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Case Series

Radiology Section

MRI Evaluation of Unusual Presentations of Intracranial Meningioma: A Case Series

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ABSTRACT

Intracranial meningiomas, though typically slow-growing and benign, can present significant diagnostic challenges when located in atypical anatomical sites or associated with unusual clinical manifestations. This case series highlights five patients with meningiomas arising in uncommon regions, including the olfactory groove, intraventricular space, sinonasal cavity, and anterior and posterior cranial fossae. Clinical presentations ranged from anosmia and visual disturbances to cranial nerve deficits and features of raised intracranial pressure. Advanced imaging, particularly MR spectroscopy, was instrumental in diagnosis, demonstrating characteristic choline and alanine peaks that differentiated meningiomas from other neoplasms. Some lesions displayed heterogeneous enhancement, irregular margins, and bone erosion, mimicking aggressive or non-meningothelial tumours. Recognition of these atypical radiological and clinical variants is crucial for accurate diagnosis, optimal surgical planning, and improved patient outcomes.

Keywords: Atypical presentation, Cerebello-pontine angle, Magnetic resonance imaging spectroscopy, Olfactory groove, Paranasal sinuses

INTRODUCTION

Meningiomas make up around 30% of all brain tumours and are the most prevalent primary intracranial neoplasms, which originate from the meninges' arachnoid cap cells and are usually benign (WHO Grade I), though there are atypical and anaplastic variants (Grades II and III) that behave more aggressively and have higher recurrence rates [1]. With a female-to-male ratio of roughly 2:1, these tumours primarily affect middle-aged women, which may indicate a hormonal component [2].

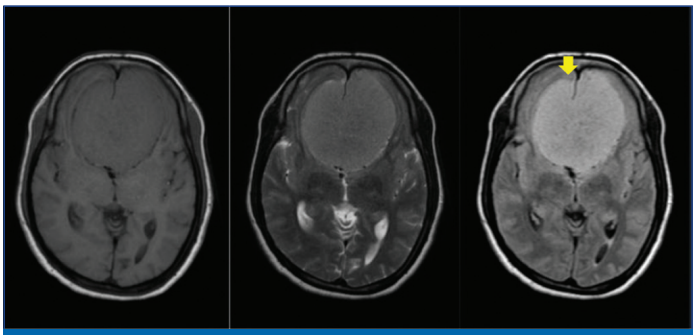
Radiologically, meningiomas typically show up as distinct extra-axial masses with uniform post-contrast enhancement. They can also show symptoms like hyperostosis of nearby bone [3]. Advanced imaging methods such as Magnetic Resonance Spectroscopy (MRS), Diffusion-Weighted Imaging (DWI), and Susceptibility-Weighted Imaging (SWI) frequently support Magnetic Resonance Imaging (MRI), especially when contrast is used [4].

Meningiomas can occur in uncommon places such as the intraventricular region, olfactory groove, Cerebello-Pontine Angle (CPA), or even extend into the paranasal sinuses and the base of the skull. These can mimic other pathologies or produce unusual symptoms, even though frontal convexity and parasagittal locations are common [5].

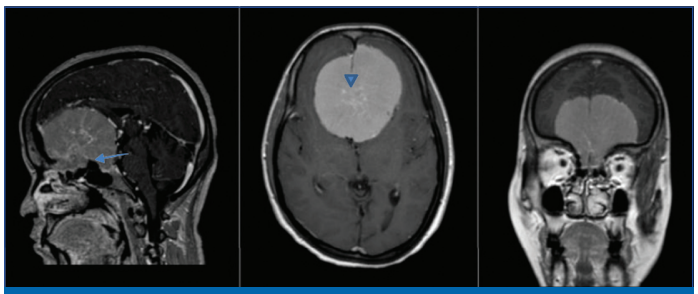
CASE REPORTS

Case 1: Giant Olfactory Groove Meningioma

A 34-year-old woman presented with headaches, sporadic fevers, and a progressive loss of vision in both eyes for three months. Clinical examination revealed optic disc pallor, left Relative Afferent Pupillary Defect (RAPD), and horizontal nystagmus. An MRI showed a distinct extra-axial lesion that was centred in the anterior craniofossa and had a maximum size of about 6.3 cm. There were regions of limited diffusion and calcification, and the lesion was T1 isointense and T2/FLAIR hyperintense [Table/Fig-1a]. On post-contrast imaging, it displayed a spoke-wheel-like appearance and avid, nearly homogeneous enhancement [Table/Fig-1b]. Compression of the optic chiasm, bilateral lateral ventricles, and displacement of the corpus callosum and anterior cerebral arteries were among the notable mass effects.



[Table/Fig-1a]: Axial T1W/T2W/FLAIR images show a large, well-defined, extra-axial mass centred in the anterior cranial fossa with heterogeneous hyperintensity (yellow arrow) and perilesional oedema causing compression of the frontal horns of bilateral lateral ventricles.

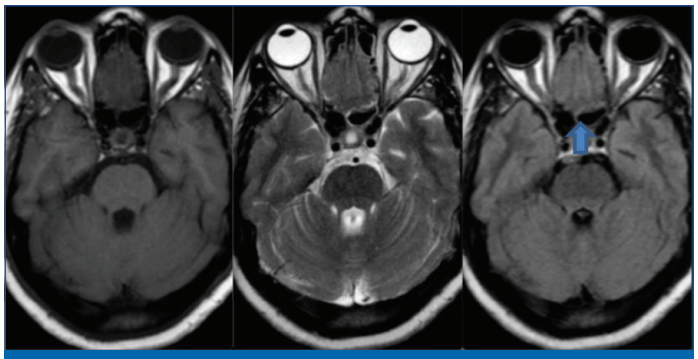


[Table/Fig-1b]: Post-contrast T1-weighted sagittal/axial/coronal images reveal avid homogeneous enhancement with spoke-wheel pattern (arrow head) and compression of the optic chiasm (blue arrow).

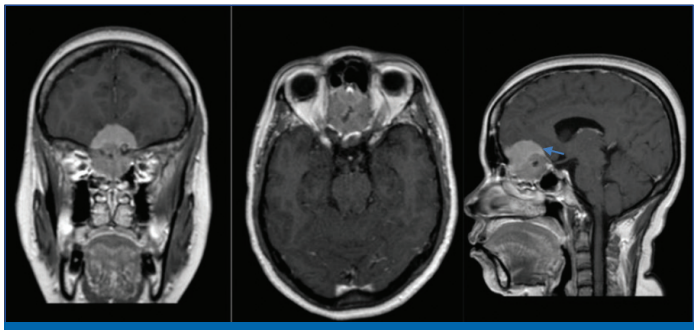
Sinonasal Meningioma

Without any accompanying visual symptoms or trauma, a 38-year-old woman reported a three-year history of anosmia and a 10-day history of headache. A distinct, extra-axial lesion in the bilateral ethmoid sinuses, measuring roughly 3.3 × 2.7 × 2.6 cm, was seen on MRI brain imaging. The cribriform plate, ethmoid trabeculae, medial orbital walls, and olfactory groove were all eroded by the lesion. Superior extension was present, along with surrounding

oedema and compression of the basifrontal lobes [Table/Fig-1c,d]. The lesion was indicative of a neoplastic process, most likely a sinonasal meningioma, and it completely obscured the bilateral spheno-ethmoidal recesses.



[Table/Fig-1c]: Axial T1W/T2W/FLAIR images reveal a lesion occupying bilateral ethmoid sinuses (blue arrow) with bony erosion of cribriform plate and ethmoid trabeculae.



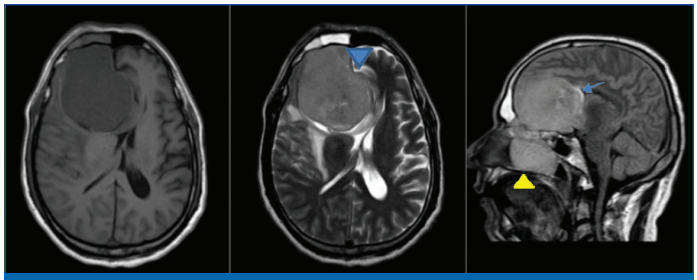
[Table/Fig-1d]: Post-contrast T1-weighted coronal/axial/sagittal images reveal superior extension into the anterior cranial fossa with compression of the Basifrontal lobes (blue arrow).

Large Anterior Cranial Fossa Meningioma with Extension into The Sinus and Nasal Cavity

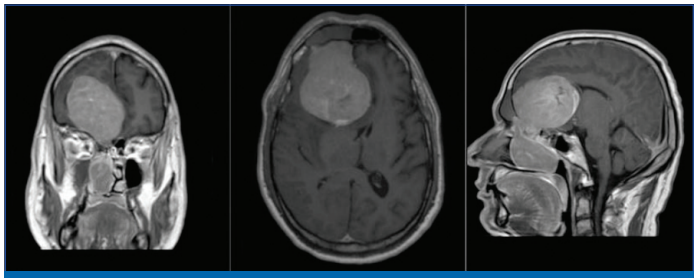
A 52-year-old male presented with complaints of a nosebleed two months back, complaints of loss of memory for 15 days, complaints of tremors for one month, and complaints of palpitations and headache for one month. MRI study revealed a well-defined, extraaxial, T1 isointense, T2/FLAIR heterogeneously hyperintense lesion measuring ~5.1x5.8x6.6 cm (CCxTRxAP) centred in the anterior cranial fossa on the right side. On DWI/ADC maps, subtle peripheral diffusion restriction was noted. On the SWI sequence, no obvious blooming foci were noted within. On post-contrast sequences, heterogeneous enhancement was noted predominantly, with few central linear non-enhancing areas. On MRS, the choline peak is noted at 3.2 ppm. Mass effect was noted in the form of compression of bilateral (right >left) basifrontal lobes, frontal horns of bilateral (right >left) lateral ventricles, subfalcine herniation to the left side and midline shift of ~2 cm to the left. Superiorly, the lesion was seen to compress and displace the genu and rostrum of the corpus callosum to the left. Inferiorly, the lesion was seen to cause widening of the olfactory groove with erosion of the right cribriform plate and extension into the right ethmoid sinus and right nasal cavity. There was surrounding T2/FLAIR hyperintensity noted in the right frontal lobe (perilesional oedema) [Table/Fig-1e-g].

Case 2: Intraventricular Meningioma

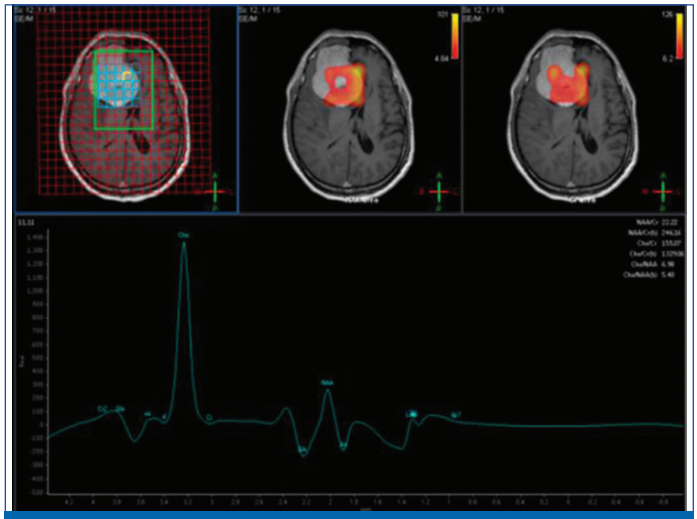
A 29-year-old woman reported with the complaint of a throbbing headache and a heavy head for a month. There were no symptoms of trauma, vomiting, or diplopia. A ~2.7 × 2.1 × 1.8 cm lesion in the left lateral ventricle's atrium was discovered by MRI [Table/Fig-2a]. With mild perilesional oedema and subtle restricted diffusion, the lesion appeared T1 isointense and heterogeneously hyperintense on T2/FLAIR. Near-homogeneous enhancement was shown by post-contrast imaging, and MRS showed increased choline peaks and decreased N-Acetyl Aspartate (NAA) [Table/Fig-2b,c]. There was no change in the midline. An intraventricular meningioma was preferred over a choroid plexus papilloma based on imaging features.



[Table/Fig-1e]: Axial T1W/T2W/FLAIR images reveal a T1 isointense/T2/ FLAIR heterogenously hyperintense lesion centered in the right anterior cranial fossa. Mass effect is noted in the form of compression of bilateral (right >left) basifrontal lobes, frontal horns of bilateral lateral (right >left) lateral ventricles, subfalcine herniation (blue arrowhead) and midline shift to the left. Superiorly, the lesion is compressing the rostrum and genu of the corpus callosum (blue arrow) and inferiorly, the lesion causes widening of the olfactory groove with erosion of the right cribriform plate and extension into the right ethmoid sinus and right nasal cavity (yellow arrow head).



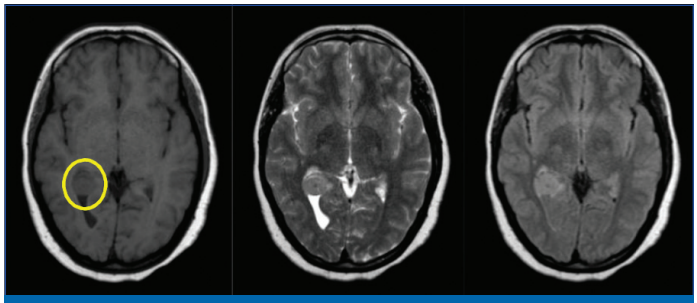
[Table/Fig-1f]: Post-contrast T1-weighted coronal/axial/sagittal images show heterogeneous enhancement with a few central linear non-enhancing areas.



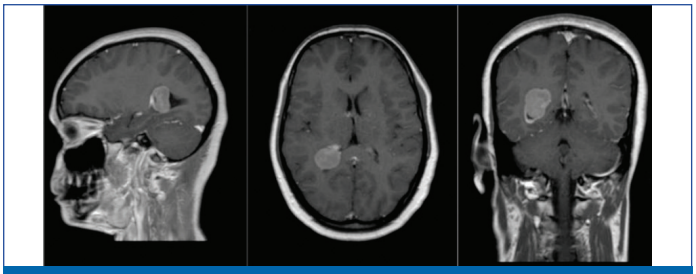
[Table/Fig-1g]: MR image of meningioma using multivoxel spectroscopy showing prominent choline peaks at 3.2 ppm, decreased N-acetyl aspartate at 2 ppm and absent Cr at 3.01 ppm.

Case 3: Gigantic Posterior Fossa Meningioma with Mass Effect and Hydrocephalus

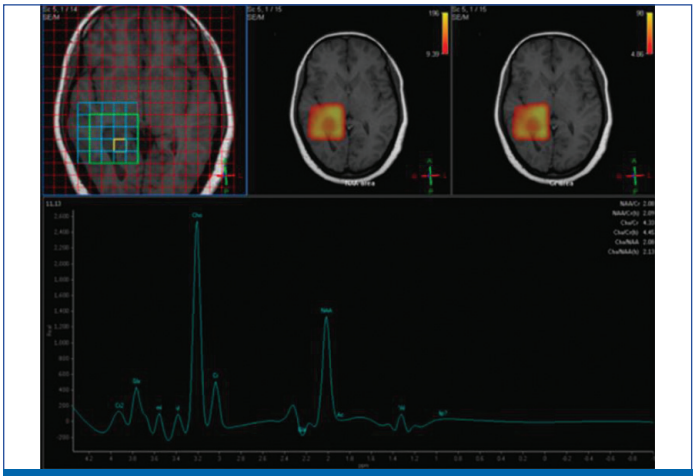
A 33-year-old male came in with a one-month history of tinnitus, headache, and vomiting along with facial numbness. An MRI of



[Table/Fig-2a]: Axial T1W/T2W/FLAIR images image demonstrates a heterogeneously Hyperintense lesion within the atrium of the right lateral ventricle (yellow circle) with minimal surrounding oedema.

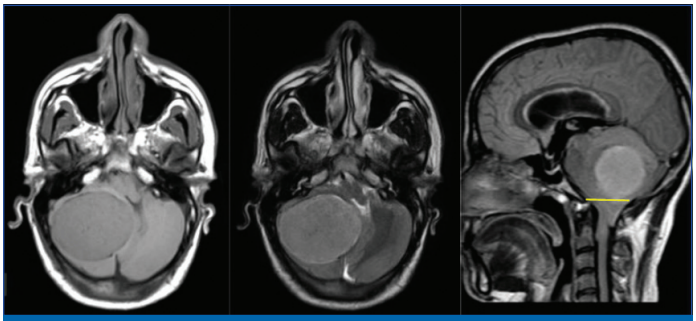


[Table/Fig-2b]: Post-contrast T1-weighted sagittal/axial/coronal image shows near-homogeneous enhancement of the intraventricular mass within the atrium of the right lateral ventricle.

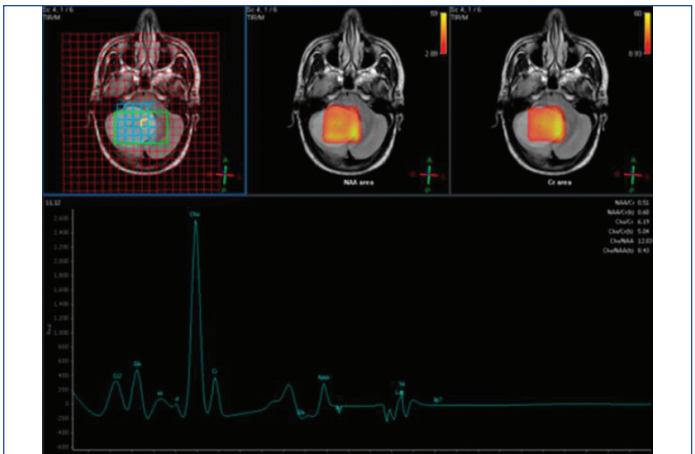


[Table/Fig-2c]: A representative MR image of meningioma using multivoxel spectroscopy showing prominent choline peaks at 3.2 ppm, decreased N-acetyl aspartate at 2.02 ppm and reduced Cr at 3.01 ppm.

the brain revealed a sizable extra-axial lesion, roughly 5.7 × 4.8 × 4.8 cm, in the right cerebellar hemisphere. The lesion had mild perilesional oedema and was T1 iso- to hypointense and T2/FLAIR hyperintense [Table/Fig-3a,b]. Both magnetic susceptibility artefacts



[Table/Fig-3a]: Axial T1W/T2W/FLAIR images illustrate a large hyperintense mass in the right cerebellar hemisphere, causing compression of the fourth ventricle with associated mass effect and mild tonsillar herniation (yellow line).



[Table/Fig-3b]: Image represents a multivoxel MR spectroscopy showing increased Choline peaks at 3.2 ppm, decreased N- Acetyl-aspartate at 2.02 ppm and decreased Cr at 3.01 ppm. The alanine doublet inversion at 1.47 ppm is suggestive of meningioma.

and restricted diffusion were absent. The fourth ventricle was compressed by the mass, which led to obstructive hydrocephalus and lateral and third ventricle dilatation. In addition, the brainstem (midbrain and pons) was anteriorly displaced, and the superior, middle, and inferior right cerebellar peduncles were compressed and displaced. The right foramen of Luschka and several posterior fossa cisterns (prepontine, ambient, and cerebellomedullary) were clearly effaced. A tonsillar herniation (~1.2 cm) and a midline shift of approximately 2 cm to the left were observed. These results show increased intracranial pressure and a high mass effect. A giant posterior fossa meningioma was determined to be the lesion; it was most likely benign in histology, but because of its unusual size and location, it produced a potentially fatal mass effect.

DISCUSSION

Visual disturbances and anterior skull base invasion were observed in a case of olfactory groove meningioma. MRS revealed a choline peak in the lesion's spoke-wheel enhancement pattern. The literature emphasises similar imaging findings, such as peritumoural oedema and strong enhancement, especially in lesions that extend into the paranasal sinuses or are linked to cribriform plate erosion [6].

Elbadry A et al., reported that visual deterioration, headaches, and significant mass effect on the optic apparatus and frontal lobes are common findings in tumours larger than 6 cm, findings that match the compression of the optic chiasm and displacement of surrounding structures seen in this case [7].

The MRI findings of the present case, i.e., cribriform plate and ethmoid erosion with extension into the olfactory groove and frontal lobe compression, correlate with Abir M et al., description of sinonasal meningiomas, which commonly show adjacent bony erosion and ethmoidal involvement [8].

The present case of a large anterior cranial fossa meningioma with extension into the ethmoid sinus and nasal cavity shows several radiologic and clinical parallels with the features described by Ikhuoriah T et al., in their report on olfactory groove meningioma [9]. In both cases, the lesion originated from the anterior cranial fossa/olfactory groove region and demonstrated inferior extension toward the paranasal sinuses with associated bony remodeling. Imaging revealed well-defined extra-axial masses with homogeneous contrast enhancement and a clear dural attachment, mirroring the classic radiologic profile highlighted by Ikhuoriah T et al., [9].

As observed by Padmaja S et al., who emphasised sinonasal extension and hyperostosis as a trait of anterior cranial fossa meningiomas, olfactory groove meningiomas are frequently linked to hyperostosis [10]. They may manifest with anosmia, as in the case of sinonasal meningioma in the present case.

Choline was elevated and NAA was decreased in the current case series of intraventricular meningioma, which appeared T1-Isointense and T2/FLAIR hyperintense. These results are consistent with the findings of Fotakopoulos G et al., who reported that intraventricular meningiomas are uncommon (2-5%) and usually exhibit homogeneous post-contrast enhancement and isointensity on T1 [11].

An uncommon but recognised symptom of sinonasal meningioma was observed in a case that included anosmia and ethmoid erosion. The diagnostic utility of MRS and careful evaluation of bone changes was further supported by reports by Padmaja S et al., and Kunimatsu A et al., that sinonasal meningiomas are frequently misdiagnosed because of overlapping features with esthesio neuroblastoma or other sinonasal masses [10,12].

Combining MRI with cutting-edge techniques like MRS and perfusion imaging can increase diagnostic confidence, particularly in cases that do not fit the traditional radiological profile [10].

Case/type	Patient details & clinical presentation	Key imaging findings	Management planned	Outcomes assessed
Case 1 (i): Giant olfactory groove meningioma	A 34-year-old female with headache, fever, progressive bilateral visual loss; optic disc pallor and left Relative Afferent Pupillary Defect (RAPD) on examination.	Large (6.3 cm) extra-axial lesion in the anterior cranial fossa; T1 isointense, T2/FLAIR hyperintense with spoke-wheel enhancement; optic chiasm and corpus callosum compression; bilateral ventricular compression; anterior cerebral artery displacement.	Surgical intervention advised; patient declined surgery and opted for alternative therapy.	Deterioration of condition; patient passed away ~6 months later.
Case 1 (ii): Sinonasal meningioma	A 38-year-old female with 3-year anosmia and 10-day headache; no visual symptoms or trauma.	Lesion (~3.3×2.7×2.6 cm) involving bilateral ethmoid sinuses with erosion of cribriform plate and ethmoid trabeculae; superior extension into anterior cranial fossa compressing basifrontal lobes; complete blockage of spheno-ethmoidal recesses.	Endoscopic transnasal resection with skull base reconstruction using navigation guidance.	Complete tumour removal; postoperative symptomatic improvement.
Case 1 (iii): Large Anterior cranial fossa meningioma with sinonasal extension	A 52-year-old male with nosebleed (2 months), tremors, memory loss (15 days), palpitations, and headache.	Extra-axial lesion (~5.1×5.8×6.6 cm) in right anterior cranial fossa; T1 isointense, T2/FLAIR heterogeneously hyperintense; heterogeneous enhancement with central non-enhancing areas; erosion of right cribriform plate with extension into right ethmoid sinus and nasal cavity; subfalcine herniation (~2 cm left shift).	Tumour excision via subfrontal approach; intraoperative neuronavigation and haemostatic control for vascular involvement.	Significant postoperative symptomatic improvement; minimal morbidity.
Case 2: Intraventricular meningioma	A 29-year-old female with 1-month throbbing headache and heavy-headedness; no vomiting, diplopia, or trauma.	Lesion (~2.7×2.1×1.8 cm) in left lateral ventricle atrium; T1 isointense, T2/FLAIR hyperintense; mild perilesional oedema; near-homogeneous enhancement; elevated choline and reduced NAA on MRS.	Neuroendoscopic resection.	Headache resolved; postoperative recovery uneventful.
Case 3: Gigantic posterior fossa meningioma with mass effect & hydrocephalus	A 33-year-old male with tinnitus, headache, vomiting, and facial numbness for 1 month.	Large (~5.7×4.8×4.8 cm) right cerebellar extra-axial lesion; T1 iso-hypointense, T2/FLAIR hyperintense; compressing fourth ventricle causing obstructive hydrocephalus; tonsillar herniation (1.2 cm); 2 cm leftward shift; elevated choline, decreased NAA, alanine doublet on MRS.	Patient underwent surgery at an outside facility.	Lost to follow-up.

[Table/Fig-4]: Summary of cases, key findings, management, and outcomes.

CONCLUSION(S)

This case series concludes by highlighting that the variety of radiological manifestations of meningiomas in unusual sites can present serious diagnostic difficulties. For precise identification and differentiation from other Intracranial lesions, multimodal imaging-especially MRI with sophisticated sequences, is essential. To guide appropriate surgical planning and improve patient outcomes, it is imperative to recognise these atypical features.

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