Extradural Resection of a Cavernous Sinus Hemangioma via Parkinson's Triangle: A Case Report Highlighting the Surgical Anatomy of the Middle Fossa

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Introduction

Lesions of the cavernous sinus remain among the most formidable challenges in skull base neurosurgery due to the compact arrangement of cranial nerves (III, IV, V1, V2, and VI) and the intracavernous segment of the internal carotid artery (ICA). Even benign lesions may result in significant neurological morbidity due to mass effect or treatment-related injury.

Cavernous sinus hemangiomas (CSHs) are rare benign vascular tumors, accounting for less than 2% of all cavernous sinus lesions. Clinically, CSHs often present with progressive cranial nerve deficits, particularly involving ocular motor function and trigeminal sensory disturbances. Radiologically, they characteristically exhibit intense, progressive contrast enhancement on MRI, often mimicking meningiomas or schwannomas, which may complicate preoperative diagnosis.

Although stereotactic radiosurgery has emerged as an alternative treatment, surgical resection remains the only definitive therapy for selected cases, particularly in patients with progressive symptoms, diagnostic uncertainty, or mass effect. Among surgical corridors, the extradural approach through Parkinson's triangle offers direct access to the lateral wall of the cavernous sinus while minimizing brain retraction.

Case Report

A 46-year-old woman presented with a long-standing history of headache. In December 2024, she developed new-onset neurological symptoms, including left trigeminal hemifacial paresthesia, diplopia, and progressive visual blurring in the left eye. Neurological examination revealed left-sided ophthalmoplegia, with paresis of the third, fourth, and sixth cranial nerves, associated with left proptosis. Sensory testing demonstrated left trigeminal hypoesthesia, more pronounced in the maxillary division (V2). Confrontation visual field examination showed severe visual impairment in the left eye, with inability to count fingers in any quadrant. Computed tomography (CT) of the brain revealed a well-circumscribed extra-axial left parasellar mass with a dural-based attachment to the cavernous sinus. The lesion caused obliteration of the superior orbital fissure, expansion of the inferior orbital fissure, and remodeling of the left sphenoid sinus walls, as well as mild caliber reduction of the cavernous segment of the left internal carotid artery, without evidence of flow compromise. Magnetic resonance imaging (MRI) of the brain demonstrated a well-defined extra-axial expansile lesion centered in the left cavernous sinus with extension into Meckel's cave. The lesion exhibited hypointensity on T1-weighted images, hyperintensity on T2-weighted images, and intense, homogeneous, and progressive contrast enhancement. Radiological features highly suggestive of a cavernous sinus hemangioma. Given the progressive neurological deterioration and radiological characteristics, surgical resection was indicated. Preoperatively, a lumbar puncture was performed for cerebrospinal fluid drainage to facilitate cerebral relaxation. A left frontotemporal craniotomy was then performed, and an extradural approach was adopted. An anterior clinoidectomy was not required. The middle meningeal artery was identified, coagulated, and divided at the foramen spinosum. The meningo-orbital fold was incised, allowing extradural peeling of the lateral wall of the cavernous sinus and the middle cranial fossa. The greater superficial petrosal nerve, trigeminal nerve branches, and the trochlear nerve were identified and preserved. Through Parkinson's triangle, a reddish, soft, highly vascular lesion was visualized within the cavernous sinus. Careful circumferential dissection allowed en bloc resection of the lesion, with preservation of adjacent neurovascular structures. The patient recovered completely from symptoms, including trigeminal function, visual acuity and eye movements. Histopathological analysis confirmed the diagnosis of hemangioma, WHO grade I.

Figure 1. Preoperative computed tomography (CT) of the brain demonstrated a well-circumscribed extra-axial mass in the left parasellar region, with a dural-based attachment to the cavernous sinus and remodeling of the left sphenoid sinus walls, consistent with a slowly growing lesion. CT angiography showed no evidence of intracranial aneurysms or vascular malformations.

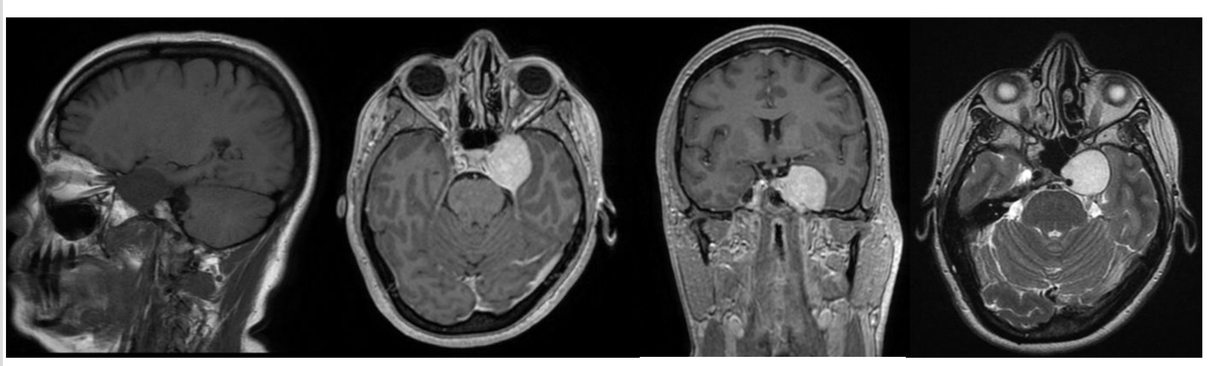

Figure 2. Magnetic resonance imaging (MRI) of the brain demonstrated a well-defined extra-axial expansile lesion centered in the left cavernous sinus, with extension into Meckel's cave. The lesion appeared hypointense on T1-weighted imagesand markedly hyperintense on T2-weighted images, and showed intense, homogeneous contrast enhancement on post-contrast sequences. These imaging characteristics are highly suggestive of a cavernous sinus hemangioma.

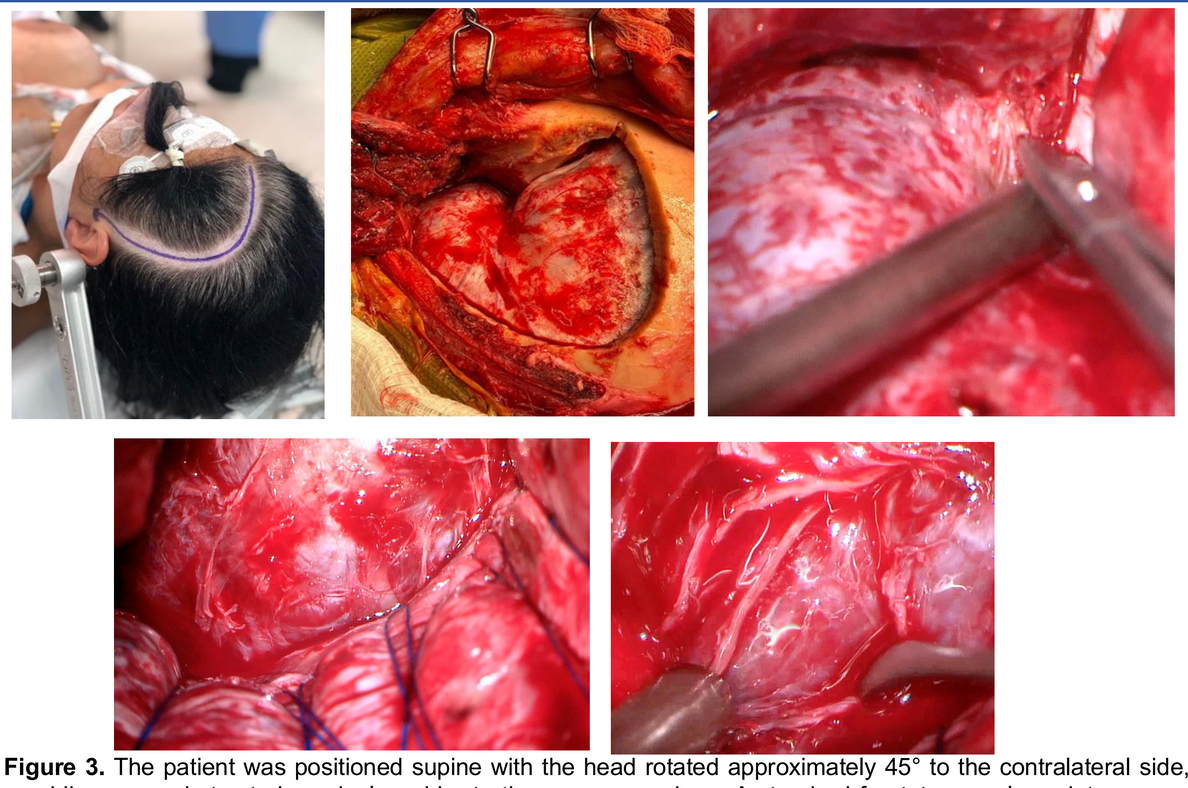

Figure 3. The patient was positioned supine with the head rotated approximately 45° to the contralateral side, providing an unobstructed surgical corridor to the cavernous sinus. A standard frontotemporal craniotomy was performed. The meningo-orbital band was identified, coagulated, and sectioned, allowing extradural dural peeling of the lateral wall of the cavernous sinus. During this maneuver, a reddish, soft, and highly vascular lesion was visualized within the cavernous sinus.

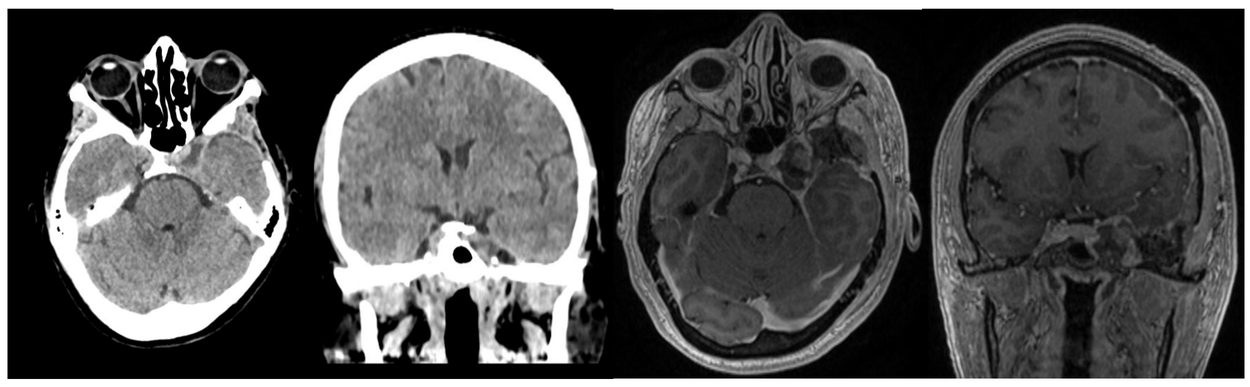

Figure 4. Postoperative axial and coronal cranial CT and contrast-enhanced MRI demonstrating a surgical cavity located anterior to the left temporal pole, corresponding to the extradural corridor used for tumor resection. Imaging confirms extensive resection of the previously described expansive lesion of the left cavernous sinus, with no evidence of residual tumor, hemorrhage, or ischemic complications.

Discussion

Cavernous sinus hemangiomas constitute a distinct pathological entity among cavernous sinus lesions, with biological behavior and surgical considerations that differ substantially from those of more common tumors such as meningiomas and schwannomas. Despite their benign histology, these lesions are characterized by marked vascularity, which historically rendered surgical resection hazardous. However, unlike infiltrative meningiomas, cavernous sinus hemangiomas are frequently well circumscribed and encapsulated, a feature that may permit en bloc resection when appropriate surgical corridors and meticulous technique are employed. Contemporary surgical series demonstrate that gross total resection is achievable in a high proportion of patients. Nevertheless, postoperative cranial nerve morbidity remains a major concern. Persistent or worsened ocular motor deficits—most commonly involving cranial nerves III, IV, and VI—have been reported in up to 70–80% of cases in some large series, reflecting the intimate relationship between these tumors and the neurovascular contents of the cavernous sinus. Although major disabling complications such as cerebral infarction or meningitis are uncommon in nonmeningiomatous lesions, the risk of significant intraoperative hemorrhage persists and has been associated with a small but measurable rate of perioperative mortality. In this context, the extradural approach through Parkinson's triangle offers several important advantages. By exploiting an interdural corridor, this technique allows direct access to the lateral compartment of the cavernous sinus while minimizing brain retraction and reducing venous bleeding from the cavernous plexus. Furthermore, the extradural route facilitates early identification and protection of critical cranial nerves and the intracavernous internal carotid artery. These advantages are particularly relevant for cavernous sinus hemangiomas, whose noninfiltrative nature and compressive growth pattern favor sharp dissection and controlled mobilization.

Nonetheless, surgical success is highly dependent on careful patient selection. Given the generally indolent natural history of cavernous sinus hemangiomas and the availability of alternative treatment modalities such as stereotactic radiosurgery, the indication for microsurgical resection must be individualized. Surgery should be reserved for patients with progressive or disabling neurological deficits, diagnostic uncertainty, or lesions causing significant mass effect. Overall, when performed in appropriately selected patients and guided by detailed anatomical knowledge of the cavernous sinus, the extradural approach via Parkinson's triangle represents a safe and effective surgical strategy for cavernous sinus hemangiomas, capable of achieving excellent tumor control with acceptable functional outcomes.

Conclusions

Cavernous sinus hemangiomas are among the few lesions within the cavernous sinus that may be safely resected with favorable outcomes. The extradural approach via Parkinson's triangle provides an effective and anatomically sound surgical corridor. Successful resection relies on meticulous microsurgical technique and comprehensive understanding of cavernous sinus anatomy. When these principles are respected, en bloc resection with excellent functional recovery is achievable.

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