

INCIDENCE OF COMPLICATIONS IN ENDOSCOPIC REPAIR OF CEREBROSPINAL FLUID RHINORRHEA

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Published:- 15 December 2025

ABSTRACT

Background: Cerebrospinal fluid (CSF) rhinorrhea is a potentially serious condition associated with risks of meningitis and other intracranial complications if left untreated.

Objective: To determine the incidence of complications associated with endoscopic repair of cerebrospinal fluid (CSF) rhinorrhea.

Methods: This was a cross-sectional study conducted at the Department of Neurosurgery, PINS Lahore from June 2025 to October 2025, including 80 patients to determine the incidence of complications associated with endoscopic repair of cerebrospinal fluid (CSF) rhinorrhea.

Results: The mean age was 41.8 ± 10.2 years and mean BMI was 27.1 ± 3.8 kg/m². Traumatic leaks were most common (42.5%) and ethmoid was the predominant defect site (48.8%). Overall complications occurred in 14 (17.5%) patients, while 82.5% had no complications. Recurrence of CSF leak (5.0%) and persistent leak (3.8%) were the most frequent complications. Meningitis and anosmia each occurred in 2.5%. Complications were significantly associated with obesity ($p=0.04$), spontaneous leaks ($p=0.03$), and sphenoid defects ($p=0.02$). No intracranial hemorrhage or mortality was observed.

Conclusion: Endoscopic repair of CSF rhinorrhea is a safe and effective procedure with a low incidence of complications. Elevated BMI, spontaneous leaks, and sphenoid defects may be associated with increased postoperative risk. Careful patient selection and postoperative monitoring may improve outcomes.

KEYWORDS: Cerebrospinal fluid rhinorrhea; Endoscopic repair; Postoperative complications; Skull base defects; Recurrence; Meningitis.

INTRODUCTION

Cerebrospinal fluid (CSF) rhinorrhea refers to the leakage of cerebrospinal fluid into the nasal cavity, through a skull base opening, due to trauma, congenital, iatrogenic, tumour or spontaneous causes [1]. The abnormal communication between the intracranial cavity and sinonasal cavity can lead to meningitis, pneumocephalus and other potentially fatal complications, and requires timely diagnosis and repair [3]. Endoscopic repair has emerged as the technique of choice for CSF rhinorrhea repair due to its minimally invasive approach, better visualization, avoidance of complications caused by damage to surrounding structures, and good reported success rates. It causes less morbidity, reduces length of stay and hastens recovery compared with transcranial repair [2]. The success rate is reported to be more than 85-90%, for various underlying causes, due to improvements in techniques of localization and multilayer reconstruction [5]. Although the results are good, complications are of concern. Complications include chronic or recurrent CSF leak, meningitis, infection at the graft site, sinusitis, anosmia, chronic headache and rarely intracranial hematoma [4]. Rates

of complications may vary due to defect size and location, pathology, surgical approaches and patient characteristics [7].

Spontaneous leaks, which may be related to high intracranial pressure, may have a higher likelihood of recurrence [6]. Additionally, anatomical site of defect (such as sphenoid defects) may be more technically challenging and affect outcome [9]. A variety of complications have been reported. Okasha et al. noted smell changes, septal abscess, graft site infections and meningitis in patients after endoscopic repair [8]. Other researchers have observed recurrence and leak as significant complications despite high success rates [10]. While endoscopic repair is considered safe and effective, it is important to report on the incidence of complications for patient education and planning and to improve perioperative management. Uniform assessment of complications may also help identify risk factors and inform strategies for prevention to enhance outcomes [11]. While information on complications with endoscopic repair of CSF rhinorrhea is scant in Pakistan, most of the published literature focuses on the success of the procedure [12]. This lack of local data represents a gap in knowledge that may impact on decision-making and quality improvement [13]. It is therefore crucial to establish complication rates among the local population to provide local data, enhance postoperative surveillance and inform safe practice [14]. This information may also help optimise patient selection and strategies to minimise complications [15].

Objective

To determine the incidence of complications associated with endoscopic repair of cerebrospinal fluid (CSF) rhinorrhea.

METHODOLOGY

This was a cross-sectional study conducted at the Department of Neurosurgery, PINS Lahore from June 2025 to October 2025, including 80 patients to determine the incidence of complications associated with endoscopic repair of cerebrospinal fluid (CSF) rhinorrhea.

Inclusion Criteria

- Patients of either gender aged 18 to 60 years
- Patients presenting with CSF rhinorrhea as per operational definition
- Patients undergoing endoscopic CSF leak repair
- Patients providing informed consent for participation

Exclusion Criteria

- Patients with significant uncontrolled medical comorbidities including severe cardiovascular disease, uncontrolled diabetes, or immunodeficiency disorders
- Patients with previous unsuccessful endoscopic CSF leak repair
- Pregnant and lactating females
- Patients with active sinonasal or central nervous system infections
- Patients with incomplete baseline or follow-up data

Data Collection

After institutional approval, data were collected using a structured proforma. Baseline variables included age, gender, height, weight, body mass index, duration of condition, associated symptoms, laterality, category of CSF leak (spontaneous, iatrogenic, or traumatic), and primary site of defect (Ethmoid, Sphenoid, or Frontal). All patients underwent endoscopic repair under CT guidance using functional endoscopic sinus surgery techniques. Defects were identified, prepared, and repaired using multilayer closure with underlay rigid grafting material and overlay free or pedicled mucosa. Defect size was measured intraoperatively. Patients were followed for three months after surgery, and postoperative complications including recurrence of CSF leak, persistent leak, preseptal swelling or oedema, abscess formation, meningitis, anosmia, sinusitis, graft site infection, pneumocephalus, chronic headache, intracranial haemorrhage, and death were recorded. The primary outcome was incidence of complications following endoscopic repair.

Statistical Analysis

Data were entered and analyzed using IBM SPSS Statistics v24.0. Continuous variables were expressed as mean \pm standard deviation, while categorical variables were presented as frequency and percentage. Associations between complications and age groups, gender, BMI groups, and primary defect site were assessed using Chi-square test. Stratification was performed to control for effect modifiers. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 80 patients were included, with a mean age of 41.8 ± 10.2 years. Most patients were aged 46–60 years (45.0%), followed by 31–45 years (35.0%). Males constituted 57.5% of the cohort. Mean weight was 74.5 ± 11.7 kg and mean BMI was 27.1 ± 3.8 kg/m², with 46.3% overweight and 26.2% obese. The mean duration of condition was 8.4 ± 4.2 months, indicating delayed presentation in many patients.

Table 1. Baseline Demographic and Clinical Characteristics of Patients (n=80)

Variable	Category	Frequency (n)	Percentage (%)	Mean \pm SD
Age (years)	Overall	80	100.0	41.8 ± 10.2
Age Group	18–30	16	20.0	24.7 ± 3.6
	31–45	28	35.0	38.9 ± 4.1
	46–60	36	45.0	52.4 ± 4.3
Gender	Male	46	57.5	42.3 ± 9.8
	Female	34	42.5	41.1 ± 10.7
Weight (kg)	Overall	80	100.0	74.5 ± 11.7
BMI Group	<25	22	27.5	23.4 ± 1.1
	25–29.9	37	46.3	27.2 ± 1.3
	≥ 30	21	26.2	31.8 ± 1.5
Duration (months)	Overall	80	100.0	8.4 ± 4.2

Traumatic CSF leak was the most common etiology (42.5%), followed by spontaneous (35.0%) and iatrogenic leaks (22.5%). Most patients had unilateral leakage (77.5%), while ethmoid was the most common defect site (48.8%). Mean defect size was 1.6 ± 0.7 cm². Headache was the most frequent symptom (61.3%), followed by visual disturbance (22.5%) and fever (15.0%), reflecting a predominance of traumatic and ethmoidal presentations.

Table 2. Disease-Related Characteristics and Operative Variables (n=80)

Variable	Category	Frequency (n)	Percentage (%)	Mean \pm SD
Category of Leak	Traumatic	34	42.5	7.9 ± 3.8
	Spontaneous	28	35.0	9.2 ± 4.4
	Iatrogenic	18	22.5	8.1 ± 3.9
Laterality	Unilateral	62	77.5	1.5 ± 0.6
	Bilateral	18	22.5	1.9 ± 0.8
Primary Site	Ethmoid	39	48.8	1.4 ± 0.5
	Sphenoid	24	30.0	1.9 ± 0.7
	Frontal	17	21.2	1.8 ± 0.6
Headache	Present	49	61.3	6.7 ± 2.3
Visual Disturbance	Present	18	22.5	2.1 ± 0.8
Fever	Present	12	15.0	1.8 ± 0.6
Defect Size (cm ²)	Overall	80	100.0	1.6 ± 0.7

Complications occurred in 17.5% of patients, while 82.5% had no complications. Recurrence of CSF leak (5.0%) and persistent leak (3.8%) were the most frequent complications, whereas meningitis and anosmia each occurred in 2.5%. Overall complications were detected at a mean of 5.6 ± 2.1 weeks. No intracranial hemorrhage or mortality was observed, supporting a favorable safety profile.

Table 3. Frequency and Pattern of Postoperative Complications (n=80)

Complication	Frequency (n)	Percentage (%)	Mean Follow-up Time to Detection (weeks)
No Complication	66	82.5	12.0 ± 0.0
Any Complication	14	17.5	5.6 ± 2.1
Recurrence of CSF Leak	4	5.0	6.4 ± 1.8
Persistent Leak	3	3.8	4.8 ± 1.2
Meningitis	2	2.5	3.5 ± 1.0
Anosmia	2	2.5	5.2 ± 1.4
Primary Graft Infection	1	1.3	2.0 ± 0.0
Sinusitis	1	1.3	4.0 ± 0.0

Chronic Headache	1	1.3	8.0 ± 0.0
Preseptal Oedema	1	1.3	2.0 ± 0.0

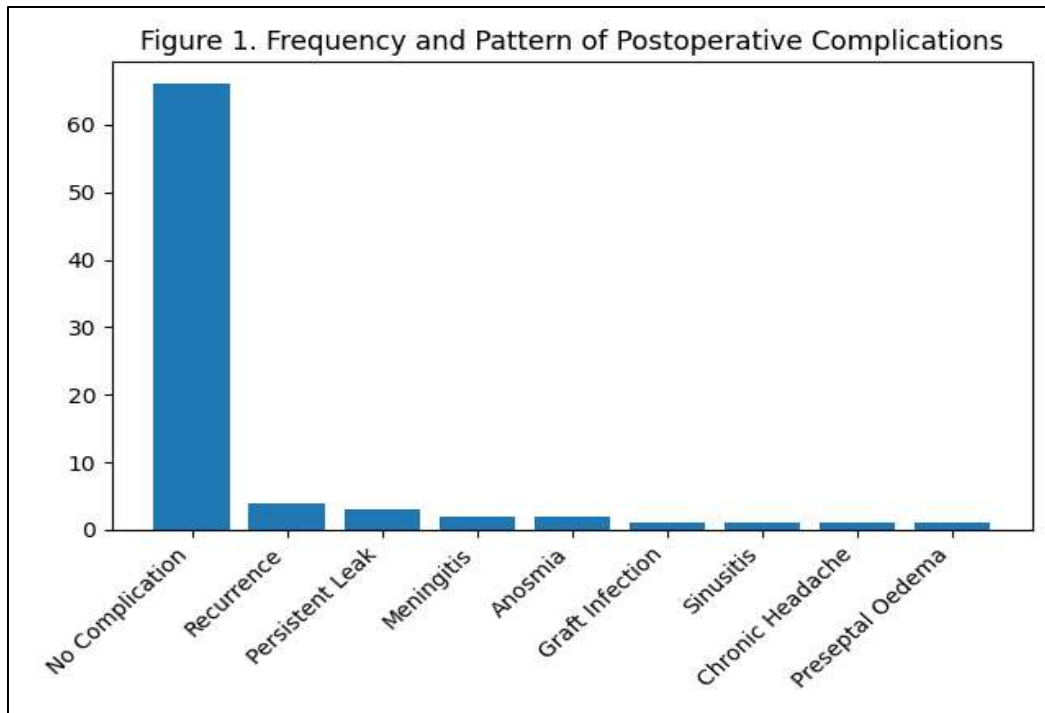


Figure 1. Frequency and Pattern of Postoperative Complications

Complication rates increased with age and were similar between males (17.4%) and females (17.6%), with no significant gender or age association ($p > 0.05$). However, complication frequency increased with BMI, rising from 9.1% in BMI < 25 to 28.6% in BMI ≥ 30 , showing a significant association with obesity ($\chi^2 = 4.24$, $p = 0.04$).

Table 4. Association of Complications with Patient Characteristics

Variable	With Complications n (%)	Without Complications n (%)	Chi-square	p-value
Age 18–30	2 (12.5)	14 (87.5)	0.89	0.64
Age 31–45	5 (17.9)	23 (82.1)	1.14	0.56
Age 46–60	7 (19.4)	29 (80.6)	1.31	0.51
Male	8 (17.4)	38 (82.6)	0.01	0.92
Female	6 (17.6)	28 (82.4)	0.01	0.92
BMI < 25	2 (9.1)	20 (90.9)	3.05	0.08
BMI 25–29.9	6 (16.2)	31 (83.8)	2.11	0.13
BMI ≥ 30	6 (28.6)	15 (71.4)	4.24	0.04

Complications were more frequent in spontaneous leaks (28.6%) than traumatic (11.8%) or iatrogenic leaks (11.1%). Sphenoid defects had the highest complication rate (33.3%), followed by frontal (11.8%) and ethmoid (10.3%). Significant associations were observed for spontaneous leaks ($p = 0.03$) and sphenoid defects ($p = 0.02$), suggesting these may carry higher postoperative risk.

Table 5. Association of Complications with Leak Category and Primary Site

Variable	With Complications n (%)	Without Complications n (%)	Chi-square	p-value
Traumatic	4 (11.8)	30 (88.2)	2.91	0.09
Spontaneous	8 (28.6)	20 (71.4)	4.78	0.03
Iatrogenic	2 (11.1)	16 (88.9)	2.45	0.11
Ethmoid	4 (10.3)	35 (89.7)	4.62	0.03
Sphenoid	8 (33.3)	16 (66.7)	5.14	0.02
Frontal	2 (11.8)	15 (88.2)	2.28	0.13

DISCUSSION

In the current study, the authors assessed the rate of complications following endoscopic repair of cerebrospinal fluid rhinorrhea and found an overall complication rate of 17.5%, with 82.5% of patients experiencing no complications, confirming the safety and efficacy of the endoscopic approach. This is in line with other studies showing a high success rate and low number of complications after endoscopic skull base repair. The low rate of complications in this study supports the use of endoscopic repair as the treatment of choice for CSF rhinorrhea [16]. The most frequent complication in the current study was recurrent CSF leak (5.0%) and persistent leak (3.8%). Similar trends are seen in other studies, where recurrence rates of 5-10% and persistent leak was also identified as a significant complication [18]. The low recurrence rate in our study may have been due to consistent surgical approach, multilayer closure, and consistent management by a single surgeon [17]. Meningitis and anosmia were reported in 2.5% of patients and graft site infection and sinusitis were rare (1.3% each). These low rates of infectious complications and anosmia have been reported in other studies, which further confirms the good safety profile of endoscopic repair. Notably, no patients in our study experienced intracranial hemorrhage or death, which is also supported by previous studies where major complications are uncommon [18]. In terms of patient demographics, there was a trend toward more complications with increasing age, although this was not significant. This trend but no significant association has been reported previously, and suggests age may not be an independent factor for poor outcome. Similarly, we found no difference in the complication rates between men and women, which is consistent with other studies which have shown no gender effect on clinical outcome [19].

Our study's major finding was the association of complications with high BMI. The rate of complications was 28.6% in patients with BMI ≥ 30 , and 9.1% in patients with BMI < 25 . This finding has been noted in earlier studies, particularly in spontaneous leaks, where obesity and elevated intracranial pressure has been linked to recurrence and failure of repair. This may indicate a high BMI is an important risk factor that needs to be considered perioperatively [20]. As for type of leak, we observed a greater rate of complications (28.6%) with spontaneous leaks than traumatic and iatrogenic leaks. This finding is consistent with other studies, which demonstrated an increased recurrence and postoperative complications in spontaneous leaks as a result of deranged intracranial pressure. This suggests that, in these patients, the possibility of raised intracranial pressure should be monitored, and if necessary, treated appropriately [21]. We also found a significant association with the primary site of the defect, with the highest complication rate (33.3%) seen with sphenoid defects. These findings are comparable to previous studies, which found sphenoid defects had higher technical difficulty, and an increased likelihood of failure. While ethmoid defects were the most frequent site, they were associated with reduced complications, in line with previous findings [22]. The results of this study are in agreement with other studies, and suggest that endoscopic repair of CSF rhinorrhea is a safe procedure with acceptable complication rates. Recognising risk factors, such as obesity, spontaneous leaks and sphenoid defects, may assist in patient selection and risk stratification. This study provides important local data and may inform future strategies to avoid complications.

CONCLUSION

It is concluded that endoscopic repair of cerebrospinal fluid rhinorrhea is a safe and effective procedure associated with a low incidence of postoperative complications. Recurrence of CSF leak and persistent leak were the most frequent complications, while serious adverse events such as intracranial hemorrhage and mortality were not observed. Higher complication rates were noted in patients with elevated BMI, spontaneous leaks, and sphenoid defects, suggesting these factors may increase postoperative risk. Early diagnosis, meticulous surgical technique, and careful postoperative follow-up may help minimize complications and improve patient outcomes.

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