

# Endoscopic Cerebral Spinal Fluid (CSF) Rhinorrhea: Clinical Experiences

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## Abstract

**Objective:** We present our experience of endoscopic repair of cerebrospinal fluid (CSF) rhinorrhea.

**Material and Methods:** This was a retrospective study including 46 patients with CSF rhinorrhea, who were managed using endoscopy at the Otorhinolaryngology Department of Ege University Hospital, between March 2010 and November 2016. The cause of CSF rhinorrhea, localization and size of the defect, repair style, and recurrence were investigated.

**Results:** Etiologically, 30 patients were traumatic and 16 were nontraumatic. Overall, 23% patients had a history of meningitis before admission to our clinic. The ethmoid roof, sphenoid sinus, and frontal recess were the commonest regions of defects. There was recurrence in 5 patients who were endoscopically managed.

**Conclusion:** Because of the advances in endoscopic sinus surgery, endoscopic intracranial procedures, and anterior skull base surgery, otorhinolaryngologists could frequently diagnose CSF rhinorrhea. Appropriate management and endoscopic techniques led to successful results.

**Keywords:** Cerebrospinal fluid rhinorrhea, endonasal endoscopic surgical procedures, spontaneous cerebrospinal fluid leaks, endoscopic repair, endoscopic anterior skull base, repair

## INTRODUCTION

Depending on the defects of the bone and/or dura, a cerebrospinal fluid (CSF) fistula is an abnormal relationship that occurs between the subarachnoid space, paranasal sinuses, and nasal cavity (1). Major complications, such as meningitis, intracranial infections, and pneumocephaly, may develop due to this defect, which is located in the base of the skull. CSF fistulas need to be treated because they may cause such complications (2). CSF rhinorrheas are investigated in two main groups according to whether they develop because of trauma; those that develop because of trauma are divided into two categories: iatrogenically developing and developing because of an accident (2). CSF leaks occur in approximately 1%-3% of all closed head traumas. Also, 50% of the leaks usually emerge within the first 2 days of the accident, and almost all emerge within the first 3 months. More than 70% of such leaks are prevented after follow-ups or conservative treatment methods (3, 4).

Nowadays, iatrogenic CSF leaks are more frequent than those occurring after traumas. Cases occurring during or after endoscopic sinus surgery (ESS) are more commonly encountered than those that occur in head or brain surgeries. In terms of all CSF leaks, the ESS-associated CSF leak frequency has been reported to be between 41.9% and 25.9% (5-7). A spontaneous CSF leak is a clinical picture, which is more commonly encountered in obese women and is accompanied by symptoms, such as headache, pulsatile tinnitus, and visual changes, along with increased intracranial pressure. Skull base malformations, excessive ventilation of the sphenoid sinus, and empty sella syndrome are also among the causes of spontaneous CSF rhinorrhea (8). Determining the correct localization of the defect in CSF fistulas is of great importance, particularly in nasal endoscopic surgery. The determination of the defect location facilitates surgery planning and reduces the risk of recurrence by increasing the chance of dural repair. Various biochemical and radiological examinations are used in the diagnosis of CSF fistulas. CSF rhinorrhea is diagnosed with the presence of the  $\beta$ -2 transferrin molecule in the rhinorrhea material and with the support of radiological examinations, such as cisternogram, computed tomography (CT), or magnetic resonance (MR) cisternography (9, 10). Today, endoscopic repair of the defect in the skull base is a very effective and reliable method. This study aimed to retrospectively present our experience of endoscopic CSF rhinorrhea surgery in the last 6 years and to reveal the challenges we faced and our clinical recommendations and experience in terms of the diagnosis and treatment of this clinical situation.

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## MATERIAL AND METHODS

Forty-six patients with CSF rhinorrhea who referred to the Ege University Hospital Department of Otorhinolaryngology between March 2010 and November 2016 were evaluated in terms of complaints at the time of application, leak area, operation performed, reconstruction technique, and recurrence. The data of patients who underwent an operation because of CSF rhinorrhea were retrospectively reviewed. CSF rhinorrhea was diagnosed with the confirmation of the  $\beta$ -2 transferrin study, which was performed in the nasal secretion at a molecular level. The patients were assessed using CT or MR cisternography prior to surgery, and the location of the defect was estimated.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

### Statistical analysis

Statistical analysis was made using software IBM SPSS ver. 22.0 (IBM Corp., Armonk, NY, USA). Chi-square exact tests were used for the comparison of categorical data. Independent and paired sample t-tests were used for the analysis of parametric variables while Wilcoxon and Mann-Whitney U tests were used for the analysis of nonparametric variables based on the distribution pattern of the data. The Shapiro-Wilk test was used for determining the distribution pattern of the data. Correlation analysis was performed via Pearson or Spearman correlation analysis based on the distribution pattern of the data.

## RESULTS

Of the 46 patients who underwent endoscopy because of CSF rhinorrhea, 31 were males (67.39%) and 15 were females (32.61%). The age of the patients ranged from 13 to 75 years, and the mean age was 44.17 years. Given the etiological causes of rhinorrhea, a total of 30 (65.21%) rhinorrheas that developed after a trauma were included in the study; 16 (34.79%) of them were iatrogenic traumas. Nontraumatic CSF rhinorrhea developed in 16 patients. Only 2 of the 16 patients with nontraumatic CSF rhinorrhea were males (12.5%). While 11 of 16 patients with CSF rhinorrhea underwent functional endoscopic sinus surgery, CSF rhinorrhea developed in 3 patients because of a mass in the nasal cavity (in 1 patient due to olfactory neuroblastoma, and another during surgery because of encephalocele; Table 1). Five patients (23%) had a history of meningitis prior to admission to our clinic.

**Table 1.** Etiology of CSF rhinorrhea

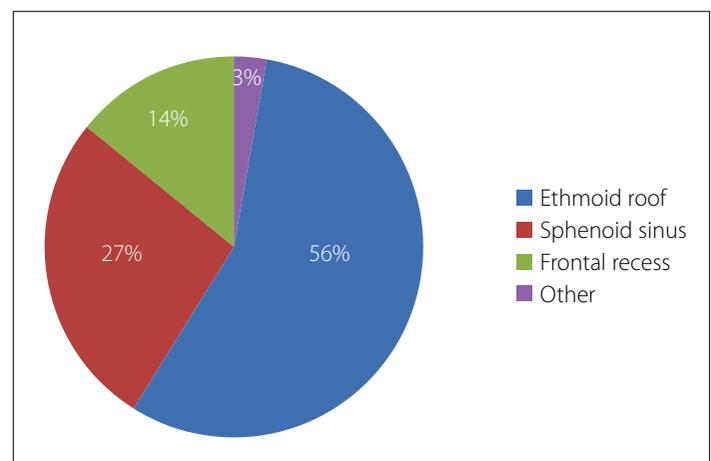
Traumatic causes (30 patients)	Nontraumatic causes (11 patients)
Environmental trauma (falling, traffic accidents, head trauma, etc.)	Spontaneous CSF rhinorrhea
Iatrogenic causes (surgery)	Empty sella syndrome
Fungal sinusitis	Idiopathic intracranial hypertension
Malignancy	
Congenital anomalies (nasal encephalocele, meningomyelocele, etc.)	
Olfactory neuroblastoma	

CSF: cerebrospinal fluid

All patients were preoperatively evaluated using paranasal sinus CT. The location of the defect was detected in 27 patients using preoperative CT cisternography; however, the location of the defect could be revealed for only 25 patients using preoperative MR cisternography. The location of the defect that was preoperatively found in these patients was different from the one that was found in the previous 3 patients. When the defect locations were endoscopically investigated, the most frequent locations were found to be the ethmoid roof (26 patients, 55.52%), sphenoid sinus (13 patients, 27.26%), and frontal recess (7 patients, 14.22%) (Figure 1). The repair technique was decided according to the localization and width of the defect during the CSF rhinorrhea surgery. The defect was repaired using multilayer fascia lata in 33 patients, septal cartilage in 5, nasoseptal flap in 3, middle turbinate flap in 2, and septal cartilage + fascia lata in 3. Reconstructions were completed using tissue adhesive and hemostatic oxidized cellulose polymer, and finally, the cavity was packed. Patients were postoperatively followed-up for head elevation, low arterial pressure, and laxatives, and they were made to avoid valsalva. Thus, low intracranial pressure was attempted to be achieved in the early period. The patients were postoperatively followed-up for an average of 26.25 months (2-72 months), and recurrence was observed in 5 patients (89.13%). It was observed that 3 of the 5 the patients who were followed-up for recurrence were operated because of spontaneous CSF rhinorrhea and 2 of them were operated because of CSF rhinorrhea that developed after trauma. While 4 patients underwent a second operation, 1 underwent a third operation. One of the patients underwent conservative treatment. In 3 patients with recurrence, the defect location was observed in a different region, and 1 patient was observed to have CSF leakage at the graft site. No complaints and rhinorrhea were observed after the second surgery.

## DISCUSSION

Rhinorrhea is a rare condition that occurs because of several etiological factors. Although the commonest cause is trauma, it can also be iatrogenic or spontaneous (5). Although rare, it can lead to serious life-threatening complications if not treated. Hence, rhinorrhea treatment is important and lifesaving. Similar to literature, CSF rhinorrhea was also observed due to traumatic causes more frequently in our series (5, 11). Most patients in the trauma group were young adult males. The patients in the spontaneous CSF rhinorrhea group usually comprised middle-aged obese female patients. While the ethmoid roof was the frequent defect location in spontaneous CSF rhinorrhea, the defect was also detected in the sphenoid



**Figure 1.** Locations of the CSF rhinorrhea defect  
CSF: cerebrospinal fluid

noid sinus and frontal recess in the other patient group; these regions are the commonest defect locations, which is consistent with literature (11).

Rhinorrhea may appear as a complication of endoscopic sinus surgery. The dura adheres to the cribriform plate and fovea, which form the anterior cranial fossa base. If the bone and dura are penetrated, a CSF leak may develop. The place where specifically the anterior ethmoidal artery leaves the ethmoid region and enters the anterior cranial fossa is the weakest point of the anterior fossa base. This region is located in the medial region of the middle concha. Therefore, the surgeon should be extremely careful when working in this area (8). Of all the cases in the present study, 30 were operated because of rhinorrhea that developed after a trauma, and 16 of them were operated because of spontaneous CSF rhinorrhea. While 11 of the 16 patients in whom CSF rhinorrhea developed because of iatrogenic causes underwent endoscopic sinus surgery, CSF rhinorrhea developed in 3 patients during surgery because of a mass in the nasal cavity, in 1 because of olfactory neuroblastoma, and in 1 because of encephalocele.

The commonest location of CSF fistulas is the anterior cranial fossa base. The defect is most commonly observed in the cribriform plate, fovea ethmoidalis, and lateral lamella. The commonest cause of CSF fistulae in these regions is that the bone lamella is very thin and that the dura adheres very tightly to the bone (12). It can be less commonly observed in the sphenoid sinus and petrous temporal bone defects (13). In our study, the defect was most commonly found in the ethmoid bone and cribriform plate. Methods, such as  $\beta$ -2-transferrin, thin-section CT, MR and MR cisternography, and CT cisternography were used in determining the presence and location of the fistula. Among imaging modalities, CT cisternography is one of the most reliable and accurate tests for the diagnosis of active CSF fistulas. However, its sensitivity is low in cases with intermittent or inactive leaks (1, 2, 14). The location of the fistula enables the evaluation of bone and/or dural defects and other accompanying pathologies. The CSF pathway image, wherein the direct contrast material passage through the bone defect is shown in the CT cisternography, or indirectly, the pooling of the contrast material in the sinus adjacent to the defect is considered a positive finding for the CSF fistula. T2-weighted sequences are used in MR cisternography. The bright signal between the nasal cavity, sinus, and subarachnoid distance is called the CSF pathway. This tractus must be shown without interruption. The focal hyperintense images should not be erroneously identified as fistula. The superior features of MR cisternography are that it is noninvasive; it does not contain radiation, and it shows accompanying leptomenigeal cysts, cerebral herniation, and empty sella. MR cisternography has shown to be superior particularly in patients with intermittent rhinorrhea. The fact that it requires clinical experience and that it is unable to demonstrate bone defects are the disadvantages (1, 2, 14). In our case, the success rate of CT cisternography in detecting the defect location was determined as 58.69% and the success rate of MR cisternography was determined as 54.34%. There was no significant difference between CT and MR cisternography. The rate of success in the first surgery has been shown to increase from 90% to 97% in a meta-analysis evaluating the success of endoscopic CSF rhinorrhea repair (10). In our study, surgical failure was observed in 5 patients (13.8%). In literature, in a 286-patient series of Castelnovo et al. (15), no success could be achieved after endoscopic surgery in 28 patients, and this result is similar to that of our study. It is remarked in many studies that the type of tissue used to repair the defect does not affect the rate of success. Because in our series many different techniques, such as fascia, cartilage, perichondrium, and pedicled flaps have been used (16). While the pedicled flaps are advantageous because of better sustenance, free grafts offer a possibility of defect repair by preserving the nasal functions. Although pedicled flaps are gen-

erally recommended for large defects, other free grafts were observed to be successful after the defect was completely closed. The multiple-layer use of the free grafts allows the utilization of several tissues, such as the fascia, perichondrium, cartilage, and mucosa.

## CONCLUSION

Rhinorrhea is a rare but important disease requiring treatment. Particularly, endoscopic sinus surgery and frequent endoscopic intracranial procedures have increased the frequency of this situation. Hence, it is important that CSF rhinorrhea repair be performed without any complications and recurrence. Considering the patient's symptoms, CSF rhinorrhea should be diagnosed through the signs of  $\beta$ -2-transferrin positivity and with the help of imaging modalities. Regardless of the cause, endoscopic endonasal approaches have become a gold standard because they are less invasive and have much lower complication rates and higher success rates for rhinorrhea repair. However, considering the success of MR and CT cisternography in detecting the defect location, we assume that revealing the entire skull base is the most accurate approach in endoscopic CSF rhinorrhea surgery.

**Ethics Committee Approval:** Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

**Informed Consent:** Informed consent was obtained from all individual participants included in the study.

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