Endonasal Endoscopic Duraplasty: Our Experience

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ABSTRACT

Objective: Endoscopic repair of cerebrospinal fluid (CSF) leaks is a recognized technique. We consider our experience and evaluate the outcomes in patients who underwent endoscopic repair of CSF leaks. **Methods:** A retrospective case note review of 135 patients who underwent anterior cranial repairs of CSF leaks between August 1995 and December 2004 at a tertiary referral center. We describe the technical details and outcomes of care by purely endoscopic procedures. **Results:** Thirteen patients had combined transcranial and endonasal repairs and 122 patients had their repairs using an endoscopic approach only. There were 64 males and 71 females with ages that ranged from 1 to 75 years (mean age 42 years, median age 44 years). The success rate for first attempt only was 93.4%. Eight of the 122 patients (6.6%) needed a second surgical repair. In one patient a bicoronal approach was necessary while in the other cases a revision endoscopic procedure was appropriate. The period of follow-up ranged from 2 months to 9 years (mean 5 years, median 39 months). **Conclusions:** Our experience confirmed that endoscopic surgery is an effective and safe method of treatment for most CSF leaks. A variety of different endoscopic techniques allowed CSF leaks to be repaired in almost every site of the anterior skull base with very few exceptions.

KEYWORDS: CSF leak, nasal endoscopy, duraplasty, sphenoidal meningoencephaloceles

In recent years the endoscopic endonasal approach has become the preferred route for repairing cerebrospinal fluid (CSF) leaks from the

anterior skull base. Its low morbidity and high success rate have made this technique more and more popular among otolaryngologists and

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neurosurgeons alike.¹⁻³ Many different techniques have been proposed to repair dural defects and high success rates range from 83% to 95%.^{4,5} The aim of this article is to consider our experience and to evaluate the outcomes in patients who underwent a purely endoscopic repair of CSF leaks in our hands.

MATERIALS AND METHODS

Between August 1995 and December 2004, 135 patients were treated for CSF leaks at the Department of Otorhinolaryngology of Ospedale di Circolo, University of Insubria, Varese and at the Department of Neurosurgery of Policlinico S. Matteo, University of Pavia. Thirteen of these patients were treated with a combined (transcranial and endonasal) approach. In this article we will consider the 122 patients who underwent a duraplasty procedure by a purely endonasal endoscopic approach. There were 64 males and 71 females.

Their ages ranged from 1 to 75 years (mean age 42 years, median age 44 years).

Surgical Technique

Surgery was performed under controlled hypotensive general anesthesia. Patients were placed supine on the operating table in a 20-degree anti-Trendelenburg position with slight extension of the head. The nasal cavity was decongested with topical application of bupivacaine or Carbocaine with adrenaline. Before surgery, 0.2 mL of 5% fluorescein mixed with 10 mL of the patient's CSF was injected through a lumbar tap.⁶ Fluorescein escaping with the CSF was easily visible in the nasal cavity and this allowed the precise site of the leak to be defined. Different technical approaches were chosen according to the precise type and location of the leak (Table 1).

The site of the defect was prepared to receive the graft and then the surgeon harvested and

Table 1 Different Types of Approaches to the Leak

Approach	Site of the Leak	Comments
I. Direct paraseptal approach to the olfactory groove	• large olfactory fissure	It permits the preservation of ethmoidal anatomical structures. Used in case of meningo/meningoencephalocele lateralizing the middle turbinate
II. Direct paraseptal approach with sphenoidotomy	• posterior sphenoid sinus wall • sphenoid roof	It permits the preservation of ethmoidal anatomical structures. Used in case of leakage after surgery of the sellar region.
III. Transethmoidal approach without removing the basal lamella of the middle turbinate	• ethmoid, laterally to the ethmoidal basal lamella	The ethmoidal roof is completely dissected to enable localization of the lesion.
IV. Transethmoidal approach with removal of the basal lamella of the middle turbinate	• narrow olfactory fissure • ethmoidal roof, with medial involvement of the olfactory fossa	The middle turbinate is removed with the entire lamella of the ethmoidoturbinals to obtain a smooth surface for the proper implantation of the graft previously harvested from the middle turbinate.
V. Transethmoidal-pterygosphenoidal approach	• lateral wall of the sphenoid sinus • CSF leak of the medial fossa	It is necessary to drill the anterior wall of the sphenoid sinus and the base of the pterygoid process as far as the lateral wall of the sphenoid sinus.

prepared the graft so that it was of a suitable shape and size. Autologous grafts, commonly acquired from the nasal cavity (nasal septum and middle turbinate), were preferred because of ease of access and compatibility with the dura. The precise method of placement of the grafts varied.

OVERLAY TECHNIQUE

The graft was fixed to the bone (extracranial). The nasal mucosa around the defect was removed to allow perfect adhesion of the graft to the bone. This technique was usually performed to close cribriform plate leaks and the grafts were mainly mucoperiosteum or mucoperichondrium harvested from the turbinates or nasal septum.

COMBINED (UNDERLAY AND OVERLAY) TECHNIQUE

In the two-graft technique, one graft was inserted under the skull base defect between bone and the dura and the other placed as an overlay.

In the three-graft technique, the first graft was inserted deep to the dura, the second one inserted between bone and dura, and the third placed extracranially as an overlay. When a three-layer duraplasty was performed, temporal fascia, fascia lata, or Lyodura® was used for the intracranial intradural layer. The same graft material and also bone or cartilage harvested from the turbinates or nasal septum was used for the intracranial extradural layer. Mucoperiosteum or mucoperichondrium was employed for the extracranial layer.

OTHER TECHNIQUES

To close leaks in the sphenoid and frontal sinuses an obliteration technique was sometimes adopted, the sinus packed with autologous abdominal fat after removal of the whole sinus mucosa.

Bed rest was enforced for the first 2 days after surgery. Patients were discharged from the hospital after 3 to 5 days and instructed to refrain from strenuous activity or Valsalva maneuver for 2 to 4 weeks.

During the follow-up period we performed endoscopic evaluations after 1 month and every 3 months for the first year, after which examinations

were made every 6 months. Six months after surgery, a T2-weighted MRI study was acquired to exclude a recurrent leak or secondary intracranial hypertension.

RESULTS

From the etiological point of view, dural defects were classified into three groups:

- Traumatic (31/122, 25.4%): the majority were caused by accidents, two cases resulting from gunshot wounds;
- Iatrogenic (29/122, 23.8%): these patients had acquired leaks following traditional sinonasal surgical approaches or functional endoscopic sinus surgery (for chronic rhinosinusitis, polyposis, or sinonasal neoplasm). Alternatively, they had undergone neurosurgical procedures.
- Nontraumatic (62/122, 50.8%): this group included pediatric cases with congenital defects and adults without any previous history of trauma or surgery.

The most frequent site of the skull base defect was the cribriform plate (42.7%), followed by the ethmoid (27.9%), sphenoid (16.4%), and frontal sinus (2.4%). In 10.6% of cases there were multiple leaks. The most frequently used graft was mucoperiosteum harvested from the middle turbinate, inferior turbinate, or the nasal septum either alone (50, 40.9%) or combined with bone, cartilage, or Lyodura® in two (30, 24.7%) or more layers (23, 18.9%). An obliterative technique was used in 13.1% of cases (2 frontal and 14 sphenoid) and in three cases (2.4%) abdominal fat was used to perform an ethmoidal duraplasty. In eight cases, there was persistence of Sternberg's canal, and a multiple-layer technique was used, without obliteration of the sphenoid sinus, through a transethmoid-pterygo-sphenoidal approach.

The success rate was 93.4% at the first attempt; only eight patients (6.6%) required a second surgical procedure. In one patient an external approach was necessary while all other cases were managed by further endoscopic procedures.

Follow-up periods ranged from 2 months to 9 years (mean 5 years, median 39 months).

DISCUSSION

Dural defects are rare but must be closed because of the risk of developing meningitis, encephalitis, or a cerebral abscess. The detection of CSF leaks is not always simple for several reasons. Our diagnostic algorithm^{7,8} comprised an accurate and detailed history, laboratory tests of rhinorrhea samples for β -2-transferrin detection or β -trace protein,^{9,10} endoscopic nasal evaluation, imaging (CT scan and MR), and if necessary a diagnostic fluorescein test.¹¹

The history should provide information about the possible cause of the CSF leak. While its cause bears no relationship to the likely success of a duraplasty, it is prudent to remember that multiple fracture lines and sites of leakage complicate trauma cases, and there is an easily overlooked higher risk of multiple and spontaneous leaks in those patients with raised intracranial pressure.¹² These facts alone should be considered if a leak recurs after a seemingly perfect surgical intervention.

Biochemical tests of rhinorrhea samples are very sensitive. Beta-2-transferrin or β -trace protein detection is very sensitive and we no longer rely on glucose ratios. Unfortunately, these estimations cannot always be performed when the rhinorrhea is intermittent. In these difficult situations, we rely on a CT scan to delineate fractures of the skull base and MR to show parenchymal or meningeal herniation. MR T2-weighted inversion recovery sequences with an inversion time for fluid suppression FLAIR (fluid attenuated inversion recovery) is very useful in the differentiation between CSF and inflammatory exudate.

A fluorescein test is performed in all patients where there is a clinical suspicion of CSF leak (recurrent meningitis or history of episodic rhinorrhea) and when all other tests are unhelpful. The presence of fluorescein-tainted fluid in the nasal

cavity is diagnostic. It is also useful to have fluorescein in the CSF during surgical repair of the defect. This facilitates identification of the defect and possibly allows a less invasive and more effective approach. Furthermore, it may alert the surgeon to other defects that had not been suspected.

In conclusion, the site and size of a CSF leak determines the technique best suited for closure of the defect (Table 1). External approaches are still necessary for some CSF leaks, particularly those in the posterior wall of the frontal sinus and those caused by multiple fractures of the anterior skull base, such as gunshot injuries. In these special cases we use a combined endoscopic endonasal and external approach. Our experience confirms that endoscopic surgery is an effective and safe method of treatment for most CSF leaks. The availability of different endoscopic techniques allows CSF leaks to be repaired in almost every site of the anterior skull base with very few exceptions.

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