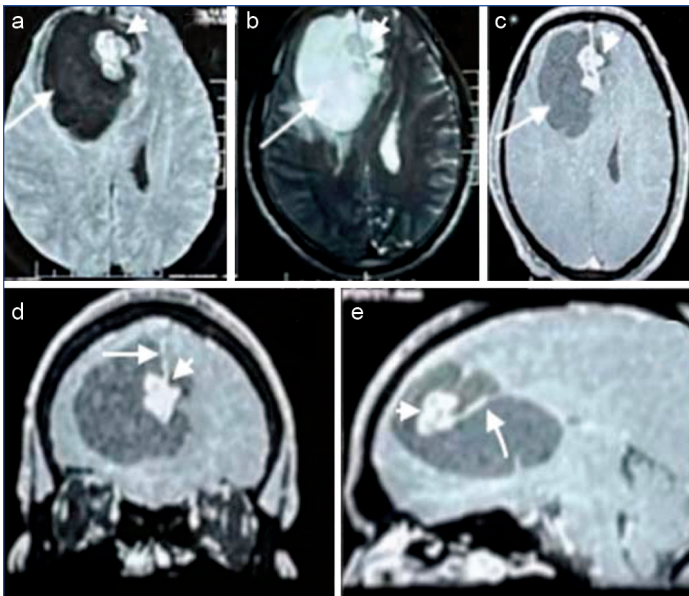
Minimal perilesional oedema and a mild left-sided midline shift, right to left subfalcine herniation with bilateral frontal horn compression were noted. No dural tail was identified.



[Table/Fig-1]: Preoperative Contrast-Enhanced CT (CECT) of the brain: a) Axial image showing mural nodule (arrow head) and cyst (arrow); b) Axial image showing subfalcine herniation (arrow); c) Sagittal image showing mural nodule (arrow head) and cyst (arrow); d) Coronal image showing mural nodule extending on both sides of the falx (arrow head) and cyst (arrow).

The imaging pattern, a cystic lesion with a small, intensely enhancing mural nodule, was atypical for a falcine meningioma and prompted a broad differential diagnosis, including haemangioblastoma, pilocytic astrocytoma, cystic glioma, and metastasis. The extra-axial dural attachment and falcine origin were the primary clues to the diagnosis of meningioma.

After review of imaging and multidisciplinary discussion, the patient was scheduled to undergo an elective right frontal craniotomy and



[Table/Fig-2]: Preoperative Contrast-Enhanced MRI (CEMRI) of the brain: a) T1-weighted axial image showing a hypointense cystic lesion (arrow) in the right frontal region with a hyperintense mural nodule (arrowhead); b) T2-weighted axial image showing a hyperintense cystic component (arrow) and a mildly hypointense solid nodule (arrowhead); c) FLAIR sequence demonstrating suppression of the cystic component (arrow) and hyperintense nodule (arrowhead); d) Post-contrast T1-weighted coronal image showing intense enhancement of the mural nodule (arrowhead) along the falx (arrow); e) Post-contrast T1-weighted sagittal image showing the mural nodule (arrowhead) along the falx (arrow).

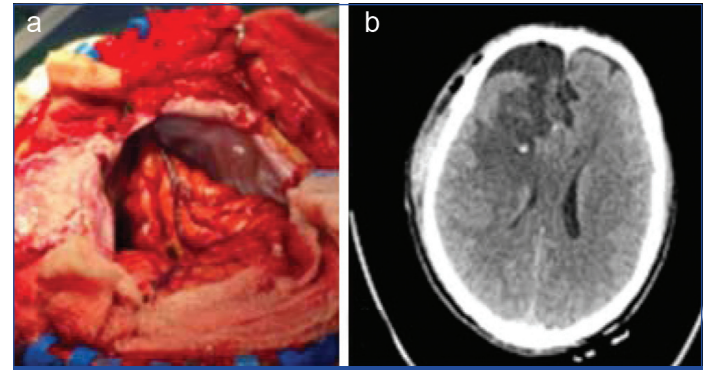
excision of the lesion. Intraoperative navigation and ultrasound were utilised to localise the cyst and identify the optimal cortical trajectory, given the deep location of the mural nodule.

During surgery, the brain was noted to be bulging. A small corticotomy was performed. Upon entering the cyst, amber-coloured fluid was encountered and evacuated. At the depth of the cyst, a reddish, firm mass adherent to the falx was identified. The nodule was extremely vascular, deriving its blood supply from falcine branches, and was friable to the touch but clearly demarcated from the surrounding brain parenchyma. Gross total resection with removal of the dural attachment was achieved (Simpson Grade I excision). Intraoperatively, significant brain sagging was observed following cyst decompression, with an identified risk of bridging vein avulsion; thorough irrigation and haemostasis were performed [Table/Fig-3a].

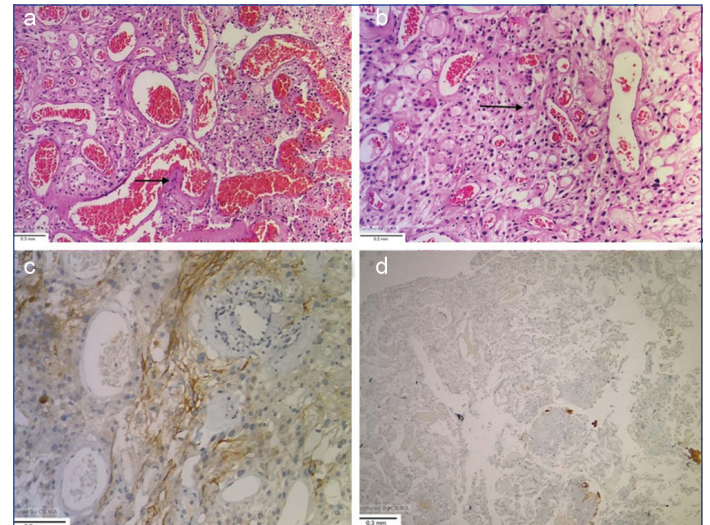
The patient was extubated on the operating table and had an uneventful postoperative course. His headache resolved, and there were no postoperative neurological deficits. He was discharged on postoperative day 6 in stable condition. At the one-month outpatient follow-up, the patient reported significant improvement in his executive function and cessation of episodic rage. Postoperative neuroimaging (CT) at one month postsurgery confirmed gross total resection with no residual tumour [Table/Fig-3b].

Histopathology [Table/Fig-4] demonstrated a tumour with a predominance of thin-walled and thick-walled blood vessels of varying calibres, some with hyalinised walls. Meningothelial tumour cells were interspersed between the vascular channels in small clusters and syncytial patterns. Occasional degenerative nuclear atypia was noted; however, no mitotic figures, necrosis, or small cell changes were identified. The Ki-67/MIB-1 proliferation index was

low. Immunohistochemistry showed positive staining for Epithelial Membrane Antigen (EMA) with a membranous pattern and negative staining for Glial Fibrillary Acidic Protein (GFAP). The appearance was consistent with an angiomatous meningioma, WHO grade 1.



[Table/Fig-3]: a) Intraoperative image post-resection of the tumour showing brain sagging; b) Postoperative CT scan of the brain showing complete tumour resection.



[Table/Fig-4]: Histopathology and immunohistochemistry of angiomatous meningioma: a) H&E stain, x100: Tumour showing numerous blood vessels of varying calibres with some hyalinised vessel walls (arrow); b) H&E stain, x200: Meningothelial tumour cells with occasional degenerative nuclear atypia, moderate eosinophilic cytoplasm (arrow). No mitosis, small cell changes, or necrosis was identified; c) EMA immunohistochemistry: positive membranous staining in tumour cells, confirming meningothelial origin; d) GFAP immunohistochemistry: negative staining, excluding glial differentiation.

DISCUSSION

Meningiomas are among the most common primary intracranial tumours, accounting for approximately 30-40% of all central nervous system neoplasms. Angiomatous meningioma is a rare histological variant, constituting approximately 1.85%-2.59% of all meningiomas [1]. It is characterised by a predominance of vascular channels with interspersed meningothelial tumour cells. Although not recognised as a distinct subtype in the 2021 WHO Classification of CNS Tumours, angiomatous meningioma presents a unique clinical and diagnostic challenge [2].

The most common location is the cerebral convexity (42-68%), followed by the parasagittal/falcine region (4-34%) and skull base locations (2-15%) [3].

[Table/Fig-5] shows the key findings of the reported studies [1,3-6].

Parameters	Hasselblatt M et al., 2004 (n=38) [6]	Liu Z et al., 2013 (n=27) [5]	Ben Nsir A et al., 2016 (n=58) [4]	Hua L et al., 2017 (n=93) [3]	Verma PK et al., 2021 (n=30) [1]
Demographics					
Incidence (% of all meningiomas)	2.1% (38/1809)	NR	NR	2.59% (93/4286)	2.46%
Mean/median age (years)	64 (median; range 38-83)	51.8 (mean; range 24-72)	53 (median; range 8-78)	51.56±11.08 (mean; range 16-80)	49.27±13.85 (mean; range 28-81)
Sex ratio (M:F)	16:22 (1:1.37)	14:13 (1.08:1)	22:36 (1:1.63)	45:48 (1:1.07)	21:9 (2.3:1)
Mean symptom duration	NR	NR	6 months	10.72±22.63 months	12.8±20.01 months

Tumour location					
Most common site	Convexity 16 (42%)	Convexity 18 (66.7%)	Convexity 34 (58.6%)	Convexity 64 (68.82%)	Convexity 14 (46.7%)
Falx/parasagittal	13 (34%)	NR	12 (20.7%)	11 (11.83%)	13 (43.3%)
Cystic changes on radiology					
Cystic changes present	NR	4/27 (14.8%)	29/58 (50%)	48/93 (51.61%)	5/30 (16.7%)
Peritumoral Brain Oedema (PTBE)					
PTBE present	26/35 (74%)	Three, seventeen and seven cases showed mild, moderate and severe peritumoral oedema, respectively.	47/58 (81%)	81/93 (87.1%)	27/30 (90%)
Histopathology					
Mean Ki-67/ MIB-1 index	2.4%	1.9%	NR	0.52%±0.89%	<2% in all cases
PR positivity	66%	NR	NR	10 (10.75%)	3/5 IHC cases

[Table/Fig-5]: Review of previous studies on angiomatous meningioma [1,3-6].

AM: Angiomatous meningioma; RT: Radiotherapy; PR: Progesterone receptor

CONCLUSION(S)

Angiomatous meningioma is a rare but clinically important subtype of meningioma that can present with an aggressive radiological picture, including large cystic components, prominent peritumoral oedema, and a small, intensely enhancing mural nodule.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Apr 07, 2026
- Manual Googling: May 22, 2026
- iThenticate Software: May 25, 2026 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Mar 29, 2026**

Date of Peer Review: **Apr 25, 2026**

Date of Acceptance: **May 28, 2026**

Date of Publishing: **Jul 01, 2026**