Cerebrospinal fluid rhinorrhea: A single center experience

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Abstract

The aim of this study is to examine the surgical methods and results according to the defect diameter and location, together with clinical and radiological findings in patients diagnosed with rhinorrhea in our clinic. Six patients diagnosed with rhinorrhea between March 2015 and August 2020 in the Department of Otorhinolaryngology and Head and Neck Surgery were evaluated retrospectively. Demographic features, clinical findings, imaging findings, and surgical treatment methods were analyzed. The age range is between 32 and 60 years, the mean age of the patients is 48.6. All six patients had a complaint of nasal discharge, which increased with leaning forward. Two patients had spontaneous rhinorrhea (2/6), two patients had traffic accident history accompanied by head trauma (2/6), in the history of other two patients included previous nasal surgery (2/6). The initial diagnosis of rhinorrhea was confirmed by studying β-2 transferrin in the samples collected from the nasal discharges of all patients. Brain magnetic resonance imaging and paranasal sinus computed tomography imaging were performed in all patients to identify the defect site. The defect site was in the lamina cribrosa in three patients (3/6; 7.4, 2, and 3 mm), in two patients, the defect site was in the sphenoid sinus lateral recess (2/6; 3.6 and 2.6 mm), and in one patient, the defect site was in posterosuperior wall of the sphenoid sinus (1/6; 3 mm). All patients underwent surgery with the endonasal endoscopic method. Surgical treatment is necessary to prevent life-threatening complications in patients with rhinorrhea. In suspected cases of rhinorrhea, the diagnosis of rhinorrhea is confirmed, and various surgical materials and methods are applied according to the defect location and size. As a surgical treatment method, endonasal endoscopic approaches have largely replaced transcranial approaches in recent years due to its high success rate and low morbidity profile.

Keywords: Rhinorrhea, cerebrospinal fluid, skull base defect, endoscopic repair

Introduction

Rhinorrhea is an abnormal leakage of cerebrospinal fluid (CSF) from the subarachnoid space into the nasal cavity or paranasal sinuses. Early diagnosis and appropriate treatment are of vital importance because it causes various complications such as meningitis, pneumocephaly, and brain abscess. It usually presents with a unilateral, metallic, or salty-tasting nasal discharge that increases with bending forward. Etiology is divided into traumatic and nontraumatic causes.[1] It has been reported in the literature that 80% of the cases develop as a result of accidental closed head trauma, 16% as iatrogenic, and 4% as nontraumatic.[2] In clinically doubtful cases, laboratory analysis of nasal discharge (β-2 transferrin and β-trace protein) confirms the diagnosis.[3,4] Various imaging methods such as high-resolution computed tomography, magnetic resonance imaging (MRI), intrathecal fluorescein, CT cisternography, and MR cisternography are used as imaging modalities in the localization of the defect.[5,6] When the diagnosis is confirmed, the defect should be closed surgically as soon as possible.[7] As a surgical treatment method, endonasal endoscopic approaches have largely replaced intracranial approaches in recent years due to its high success rate and low morbidity profile. Commonly used endonasal endoscopic repair techniques include free tissue grafts, vascularized flaps, and tissue adhesives and combinations thereof.[8] In this case series, we present our experience in endoscopic repair together with the diagnosis and treatment algorithm of our patients diagnosed with CSF rhinorrhea between March 2015 and August 2020 in our clinic.

Case Series

The files of six patients who were admitted to the Otorhinolaryngology and Head and Neck Surgery clinic of Bakırköy Dr. Sadi Konuk Training and Research Hospital and who were followed-up with rhinorrhea between March

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Table 1. Demographic and Clinical Information of Patients

Patient No.	Age/ Gender	Etiology	Previous Surgery	Laboratory	Radiology	Defect Location/ Diameter	Follow-Up
Patient 1	60/F	Spontaneous	No	β-2 transferrin+	PNS CT Brain MRI	LC/7.4 mm	ARS after 6 months
Patient 2	32/M	Spontaneous	Transcranial rhinorrhea repair	β-2 transferrin+	PNS CT Brain MRI	SSLR/3.6 mm	No complications
Patient 3	55/F	TA	No	β-2 transferrin+	PNS CT Brain MRI	SSLR/2.6 mm	No complications
Patient 4	40/F	TA	No	β-2 transferrin+	PNS CT Brain MRI	LC/2 mm	No complications
Patient 5	55/M	Nasal surgery	Septoplasty	β-2 transferrin+	PNS CT Brain MRI	LC/3 mm	No complications
Patient 6	50/F	Nasal surgery	Endoscopic sinus surgery	β-2 transferrin+	PNS CT Brain MRI	SSPSW/3mm (latrogenic)	ARS after 4 months

M: male; F: female; TA: traffic accident; LC: lamina cribrosa; SSLR: Sfenoid Sinus Lateral Reses; SSPSW: Sfenoid Sinus Postero Superior Wall; ARS: Acut Rinosinusitis.

Table 2. Materials Used During Surgery

Patient No.	Fat Tissue (Region)	Fascia/Muscle	Mucosa	Cartilage/Bone	Flap	Biosynthetic Adhesive (Duragen®, Surgicel®, Bone Wax®, Tissel®, etc.)
Patient 1	–	–	Middle turbinate	Cartilage septum	Nasoseptal	Tissel, Surgicel
Patient 2	–	Fascia Lata	–	–	–	Tissel
Patient 3	Femoral	Fasia Lata/Quadri-seps Femoris	–	–	–	Tissel
Patient 4	–	–	Middle turbinate	Cartilage septum	Nasoseptal	Tissel, Surgicel
Patient 5	Umblical	–	–	–	Middle turbinate	Tissel, Surgicel
Patient 6	–	–	–	–	Nasoseptal	Tissel

2015 and August 2020 were retrospectively analyzed. Demographic characteristics of the patients, etiology of rhinorrhea, previous surgery, laboratory-imaging findings, and materials used for surgical repair were documented. The findings were presented in the light of the current literature. An informed consent was obtained from all patients included in this study.

The age range is between 32 and 60 years, and the mean age of the patients is 48.6. All six patients had a complaint of nasal discharge, which increased with leaning forward. All six patients had a complaint of nasal discharge, which increased with leaning forward. Two patients had spontaneous rhinorrhea (2/6), two patients had traffic accident history accompanied by head trauma (2/6), and the history of other two patients included previous nasal surgery (2/6). The initial diagnosis of rhinorrhea was confirmed by studying β-2 transferrin in the samples collected from the nasal discharges of all patients. Brain MRI and paranasal sinus computed tomography (PNS CT) imaging were performed in all patients. Defect location and size were determined preoperatively radiologically in all patients except patient six and were confirmed by the endonasal endoscopic method during the operation. The defect site was in the lamina cribrosa in three patients (3/6; 7.4, 2, and 3 mm), in two patients, the defect site was in the sphenoid sinus lateral recess (2/6; 3.6 and 2.6 mm), and in one patient, the defect site was in posterosuperior wall of the sphenoid sinus (1/6; 3 mm) (Table 1).

After the defect area was detected with the endonasal endoscopic method, multilayer repair was performed in two patients, multilayer repair and repair with pedicle flap in three patients, and repair with pedicle flap in one patient. Tissue grafts, flaps, and biosynthetic adhesive types used in combination during surgery were analyzed and listed in Table 2. One of our patients (patient 1), who had a unilateral nasal discharge for 3 years, applied to the emergency department with symptoms of agitation and delirium. CSF culture was taken with the suspicion of meningitis. Our patient was hospitalized because of the growth of *Streptococcus pneumoniae* in his culture, and surgical treatment was performed after medical treatment. The 7.4 mm defect in the lamina cribrosa on PNS CT of patient one is shown in Figures 1 and 2. Patient 2's 3.6 mm defect in the lateral recess of the sphenoid sinus is shown in Figure 3 and Figure 4.

latrogenic rhinorrhea developed in one patient (patient 6) during endoscopic sinus surgery due to inverted papilloma. In this patient, the location and size of the defect were determined during the operation by endonasal endoscopic method (Figure 5). The patient's defect was

Figure 1a,b. (a) A 7.4 mm defect in the lamina cribrosa is shown in the axial section PNS CT of patient 1. (b) The 7.4 mm defect in the lamina cribrosa is shown in the coronal section PNS CT of patient 1.

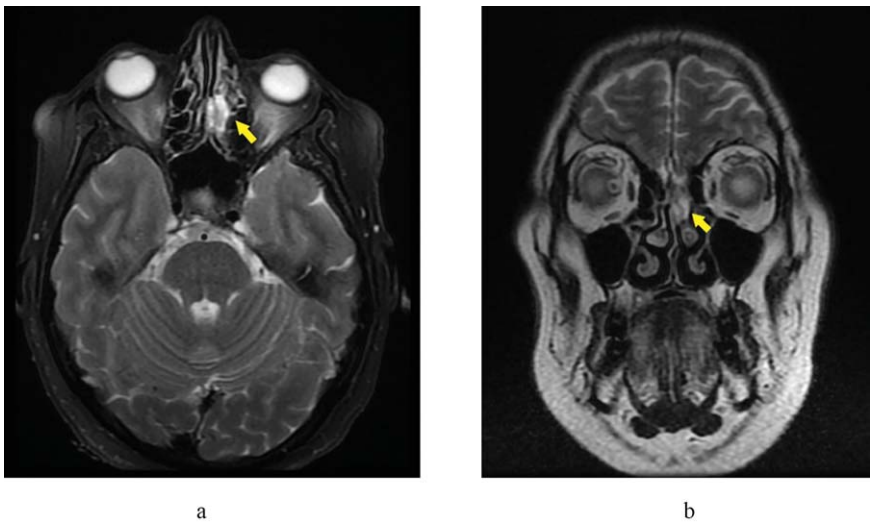

Figure 2a,b. (a) A 7.4 mm defect in the lamina cribrosa is shown in the axial section T2 brain MRI of patient 1. (b) The coronal section T2 brain MRI of patient 1 shows a 7.4 mm defect in the lamina cribrosa.

repaired in the same session using a nasoseptal flap and Tissel (Figure 6). No additional pathology was detected in the control endonasal endoscopic examination of the patient who had no complaints in the eighth month after the operation (Figure 7).

The patients were followed-up in the first 6 months after the operation, once a month, and then once a year. Two of the six patients developed acute rhinosinusitis in the late postoperative period, and no clinical findings were observed after medical treatment. All patients were treated with the endonasal endoscopic sinus surgery method, and no transcranial approach was required during the surgery and postoperative follow-ups.

Discussion

Rhinore was first reported by Bidloo in the 17th century.[9] It is divided into two as traumatic and nontraumatic.[1] Although postaccident rhinorrhea is more common in traumatic rhinorrhea, the widespread use of endoscopic sinus surgery in nasal surgeries has led to an increase in the frequency of iatrogenic rhinorrhea.[10]

CSF fistulas, especially fistulas at the anterior skull base, are potentially life-threatening conditions if they are not diagnosed or properly treated. These fistulas cause increased contamination of CSF with the passage of nasal flora, which can lead to bacterial meningitis, which is a significant cause of morbidity and mortality, as in our case (patient 1). Therefore, early diagnosis and appropriate treatment are vital.

The ideal method of confirming a CSF leak should be the absolute recognition of even small amounts of CSF using a highly sensitive and reliable method without posing any risk to the patient. Reliable CSF diagnosis from nasal secretion is the most important cornerstone in the

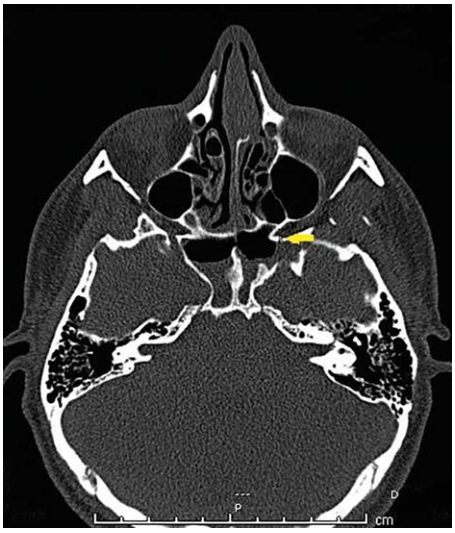

Figure 3. A 3.6 mm defect in the lateral recess of the sphenoid sinus is shown in the axial section PNS CT of patient 2.

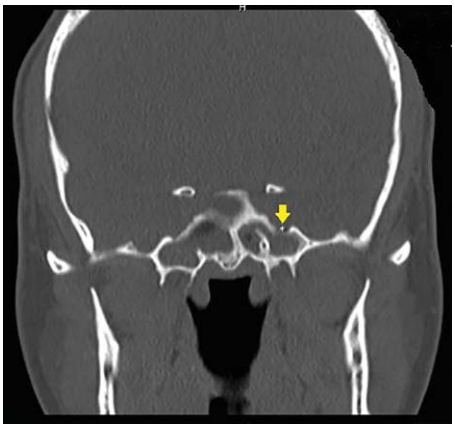

Figure 4. The 3.6 mm defect in the sphenoid sinus lateral recess is shown in the coronal section PNS CT of patient 2.

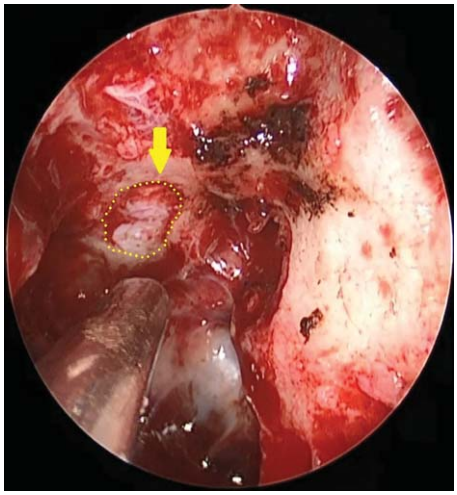

Figure 5. The defect that occurred in the posterosuperior wall of the left sphenoid sinus during endoscopic sinus surgery due to inverted papilloma in patient 6 is shown.

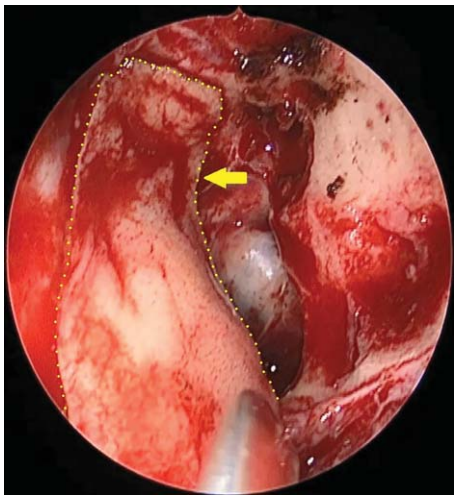

Figure 6. The repair of the defect in the posterosuperior wall of the left sphenoid sinus with a nasoseptal flap during the endoscopic sinus surgery of patient 6 is shown.

treatment of CSF fistulas. Detection of CSF proteins in collected nasal secretion samples is routinely used for this purpose. The most frequently used and pathognomonic in practice is the qualitative detection of beta-2-transferrin.[3,4] Beta-2-transferrin was first used by Meurman and Irjala[11] in 1979 to diagnose CSF leakage. Oberascher and Arrer[12] later described the method showing beta-2 transferrin in CSF leak and reported 100% sensitivity and specificity about the method. The presence of beta-2-transferrin in nasal fluid is a sensitive, inexpensive, and specific method to confirm the presence of CSF leakage. Only a small amount of fluid is required, and with this method, the need for costly invasive diagnostic methods can be reduced. Therefore, beta-2-transferrin should be considered as the first-line test to confirm the diagnosis of CSF rhinorrhea.[3,4] We also studied beta-2-transferrin in nasal secretion in patients with suspected CSF rhinorrhea in our clinic and confirmed the diagnosis of CSF rhinorrhea in all our patients with this method.

Imaging methods play a very important role in the diagnosis and treatment of CSF rhinorrhea. A finely detailed coronal CT with 1-2 mm thick sections from the anterior skull base can show small defects and fractures in this region. CT cisternography applied in the presence of active CSF leakage is another method that can be used to detect the presence and location of the defect. This method, which is applied by administering intrathecal contrast material, does not contribute to the diagnosis in cases where CSF leakage is not active or leakage cannot be stimulated by methods such as Valsalva maneuver. MR cysternography, on the other hand, shows CSF leakage in T2-weighted thin sections without the need for contrast material, but it is insufficient to determine the localization of the defect due to its inability to show the details of the bone tissue, but it can help distinguish inflammatory tissue from dura and determine its content.[5] Therefore, we used thin-section PNS CT and brain MRI to detect the defect area causing rhinorrhea in all our patients

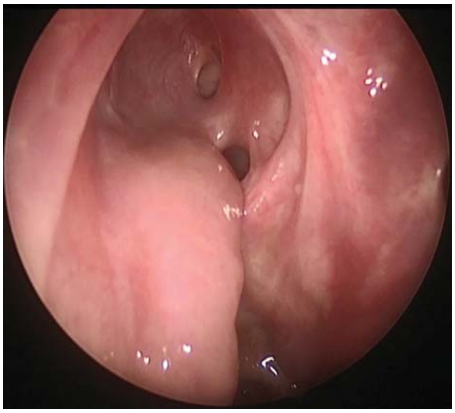

Figure 7. The defect area repaired by the endonasal endoscopic method of patient 6 at the eighth month postoperative follow-up.

in our case series, and none of our patients needed additional imaging methods.

Although open intracranial approaches have been used in the repair of skull base defects that cause rhinorrhea in the past, these applications have been largely replaced by endonasal endoscopic approaches in recent years due to their high success and low morbidity.[13] Commonly used endoscopic techniques for rhinorrhea include free tissue grafts, vascularized flaps, and tissue adhesives, as well as multilayered uses of these methods in various combinations.[8] In 2014, Soudry et al.[14] reported that the use of multilayer grafts and biosynthetic materials and the use of pedicled vascularized flaps in the repair of small defects produced similar results, while the use of pedicled vascularized flaps was superior to others in large skull base defects. In 2012, Harvey et al.[15] reported a lower rate of leakage as a result of repair with vascularized grafts compared to free tissue grafts. Deconde et al.[16] reported in 2015 that multilayer repair in spontaneous rhinorrhea can reduce the risk of early and late recurrence. We also perform defect repair with multilayer closure method and/or pedicle flap with endonasal endoscopic approach in CSF Rhinorrhea cases in our clinic. In our case series, we confirmed the diagnosis of rhinorrhea in our patients with suspected rhinorrhea, based on the history and clinical findings, as well as the literature, with various diagnostic methods. We performed rhinorrhea repair with endonasal endoscopic approach to our patients with various materials and methods. On this occasion, we emphasize the importance of endonasal endoscopic sinus surgery methods in the repair of skull base defects in order to prevent possible intracranial events in the future in patients with rhinorrhea.

Conclusion

Rhinorrhea repair by endonasal endoscopic method seems to be a safe and effective treatment method. Larger case series are needed in this regard.

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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Conflict of Interest: The authors have no conflicts of interest to declare.

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