Abnormal Course of the Oculomotor Nerve on the Clivus Combined with a Petroclival Meningioma: Case Report

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ABSTRACT

The course of the oculomotor nerve on the clivus was abnormal in a patient with petroclival meningioma. He complained of gait disturbance. A gadolinium-enhanced magnetic resonance image demonstrated a 4.4-cm enhancing mass in the petroclival region. The tumor was removed via an anterior transpetrosal-transtentorial approach. Normally, the oculomotor nerve originates from the brainstem and enters the oculomotor trigone. In this patient, the oculomotor nerve entered the dura mater at the upper clivus, behind the posterior clinoid process, and coursed parallel to the basilar artery. This entrance is lower than the normal entry point of the oculomotor nerve. The abnormal entrance of the oculomotor nerve may reflect an atypical developmental relationship among the cranial nerves, meninges, and bones during embryogenesis.

KEYWORDS: Petroclival meningioma, anatomical variation, oculomotor nerve, microanatomy, anterior transpetrosal-transtentorial approach

Understanding the microanatomy of the blood vessels, cranial nerves, brain, and cranium is important for microsurgery. Many anatomical variations of these structures have been reported, but an abnormal course of the oculomotor nerve has never been reported. We describe a patient whose oculomotor nerve entered the dura at an atypical location.

CASE REPORT

A 63-year-old man had experienced a gait disturbance for 5 months. On examination, a mild cerebellar ataxia was observed on the right. No other neurological finding reflected cranial nerve dysfunction and no systemic congenital anomaly was observed.

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Figure 1 (A) Axial and (B) sagittal gadolinium-enhanced T1-weighted MRIs show a homogeneously enhancing tumor in the right petroclival region. The tumor compressed the brainstem and was located in the supratentorial region, infratentorial region, and middle cranial fossa.

Computed tomography scanning (CT) revealed a $4.4 \times 4.4 \times 4.4$ -cm homogeneously enhancing mass with a remarkable calcification in the right petroclival region. A homogeneously enhancing mass with dural tail signs was isointense on T1-weighted magnetic resonance imaging (MRI) and hyperintense on T2-weighted MRI (Fig. 1). The tumor was mainly located in the infratentorial region but partially extended into the cavernous sinus and middle cranial fossa. The tumor was supplied by the right meningohypophyseal trunk but not by the external carotid or vertebral arteries.

The tumor was accessed through an anterior transpetrosal-transtentorial approach.¹ The anterior part of the pyramid was resected, and the superior petrosal sinus and tentorium were incised along the posterior edge of the tumor. Meckel's cave was opened and the trigeminal nerve was mobilized inferolaterally. The right trochlear nerve was sacrificed because it was encased by tumor. The tumor attachment was on the inferolateral triangle² of the cavernous sinus. The tumor extended to the posterior cavernous sinus, which was opened. The tumor was removed and the oculomo-

tor nerve could be seen entering the dura mater at the upper clivus, behind the posterior clinoid process and medial to the tumor attachment. The nerve coursed parallel to the basilar artery (Fig. 2). The tumor was diagnosed as a meningotheelial meningioma by pathological analysis.

Postoperatively, the patient's consciousness deteriorated but gradually improved 1 month after surgery. He had persistent right ophthalmoplegia but no other neurological deficit. Postoperative MRI 5 months later showed no residual tumor (Fig. 3).

DISCUSSION

Abnormal courses of cranial nerves are rarely reported. So far such cases have only been reported in patients with congenital hypoplasia or in those with an abnormal relationship between cranial nerves and cerebral vessels.³⁻⁸ An abnormal entrance of the oculomotor nerve into the dura mater, other than the oculomotor trigone, has never been reported.

Figure 2 (A) Operative photograph and (B) schematic drawing of the anterior transpetrosal-transtentorial approach. The oculomotor nerve enters the dura mater at the upper clivus. III, oculomotor nerve; IV, trochlear nerve; V, trigeminal nerve; VI, abducens nerve; BA, basilar artery; GSPN, greater superficial petrosal nerve; ICA, internal carotid artery; PCoA, posterior communicating artery; PV, petrosal vein; SCA, superior cerebellar artery; SPS, superior petrosal sinus.

Normally, the oculomotor nerve originates in the midbrain, enters the oculomotor trigone, and courses along the roof of the cavernous sinus (Fig. 4).⁹ The oculomotor trigone is defined by the anterior petroclinoid ligament, posterior petroclinoid ligament, and interclinoid ligament.¹⁰ Therefore in patients with petroclival meningioma, the oculomotor nerve can deviate superiorly along the upper

margin of the tumor without exception.¹¹ In our patient, however, the oculomotor nerve coursed medial to the tumor attachment in the inferolateral triangle, and entered the dura mater of the upper clivus. The abnormal dural entrance of the oculomotor nerve thus cannot be explained by tumor compression. Instead, an atypical developmental relationship between the chondrocranium and dura mater during embryogenesis could be responsible for the anomalous entrance point.

The oculomotor nerve originates from the basal plate of the mesencephalon^{12,13} and extends

Figure 3 Axial gadolinium-enhanced T1-weighted MRIs 5 months after the operation shows no residual tumor.

Figure 4 A cadaveric dissection showing the oculomotor nerve entering the oculomotor trigone. III, oculomotor nerve; ICA, internal carotid artery; OMT, oculomotor trigone; PCoA, posterior communicating artery.

directly toward the orbital region in embryos at about 6 weeks.¹⁴ The neurocranium originates from the mesoderm around the developing neural tube and then differentiates into the chondrocranium. The cartilaginous neurocranium is formed in embryos at about 20 weeks.¹² Normally, the primitive dural entrance of the oculomotor nerve is fixed in embryos at about 6 weeks.¹⁴ The oculomotor nerve passes through the oculomotor trigone after the cartilage forms in embryos at about 20 weeks. A developmental delay or early development of these structures is considered to induce an abnormal anatomical relationship among the cranial nerves, meninges, and bones.

Tumors originating from the petroclival region or the posterior cavernous sinus often displace the oculomotor nerve upward. Therefore, the tumor in the cavernous sinus can be removed without injuring the oculomotor nerve. In our case, however, we did not expect to find the oculomotor nerve in the posterior fossa, and the nerve was injured when the tumor was removed from the posterior cavernous sinus. Stereotactic radiosurgery might be considered as an option for treating residual tumor in the cavernous sinus. This modality recently has been used to treat unresectable tumors in the cavernous sinus and has reduced the risk of cranial nerve paresis.¹⁵ In such cases, surgical resectioning of the tumor in the cavernous sinus should not be attempted and stereotactic radiosurgery should be applied as an adjuvant treatment.

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