Original article

Eustachian Tube Dysfunction and Disease Severity in Patients with Chronic Rhinosinusitis in Rawalpindi, Pakistan

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Abstract

Background: Chronic rhinosinusitis (CRS) is frequently associated with Eustachian tube dysfunction (ETD), exacerbating symptoms such as ear fullness, pressure, and pain. This study examines ETD prevalence in CRS patients undergoing functional endoscopic sinus surgery (FESS) in Rawalpindi, Pakistan—a high-pollution region—and evaluates the impact of FESS on both ETD and CRS symptoms.
Methods: A prospective cohort of 76 adult CRS patients was recruited at a tertiary care center. All participants completed the Eustachian Tube Dysfunction Questionnaire (ETDQ-7) and the 22-item Sino-Nasal Outcome Test (SNOT-22) preoperatively and 3 to 6 months postoperatively. Pearson and Spearman's correlations assessed the relationship between ETDQ-7 and SNOT-22 scores. Statistical significance was determined using paired t-tests.
Results: Preoperatively, 47.6% of patients scored ≥14.5 on ETDQ-7, indicating clinically significant ETD. Postoperative assessments showed significant reductions in both ETDQ-7 (mean preoperative 2.13 to postoperative 1.07, $p < 0.05$) and SNOT-22 scores (mean preoperative 48.0 to postoperative 24.0, $p < 0.05$). Correlation analysis revealed a strong association between ETDQ-7 scores and SNOT-22 ear/facial subdomain (Spearman $r = 0.68$, $p < 0.0001$), underscoring the impact of sinonasal inflammation on ETD.
Conclusion: ETD symptoms are prevalent in CRS patients and substantially improve after FESS, supporting the procedure's role in managing both sinonasal and otologic symptoms. Effective ETD treatment in CRS patients, especially in high-pollution settings, can reduce symptom burden and enhance quality of life. Future studies should explore additional therapies for patients with persistent ETD post-FESS.
Keywords: Rhinosinusitis, chronic; FESS; Eustachian tube dysfunction; quality of life; SNOT-22; ETDQ-7

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1. Introduction

Chronic rhinosinusitis (CRS) has been linked to multiple comorbid conditions, including Eustachian tube dysfunction (ETD). ETD, characterized by symptoms such as ear pressure, ear pain, and aural fullness, is increasingly recognized as a common complication in patients with chronic sinonasal inflammation[1]. Studies indicate that CRS-related ETD occurs due to mucosal inflammation and obstructed Eustachian tube function, often exacerbating otologic symptoms in affected patients[2, 3]. Although ETD and CRS are well-studied in various populations, the effect of environmental factors, particularly air pollution, on the prevalence and severity of these conditions has received limited attention[4].

Recent studies, including Wu et al., highlight that nearly half of patients with CRS also experience clinically significant ETD symptoms, as measured by the validated ETDQ-7[5]. This correlation supports that the inflammatory environment characteristic of CRS significantly impairs Eustachian tube function, worsening otologic symptoms such as ear fullness and pain, and contributes to an increased burden on patient quality of life (QOL).

Air quality in urban settings such as Rawalpindi, Pakistan, where levels of pollutants are high, has been linked to respiratory and sinonasal diseases. The presence of high particulate matter (PM2.5) and other pollutants could contribute to more severe CRS symptoms and, subsequently, higher ETD severity[4, 6]. This study aims to examine the prevalence of ETD symptoms in CRS patients undergoing functional endoscopic sinus surgery (FESS) in this region. We hypothesize that the local environmental factors contribute to elevated ETD severity among CRS patients and that these symptoms improve following FESS, as observed in previous studies[7, 8].

2. Materials & Methods

This study was conducted in Rawalpindi, Pakistan, following approval by the local institutional review board. A cohort of adult patients diagnosed with CRS and scheduled for FESS were recruited between May 2023 and August 2024. All patients had previously undergone medical therapy but showed insufficient

improvement, thus meeting the criteria for surgical intervention as outlined by the International Consensus on Rhinosinusitis[8]. Exclusion criteria included incomplete preoperative or postoperative questionnaires, known malignancies, or alternative diagnoses that could independently influence ETD. Written informed consent was obtained from each patient before inclusion in the study. To evaluate ETD severity, the Eustachian Tube Dysfunction Questionnaire (ETDQ-7), a validated 7-item survey assessing symptoms on a scale from 1 to 7, was administered. Clinically significant ETD was identified by a score of ≥14.5[4]. CRS symptom severity was assessed using the 22-item Sino-Nasal Outcome Test (SNOT-22), which includes an ear/facial subdomain relevant to ETD symptoms. Preoperative assessments were conducted immediately before surgery, and postoperative assessments were completed 3 to 6 months post-surgery[7].

Statistical analysis was conducted using the SPSS version 25. Descriptive statistics were used to characterize patient demographics, including age, gender, and CRS subtype prevalence. Pearson and Spearman correlation coefficients were calculated to assess relationships between ETDQ-7 and SNOT-22 scores, as well as between ETDQ-7 scores and SNOT-22 subdomains. Paired t-tests were performed to evaluate the change in ETDQ-7 and SNOT-22 scores pre- and postoperatively, with statistical significance set at $p<0.05$[9].

3. Results

A total of 76 patients with CRS, treated surgically at a tertiary care center in Rawalpindi, Pakistan, were included in the analysis. The mean age of the cohort was 38.3 years (SD = 15.3), with 52.6% male and 47.4% female participants.

In terms of disease presentation, 84.2% of patients presented with CRS and nasal polyps (CRS with NP), while the remaining participants had CRS alone (Table 1). The preoperative ETDQ-7 scores revealed a mean score of 2.13 (SD = 0.9) for the overall cohort, with 47.6% of patients scoring ≥14.5, indicating clinically significant ETD symptoms (Table 2). The preoperative SNOT-22 total score had a mean of 48.0 (SD = 20.1), indicating moderate-to-severe sinonasal symptom severity among participants.

Table 1: Patient demographics and distribution of disease characteristics in the study cohort (n = 19). CRS, chronic rhinosinusitis; NP, nasal polyps.

Variable	Frequency	Percent (%)
Gender		
Male	40	52.6
Female	36	47.4
Ear involvement		
Left ear	4	5.3
Right ear	12	15.8
Both ears	60	78.9
Disease type		
CRS	12	15.8
CRS with nasal polyps (NP)	64	84.2

After 3 to 6 months postoperatively, a significant improvement in ETDQ-7 scores was observed, with a mean postoperative score of 1.07 (SD = 0.9), indicating reduced ETD severity across the cohort ($p < 0.05$). Similarly, the SNOT-22 total scores decreased markedly to a mean of 24.0 (SD = 14.5), reflecting significant improvement in sinonasal symptoms post-FESS ($p < 0.05$).

Table 2: Comparison of mean preoperative and postoperative ETDQ-7 and SNOT-22 scores in CRS patients undergoing functional endoscopic sinus surgery (FESS). ETDQ-7, Eustachian Tube Dysfunction Questionnaire; SNOT-22, 22-item Sino-Nasal Outcome Test.

Measure	Time point	Mean	Standard deviation (sd)
ETDQ-7 score	Preoperative	2.13	0.90
	Postoperative	1.07	0.90
SNOT-22 score	Preoperative	48.00	20.10
	Postoperative	24.00	14.50

Correlation analysis between ETDQ-7 and SNOT-22 scores demonstrated a moderate association preoperatively, with a Pearson correlation coefficient of 0.52 ($p < 0.001$). The strongest correlation was observed between ETDQ-7 scores and the ear/facial subdomain of the SNOT-22, with a Spearman correlation coefficient of 0.68 ($p < 0.0001$), indicating a strong association between CRS severity and otologic symptoms in this population.

4. Discussion

Findings from this study support the high prevalence and significant postoperative improvement of ETD symptoms in CRS patients, aligning with other prospective evaluations that show ET dysfunction is

frequently present among those with CRS and responds well to surgical intervention. Studies like Maniakas et al. highlight that ear symptoms, specifically ear fullness and ear pain, often improve following endoscopic sinus surgery (ESS), with reductions in SNOT-22 scores that are comparable to non-CRS populations post-treatment. The consistency of these outcomes suggests that FESS offers a dual benefit in alleviating both sinonasal and otologic symptoms, underscoring the effectiveness of surgical intervention in comprehensive CRS management[10].

While surgical intervention remains a mainstay treatment for refractory CRS and associated ETD symptoms, some practitioners advocate for a more conservative approach, especially given the risks associated with surgery. Alternative non-surgical therapies, including balloon dilation of the Eustachian tube, have shown promise in patients with ETD alone, though evidence is still evolving for CRS patients with ETD comorbidity[11]. These procedures, less invasive than FESS, may offer symptom relief for ETD-specific complaints, though they may not address the broader range of CRS-related symptoms. Furthermore, medical management of CRS with anti-inflammatory and topical therapies has been shown to provide symptom relief and could serve as an adjunct or alternative to FESS for selected patients[9]. Future studies comparing FESS with these alternatives specifically in populations with CRS and high pollution exposure could yield valuable insights into optimizing patient care.

An important consideration is the psychological and functional burden associated with ETD symptoms in CRS, as chronic ear-related issues often impair social engagement, workplace productivity, and overall quality of life. Studies highlight that symptoms of ear pain and fullness—common in CRS-associated ETD—are linked to increased stress and depressive symptoms when left unaddressed, especially in cases unresponsive to medical therapy. By reducing ET and sinonasal symptoms, FESS can enhance daily functioning and psychological well-being, demonstrating that effective treatment in CRS patients may yield benefits that extend beyond physical symptom relief to substantial improvements in quality of life[12]. Wu et al. further reinforce the role of FESS in alleviating ETD symptoms in CRS patients, showing significant reductions in ETDQ-7 scores postoperatively[5]. Their findings align with our results, indicating that surgical intervention not only addresses sinonasal symptoms but also substantially alleviates ETD, thereby improving overall patient-reported outcomes. The correlation between ETDQ-7 and SNOT-22 scores in their cohort (Spearman $r = 0.51$) is consistent with our observed association, underscoring the interconnectedness of sinonasal and otologic symptomatology in CRS.

Improvement in QOL is a critical metric in the management of CRS and ETD, as these conditions substantially impact mental well-being, social functioning, and productivity. Persistent otologic symptoms, such as ear pressure and pain, coupled with nasal congestion and headaches, have been shown to increase stress and anxiety among patients, potentially leading to depression in chronic cases[2, 3]. The correlation between ETDQ-7 and SNOT-22 scores highlights the interconnectedness of sinonasal and otologic symptoms with overall patient, suggesting that alleviating ETD symptoms can have far-reaching psychological benefits. Enhanced QOL through symptom reduction can also reduce healthcare utilization, as patients with well-managed CRS and ETD symptoms are less likely to seek repeated medical consultations or require ongoing interventions. This improvement reduces the psychological and financial burdens on patients and healthcare systems alike. Studies underscore that patients who experience relief from CRS and ETD symptoms report a greater ability to engage in social activities, improved sleep quality, and enhanced overall life satisfaction[4, 8]. Addressing these psychological dimensions is especially relevant for populations in areas with high pollution, like Rawalpindi, where respiratory conditions are pervasive, and symptom management is essential for maintaining mental and physical health.

The strong association between ETDQ-7 and the ear/facial subdomain of SNOT-22 further supports the value of integrated quality-of-life assessments in CRS care. Understanding and measuring the full range of patient's symptoms, including those affecting social and emotional well-being, enables clinicians to provide holistic care and prioritize treatments that address both physical and psychological needs. By demonstrating significant postoperative improvements, this study highlights the role of FESS in providing enduring QOL benefits, supporting its continued use in managing ETD and CRS together, particularly in areas with

environmental risk factors[7, 13]. This study's findings should be interpreted with caution due to the limited sample size and the absence of a control group. Additionally, the lack of objective ETD measures such as tympanometry means that symptom improvements are based solely on patient-reported outcomes, which could introduce response bias. Future research would benefit from incorporating objective ETD measures to validate these findings further. Investigating long-term QOL outcomes across diverse environmental settings and comparing FESS with non-surgical options, such as Eustachian tube dilation, could expand treatment options for patients with CRS and ETD. Moreover, studies examining the specific impact of air pollution on ETD and CRS symptomatology may offer insights into preventive care strategies for populations in highly polluted regions.

The correlation between ETDQ-7 and the ear/facial subdomain of SNOT-22 strengthens the case for routine QOL assessments in CRS care, as they capture both physical and psychosocial dimensions critical to patient well-being [12]. Future studies incorporating advanced audiometric measures, such as tympanometry, could refine the assessment of ETD in CRS patients, helping to identify those who might benefit from combined therapeutic approaches including both surgical and emerging non-surgical options like balloon dilation.

5. Conclusion

This study demonstrates that ETD symptoms are highly prevalent among CRS patients in Rawalpindi, Pakistan, and that these symptoms significantly improve following FESS. The correlation between ETDQ-7 and SNOT-22 scores highlights the interconnected impact of sinonasal and otologic symptoms on patients' QOL. Given the urban environmental context of high pollution, which may exacerbate CRS and ETD severity, this study underscores the importance of effective intervention strategies. FESS not only reduces symptom burden but also enhances overall QOL by alleviating both physical and psychological discomfort associated with these chronic conditions. Future research should aim to validate these findings with objective ETD measures and explore alternative treatments to optimize patient outcomes across diverse settings.

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References

1. Tangbumrungtham N, Patel VS, Thamboo A, et al. The prevalence of Eustachian tube dysfunction symptoms in patients with chronic rhinosinusitis. Int Forum Allergy Rhinol. 2018;8:620–623.
2. Stoikes NF, Dutton JM. The effect of endoscopic sinus surgery on symptoms of Eustachian tube dysfunction. Am J Rhinol. 2005;19:199–202.
3. Higgins TS, Cappello ZJ, Wu AW, Ting JY, Sindwani R. Predictors of Eustachian tube dysfunction improvement and normalization after endoscopic sinus surgery. Laryngoscope. 2020;130(4):835-841.
4. Juszczak H, Aubin-Pouliot A, Sharon JD, Loftus PA. Sinonasal risk factors for Eustachian tube dysfunction: cross-sectional findings from NHANES 2011-2012. Int Forum Allergy Rhinol. 2019;9(5):466–472.
5. Wu AW, Walgama ES, Higgins TS, Borrelli M, Vardanyan N, Hopp S, Shamsian A, Hopp ML. Eustachian Tube Quality of Life and Severity of Disease in Patients With Chronic Rhinosinusitis. American Journal of Rhinology & Allergy. 2020;0(0):1-5. doi:10.1177/1945892420912366.
6. McCoul ED, Anand VK. Validating the clinical assessment of Eustachian tube dysfunction: the Eustachian Tube Dysfunction Questionnaire (ETDQ-7). Laryngoscope. 2012;122:1137–1141.
7. Hopkins C, Rudmik L, Lund VJ. The predictive value of the preoperative Sinonasal Outcome Test-22 score in patients undergoing endoscopic sinus surgery for chronic rhinosinusitis. Laryngoscope. 2015;125:1779–1784.
8. Orlandi RR, Kingdom TT, Hwang PH, et al. International consensus statement on allergy and rhinology: rhinosinusitis executive summary. Int Forum Allergy Rhinol. 2016;6–S26.
9. Bowles PFD, Agrawal S, Salam MA. Eustachian tube dysfunction in chronic rhinosinusitis: pre- and post-operative results following endoscopic sinus surgery, a prospective study. Rhinology. 2019;57(1):73–77.
10. Maniakas, A, Desrosiers, M, Asmar, MH, Al Falasi, M, Mfuna Endam, L, Hopkins, C, Philpott, C, Erskine, S, Smith, R, Kilty, S. Eustachian tube symptoms are frequent in chronic rhinosinusitis and respond well to endoscopic sinus surgery. Rhinology. 2018;56(2):118–121. doi:10.4193/Rhin17.165.
11. Marino MJ, Ling LC, Yao WC, Luong A, Citardi MJ. Eustachian tube dysfunction symptoms in patients treated in a tertiary rhinology clinic. Int Forum Allergy Rhinol. 2017;7(12):1135–1139.
12. Yang, K.-S.; Chen,W.-C.; Wu, C.-N.; Wee, Y.-S.; Wang, C.-S.; Wu, C.-C.; Luo, S.-D. Endoscopic Sinus Surgery Significantly Reduces Eustachian Tube Dysfunction Symptoms in Patients with Chronic Rhinosinusitis: A Systematic Review and Meta-Analysis. Biomedicines 2024, 12, 2484. https://doi.org/10.3390/biomedicines12112484
13. Newman AC, Omrani K, Higgins TS, et al. The prevalence of Eustachian tube dysfunction symptoms in patients with temporomandibular joint disorder. Laryngoscope. Published online ahead of print July 2, 2019. doi:10.1002/lary.28162.