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Cerebral spinal fluid leak repair

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Endoscopic repair of the skull base is now widely accepted to be superior to the previously used open approaches to the skull base in most cases. Endoscopic approaches have the benefit of less morbidity to the patient and high success rates in experienced hands. We delineate a few of the myriad of techniques used to repair some of the common cerebral spinal fluid leaks encountered by the practicing rhinologist.

Introduction

With advances in instrumentation and surgical techniques, endoscopic repair of anterior skull base cerebral spinal fluid (CSF) leaks has become the standard of care, with success rates more than 90%.[1,2] CSF leaks are typically classified as traumatic or nontraumatic etiologies. Traumatic causes include iatrogenic and accidental injuries. Nontraumatic causes include spontaneous leaks that can be associated with elevated intracranial pressure (ICP), neoplasms, congenital defects, meningoceles, and encephaloceles. Higher failure rates of repair have been documented in patients with elevated ICP.[3]

Unrepaired defects expose patients to the risk of meningitis, intracranial abscess, and pneumocephalus. The workup of CSF leaks includes a beta-2 transferrin test of nasal discharge, intrathecal fluorescein with nasoendoscopy, computed tomography (CT) scan, and magnetic resonance imaging (MRI), which identify the leak site in more than 90% of cases. Radiolabeled cisternogram or CT/MRI cisternograms are used less frequently. The patient may be referred to neurosurgery for evaluation before operative repair depending on the size and location of the area to be repaired.

The endoscopic approach depends on the location of the defect. The most common defect location is the ethmoid roof and cribriform region followed by the sphenoid sinus.[2] The most common causes of CSF leak are spontaneous followed by iatrogenic trauma.[2] The most common site of iatrogenic injury is along the ethmoid roof and lateral lamella.[4] Figure 1 demonstrates a recent referral for repair after iatrogenic injury to this region during routine endoscopic sinus surgery. Multiple approaches to the skull base have been described, including transethmoidal, transsphenoidal, transcribiform, transpterygoid, transclival, and transplanum.[5-7]

A variety of material may be used for repair, including fat, fascia, cadaveric dermis or fascia, free mucosal or mucoperichondrial graft, and local pedicled flaps.[1] Since its introduction in 2006, the pedicled nasoseptal flap (PNSF) has become a workhorse for large skull base defects or high-flow CSF leaks and has been shown to provide improved results.[8-10]

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Herein, we describe a few different approaches for CSF leak repair. We begin with an inlay and overlay technique that can be used for smaller defects and finish with a multilayer repair with a PNSF for large skull base defects.

Operative techniques

Small- to medium-sized defects

The approach to repair is determined by the site of injury. An appropriate and complete endoscopic sinus surgery is performed first to expose the defect and open the surrounding sinuses. The entire defect must be clearly delineated, and the overlying and immediately surrounding mucosa must be stripped. A rim of denuded bone should completely surround the defect. Residual mucosa can lead to possible mucocele formation and poor graft adherence. If a meningocele or encephalocele is present, the intranasal portion is debulked as in a polyp case, and the pedicle adjacent to the skull base is preserved and cauterized with bipolar cautery. The latter prevents intracranial hemorrhage after the pedicle and the surrounding dura are elevated to create an epidural pocket for the inlay graft, as described in the following section.

In the case of iatrogenic injury where the location is known or if the defect can be clearly identified on CT or MRI, intrathecal fluorescein is not necessarily used. If the defect location is less apparent, is spontaneous, or may be multiple, a lumbar puncture is performed, and fluorescein is injected 1 hour before surgery using 0.1 mL of 10% fluorescein mixed with 10 mL of CSF and reinjected slowly. The patient is then placed in trendelenburg position to allow the fluorescein to reach the intracranial compartment. It is especially important to use intrathecal fluorescein in cases where there may be multiple defect sites or concurrent leaks.

General anesthesia is induced. The nasal cavity is decongested with oxymetazoline-soaked pledgets, and 1% lidocaine with 1:100,000 of epinephrine is injected in the usual manner for endoscopic sinus surgery. Controlled hypotensive anesthesia is used to improve visualization. The appropriate endoscopic sinus surgery is performed to expose the defect in its entirety and to open widely all the surrounding sinuses to ensure that there is no postoperative sinus obstruction. For an ethmoid roof defect, a complete ethmoidectomy is generally performed, and if necessary, the middle turbinate is trimmed and removed along the vertical lamella to visualize the defect. The mucosa surrounding the defect is removed using blunt instruments. For the rarer posterior wall frontal sinus defect, an endoscopic Lothrop procedure is typically performed to improve exposure and bimanual access through both the nostrils. For the typical lateral sphenoid recess meningoceles and leaks, a transpterygoid exposure is imperative to gain access to the lateral recess lateral to the defect. This involves drilling away the medial portions of the base of the medial pterygoid plate as one extends the sphenoid sinusotomy laterally.

For small iatrogenic injuries with no suspicion for intracranial hypertension, a simple mucosal onlay graft can be used. This can be harvested from the septal mucosa or turbinates. For larger defects or those associated with spontaneous CSF leak, especially those thought to be associated with increased intracranial hypertension, a 2-layer closure composed of an inlay graft and separate overlay graft is used. Currently, commercially available acellular graft material is used for most reconstructions; that is, AlloDerm (Lifecell Corporation, Bridgewater, NJ) or Biodesign (Cook Medical, Bloomington, IN). However,

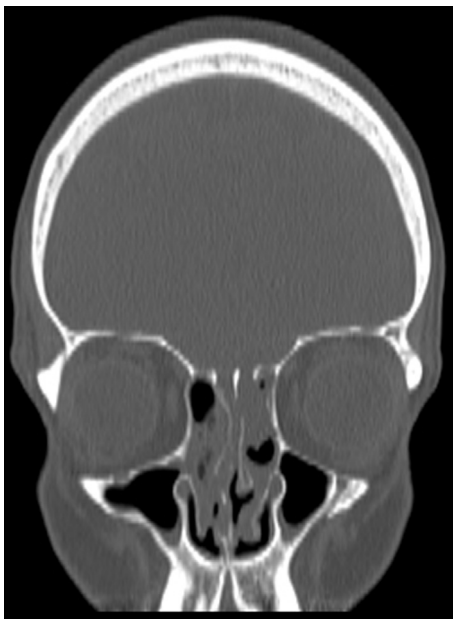

Figure 1 CT scan of an iatrogenic leak in the lateral lamella on the patient's left side.

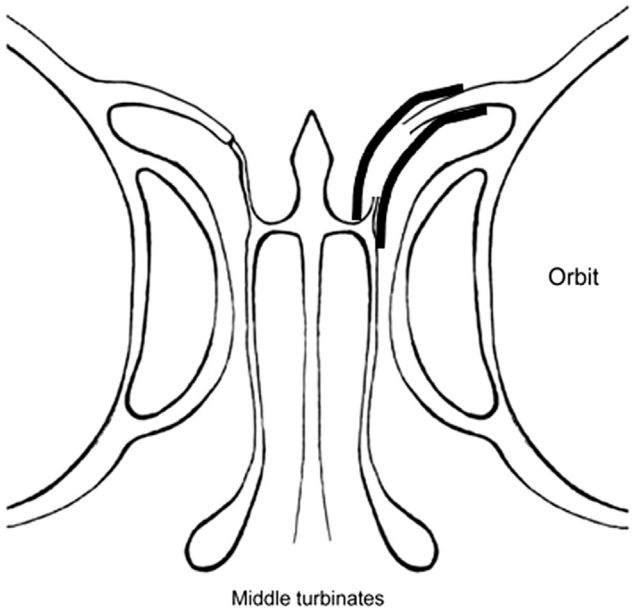

Figure 2 A basic repair of a CSF leak with an inlay and onlay graft.