



Evaluation of Olfactory Dysfunction and Its Association with Nasal Endoscopic Findings in Chronic Rhinosinusitis Patients

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Abstract:

Background: Chronic Rhinosinusitis (CRS) is a common inflammatory disease of the nose and paranasal sinuses characterized by persistent symptoms lasting more than 12 weeks. Olfactory dysfunction is a frequently reported symptom among CRS patients and significantly affects quality of life. The severity of smell impairment may be associated with mucosal inflammation, nasal polyps, and structural abnormalities observed during nasal endoscopy.

Objectives

1. To assess olfactory function in patients with chronic rhinosinusitis.
2. To correlate olfactory dysfunction with nasal endoscopic and radiological findings.

Materials and Methods: A prospective observational study was conducted among 100 clinically diagnosed CRS patients attending the Department of Otorhinolaryngology of a tertiary care hospital over a period of 12 months. Olfactory function was assessed using the University of Pennsylvania Smell Identification Test (UPSIT). Nasal endoscopy was performed and scored according to the Lund-Kennedy system. Computed Tomography (CT) of the paranasal sinuses was evaluated using the Lund-Mackay scoring system. Statistical analysis was performed using Pearson correlation and Chi-square tests.

Results: Among 100 CRS patients, 62% demonstrated olfactory dysfunction. Hyposmia was observed in 45% and anosmia in 17% of patients. The prevalence of olfactory dysfunction was significantly higher in patients with nasal polyps (84.2%) compared to those without polyps (46.3%) ($p < 0.001$). A significant positive correlation was observed between Lund-Kennedy endoscopic scores and severity of olfactory dysfunction ($r = 0.61$, $p < 0.001$). CT Lund-Mackay scores also showed a significant correlation with olfactory impairment ($r = 0.56$, $p < 0.001$).

Conclusion: Olfactory dysfunction is highly prevalent among CRS patients and is significantly associated with nasal endoscopic and radiological disease severity. Nasal endoscopy serves as a useful tool in predicting olfactory impairment and guiding clinical management.

Keywords: Chronic rhinosinusitis, Olfactory dysfunction, Hyposmia, Anosmia, Nasal endoscopy, Lund-Kennedy score.

Introduction

Between 14 and 30% of those patients who suffer from chronic rhinosinusitis have olfactory dysfunction, a condition that affects more than 10 million people.

Inflammatory conditions such as rhinosinusitis are characterized by having two components: the inflammatory component itself and the conductive component.

which impedes the arrival of odorants to the olfactory epithelium. Nasal endoscopy is an essential diagnostic tool for evaluating CRS. It enables direct visualization of mucosal edema, nasal polyps, purulent secretions, and anatomical abnormalities. The Lund-Kennedy endoscopic scoring system provides an objective assessment of disease severity. Similarly, CT imaging of the paranasal sinuses remains the gold standard radiological investigation, with the Lund-Mackay score widely used to quantify sinus involvement.

Several studies have demonstrated an association between olfactory dysfunction and disease severity in CRS; however, the relationship between olfactory impairment and objective endoscopic findings remains incompletely understood. Understanding this correlation may aid clinicians in predicting disease burden and treatment outcomes.

Computed tomography (CT) scan plays a vital role in the diagnosis of CRS and in detecting its complications. It has the ability to detect mucosal disease and anatomical variations, to demonstrate a primary obstructive pathology and to visualise posterior ethmoid, sphenoid sinuses and thus helps in the management of CRS. Nasal endoscopy helps in evaluation of the osteomeatal complex for evidence of the disease and to detect anatomical defects that compromise ventilation and mucociliary clearance. Hence nasal endoscopy and CT have brought the revolution in understanding CRS and are the prerequisites for Functional Endoscopic Sinus Surgery. The CT scan is considered as a gold standard diagnostic test for CRS. However, the relationship between olfactory dysfunction and chronic rhinosinusitis has been rarely studied. Certain researchers have suggested that the causes of olfactory dysfunction are nasal polyposis, allergic rhinitis, asthma, septal deviation, turbinate hypertrophy, and rhinosinusal surgery, but an agreement has not been reached yet. On the other hand, some studies have shown that olfactory levels are variable after medical and surgical treatment of chronic rhinosinusitis.

Therefore, the present study was undertaken to evaluate olfactory dysfunction in CRS patients and correlate it with nasal endoscopic and radiological findings.

Materials and Methods

Study Design

Prospective observational study.

Study Setting

Department of Otorhinolaryngology, tertiary care teaching hospital.

Study Duration

12 months.

Sample Size

100 patients diagnosed with Chronic Rhinosinusitis.

Inclusion Criteria

- Patients aged 18–65 years.
- Clinically diagnosed CRS according to EPOS criteria.
- Symptoms persisting for more than 12 weeks.
- Willingness to participate in the study.

Exclusion Criteria

- Previous sinonasal surgery.
- Acute upper respiratory tract infection.
- Head trauma.
- Neurodegenerative disorders affecting smell.
- Congenital anosmia.
- Malignancy of nose and paranasal sinuses.

Study Procedure

Detailed history and ENT examination were performed for all participants.

Olfactory Assessment

Olfactory function was assessed using the University of Pennsylvania Smell Identification Test (UPSIT).

Classification:

- Normosmia
- Mild Hyposmia
- Moderate Hyposmia

- Severe Hyposmia
- Anosmia

Nasal Endoscopy

Diagnostic nasal endoscopy was performed using a rigid nasal endoscope.

Parameters evaluated:

- Polyps
- Edema
- Discharge

Scoring was performed using the Lund-Kennedy Endoscopic Score.

Radiological Assessment

CT scan of the paranasal sinuses was obtained for all patients.

Disease severity was graded using the Lund-Mackay Scoring System.

Statistical Analysis

Data were analyzed using SPSS version 26.0.

Tests used:

- Mean \pm SD
- Chi-square test
- Pearson correlation coefficient
- Independent t-test

A p-value <0.05 was considered statistically significant.

Results

Table 1: Demographic Characteristics of Study Population (n=100)

Variable	Number (%)
Male	60 (60%)
Female	40 (40%)
Mean Age (Years)	41.9 \pm 12.5
CRS with Polyps	39 (3%)
CRS without Polyps	61 (61%)

Table 1 presents the demographic characteristics of the study population, which consisted of 100 participants. Among them, 60 participants (60%) were male and 40 participants (40%) were female, indicating a higher proportion of males in the study. The mean age of the participants was 41.9 \pm 12.5 years, suggesting that the average age was approximately 42 years with a moderate variation in age distribution. Regarding the clinical classification of chronic rhinosinusitis (CRS), 39 participants were

reported to have CRS with nasal polyps and 61 participants had CRS without nasal polyps. Since the total sample size was 100, the percentage for CRS with polyps is likely 39% rather than the 3% reported in the table, suggesting a possible typographical error. Overall, the study population was predominantly male, middle-aged, and included both CRS with and without nasal polyps, with the latter being more common.

Table 2: Distribution of Olfactory Function Among CRS Patients

Olfactory Status	Number (%)
Normosmia	38 (38%)
Mild Hyposmia	21 (21%)
Moderate Hyposmia	15 (15%)
Severe Hyposmia	10 (10%)
Anosmia	17 (17%)

Total olfactory dysfunction: 62%

Table 2 shows the distribution of olfactory (smell) function among patients with chronic rhinosinusitis (CRS). Out of the 100 patients

included in the study, 38 (38%) had normosmia, indicating normal olfactory function. The remaining patients exhibited varying degrees of olfactory impairment. Mild hyposmia was observed in 21 patients (21%), moderate hyposmia in 15 patients (15%), and severe hyposmia in 10 patients (10%). Additionally, 17 patients (17%) had anosmia, which refers to a complete loss of the sense of smell. When all

categories of olfactory impairment (mild, moderate, severe hyposmia, and anosmia) are combined, a total of 62 patients (62%) were found to have some degree of olfactory dysfunction. These findings indicate that olfactory impairment is common among CRS patients, affecting nearly two-thirds of the study population, while only 38% retained normal olfactory function.

Table 3: Association Between Nasal Polyps and Olfactory Dysfunction

Nasal Polyps	Olfactory Dysfunction Present	Normal Smell	Total
Present (n=38)	32 (84.2%)	6 (15.8%)	38
Absent (n=62)	30 (48.4%)	32 (51.6%)	62

Chi-square = 13.8, $p < 0.001$

Table 3 demonstrates the association between the presence of nasal polyps and olfactory dysfunction among patients with chronic rhinosinusitis (CRS). Among the 38 patients with nasal polyps, 32 (84.2%) experienced olfactory dysfunction, while only 6 (15.8%) had a normal sense of smell. In contrast, among the 62 patients without nasal polyps, 30 (48.4%) had olfactory dysfunction and 32 (51.6%) maintained normal olfactory function. These

findings indicate that olfactory dysfunction was substantially more common in patients with nasal polyps than in those without polyps. The Chi-square value of 13.8 and a p-value of less than 0.001 demonstrate that this association is statistically highly significant. Therefore, the presence of nasal polyps is strongly associated with an increased likelihood of olfactory dysfunction in CRS patients, suggesting that patients with nasal polyps are at a considerably higher risk of experiencing impaired smell compared to those without polyps.

Table 4: Correlation of Olfactory Dysfunction with Endoscopic and CT Scores

Parameter	Correlation Coefficient (r)	p-value
Lund-Kennedy Endoscopic Score	0.61	<0.001
Lund-Mackay CT Score	0.56	<0.001

Table 4 presents the correlation between olfactory dysfunction and disease severity as assessed by endoscopic examination and CT imaging in patients with chronic rhinosinusitis (CRS). The results show a positive correlation between the degree of olfactory dysfunction and both the Lund-Kennedy Endoscopic Score ($r = 0.61$) and the Lund-Mackay CT Score ($r = 0.56$). A correlation coefficient (r) ranges from -1 to +1, with values closer to +1 indicating a stronger positive relationship. The correlation coefficient of 0.61 suggests a moderately strong positive association between worsening endoscopic findings and increased olfactory dysfunction, while the coefficient of 0.56 indicates a moderate positive association between higher

CT scan scores and impaired olfactory function. Furthermore, the p-values for both correlations are less than 0.001, demonstrating that these associations are statistically highly significant and unlikely to have occurred by chance. These findings suggest that as the severity of CRS increases, as evidenced by higher endoscopic and radiological scores, the likelihood and severity of olfactory dysfunction also increase. Therefore, olfactory impairment appears to be closely associated with the extent of sinonasal disease in CRS patients.

Discussion

Our study Table 1 presents the demographic characteristics of the study population, which

consisted of 100 participants. Among them, 60 participants (60%) were male and 40 participants (40%) were female, indicating a higher proportion of males in the study. The mean age of the participants was 41.9 ± 12.5 years, suggesting that the average age was approximately 42 years with a moderate variation in age distribution. Regarding the clinical classification of chronic rhinosinusitis (CRS), 39 participants were reported to have CRS with nasal polyps and 61 participants had CRS without nasal polyps. Since the total sample size was 100, the percentage for CRS with polyps is likely 39% rather than the 3% reported in the table, suggesting a possible typographical error. Overall, the study population was predominantly male, middle-aged, and included both CRS with and without nasal polyps, with the latter being more common.

The demographic characteristics observed in the present study are comparable to those reported in earlier studies on chronic rhinosinusitis (CRS). In the current study, males constituted 60% of the study population, females 40%, and the mean age was 41.9 ± 12.5 years. Similarly, Gelardi et al. (2019) reported a predominance of male patients (59.7%) among individuals with chronic rhinosinusitis with nasal polyps, with a mean age of 49 years, indicating that CRS commonly affects middle-aged adults and is more prevalent among males. The findings are also consistent with those reported by Schlosser et al. (2020), who studied patients with CRS and found that demographic characteristics such as age and sex distribution were similar to those observed in most CRS cohorts, with middle-aged adults representing the majority of affected individuals. Their study further highlighted the association between nasal polyposis and disease severity, supporting the substantial proportion of patients with nasal polyps observed in the present study.

Our study Table 2 shows the distribution of olfactory (smell) function among patients with chronic rhinosinusitis (CRS). Out of the 100 patients included in the study, 38 (38%) had normosmia, indicating normal olfactory

function. The remaining patients exhibited varying degrees of olfactory impairment. Mild hyposmia was observed in 21 patients (21%), moderate hyposmia in 15 patients (15%), and severe hyposmia in 10 patients (10%). Additionally, 17 patients (17%) had anosmia, which refers to a complete loss of the sense of smell. When all categories of olfactory impairment (mild, moderate, severe hyposmia, and anosmia) are combined, a total of 62 patients (62%) were found to have some degree of olfactory dysfunction. These findings indicate that olfactory impairment is common among CRS patients, affecting nearly two-thirds of the study population, while only 38% retained normal olfactory function. Similar findings were reported by Jamie R. Litvack et al. (2009), who observed that olfactory impairment was a common feature among CRS patients and was associated with increased disease severity. Their study found that patients with hyposmia and anosmia constituted a substantial proportion of the CRS population, highlighting the significant burden of smell dysfunction in these patients. Furthermore, olfactory impairment was found to correlate with objective measures of sinonasal disease, supporting the high prevalence of olfactory dysfunction observed in the present study. Comparable results were also reported by Justin H. Turner and colleagues (2019), who evaluated patterns of olfactory dysfunction in CRS patients and found that smell impairment was present in the majority of affected individuals. Their analysis identified distinct groups of patients with varying degrees of hyposmia and anosmia, demonstrating that olfactory dysfunction is a common manifestation of CRS and contributes significantly to disease burden. These findings are consistent with the present study, where nearly two-thirds of patients exhibited some degree of olfactory dysfunction.

Our study Table 3 demonstrates the association between the presence of nasal polyps and olfactory dysfunction among patients with chronic rhinosinusitis (CRS). Among the 38 patients with nasal polyps, 32 (84.2%) experienced olfactory dysfunction, while only 6 (15.8%) had a normal sense of smell. In contrast,

among the 62 patients without nasal polyps, 30 (48.4%) had olfactory dysfunction and 32 (51.6%) maintained normal olfactory function. These findings indicate that olfactory dysfunction was substantially more common in patients with nasal polyps than in those without polyps. The Chi-square value of 13.8 and a p-value of less than 0.001 demonstrate that this association is statistically highly significant. Therefore, the presence of nasal polyps is strongly associated with an increased likelihood of olfactory dysfunction in CRS patients, suggesting that patients with nasal polyps are at a considerably higher risk of experiencing impaired smell compared to those without polyps.

Similarly, Soler et al. (2016) reported that nasal polyposis was one of the strongest predictors of olfactory loss in patients with CRS. Their study showed that patients with CRS and nasal polyps exhibited significantly worse olfactory test scores compared to patients without polyps. The authors concluded that the presence of nasal polyps was independently associated with smell dysfunction and represented an important marker of disease severity. These findings support the results of the present study, emphasizing that nasal polyposis is a major risk factor for olfactory impairment in CRS patients. These findings are consistent with those reported by Litvack et al. (2008), who demonstrated that olfactory dysfunction was significantly more prevalent among CRS patients with nasal polyposis than among those without polyps. The authors suggested that mechanical obstruction of the olfactory cleft and chronic mucosal inflammation associated with nasal polyps contribute substantially to impaired olfactory function.

Our study Table 4 presents the correlation between olfactory dysfunction and disease severity as assessed by endoscopic examination and CT imaging in patients with chronic rhinosinusitis (CRS). The results show a positive correlation between the degree of olfactory dysfunction and both the Lund-Kennedy Endoscopic Score ($r = 0.61$) and the Lund-Mackay CT Score ($r = 0.56$). A correlation

coefficient (r) ranges from -1 to +1, with values closer to +1 indicating a stronger positive relationship. The correlation coefficient of 0.61 suggests a moderately strong positive association between worsening endoscopic findings and increased olfactory dysfunction, while the coefficient of 0.56 indicates a moderate positive association between higher CT scan scores and impaired olfactory function. Furthermore, the p-values for both correlations are less than 0.001, demonstrating that these associations are statistically highly significant and unlikely to have occurred by chance. These findings suggest that as the severity of CRS increases, as evidenced by higher endoscopic and radiological scores, the likelihood and severity of olfactory dysfunction also increase. Therefore, olfactory impairment appears to be closely associated with the extent of sinonasal disease in CRS patients.

Similar results were reported by Litvack et al. (2008), who investigated the relationship between olfactory function and disease severity in CRS patients and found that poorer olfactory performance was significantly associated with higher CT and endoscopic scores. The authors concluded that objective measures of sinonasal inflammation and obstruction were important determinants of olfactory dysfunction in CRS.¹⁴

Comparable findings were also reported by Schlosser et al. (2016), who evaluated factors contributing to olfactory loss in CRS and observed significant correlations between impaired olfaction and both radiographic and endoscopic indicators of disease severity. Their study demonstrated that patients with more extensive sinonasal disease on CT imaging and nasal endoscopy had significantly worse olfactory outcomes. These findings support the results of the present study and suggest that olfactory dysfunction may serve as an important clinical marker of CRS severity.

Conclusion

Olfactory dysfunction is highly prevalent among patients with chronic rhinosinusitis and is significantly associated with the severity of

endoscopic and radiological findings. Patients with nasal polyps exhibit a higher incidence of smell impairment. Lund-Kennedy endoscopic scores and Lund-Mackay CT scores correlate positively with olfactory dysfunction severity. Routine assessment of olfactory function should be incorporated into the evaluation and management of CRS patients.

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