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Sphenoid sinus cerebrospinal fluid leaks

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There are a number of special considerations regarding endoscopic repair of cerebrospinal fluid (CSF) leaks and encephaloceles occurring in the sphenoid sinus. The sphenoid sinus is formed by the anterior and middle cranial fossae, is in close proximity to the internal carotid artery and optic nerve, and may have extreme lateral pneumatization that limits accessibility via normal endoscopic routes. Although CSF leaks and encephaloceles can occur anywhere within the sphenoid sinus, they are generally divided into a medial, perisellar type and a lateral, sphenoid recess type. The diverse etiologies of sphenoid sinus CSF leaks make it essential to have a thorough understanding of the underlying pathophysiology, and treatment principles and treatment options to achieve excellent outcomes. The specific surgical approach for a sphenoid sinus skull base defect is dependent on the exact site of the defect within the sphenoid sinus. Once an appropriate endoscopic approach with wide local exposure is obtained, reconstruction of the skull base is dependent on the etiology of the leak and other factors, including the underlying intracranial pressure. This article will highlight the surgical techniques and perioperative care relevant to sphenoid CSF leaks and encephaloceles.

Until recently, encephaloceles of the lateral recess of the sphenoid sinus were relatively undocumented.[1-3] These lesions evolve from the herniation of temporal lobe tissue through a middle cranial fossa defect lateral to the foramen rotundum and vidian canal (Figure 1). These patients have excessive pneumatization of the pterygoid process, with an attenuated sphenoid sinus recess roof and skull base. This increases the likelihood of defects developing in the floor of the middle fossa.[4] Other factors, including elevated cerebrospinal fluid (CSF) pressures, may contribute to the development of these CSF leaks.

Patients with spontaneous CSF leaks frequently have increased CSF pressure, which increases hydrostatic force at the weakest sites of the skull base. The increased CSF pressures seen in this subset of patients lead to the highest rate (range 50% to 100%) of encephalocele formation and the highest recurrence rate after surgical repair of the leak (range 25% to 87%), compared with less than 10% for most other etiologies.[5-7] Underlay bone grafts add support and help prevent encephalocele herniation and disruption of the repair. In addition, lumbar drains and acetazolamide are recommended to lower documented increase of the intracranial pressure.

Neoplasms

Sinonasal tumors and skull base neoplasms can create sphenoid sinus CSF leaks directly through erosion of the anterior cranial fossa (superior) or middle cranial fossa (posterior and lateral), or indirectly secondary to therapeutic treatments for the tumor (Figures 2 and 3). One of the most common causes of sphenoid CSF leaks is from transsphenoidal pituitary resection. In 1 study, CSF leaks after transsphenoidal surgery occurred in 6.0% of cases.[8] Persistent malignant tumor after resection and repair will continue to erode the skull base and contribute to sphenoid sinus CSF leaks. Prior chemotherapy or radiation creates significant healing difficulties because of poor vascularity of the wound bed.

Traumatic/iatrogenic

Sphenoid sinus CSF leaks may result from blunt or penetrating trauma. Traumatic disruption of the sphenoid sinus

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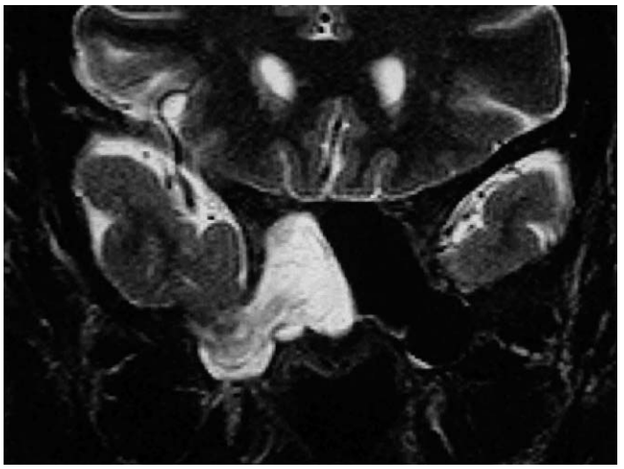

Figure 1 Coronal T2-weighted magnetic resonance image showing herniated brain and encephalocele into the lateral recess of the right sphenoid sinus in a spontaneous CSF leak.

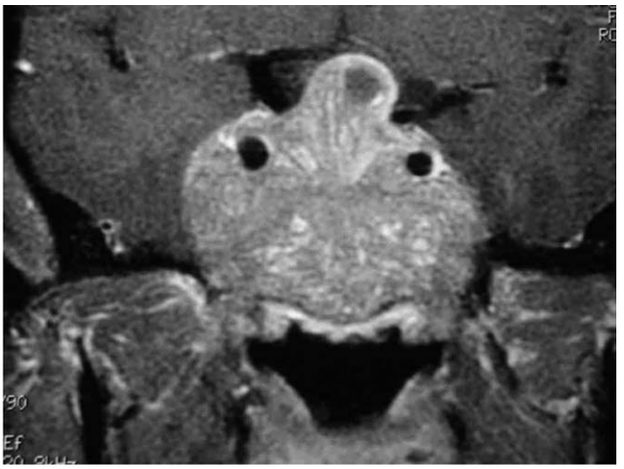

Figure 3 Coronal magnetic resonance image showing a large pituitary adenoma with disruption of the sellar diaphragm, predisposing to an intraoperative CSF leak.

walls can create an obvious CSF leak or present years later with meningitis, delayed leak, or encephaloceles. Although more than 70% of traumatic CSF leaks close with observation or conservative treatment, a 29% incidence of meningitis has been reported in long-term follow-up when treated nonsurgically.[9]

Functional endoscopic sinus surgery and neurologic surgery are the 2 most common surgeries leading to iatrogenic skull base defects. Significant defects can result from powered instrumentation if they occur during bone resection near the skull base. A CSF leak can occur in the roof of the sphenoid sinus during routine sphenoidotomy. An expansile mucocele or tumor can create dehiscences in the sphenoid roof that are more susceptible to iatrogenic CSF leak during instrumentation.

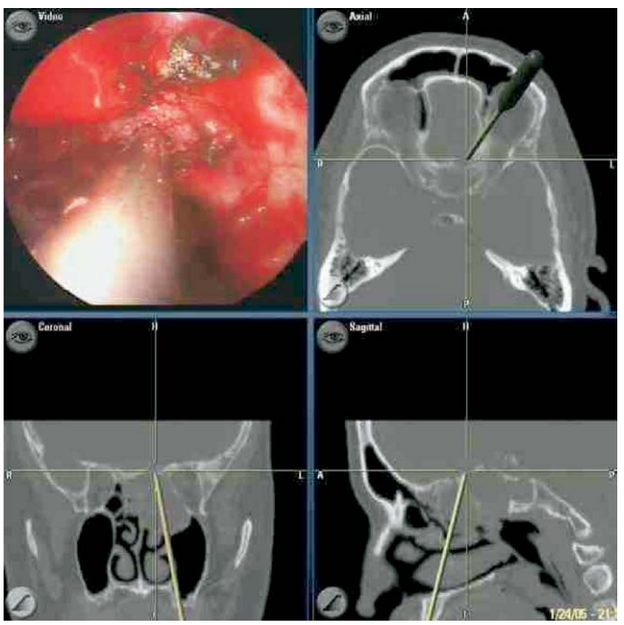

Figure 2 Triplanar computerized tomography illustrating a meningioma with erosion through the roof of the sphenoid and ethmoid sinuses. Completing a septectomy, bilateral sphenoidotomies, and total ethmoidectomies were used to perform endoscopic resection of this neoplasm, and resulted in a 2 × 3-cm skull base defect. Successful skull base repair was performed using soft tissue for both underlay and overlay grafts without a lumbar drain. (Color version of figure is available online.)

Congenital

Congenital encephaloceles were initially divided into sincipital, also referred to as anterior or frontoethmoidal, and basal encephaloceles. The basal-type encephaloceles are intranasal in location and have been variously described as transethmoidal, sphenoethmoidal, sphenomaxillary, sphenoorbital, transsphenoidal, and transtemporal.[10] Clinically, transsphenoidal encephaloceles are the only congenital type found in the sphenoid sinus. Abiko et al[11] further noted 2 types of transsphenoidal meningoencephaloceles: the intrasphenoidal and the true transsphenoidal. The former describes meningoencephaloceles extending into the sphenoid sinus but confined by its floor. The latter describes those encephaloceles traversing the floor of the sphenoid sinus and protruding into the nasal cavity or nasopharynx.

The true transsphenoidal-type encephaloceles, which are transmitted through the sphenoid bone, will most commonly have coexisting abnormalities of the face, optic system, and brain, corresponding to the median cleft face syndrome.[12] High surgical risks may be encountered with transsphenoidal encephalocele in the early infantile period because the pituitary-hypothalamic structures are usually incorporated in the herniated encephalocele of this age group.[13] Presentation in adults is rare because congenital facial anomalies are subtle or absent, and diagnosis is delayed until rhinorrhea occurs, a visual field defect becomes evident, hormonal deficiency is noted, or an epipharyngeal mass is discovered. In adults, the intrasphenoidal type of congenital encephalocele has reportedly had a good outcome with transsphenoidal repair, but a true transsphenoidal meningoencephalocele must be viewed with caution because of the complexity of the distorted anatomy and involvement of vital structures.[14]