

CASE REPORTS

SURGICAL TREATMENT AND PATHOHISTOLOGICAL CHARACTERISTICS OF CAVERNOUS SINUS MENINGIOMA

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ABSTRACT

INTRODUCTION: Meningiomas are among the most common primary brain tumors, generally following a benign course, and account for about 40% of central nervous system tumors. These tumors can develop in various locations, depending on the origin of the altered meningotheelial cells within the arachnoid layers. For this reason, there are numerous classification systems for meningiomas, with the most significant factors being tumor location and histological type. Cavernous sinus meningiomas are quite rare, occurring at a rate of approximately 2 cases per 100,000 people annually. The majority of tumors in the cavernous sinus are of meningeal origin.

Treatment options include microsurgical resection, with the goal of maximal tumor extirpation, although the delicate area of the cavernous sinus rarely allows for radical surgery. Other literature suggests that stereotactic radiosurgery (SRS) is an alternative method of treatment. This type of treatment is overtreated in processes with small tumor volume, which is not applicable in the presented clinical case due to the larger tumor volume.

CASE PRESENTATION: We present the case of a 49-year-old woman with a clinical presentation of double vision, difficulty focusing on objects, and mild ptosis of the left eyelid. Magnetic resonance imaging revealed a lesion in the left cavernous sinus, consistent with a cavernous sinus meningioma. The chosen treatment was microneurosurgical resection via a left pterygoid approach, combined with superior lateral orbitotomy and anterior clinoidectomy. Extradural access to the cavernous sinus allowed for a subtotal resection of the tumor.

RESULTS: Postoperatively, the neurologic status worsened on the part of the oculomotor nerves, and the patient was discharged from the neurosurgery department with evidence of complete ophthalmoplegia.

CONCLUSION: The aim of this case report is to present the features of microsurgical access to the cavernous sinus, to compare the surgical treatment with radiosurgery, and the possibilities of postoperative complications.

Keywords: cavernous sinus, meningiomas, fibrous meningioma, skull base, brain tumors

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INTRODUCTION WITH LITERATURE REVIEW

The parasellar region, located around the sella turcica, is challenging for microneurosurgical approaches due to the complexity of the anatomical structures it encompasses (1,2). This area is often affected by various lesions, including inflammatory processes, vascular diseases, and tumors. Parasel-



lar meningiomas are a common finding in this area, typically classified as WHO grade I, indicating their benign nature (3,4,5,6). Diagnosing cavernous sinus meningiomas involves conducting computed tomography (CT) and magnetic resonance imaging (MRI) scans of the brain. Preferred surgical approaches for these tumors include microneurosurgical extirpation through a classical pterional approach or extended endonasal transsphenoidal surgery (6). In microsurgical resection, the main focus is on the maximum degree of resection and reducing the risk of recurrence, with maximum preservation of neurological functions (1,2,5,7,8). In our clinical case, we chose the microsurgical resection through a pterional approach extended with a superior lateral orbitotomy and an anterior clinoidectomy, which provided us with a good extradural corridor to the meningioma formation.

CLINICAL CASE PRESENTATION

A 49-year-old woman with a history of double vision, difficulty focusing on objects, and transient headache, beginning about three months ago, was admitted to the neurosurgery department after CT and MRI of the brain. Prior to hospitalization,

the patient visited an ophthalmologist regarding the symptoms described above, and during the examination, reduced vision of the left eye was detected. The patient was referred to a neurologist, where, after a neurological examination, it was found that the left pupil was less responsive to light stimuli, indicating a damage to the oculomotor nerve, as well as a slight downward and lateral deviation of the left eye. Tests for latent paresis were negative, and the patient exhibited no disturbances in muscle tone, gait, or coordination. Tendon-periosteal reflexes and sensory functions were preserved.

From the performed MRI, a tumor formation was established in the axillary and coronary sections, which in the T2 sequence has a hyperdense path and is located in the area of the left cavernous sinus with dimensions of about 2.26/2.18 cm measured in axial sections. Contrast-enhanced T2 sequences with intravenous gadolinium contrast demonstrate a homogeneously contrast-enhanced meningioma mass (Fig. 1, A and B). The main treatment for the patient was microneurosurgical resection of the tumor of the cavernous sinus, by means of pterional access extended with upper lateral orbitotomy and anterior clinoidectomy on the left. Subtotal removal of the

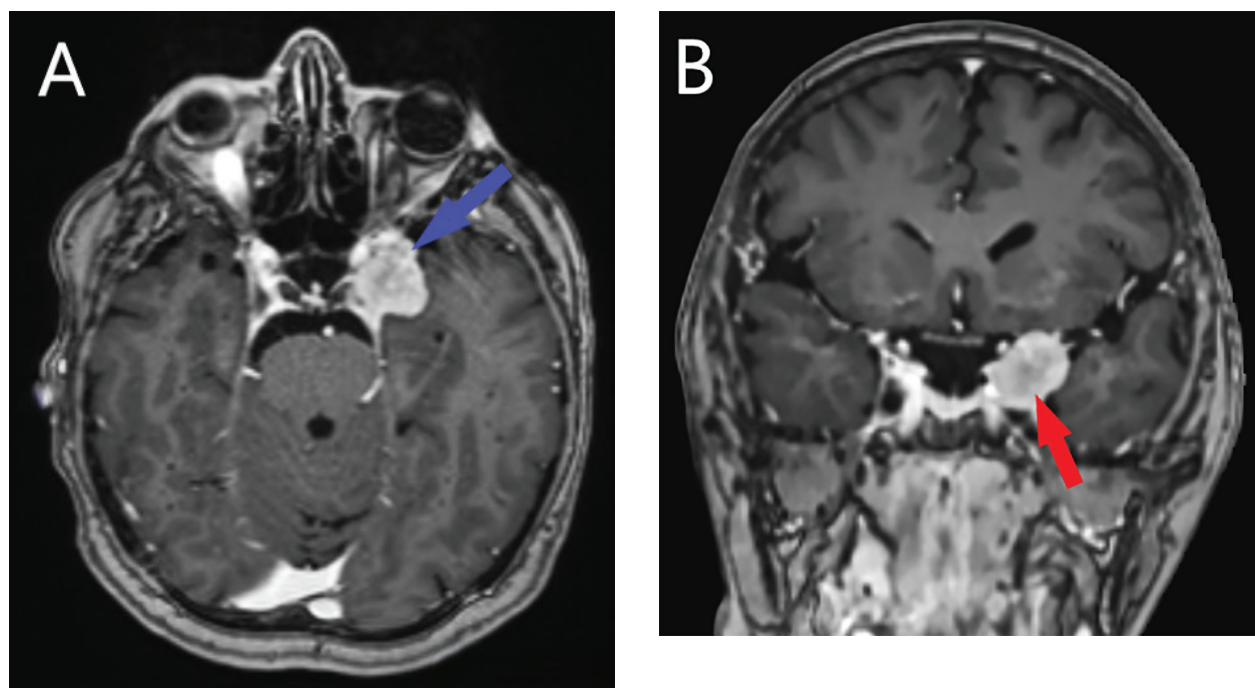


Fig. 1. (A and B). MRI of the brain with administration of intravenous contrast material (gadolinium). Figure A shows, in an axial projection of T2 sequence, a hyperintense tumor formation homogeneously taking up contrast material (blue arrow). Figure B presents a coronal view of a meningioma located in the area of the left cavernous sinus (red arrow).

tumor mass was achieved during the surgical intervention. According to the Simpson classification, it represents class II tumor excision. The detailed assessment of the intraoperative resection was most accurately presented by means of an MRI of the brain taken three months after the surgical intervention. T2 sequences without administration of intravenous contrast showed tumor dimensions of about 1.17/1.20 cm (Fig. 2).

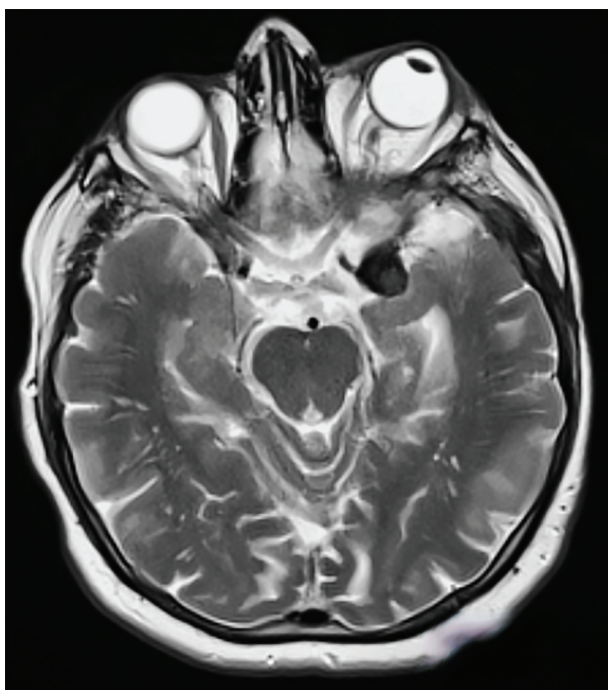


Fig. 2. Native MRI image of the brain taken three months after the surgical intervention, where a significantly smaller meningioma formation can be seen in the area of the left cavernous sinus.

Histological verification confirmed the diagnosis of a cavernous sinus meningioma fibrous variant, which is a slow-growing WHO grade I tumor. These tumors are benign in 80% of the cases, with clinical observation being the primary management approach and radiosurgery used less frequently. The Ki-67 proliferative index was below 1%. Fibrous meningioma is characterized by spindle cells with few or no whorls or meningothelial nests, often featuring thick bundles of collagen (Fig. 3).

Postoperatively, the patient recovered well, was extubated postoperatively, and was clearly conscious, contact and adequate, but with impossible eye reflexes. She was discharged from the hospital on the sev-

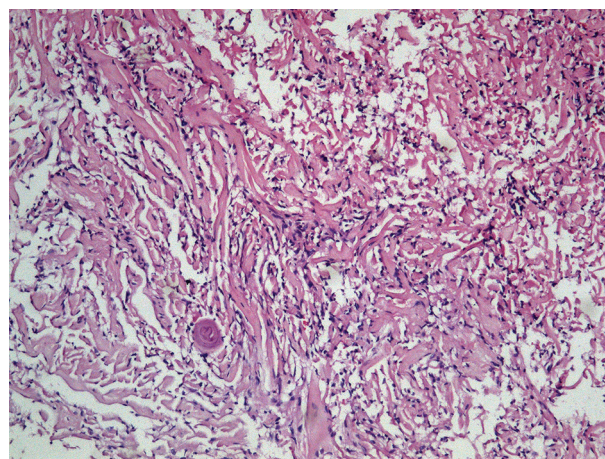


Fig. 3. Fibrous meningioma with collagen bundles, as well as occasional psammoma bodies and scattered meningothelial cells (H&E stain, original magnification X100).

enth postoperative day, and the neurological status from the side of the cranial nerves showed complete ophthalmoplegia of the left eye with preserved facial sensation. Three months after the surgical intervention, the neurological status was unchanged.

DISCUSSION

Cavernous sinus tumors present a serious challenge, with WHO grade I meningiomas being the most common, although many tumors adjacent to the parasellar region could invade the cavernous sinus. Such can be trigeminal nerve schwannomas, pituitary adenomas, chordomas, and chondrosarcomas (3,9,10). In our clinical case, we present a fibrous variant of meningioma invading the left cavernous sinus. From a histological point of view, this type of tumor is common and the diagnosis is based on the monomorphic appearance of oval cells and single psammoma bodies. A fibrous meningioma consists of spindle-shaped cells that form parallel and intersecting bundles or storiform whorls. Nuclei are hyperchromic and spindle-shaped (11,12).

In terms of differential diagnosis, it is important to differentiate it mostly from schwannoma or solitary fibrous tumor, as well as from hemangiopericytoma, but it is positive for meningothelial markers and EMA, as well as negative for STAT6.

Fibrous meningiomas are NF2 mutated and more commonly located in the convexity, falx, or tentorium.

Surgical approaches to the area of the cavernous sinus have seen significant progress in recent years, especially after the improvement of microneurosurgical access techniques and the introduction of 360° accesses to the cavernous sinus through the endonasal endoscopic route (3,10,11,12). Despite the improvement of the surgical technique, the literature data indicate that the iatrogenic trauma on the cranial nerves passing through the cavernous sinus is too great, even if their integrity was preserved; in a large percentage of cases their function was permanently damaged (13). For meningiomas invading the cavernous sinus, the preferred method of treatment, especially after the introduction of MRI of the head, is stereotactic radiosurgery, which provides high local tumor control and significant improvement of cranial nerve functions.

Scientific reports from large randomized clinical trials confirm that stereotactic radiosurgery gives good results for tumors up to 3 cm in size, even in cases without histological verification. Preserving the integrity of the optic nerve and maintaining unimpaired vision play an important role for the patient's quality of life, making iatrogenic damage a significant concern during radiosurgery. Studies indicate that the application of up to 10 Gy in close proximity to the optic nerve does not impair its function (4,7,13). In our patient, we preferred to use a classical surgical technique due to the tumor size being too large for radiosurgery.

The surgical anatomy of the area is key to preserving the function of the oculomotor nerves and the cavernous segment of the carotid artery. Important for surgical access is the dura, which covers the upper surface of the anterior clinoid process, outlines the optic trunk and forms the anteromedial part of the distal dural ring, which merges with the proximal dural ring radiating to the diaphragm of sella turcica. The dural membrane that covers the lower edge of the anterior clinoid process makes a medial extension to surround the cavernous segment of the carotid artery and form the proximal dural ring and the carotid circummotor membrane, forming the anterior part of the roof of the carotid sinus (4). Careful and stepwise dissection of the dura along the anterior clinoid process is essential, and its drilling with a diamond bur provides a good corridor to carotid sinus tumors. The ophthalmic artery is the first branch of

the supraclinoid segment of the cavernous segment of the carotid artery, necessitating careful manipulation and coagulation in this section (4,6,14).

The surgical technique involves rotating the head 20 degrees to the contralateral side and fixing it on a three-point holder. A frontotemporal craniotomy is performed in one plane parallel to the anterior cranial fossa, combined with a superior lateral orbitotomy and extradural drilling of the anterior clinoid process, which allows early decompression of the optic nerve, devascularization of the meningioma, identification of the cavernous segment of the carotid artery, resulting in good surgical control over important anatomical structures (4,15). Our case and the literature data indicate that the cranial nerves passing through the carotid sinus are in most cases entangled in the tumor and their preservation during microsurgical dissection is practically impossible.

CONCLUSION

Our case report shows a rare anatomical localization of meningiomas at the skull base. It aims to show the surgical technique for extirpation of such tumors and the possible postoperative complications. In case of small tumor volume, stereotactic radiosurgery is the recommended method of treatment. Complications after this type of surgery are most commonly associated with the following symptoms: diplopia and ptosis of the eyelid, paralysis of the *nervus oculomotorius*, *nervus trochlearis*, and *nervus abducens*, and hypoesthesia on the respective half of the face from involvement of V1 of the *nervus trigeminus*, which also occurred in the clinical case we presented. Very rarely, thrombosis of the cavernous segment of the carotid artery can occur, which was not seen in the case presented.

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