

Endoscopic Transnasal Cerebrospinal Fluid Leak Repair: A 10 Year Experience

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ABSTRACT: **Background:** Endoscopic techniques have gained popularity for the repair of anterior skull base defects.

Objective: To describe the 10 year experience with endoscopic surgical repair of cerebrospinal fluid (CSF) rhinorrhea in a tertiary medical center.

Methods: The files of all patients who underwent endoscopic transnasal CSF leak repair in our institution between 1996 and 2006 were reviewed.

Results: Twenty-four patients were identified: 16 women and 7 men with a mean age of 48 years and one child aged 9.5 years. The leak was trauma-induced in 17 patients and occurred spontaneously in the other 7. The defect was localized by preoperative computed tomography or CT/cysternography in 86% of cases. A fascia lata graft was the dominant choice for defect closure, and it was combined with a conchal or septal flap, fat, periosteum, or fibrin glue in 15 patients. The success rate was 83% after the first closure attempt and 91% after the second. Two patients required a craniotomy at the third attempt. Mean hospitalization time was 6.7 days. There were two minor complications. Two patients were lost to follow-up; none of the others had a recurrence during 2 years of follow-up.

Conclusions: The endoscopic transnasal technique for the repair of CSF rhinorrhea is associated with a high success rate and low morbidity, and it should be considered for the majority of cases. Repeated attempts may improve success.

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KEY WORDS: cerebrospinal fluid rhinorrhea, endoscopic repair

Cerebrospinal fluid rhinorrhea is characterized by the breakdown of all barriers that separate the subarachnoid space from the upper aerodigestive tract, namely, the mucosa of the nasal cavity or paranasal sinuses, bone of the skull base, dura matter, and arachnoid membrane. The most common cause is accidental trauma, followed by iatrogenic trauma, and tumors. Spontaneous and congenital CSF leaks have also been reported. Although less than 1% of endoscopic sinus surgeries may be complicated by CSF rhinorrhea, they nevertheless constitute a common iatrogenic cause [1,2].

CSF = cerebrospinal fluid

The most frequent clinical manifestation of CSF rhinorrhea is watery nasal discharge. Most patients do not complain of headache, and its presence should raise the suspicion of elevated intracranial pressure and intracranial pathology [3]. The diagnosis of CSF fistula is based on a thorough history provided by the patient, with emphasis on previous trauma or surgery, followed, in clinically suspicious cases, by laboratory analysis of CSF markers. Glucose level in the fluid is probably the easiest and most available marker; B2 transferrin is both a sensitive and specific marker of CSF. B trace protein, another reliable marker, is not yet widely available [4,5].

Most acute post-traumatic cases of CSF rhinorrhea resolve with conservative treatment. In the event of a chronic or prolonged leak, however, a surgical solution is mandatory. Thanks to improvements in technology and instrumentation in the last decade, the surgical repair of CSF leak has evolved from a craniotomy-based to an endoscopic procedure. Studies of large series of endoscopically treated patients report high success rates, approaching 95% at the first closure attempt [1,6,7].

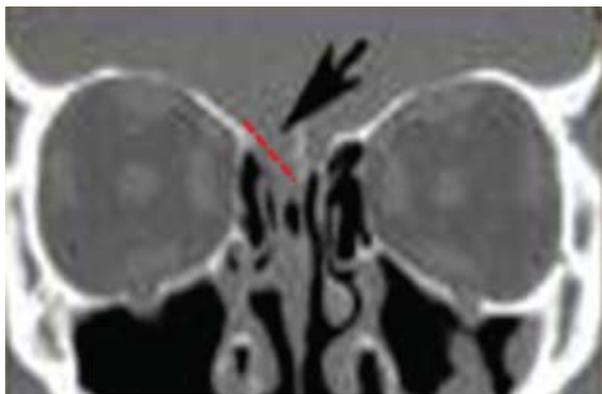
Factors critical to surgical success include identification of the leak site and site preparation, accurate graft placement, and good postoperative management. The surgical approach is determined by the site of the leak. The cribriform plate is the most common site (35%), followed by the sphenoid sinus (26%), anterior ethmoid sinus (18%), frontal sinus (10%), and posterior ethmoid sinus and clivus. Frontal sinus leaks usually require an open approach [8].

Multiple graft options have been suggested in the literature. Fascia lata grafts appear to be most popular, but temporalis fascia, middle turbinate, fat, free cartilage or bone, vascular nasoseptal flap [9] and acellular skin grafts have all been employed [1,4,10].

The aim of the present study was to review 10 years experience with endoscopic transnasal surgical repair of CSF leak at a major medical center.

PATIENTS AND METHODS

The study group consisted of all patients with clinical and laboratory-confirmed CSF rhinorrhea who underwent endoscopic transnasal repair in a tertiary university-affili-

Figure 1. Underlay procedure for the fascia lata graft

ated medical center between 1996 and 2006. The files were reviewed for background data, surgical technique, outcome, and postoperative course.

SURGICAL TECHNIQUE

High resolution computed tomography was performed before every surgical procedure. Following induction of general anesthesia, the nasal cavity was decongested with lidocaine and adrenaline-soaked tampons for 15 minutes. We used a 0 and 30 degree rigid endoscope. The leakage site, according to the imaging findings, was approached transnasally, transseptally or transthemoidally. In no case was intrathecal dye required for identification of the site. In some cases, access was augmented by positioning the patient in the Trendelenburg position. After the affected area was located, the surrounding mucoperichondrium was detached to expose the bone and dural defect. The brain tissue was gently mobilized from the dural edges around the defect to create a circumferential space. A fascia lata flap

was harvested through a small cut made in the outer thigh. The flap was measured to be 10–20 mm larger than the defect diameter so that there would be at least 5 mm of graft to insert into this space between brain and dura (“underlay”) [Figure 1]. For larger defects (usually more than 2 cm) or with repeated closure attempts, a second layer of tissue was placed on the nasal surface (“onlay”) followed by fibrin glue. The second-layered tissue was either the middle turbinate, a septal flap, fat, or periosteum. The reconstruction was supported by absorbable (Surgicel[®], Ethicon, Neuchatel, Switzerland) and non-absorbable nasal packing.

POSTOPERATIVE MANAGEMENT

Patients were prescribed bed rest for 48–72 hours, with the head elevated 30–45 degrees. The non-absorbable nasal packing was removed within 3–4 days.

Stool softeners, antihistamines, and antiemetics were administered as needed for 2 weeks to reduce intraabdominal pressure. Patients were also instructed to avoid blowing their nose. The mean duration of follow-up was 2 years (range 0.5–8 years).

RESULTS

Our file review identified 24 patients who met the study criteria. The mean age of the 16 women and 7 men was 48 years, and one child was 9.5 years old. In 17 patients (74%) the CSF rhinorrhea was preceded by accidental trauma (6 patients) or surgery (sinus surgery in 7, neurosurgery in 4); no cause was found (“spontaneous leaks”) in the remaining 7 patients. Six of the seven patients with spontaneous leaks were females. See Table 1 for further details on patients with spontaneous vs. traumatic leaks.

The defect was demonstrated by CT scan in 68% of the patients and by subsequent CT cisternography in another 19%, for a total preoperative imaging detection rate of 87%. At surgery, the defect site was precisely identified in all patients but one. The most common leak site was the cribriform plate in 20 patients. Four patients had larger defects of anterior cranial base after neurosurgery (three patients) and functional endoscopic sinus surgery (one patient). Eight patients were treated with a fascia lata graft with mucoperichondrium; in the remainder, the graft was supported by the middle turbinate (six patients), fibrin glue (six patients), a septal flap (four patients),

Table 1. Patients' characteristics

Leak type	No. of patients	Gender		Age (yrs, (median))	Leak site	Antibiotic treatment	CDC	Recurrence after first attempt
		M	F					
Spontaneous	7	1	6	47.8	7 CP	4	2	0
Post-traumatic	17	6	10	48	13 CP 4 ASB	0 3	1 4	1 3

CDC = continuous drainage catheter, CP = cribriform plate, ASB = anterior skull base

Table 2. Patients requiring repeated closure attempts

Patient	Age (yrs)	Gender	Cause for leak	Imaging	First attempt	Other attempts
1	56	F	s/p FESS	Meningocele	FL+ periost + glue	2 FL + gelfoam
2	47	F	s/p Neurosurgery	ASB defect	FL	2 FL, 3 craniotomy
3	24	M	s/p Neurosurgery, multiple	Large ASB defect	FL+ concha + glue	2 FL, 3 craniotomy
4	39	F	s/p Neurosurgery	Site was not recognized	FL+ concha + glue	2 FL+ glue + CD

FESS = functional endoscopic sinus surgery

fat (three patients), or periosteum (one patient). Closure technique was selected according to the size of the defect and the surgeon's preference. Small defects were repaired with fascia lata and mucoperichondrium or fat; in medium-size defects with clear CSF leak during surgery middle turbinate was used together with fibrin glue; larger defects were repaired with the addition of well-vascularized septal flap or periosteum.

The success rate of endoscopic repair was 83% after the first closure attempt and 91% after the second. All patients who failed the first attempt belonged to the trauma leak group. Two patients required a craniotomy at the third closure attempt. These patients had large skull base defects due to multiple neurosurgeries. Table 2 presents further details on patients who required repeated attempts for CSF leak repair.

Mean hospitalization time was 6.7 days. In 8 patients (33%) a continuous drainage catheter was placed for at least 48 hours postoperatively. A continuous drainage catheter was inserted whenever there was a doubt about CSF leak control during surgery (four patients), in repeated closure attempts (three patients) or in cases of larger defects (one patient). Six patients received prophylactic antibiotics (amoxicillin-calvulanate or ceftriaxone). Prophylaxis was given for recurrent attempts or in patients who had a record of recent meningitis, caused possibly by the skull base defect [Table 1].

There were two minor postoperative complications. One patient had fever higher than 38°C for 24 hours that was treated with antibiotics, and one had a CSF leak that required insertion of a continuous drainage catheter.

The sole patient in the study in whom the defect site was not identified after thorough investigation had two episodes of CSF rhinorrhea during follow-up (after two closure attempts). The rhinorrhea finally resolved with conservative treatment by continuous drainage catheter and antibiotics. In addition, two patients required craniotomy, one for persistent CSF leakage and one for recurrent empyema at a tumor site. Two patients were lost to follow-up.

DISCUSSION

The present study describes the 10 year experience of a tertiary medical center with endoscopic surgical closure of CSF leak. The success rates of 83% after the first attempt, rising to 91% after the second attempt, are in line with reports in the literature [1,6,7].

As the majority of acute post-traumatic CSF leaks resolve spontaneously within 10–14 days, the initial treatment is always conservative, consisting of bed rest, fluid restriction, antihistamines, diuretics, stool softeners, and in some cases, continuous drainage catheterization [10]. Surgery is necessary only when the leak persists. The literature contains several algorithms for preoperative diagnosis and fistula localization [4,10]. We use high resolution CT in every case, followed

by CT cisternography as necessary. With these methods, we successfully localized 22 fistulas in our cohort; the remaining fistula was identified by a meticulous search at surgery. CT and CT cisternography are widely available, easy to use, and constitute a low risk for the patient. Magnetic resonance imaging is used to differentiate between tumor, brain tissue, and meningocele in appropriate cases.

Patients should be carefully selected for endoscopic repair. Contraindications include the presence of intracranial lesions, comminuted fractures of the cranium base, fractures of the posterior wall of the frontal sinus, and lateral extensions of frontal sinus fractures. Factors that pose a risk to treatment failure are preoperative difficulty in localizing the defect, nature of the leak site (large anterior skull base after trauma or neurosurgery and sphenoid leaks are more likely to fail), large CSF leak site [10], and elevated intracranial pressure [11].

Continuous drainage for 24 to 120 hours postoperatively is recommended by many authors [1,7] in order to reduce the CSF pressure and the flow of leakage through large fistulas, thereby facilitating graft adhesion. Hegazy et al. [1], however, claimed that continuous drainage may not be necessary in every case: only 50% of their patients received continuous drainage with no decrease in postoperative success. Casiano and Jassir [12] reported similar results. We too, applied continuous drainage in only half of the patients. We suggest that it be limited to large defects, complex repairs, and first-attempt failures [1].

Prophylactic antibiotics should be administered to patients with a record of meningitis and to patients who undergo recurrent closure attempts [14].

Numerous types of graft material have been suggested in the literature [1,14,16]. We found that the fascia lata graft with mucoperichondrium or in combination with other tissues was easy to harvest, easy to place, and reliable for the repair of selected anterior skull base defects.

After a first endoscopic attempt fails, a second attempt can be made, usually with good results. In our study, about 30% of the cases that failed after the first closure attempt were successful after the second.

The endoscopic procedure has been found to shorten hospitalization time and reduce morbidity compared with open procedures [1,10]. The mean hospitalization time in our cohort was 6.7 days.

Two of our patients required craniotomy. A novel reconstructive technique for endoscopic closure of large defects utilizes a nasoseptal flap, which is a mucoperichondrial flap rotated on its vascular pedicle [9]. This flap is now being employed by us with excellent ongoing results. It has been found to be highly durable and may eventually eliminate the need for craniotomy.

In conclusion, we have had very good experience with endoscopic transnasal CSF leak repair, with high success rates and low morbidity. Our results support the effectiveness and

safety of this technique, and should encourage clinicians to apply the procedure in most cases of cerebrospinal fluid leak.

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