Neoplasm

ABDUCENS SCHWANNOMA INSIDE THE Cavernous Sinus Proper: Case Report

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BACKGROUND
Only 2 cases of abducens nerve schwannoma solely inside the cavernous sinus have been reported. In both cases, abducens nerve palsy remained after operation. We report the first case of abducens nerve schwannoma inside the cavernous sinus proper with postoperative recovery from abducens nerve palsy.

CASE DESCRIPTION
The patient was a 47-year-old female who developed left abducens and trigeminal nerve palsies. Neuroradiological examination revealed left intra-cavernous sinus tumor. Total removal of the tumor was performed. The location of the tumor was confirmed intraoperatively inside the cavernous sinus itself, with no relation to the trigeminal nerve. Further, the relation of the tumor to one particular nerve fiber within the abducens nerve bundle was confirmed inside the cavernous sinus. After surgery, the patient had transient abducens nerve palsy. It had totally disappeared by 6 months.

CONCLUSION
When the tumor origin is just within the spacious cavernous sinus rather than more posterior in the narrow dural tunnel of Dorello’s canal, successful preservation of the nerve function is possible postoperatively through a thorough knowledge of the membranous anatomy and careful preoperative study of the radiographic findings. © 2004 Elsevier Inc. All rights reserved.

KEY WORDS
Abducens schwannoma, intracavernous sinus, functional preservation.

Shwannomas account for 8% of intracranial tumors [12,24]. Most shwannomas arise from sensory nerves such as the vestibular part of the acoustic nerve and the trigeminal nerve [12,16,24]. Ten abducens nerve schwannoma cases have been reported [1,4,8,10,12,19,20,23,24] and only 2 of them are located inside cavernous sinus [10,24]. We report the first case of abducens schwannoma inside the cavernous sinus proper with improvement of abducens palsy after the operation. We also discuss the mechanism of this fortunate recovery of the abducens nerve function in relation to the anatomic characteristics of the abducens nerve, particularly within the cavernous sinus.

Case Report
A 38-year-old female presented at our hospital because of transient left abducens nerve palsy on October, 1988. On admission, computed tomography (CT) scanning and magnetic resonance imaging (MRI) at that time revealed a small mass lesion in the posterior cavernous sinus. Although we did not reach a specific diagnosis, we believed the lesion was benign. Therefore, we followed the patient in the outpatient clinic without any operation. The patient stopped attending the outpatient clinic for a period of 5 years. However, in December of 1993, 5 months before admission, she (at 47 years old) complained once more of diplopia and left facial paresthesia. Neurologic examination revealed she had left abducens palsy and left facial paresthesia of the mandibular nerve area. Physical and blood examinations were normal. Horner’s syndrome was not observed. There were no cutaneous manifestations of von Recklinghausen’s disease. MRI revealed an enlargement of the left intracavernous sinus tumor (Figure 1A) and extra cranial protrusion of the tumor through the enlarged foramen lacerum (Figure 1B). The preoperative differential diagnoses...
were schwannoma, cavernous angioma, or meningioma in the cavernous sinus.

The operation was performed using the zygomatic anterior transpetrosal approach [26]. The tumor was located inside the left cavernous sinus and laterally compressed the trigeminal nerve. The ophthalmic and mandibular branches of the trigeminal nerve were flattened, and no invasive

![Image 1](A) Axial T1-weighted MR image revealing homogeneously enhanced grown intra-cavernous sinus tumor (Arrow). Arrowhead indicates the C5 portion of the left internal carotid artery shifted anteriorly. (B) Coronal T1-weighted MRI. Arrow indicates the protruded tumor through the foramen lacerum.

![Image 2](Histologic specimen, cell nuclei forming palisades, showing the typical fascicular constitution of the neurinoma (H&E).
relation between the tumor and the trigeminal nerve was confirmed intraoperatively. The tumor was totally removed and one particular nerve fiber of the abducens nerve bundle was also sacrificed. The oculomotor, trochlear, and maxillary nerves were identified as intact. The C4 portion of the internal carotid artery was free from invasion by the tumor. Pathologic examination confirmed the tumor was schwannoma (Figure 2). The patient’s left abducens palsy remained after the operation (Figure 3A) but gradually improved and finally disappeared completely at 6-month follow-up (Figure 3B). The patient’s facial paresthesia improved soon after the operation, and no postoperative instance of Horner’s syndrome was seen. Follow up MRI revealed no sign of tumor regrowth (Figure 4).

**Discussion**

In recent years, the understanding of the detailed anatomy of the cavernous sinus has rapidly expanded [11,22]. In particular, increased knowledge of the membranous anatomy allows precise dissection and safe total tumor removal. MRI is an excellent diagnostic tool, but even with MRI, membranous structures cannot be imaged. Thus, tumors that appear on MRI to be located within the cavernous sinus may in fact be separated from the cavernous sinus itself by a membrane such as the periosteal dura (periosteum forming the medial and inferior wall of the cavernous sinus), the meningeal dura (outer or superficial layer of the lateral wall of the cavernous sinus), and the inner reticular layer (inner or deep layer of the lateral wall of the cavernous sinus) [7]. Careful consideration of the membranous anatomy is very important when making differential diagnosis and planning the surgical approach.

The location of the mass lesion is a clue to the origin of the tumor. If it had been located within the inner reticular layer of the cavernous sinus or in Meckel’s cave, then the tumor would have been associated with the trigeminal nerve. Preoperative MRI showed protrusion of the tumor through the
foramen lacerum, thus indicating that the tumor shared the same space as the carotid artery, i.e., inside the cavernous sinus proper and not in Meckel’s cave. During the operation, we were able to confirm that the tumor had no invasive relation with the trigeminal nerve. The tumor was in fact located inside the cavernous sinus and involved one particular fiber bundle of the abducens nerve, which was cut precisely during the tumor removal. The only other candidate for the origin of this tumor of the cavernous sinus proper would be the sympathetic nerve, which joins the abducens nerve just within the cavernous sinus. To the best of our knowledge, there has been no report to date concerning intracranial sympathetic neurinoma. In addition, in our case, there was no symptom of sympathetic nerve disturbance, such as Horner’s syndrome. There was therefore quite a low possibility that the origin was the sympathetic nerve. On the other hand, abducens nerve palsy was observed as a pre- and postoperative symptom, so we surmised that the origin of this tumor was in the abducens nerve bundle in the cavernous sinus.

There are only 2 cases of intracavernous sinus abducens nerve schwannoma in the literature and both cases had permanent abducens nerve palsy after the operation [10,24]. However, in our case, the patient’s abducens nerve palsy gradually improved and finally disappeared in a 6-month follow-up. Recovery of abducens nerve function has been reported in 2 cases. In both cases, tumors are located in prepontine cistern [19,23]. This is the first case of recovery of abducens nerve function after the total removal of intracavernous tumor. We are considering 2 possible anatomic explanations for this functional recovery of the abducens nerve. First, in the cavernous sinus, the abducens nerve splits into many fibers, with Harris et al reporting as many as 5 fibers [11]. Therefore, there is a strong possibility that the tumor originated from one of these split nerves in the cavernous sinus, and we cut only the 1 particular nerve fiber where the tumor originated. Second, because the cavernous sinus has a large volume, such as prepontine cistern, any tumor that originates from one of these divided fibers can grow bigger and compress other non-pathologic abducens fibers without complete destruction of their function. Such growth is impossible in the restricted area of Dorello’s canal, as was mostly the case in the previous reports [8,23,24]. Even with our present understanding of the membranous structures, it might be difficult to preserve the function of the abducens nerve when the tumor is located both in Dorello’s canal and in the cavernous sinus. Because the abducens nerve courses within the narrow tunnel formed by the dural sleeve at Dorello’s canal, all the nerve fibers of the abducens nerve could be compromised easily by the tumor growth, and securing all fibers of the abducens nerve intraoperatively might be technically difficult within such a narrow space as Dorello’s canal.

The possibility of preserving the abducens function postoperatively exists only if the tumor is not located in the dural sleeve at Dorello’s canal, like our reported case. Because the anatomic considerations of the abducens nerve and cavernous sinus could suggest the possibility of preserving the function, precise tumor removal and securing the nerve function should be mandatory in abducens schwannoma located inside the cavernous sinus proper.

**CONCLUSION**

We report the first case of abducens nerve neurinoma inside the cavernous sinus proper with postoperative recovery from abducens nerve palsy. When abducens nerve neurinoma exist solely in the cavernous sinus, successful preservation of the nerve function is possible postoperatively through a thorough knowledge of the membranous anatomy and careful preoperative study of the radiographic findings.

**REFERENCES**

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COMMENTS
The authors add to the existing literature a third case of intracavernous abducens schwannoma and the only case in which total tumor resection was accomplished with preservation of abducens nerve function. The recognition by the authors that extension of tumor through the foramen lacerum localized the tumor to the same true cavernous sinus space occupied by the C4 segment of the internal carotid artery demonstrates their exquisite knowledge of the anatomy of the cavernous sinus and the utility of such anatomic knowledge in their hands. This same knowledge along with a masterful technique is demonstrated in their navigation of the cavernous sinus; identification of neurovascular structures within the cavernous sinus during surgery, when many structures are obscured by bleeding and are injured; and in the patient’s functional outcome. A previous case in which we “inadvertently” sacrificed the abducens nerve but retained normal abducens function prompted our own review of the literature on abducens nerve anatomy. We found our good fortune lay in a known 8 to 18% incidence of duplicate abducens nerve within the cavernous sinus [1] which is different from the authors’ observation of tumor origin from “one particular nerve fiber within the abducens nerve bundle.” Without Horner’s syndrome before or after surgery, the authors are correct to exclude sympathetic plexus schwannoma from the differential diagnosis. However, there has been a recent report of just such a tumor that was successfully resected, but of course with partial Horner’s syndrome after surgery [2]. We congratulate the authors on their excellent work.

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REFERENCES