Endoscopic endonasal treatment of a spontaneous temporosphenoidal encephalocele with a detachable silicone balloon

Case report

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Temporosphenoidal encephaloceles are rare entities that occur when the temporal lobe herniates into the sphenoid sinus through a skull base defect of the temporal bone. Both an iatrogenic and a traumatic pathogenesis have been proposed. The authors describe a spontaneously occurring temporosphenoidal encephalocele in a 63-year-old woman who had a 4-year history of rhinorrhea. Spiral computerized tomography (CT) scanning revealed a bone defect located inside the ophthalmomaxillary triangle. The intrasphenoidal encephalocele had a heterogeneously hypointense signal compared with cerebrospinal fluid (CSF) on T1-weighted magnetic resonance (MR) images and a hyperintense signal compared with CSF on T2-weighted MR images. Two previous endonasal endoscopic procedures, performed by ear, nose, and throat surgeons, had been unsuccessful. The authors performed an endoscopic endonasal right nostril procedure by using 0° and 45° rigid-lens endoscopes that were 4 mm in diameter and 18 cm long. The encephalocele in the sphenoid sinus was partially removed. DuraGen and fat graft were positioned in the bone defect. Two No. 2 French detachable silicone balloons (1.5 cm³ volume) inflated with surgical glue were introduced into the skull defect and into the sphenoid sinus, respectively. The CSF leakage stopped immediately. No nasal packing or postoperative CSF lumbar drainage was necessary. The patient did well. Postoperative CT and MR imaging, obtained at 24 hours and at 3 months, demonstrated that the balloon and the fat graft filled the bone defect and the sphenoid sinus. Eight months postprocedure no CSF leakage was observed. This appears to be the first case reported in the literature of a temporosphenoidal encephalocele successfully treated by an endoscopic endonasal technique involving packing of the defect with inflated detachable balloons.

**KEY WORDS** • detachable silicone balloon • endoscope • pituitary surgery • sphenoid encephalocele

**S**phenoid sinus encephaloceles are uncommon. The authors describe a spontaneously occurring temporosphenoidal encephalocele in a 63-year-old woman who had a 4-year history of rhinorrhea. Spiral computerized tomography (CT) scanning revealed a bone defect located inside the ophthalmomaxillary triangle. The intrasphenoidal encephalocele had a heterogeneously hypointense signal compared with cerebrospinal fluid (CSF) on T1-weighted magnetic resonance (MR) images and a hyperintense signal compared with CSF on T2-weighted MR images. Two previous endonasal endoscopic procedures, performed by ear, nose, and throat surgeons, had been unsuccessful. The authors performed an endoscopic endonasal right nostril procedure by using 0° and 45° rigid-lens endoscopes that were 4 mm in diameter and 18 cm long. The encephalocele in the sphenoid sinus was partially removed. DuraGen and fat graft were positioned in the bone defect. Two No. 2 French detachable silicone balloons (1.5 cm³ volume) inflated with surgical glue were introduced into the skull defect and into the sphenoid sinus, respectively. The CSF leakage stopped immediately. No nasal packing or postoperative CSF lumbar drainage was necessary. The patient did well. Postoperative CT and MR imaging, obtained at 24 hours and at 3 months, demonstrated that the balloon and the fat graft filled the bone defect and the sphenoid sinus. Eight months postprocedure no CSF leakage was observed. This appears to be the first case reported in the literature of a temporosphenoidal encephalocele successfully treated by an endoscopic endonasal technique involving packing of the defect with inflated detachable balloons.

**Case Report**

**History.** This 63-year-old woman presented with a 4-year history of nontraumatic intermittent leaking of CSF
from the right nostril. The year before she was admitted to our department she underwent biopsy sampling and a second endoscopic endonasal procedure involving intrasphenoidal packing with fat graft and surgical glue, performed by ear, nose, and throat surgeons. Three months later CSF leakage recurred.

_Examination and Neuroimaging._ The CSF leak was so plentiful that the patient could not sleep supine. A spiral CT scan with three-dimensional reconstructions revealed a defect of the right lateral wall of the sphenoid sinus. The bone defect was located between the ophthalmomaxillary prominences: the V1–V2 triangle. The right anterior part of the temporal lobe extended from the temporal fossa into the right sphenoid sinus (Fig. 1).

The bone defect was also evident on axial T2-weighted MR imaging. The intrasphenoidal tissue showed a heterogeneous signal: it was hypointense compared with CSF on T1- and hyperintense on T2-weighted MR images anteriorly and superiorly; however, its lateral and inferior portions were hypointense with gray matter on T1- and T2-weighted slices (Fig. 2).

A preoperative endoscopic study demonstrated a plentiful CSF leak from the right sphenoid sinus. The previous intrasphenoidal sinus packing with fat graft had become partially dislodged due to brain pulsation.

**Operation.** The patient underwent surgery via an endoscopic endonasal approach (A.A.). The operation was performed using 0° and 45° rigid-lens endoscopes, measuring 4 mm in diameter and 18 mm in length. The sphenoid ostium was intact; however, the anteroinferior wall of the sphenoid sinus had been partially removed during previous surgeries. The previous anterior sphenoidotomy was not enlarged nor was the sphenoid septum removed so as to reduce the possibility of expulsion of intrasphenoidal packing. The encephalocele in the sphenoid sinus was partially removed, and then DuraGen (Integra NeuroSciences, Plainsboro, NJ) and fat graft were placed in the bone defect. A 1.5-cm³ No. 2 French detachable silicone balloon was introduced into the sphenoid sinus to push the mixture of fat graft and DuraGen into the skull defect and to keep it in place. A custom-made 15-cm-long rigid injector was used to inflate the balloon with surgical glue (NBCA). When the skull defect was completely filled, CSF leakage stopped immediately. A second balloon was inflated through the sphenoid ostium to fill completely the right part of the sphenoid sinus.

**Histopathological Examination and Postoperative Course.** Histopathological examination of the cephalocele showed glial tissue and chronic inflammatory infiltrate. No nasal packing or postoperative lumbar CSF drainage were necessary. The patient did well. Seven days postsurgery she complained of epistaxis during a hypertensive episode (230/120 mm Hg), which resolved spontaneously within a few minutes. The patient was treated with antihypertensive drugs and underwent an endoscopic examination, which excluded major bleeding. No CSF leakage was observed endoscopically. Minimal breathing difficulties in the right nostril had disappeared by 2 weeks postsurgery.

The postoperative CT and MR images obtained at 24 hours and at 3 months demonstrated that the balloon and the fat had filled the bone defect (Figs. 4 and 5). After an 8-month follow-up course no recurrence of rhinorrhea was observed.
Discussion

Sphenoid encephaloceles are rare. Their origin can be traumatic, postoperative, or spontaneous. To explain the pathogenesis of the spontaneous type, congenital and acquired mechanisms have been postulated. During fetal development the temporal lobe can herniate through skull base defects that form between the ossification nuclei of the sphenoid.15 The theory of acquired encephaloceles is based on autopsy findings of small perforations in the floor of the middle cranial fossa, the so-called “pit-holes.”24 After birth the encephaloceles develop through these small defects. In addition enlargement of the skull defect can be facilitated by pneumatization of temporal bone23 and by physiological episodes of intracranial hypertension.11

Sphenoid encephalocele can develop through the mid-line, the perisellar area, or through the lateral walls of the sphenoid sinus, lateral to the cavernous sinus area. The median type is usually treated using a conventional transsphenoidal approach, which allows full visualization of the midline structures in the sphenoid sinus, whereas, when sphenoid encephalocele originates from the lateral wall of the sphenoid sinus, a more complex surgical management may be necessary. Among 19 cases of spontaneous temporosphenoidal encephalocele described in the literature,5,24,26 five conventional transsphenoidal microsurgical procedures were performed as the first treatment.25 Transsphenoidal surgery failed in two cases, and a second procedure in which a transcranial approach was used was necessary.24 To the best of our knowledge, purely endoscopic endonasal procedures have been reported in only three cases;9,12 in one case the goal was biopsy sampling and then a second intracranial approach was necessary. The other two cases were successfully treated by the endoscopic endonasal procedure alone.9,12 In the first case the defect was closed with fascia lata and fat9 and the second was sealed with fascia lata and glue.12

It is widely known that conventional transsphenoidal surgery does not allow lateral visual control of the sphenoid sinus because of the presence of nasal retractor, which limit the possibility of seeing around the corners. This is particularly true in a case of temporosphenoidal encephalocele arising from the lateral walls of the sphenoid sinus.24,26 This limitation has been overcome by using the endoscopic technique. The absence of nasal retractors, the wider surgical field, and the use of angled-lens endoscopes allow full visualization of the structures in the sphenoid sinus, as well as the lateral walls and lateral recesses.1–3,6,7,16–22

After our evaluation of the patient, an endonasal approach was chosen as the first-choice treatment. Several reasons influenced our decision: the procedure is minimally invasive and facile, it involves reduced surgical risk, and it was the patient’s first-choice procedure. Once the endonasal approach was decided on, we considered strategies for successful treatment. Currently, the main difference in the endoscopic technique compared with the transcranial approach is the difficulty in placing sutures because of the very narrow surgical field and a lack of proper tools. The only way to stop CSF leakage is by using a packing. Several materials have been used to do so: fat, muscle, hemostatics (for example, Surgicel), dura...
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mater, fascia lata, autologous bone, titanium mesh, and, recently, hydroxyapatite cement.10

In the present case previous attempts to stop CSF leakage with a combination of intrasphenoidal fat graft and fibrin glue have failed; brain pulsation pushed them out. The ideal solution would have been a tool that could be used to push the encephalocele intracranially while keeping the packing inside the skull base defect and the sphenoid sinus, thus avoiding the risk of expulsion from brain pulsation. Thinking along those lines we planned to use a detachable silicone balloon, commonly used for endovascular procedures. Detachable silicone balloons can be slowly inflated until reaching the desired volume. They can be either easily deflated or removed if necessary. Several filling materials are currently used. In general they are radiopaque liquid polymers with embolic properties. Among them the most used are the cyanoacrylates.5

More recently a new liquid embolic agent consisting of ethylene-vinyl-alcohol copolymer, dimethyl sulfoxide, and tantalum (ONYX) has been introduced for endovascular embolization. This is a promising new nonadhesive agent, which is particularly suitable for preoperative embolization of arteriovenous malformations.13

We sought out a solidifying material, something already used and consolidated in clinical practice, with an adhesive, stable, and rapid polymerization to prevent volume loss in the balloon. Among the filling materials currently used during endovascular procedures, NBCA was found to be the most suitable for our purposes. We inflated the balloon with liquid surgical glue (NBCA). The volume of the balloon can be modeled and shaped according to the size of the defect. The double effect of pushing the encephalocele intracranially and of closing the skull defect has been shown to be immediately effective.

Nagao, et al.,25 successfully treated patients with empty sella syndrome by transsphenoidal extradural balloon inflation. Later, Gazioglu, et al.,14 used the same technique in three patients with empty sella syndrome. Even though their patients always recovered, the authors do not recommend this technique because the postoperative MR imaging demonstrated balloon deflation in all cases.

Although the follow-up period is short, MR images obtained at 3 months in our patient did not reveal any balloon deflation (Fig. 5 right).

Our primary goal was to identify the site of the CSF leak and to close it with a system able to resist expulsion by brain pulsation, thus obtaining a watertight closure until fibrosis produced a permanent seal. Theoretically, even if we did observe later balloon deflation, the permanent seal would prevent recurrence of CSF leakage.

Conclusions

We found this technique easy and effective for treatment of recurrent CSF leakage due to a temporosphenoidal encephalocele. The silicone detachable balloon was easily introduced endoscopically because of its very small size prior to inflation. After closing the skull base defect, the CSF leak stopped immediately.

Application of this technique in a large number of cases is necessary to prove its effectiveness, although temporosphenoidal CSF fistulas are very rare.

We are also considering this technique for the treatment of other sphenoid and ethmoid fistulas. Further studies on filling materials and balloon technology may improve results.

References


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