Transpterygoid Trans-sphenoid Approach to the Lateral Extension of the Sphenoid Sinus to Repair a Spontaneous CSF Leak

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ABSTRACT

Objective and Importance: Cerebrospinal fluid (CSF) fistula from the middle cranial fossa into the sphenoid sinus is a rare condition. In the past, the treatment of choice has been closure via a craniotomy. Only few geriatric cases are known, which were successfully operated by endoscopic surgery. We present a further case of nontraumatic CSF fistula originating from the middle cranial fossa. A new endoscopic technique was applied. We discuss treatment options for this rare defect. **Clinical Presentation:** A 76-year-old patient presented with a 2-year history of rhinorrhea. High levels of β -trace protein pointed to a diagnosis of CSF fistula. The defect was located at the anterior and inferior aspect of the pterygoid recess of the left sphenoid sinus. **Intervention:** The patient was operated using an endoscopic trans-sphenoidal approach. After endoscopic opening of the maxillary and sphenoid sinus, a complete posterior ethmoidectomy was performed. The medial part of the pterygoid process was removed, allowing endoscopic exposure and closure of the defect. At 1-year follow-up, the CSF fistula had not recurred and the patient had no sequel from the surgical procedure. **Conclusion:** In selected cases, this new endoscopic partial transpterygoid approach to the middle cranial fossa is recommended for surgical repair of CSF fistula involving the lateral extension of the sphenoid sinus. To our knowledge, ours is the oldest patient with this condition successfully operated by endoscopic means at the world's most northern university hospital.

KEYWORDS: Gerontology, cerebrospinal fluid, fistula, middle cranial fossa, endoscopic surgery

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Cerebrospinal fluid (CSF) fistula from the middle cranial fossa through a lateral extension of the sphenoid sinus is a diagnostic and therapeutic challenge. Patients with a CSF fistula from the sphenoid sinus present with intermittent rhinorrhea which can be misdiagnosed as vasomotor rhinitis and this often delays the diagnosis. Many patients undergo several operations before closure of the leak finally is achieved. Trans-septal or transnasal blind packing of the sphenoid sinus is usually not successful. Endoscopic obliteration of the sphenoid sinus using fascia lata or abdominal fat is only recommended in patients with CSF leaks from the pituitary fossa or posterior segment of the lateral sphenoid sinus.¹ Morley and Wortzman in 1965 were the first to draw attention to the clinical importance of the lateral extension of the anterior segment of the sphenoid sinus in patients with post-traumatic CSF rhinorrhea.² Today, two approaches are used in the treatment of this condition. Successful closure of a CSF fistula from the middle cranial fossa has been described by several authors³⁻¹⁵ using two different routes: the middle cranial fossa or the

endoscopic transpterygoid approach. The literature on CSF leaks from the middle cranial fossa or on temporosphenoidal encephaloceles consists of single patient case reports and of case series on two patients by Brisman and associates⁴ in 1970, on four patients by Kaufman et al¹⁵ in 1977 and Landreneau and colleagues¹² in 1998, and on five patients by Lopatin and others¹⁵ in 2003. The number of geriatric patients will increase in the future. Surgical interventions in geriatric patients should be carefully selected in order to minimize postoperative mortality. We present an elderly patient who presented with a nontraumatic spontaneous CSF leak from the lateral extension of the sphenoid sinus. She was successfully treated using a modified endoscopic approach.

CASE REPORT

A 76-year-old patient attended our cancer clinic for routine follow-up. She reported having watery

Figure 1 (A) Preoperative axial computed tomography scan shows a bony defect at the lateral extension of the left sphenoid sinus (arrow). A small amount of fluid was found at the posterior aspect of the sphenoid sinus (asterisk). (B) Preoperative coronal computed tomography scan, taken on another occasion. The bony defect (arrow) was situated inferiorly between the maxillary nerve (white asterisk) and the Vidian nerve (black asterisk).

Figure 2 (A) Preoperative axial magnetic resonance image, T₁-weighted, consistent with fluid in the left sphenoid sinus (asterisk). (B) Preoperative axial magnetic resonance image, T₂-weighted, consistent with fluid in the left sphenoid sinus (asterisk).

rhinorrhea every day for more than 2 years. The past medical history was notable only for a tonsillar squamous cell carcinoma that had been treated with radiotherapy and a radical neck dissection 1993.

On examination, a clear watery fluid ran from the left nostril when the patient bent forward. Fluid samples, taken on two different occasions, contained 59.7 and 63.1 mg/L β -trace protein (prostaglandin D synthase), respectively, clearly indicating^{16,17} CSF rhinorrhea. Beta-trace protein was assayed on a laser-nephelometer (Behring NephelometerTM Analyzer II) using antibodies from the N-latex- β -trace-protein research kit (Dade Behring, Marburg, Germany). A computed tomographic scan revealed a 4-mm bony defect of the left lateral extension of the sphenoid sinus (Fig. 1). Magnetic resonance imaging failed to detect any brain metastases (Fig. 2).

The patient was admitted for surgery in January 2004 at the University Hospital of Northern Norway. A lumbar drain was inserted before induction of general anesthesia. Rigid endoscopes with 4-mm outer diameter and 0-degree and 30-degree enlarged angled views were used and connected to a suction-irrigation holder (Storz, Tuttlingen,

Germany). A partial conchotomy of the middle nasal concha was performed, the mucosa dissected and preserved for reconstruction. The sphenoid and the maxillary sinus were opened widely, and a complete posterior ethmoidectomy was performed. The optic nerve and the internal carotid artery were identified. Using a cutting burr, the medial aspect of the pterygoid process was removed between the posterior roof of the maxillary sinus and the sphenoid sinus foramen. In this way the lateral extension of the sphenoid sinus became visible in its entirety. Clear fluid was running from a defect of the lower anterior aspect of the lateral extension of the sphenoid sinus. The mucosa around the defect and along the lateral wall of the sphenoid sinus was carefully and completely removed with curved dissector instruments. This was possible only because of the transpterygoid access. The internal carotid artery had bony defects in two places. The defect was closed using three indifferent autologous tissues. A free fascia lata graft and free fat tissue were obtained from the right thigh. A small amount of fat was pushed into the bony defect in a bath-plug fashion, a free 1 $\times$ 1-cm fascia lata graft was placed into the lateral recess and a free 2 $\times$ 3-cm fascia lata graft was

Figure 3 Postoperative coronal computed tomography scan. Note the partial bony defect at the medial aspect of the pterygoid process (arrows).

placed over the entire lateral wall of the sphenoid sinus using the onlay technique. On top of this, the free mucosa graft taken from the nasal concha was secured using fibrin glue. Thin silicone foil was covered the grafts before the nose was packed using nasal dressings with antibiotic ointment. The lumbar drain was set so that 120 mL/day were drained over a period of 3½ days. The dressing in the lower nasal cavity was removed on the second postoperative day. The dressing in the sphenoid sinus and the silicone foil were removed after 10 days. The patient developed fever and headache for a short period in spite of prophylactic intravenous cefalotin. Meningitis was ruled out by lumbar puncture and culture. After this, she recovered without any complication from surgery. At the 6-month and 1-year follow-up there were no signs of rhinorrhea. She did not develop hydrocephalus. Ophthalmoscopy revealed a normal optic disc and there were no signs indicating papilledema. A computed tomographic scan confirmed closure of the fistula and normal ventricular sizes (Fig. 3).

DISCUSSION

Lateral extensions of the sphenoid sinus are not rare in adults.^{18,19} These extensions are related to the

middle cranial fossa, lateral to the cavernous sinus.²⁰ Several attempts are usually undertaken to treat these defects by obliteration. To obliterate the sphenoid sinus, it is mandatory to remove the sinus mucosa completely.²¹ In the majority of patients without lateral extension of the sphenoid sinus, this can be done via a transnasal or paranasal route using the endoscope or microscope. Complete removal of the sinus mucosa is not possible by standard endoscopic paranasal sinus surgical means in patients with an extensive lateral extension or pterygoid recess of the sphenoid sinus. The pterygoid process is like a pillar in front of the defect. The removal of the mucosa is impossible because the defect is situated behind this corner. This is why attempts to close a defect at this site by obliterating the sphenoid sinus often fail.

Traditionally, CSF leaks from the middle cranial fossa into the lateral sphenoid sinus were repaired by a transcranial approach. Several cases have been treated successfully by a middle cranial fossa approach after attempts via the transnasal route have failed. We agree with Landrenau and coworkers¹² that the middle cranial fossa approach is reliable. However, the transcranial approach is more invasive because this approach requires a craniotomy and retraction of the temporal lobe. Elderly patients are at higher risk when operated by the middle cranial fossa approach.

More recently, the endoscopic transpterygoid approach has been advocated. Bolger and Osenbach²² reported a case with an encephalocele from the lateral recess of the sphenoid sinus. This patient suffered from seizure despite medical treatment. The transcranial approach was therefore considered problematic. Instead, the encephalocele was resected endoscopically and the CSF leak was sealed successfully by this new technique. Bolger and Osenbach described the total removal of the pterygoid process. Later, Pasquini and colleagues²³ published four cases using a total or partial removal of the pterygoid process an approach to the lateral recess of the sphenoid sinus. The use of a neuroendoscopic approach was tried in nine patients, but the sites of the CSF lesions were not stated.²⁴

Table 1 Summary of Endoscopic/Endonasal Closure of CSF Fistula from the Lateral Extension of the Sphenoid Sinus

Author	Number of Patients	Patients Age	Approach	Follow-Up
Albernaz et al ³	1	47	Trans-sphenoid	24 months
Bolger and Osenbach ²²	1	39	Transpterygoid	9 months
Schlosser and Bolger	3	(60)	Transpterygoid	No details
Lopatin et al ²³	5	≤ 64	Trans-sphenoid	9–42 months
Pasquini et al ²³	4	48–73	Transpterygoid	10–26 months
Bachmann-Harildstad et al	1	76	partial transpterygoid	13 months

CSF, cerebrospinal fluid.

In this patient, the endoscopic approach was clearly indicated because of the patient's age. Indeed this is the oldest patient reported to date (Table 1).

The treatment of CSF leaks from the lateral extension of the sphenoid sinus differs from the treatment of CSF leak from the anterior skull base and requires considerable expertise. The middle cranial fossa approach seems to be reliable. However, in experienced hands, the new endoscopic transpterygoid closure minimizes postoperative mortality. We agree with Pasquini that, to achieve a reliable closure of the CSF fistula, it is not always necessary to remove the pterygoid process completely. A partial removal of the pterygoid process might be enough, depending on the degree of pneumatization of the facial skeleton. Follow-up for at least 1 year is strongly recommended to exclude recurrent CSF leak.

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