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5-Item sino-nasal outcome test and 22-item sino-nasal outcome test relationship with endoscopic and radiologic scores in chronic rhinosinusitis with nasal polyps

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ABSTRACT

Background: The 22-item sino-nasal outcome test (SNOT-22) is a frequently used patient-recorded outcome measure in patients with chronic rhinosinusitis with nasal polyps (CRSwNPs). Objective findings of nasal polyps and paranasal sinus inflammation are frequently graded using nasal polyp score (NPS) and Lund-Mackay Score (LMS), respectively.

Objective: To evaluate a novel, abbreviated, rhinology-focused, five-domain SNOT-5 questionnaire because we had anecdotally noticed a relative disconnect between SNOT-22 and endoscopy and imaging scores.

Methods: We performed a retrospective, cross-sectional, single-center review of patients with CRSwNPs who had filled out a SNOT-22, along with post hoc–derived SNOT-5 scores, which were then assessed in relation to NPS and LMS.

Results: A total of 129 patients were included in the analysis. SNOT-5 but not SNOT-22 scores significantly correlated vs either NPS ($P < .005$) and LMS ($P < .001$), whereas only SNOT-5 differed significantly when comparing the cohort's lowest and highest tertiles for mean LMS: 11.8 vs 16.8 (95% CI, 1.5-8.4; $P < .01$) and for mean NPS 12.4 vs 15.6 (95% CI, 0.5-5.9; $P < .05$).

Conclusion: In a retrospective, real-life cohort study of CRSwNP, there was a relative disconnect between the significant association of SNOT-5 but not SNOT-22 in relation to objective endoscopy and imaging measures. We, therefore, propose that further prospective intervention studies are indicated in CRSwNP to evaluate the SNOT-5 score including establishing the minimal clinically important difference.

Introduction

Chronic rhinosinusitis (CRS) is defined as inflammation of the nose and paranasal sinuses persisting for more than 12 weeks with nasal blockage and/or nasal discharge and/or decreased sense of smell and/or facial pain/pressure.[1] Clinical diagnosis of CRS with nasal polyps (CRSwNPs) is made based on symptoms and the presence of nasal polyps on nasal endoscopy and mucosal changes within the ostiomeatal complex and sinuses on computed tomography (CT) scan.[2,3] The objective findings of CRSwNP such as nasal polyps and paranasal sinus inflammation are graded using different endoscopic nasal polyp scoring systems and most frequently Lund-Mackay score (LMS), respectively.[3-5]

The subjective symptoms of CRSwNP are frequently assessed with the 22-item sino-nasal outcome test (SNOT-22) which is one of the most often used patient-reported outcome measure (PROM) quality-of-life (QoL) questionnaires, each domain of 5, with a total score of 110.[6] Nasal polyp score (NPS), LMS, and SNOT-22 are frequently used in clinical trials to assess the effectiveness of investigational medicinal products on objective and subjective CRSwNP outcomes. Moreover, documenting NPS, LMS, and SNOT-22 in routine clinical practice helps assess disease progression and severity before and after medical and/or surgical interventions. There has been a shift from objective to subjective CRSwNP findings to guide the choice of therapy.

To put the present study in clinical context, we had anecdotally noticed a relative disconnect between SNOT-22 scores and objective endoscopy or imaging scores, where the former had been a major inclusion criterion for entry into a randomized controlled trial involving a novel biologic drug in patients with severe CRSwNP. Such patients often had a low overall SNOT-22 score but exhibited high scores for individual rhinology-specific domains such as sense of smell/taste and blockage/congestion. Here, we formally assessed in a real-life, retrospective cohort study the utility of a novel, abbreviated,

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rhinology-focused SNOT-5 score in association with NPS and LMS, in patients with CRSwNP attending our clinic.

Methods

We undertook a retrospective, cross-sectional, single-center review of medical case records of patients with CRSwNP seen in the Tayside rhinology clinic in Scotland between January 2021 and December 2022. Caldicott Guardian approval was granted for accessing and collecting the data (IGTCAL10373+).

Adult patients with a diagnosis of bilateral CRSwNP who completed a SNOT-22 questionnaire during the outpatient clinic appointment were included in the study. The rhinology-focused, abbreviated SNOT-5 score domains consisted of need to blow nose, runny nose, thick nasal discharge, sense of smell/taste, and blockage/congestion.

Diagnosis of CRSwNP was based on EPOS2020 criteria for symptoms and endoscopic and sinus CT findings.

Patients were excluded from the study if they had endoscopic sinus surgery (ESS) or surgical polypectomy within 1 year or medical polypectomy with oral corticosteroids within 6 months before the clinic appointment; or had been taking regular systemic corticosteroids, immunosuppressive drugs, or monoclonal antibodies for systemic vasculitis, rheumatoid conditions, asthma, atopic dermatitis, and those undertaking aspirin desensitization therapy for aspirin-exacerbated respiratory disease (AERD); or had septal perforation, severe septal deviation, rhinitis medicamentosa, cystic fibrosis, ciliary dyskinesia, odontogenic CRS, allergic fungal rhinosinusitis, fungal ball, osteoma/osteochondroma, or frontal sinus mucocele.

NPSs were obtained from clinic letters reported by 2 ear, nose, and throat (ENT) consultants. Nasal polyp score grading system was used, with the grading in each nasal passage being scored from 0 to 4 (0, no nasal polyps; 1, small polyps confined to the middle meatus; 2, moderate-sized polyps reaching below the lower border of the middle turbinate; 3, large polyps reaching the lower edge of the inferior turbinate or polyps medial to the middle turbinate; 4, large polyps touching the floor of the nasal passage) with a total maximum score of 8.[4]

The severity of sinus inflammation was quantified by assessing the degree of sinus mucosal thickening on CT sinus imaging using the LMS system.[7] In the LMS system, each paranasal sinus is graded separately from 0 to 2 (0, no opacification; 1, partial opacification; 2, complete opacification), and the ostiomeatal complex is graded with 0 (not obstructed) or 2 (obstructed). The combined score ranges from 0 to 24. Only CT sinus scans performed within 3 months before or after the outpatient clinic appointment having not had medical polypectomy during the time were included in the data analysis.

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics version 27.0. Continuous variables were assessed for the distribution of normality with normality plots. Pearson's correlation was used for normally distributed data analysis to determine the correlation between the total SNOT-22 score or SNOT-5 vs either NPS or LMS. Spearman correlation was used for correlation analysis of non-normally distributed data of the various SNOT-22 domains. The patient cohort was also divided into the lowest, middle, and highest tertiles for SNOT-22, NPS, and LMS. In addition, we used a previously reported grading of SNOT-22 based on their total score as mild (≤20), moderate (21-50), and severe (>50).[6]

Student unpaired *t* tests were used to compare means between groups with continuous variables where data were normally distributed. We compared between the lowest vs highest cohort tertiles or between mild vs severe groups for SNOT-22 and SNOT-5 scores in regard to putative differences in LMS or NPS. Statistical significance was determined with a 2-tailed alpha error of 0.05.

Results

Demographics and Overall Results

All the 129 patients analyzed had filled out the SNOT-22 questionnaire, of which 126 had NPS recorded and 88 had a CT sinus scan. The demographic and clinical data are summarized in Table 1.

Associations Between 22-Item Sino-Nasal Outcome Test vs Lund-Mackay Score and Nasal Polyp Score

There were no significant correlations between SNOT-22 vs either NPS or LMS (Fig 1). There was a significant correlation between NPS and LMS ($r = 0.50$, $P < .001$). Patients with no history of previous ESS also had a significant correlation between NPS and LMS ($r = 0.46$, $P < .001$) as did patients with a history of at least one previous ESS ($r = 0.57$, $P < .001$).

There were 24, 52, and 53 patients in each group with mild (≤20), moderate (21-50), and severe (>50) SNOT-22 scores, respectively. There were no significant differences in mean LMS or NPS between patients with mild and severe SNOT-22 scores.

The cohort-based tertiles for SNOT-22, LMS, and NPS are shown in Table 2. There were no differences in mean LMS or NPS between the lowest and highest SNOT-22 tertiles.

There was a significant difference in mean LMS between lowest vs highest NPS tertiles: 8.3 vs 15.2 (95% CI, 4.1-9.8; $P < .001$), as well as a significant difference in mean NPS between lowest vs highest LMS tertiles: 3.7 vs 5.8 (95% CI, 1.1-3.1; $P < .001$).

Associations Between Individual 22-Item Sino-Nasal Outcome Test Domains, 5-Item Sino-Nasal Outcome Test vs Lund-Mackay Score and Nasal Polyp Score

Most of the individual rhinology-specific SNOT-22 domains significantly correlated with LMS or NPS (Table 3). The strongest individual domain was sense of smell/taste which correlated at 0.44 ($P < .001$) for LMS and 0.31 ($P < .001$) for NPS.

When combining the 5 rhinology-specific domains to create an abbreviated SNOT-5 score, there were significant correlations with LMS and NPS (Fig 1). Moreover, there were significant differences in mean SNOT-5 between the lowest vs highest LMS tertiles: 11.8 vs 16.8 (95% CI, 1.5-8.4; $P < .01$) and between the lowest vs highest NPS tertiles: 12.4 vs 15.6 (95% CI, 0.5-5.9; $P < .05$).

The only nonrhinology-specific SNOT-22 domains that significantly correlated with at least one of the objective CRSwNP measures were sadness and embarrassment (Table 3).

Table 1
Demographics and Mean Results of NPS, LMS, and SNOT-22

Total number of patients	129
Age, y[a]	54.0 ± 14.1
Sex, male, n (%)	83 (64.3)
Smoker, n (%)	9 (7.0)
CRSwNP only, n (%)	50 (38.8)
CRSwNP + asthma, n (%)	53 (41.1)
CRSwNP + AERD, n (%)	26 (20.2)
History of a previous ESS, n (%)	51 (39.5)
NPS[a]	4.79 ± 2.1
LMS[a]	13.1 ± 5.6
Total SNOT-22 score[a]	44.7 ± 23.2

Abbreviations: CRSwNP only, CRS with lone nasal polyps; CRSwNP + asthma, CRS with nasal polyps and asthma; CRSwNP + AERD, CRS with nasal polyps and aspirin-exacerbated respiratory disease; ESS, endoscopic sinus surgery; LMS, Lund-Mackay score; NPS, nasal polyp score; SNOT-22, 22-item sino-nasal outcome test.
[a]Values are depicted as means ± SD.

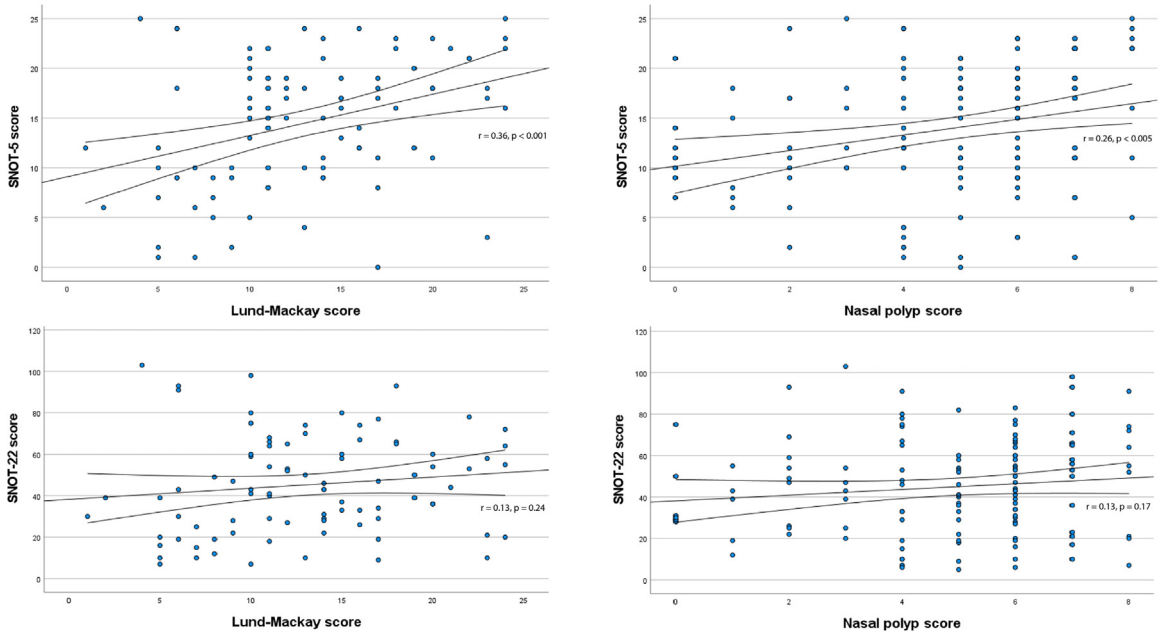

Figure 1. Correlation between SNOT-5 or SNOT-22 vs LMS and NPS. Scatter plots are depicted along with regression lines and associated 95% CIs. LMS, Lund-Mackay score; NPS, nasal polyp score; SNOT-5, 5-item sino-nasal outcome test; SNOT-22, 22-item sino-nasal outcome test.

Discussion

The main findings of the present study were the significant associations between SNOT-5 but not SNOT-22 scores and either NPS or LMS. The SNOT-5 is a basket of rhinology-specific domains which significantly correlated with either LMS or NPS. Our findings of SNOT-22 not correlating with NPS or LMS are similar to several studies but opposite to the findings of the meta-analysis by Chen et al[3] who found a moderate correlation between LMS and the total SNOT-22 score.[8] A meta-analysis by Jeong et al[4] has similarly reported no correlation between NPS and SNOT-22 but highlighted that rhinology-specific domains were more likely to correlate with NPS which we have found here in our analysis. It would seem that the total SNOT-22 score as a screening tool does not help predict NPS, reinforcing the need to always perform nasal endoscopy along with imaging to properly stage the disease severity.

For SNOT-22 individual domains, the highest significant correlations were observed between "sense of smell/taste" vs LMS and NPS which is similar to that reported by Chen et al[3] (Table 3). We appreciate that our choice of rhinology-specific SNOT-22 domains might differ from other studies. We elected not to include sneezing, postnasal discharge, and facial pain/pressure in the rhinology-specific domains group and in the SNOT-5 as these did not correlate with LMS or NPS and these symptoms are not uncommon in non-CRS conditions.[9-11]

Table 2
Study Cohort Tertiles for SNOT-22, SNOT-5, NPS, and LMS

Clinical feature	Lowest tertile	Middle tertile	Highest tertile
SNOT-22	n = 43 19.2 (16.7-21.7)	n = 44 44.4 (42.3-46.6)	n = 42 71.2 (67.3-75.1)
SNOT-5	n = 40 6.6 (5.5-7.7)	n = 44 13.8 (13.1-14.5)	n = 45 20.6 (20.0-21.3)
NPS	n = 28 1.6 (1.1-2.0)	n = 41 4.5 (4.4-4.7)	n = 57 6.6 (6.4-6.8)
LMS	n = 31 7.2 (6.3-8.2)	n = 28 12.9 (12.3-13.5)	n = 29 19.6 (18.2-20.7)

Abbreviations: LMS, Lund-Mackay score (of 24); NPS, nasal polyp score (of 8); SNOT-5, 5-item sino-nasal outcome test (of 25); SNOT-22, 22-item sino-nasal outcome test (of 110).
NOTE. Values are illustrated as means and 95% CI.

Feeling sad and embarrassed were the only 2 nonrhinology-specific SNOT-22 domains that correlated with NPS; therefore, patients with CRS with large nasal polyps might conceivably socialize less due to feeling this way. Hence, we speculate that medical or surgical reduction of polyp size might improve patients' psychological well-being.

Overall, SNOT-22 is a good QoL questionnaire for the evaluation of disease management and the success of medical or surgical interventions.[12,13] It measures outcomes reported directly by patients without interpretation or influence by a clinician.[3] But as more than half of SNOT-22 domains are nonrhinology specific, the scores can be influenced by the presence of various related conditions such, but not exclusively, as asthma, allergic rhinitis, persistent throat symptoms, Eustachian tube dysfunction, ear pathologies, sleep disturbances, depression, and socioeconomic factors that affect QoL.[9,10,14-18] As reported here, many domains did not correlate well or at all with CRSwNP objective findings, other than rhinology-specific symptoms. Hence, a more rhinology-focused abbreviated SNOT-5 might be a better PROM for the assessment of CRSwNP. This is indirectly supported by nasal congestion being used as a co-primary end point in phase 3 clinical trials with biologics such as dupilumab, omalizumab, and mepolizumab for CRSwNP.[19-21] In this regard, we are presently evaluating the use of a novel smartphone-based application visual analogue scale for loss of smell and congestion along with peak nasal inspiratory flow in patients with CRSwNP.

Clinicians should be cautious when comparing SNOT-22 scores between patients as the severity of CRSwNP is not the same as the impact of CRSwNP symptoms on QoL. The severity of CRSwNP can be separated into subjective and objective severity. The subjective severity of CRSwNP may be defined using rhinology-focused SNOT-5, and the objective severity of CRSwNP is defined by NPS and LMS. The overall impact of CRSwNP symptoms on QoL may be defined using the total SNOT-22 score.

Here, we also describe significant and close associations between NPS and LMS, which is perhaps to be expected because the presence of a higher volume of intranasal polyps occupying the middle meatus worsens ostiomeatal complex drainage, in turn, resulting in greater sinus mucosal inflammation with further growth of polyps and vice versa. The association was indeed significant for NPS between LMS tertiles and vice versa for LMS between NPS tertiles.

Table 3
Correlation of SNOT-22 Domains With LMS and NPS

SNOT-22 domain	LMS	NPS
1. Need to blow nose[a]	0.19	0.20[b]
2. Sneezing	−0.15	0.06
3. Runny nose[a]	0.31[c]	0.27[c]
4. Cough	−0.1	−0.16
5. Postnasal discharge	0.1	−0.04
6. Thick nasal discharge[a]	0.25[b]	0.15
7. Ear fullness	0.1	−0.02
8. Dizziness	−0.13	−0.14
9. Ear pain/pressure	0.17	0.11
10. Facial pain/pressure	−0.06	−0.04
11. Difficulty falling asleep	0.09	0.14
12. Waking up at night	0.13	0.04
13. Lack of good night's sleep	0.13	0.02
14. Waking up tired	0.004	0.04
15. Fatigue during the day	−0.05	0.03
16. Reduced productivity	−0.09	0.02
17. Reduced concentration	0.01	0.11
18. Frustrated/restless/irritable	0.19	0.15
19. Sad	0.09	0.20[b]
20. Embarrassed	0.14	0.3[d]
21. Sense of smell/taste[a]	0.44[d]	0.31[d]
22. Blockage/congestion[a]	0.24[b]	0.22[b]

Abbreviations: LMS, Lund-Mackay score; NPS, nasal polyp score; SNOT-22, 22-item sino-nasal outcome test.
[a]Rhinology-specific SNOT-22 domains.
[b]$P < .05$ for Spearman correlation coefficient.
[c]$P < .01$ for Spearman correlation coefficient.
[d]$P < .001$ for Spearman correlation coefficient.

One useful lay analogy that we use with patients in our clinic is that the relation between NPS and LMS resembles an iceberg. The iceberg part above the water line is the nasal polyps visible at endoscopy and the iceberg part below the water is the concomitant paranasal sinus inflammation visible on CT imaging. Thus, seeing larger polyps at endoscopy helps anticipate a higher mucosal disease burden in the sinuses. Contrary to our findings, Mamat Nasir et al[1] reported no correlation between NPS and LMS when dividing patients with CRSwNP into eosinophilic and non-eosinophilic based on polyp biopsy albeit with a limited sample size.

We appreciate that our study has limitations. As for many retrospective studies, some data were missing for NPS and imaging which subsequently might have affected data analysis and results. Indeed, patients who for unknown reasons elected not to fill out the SNOT-22 questionnaire were not included, in turn resulting in a degree of selection bias. NPS was reported by 2 ENT consultants; therefore, some NPS have potentially been scored higher or lower as there might conceivably be a difference in scoring between clinicians.[4] We elected to not include some of the SNOT-22 domains in the abbreviated SNOT questionnaire that some authors potentially would have, such as sneezing, postnasal discharge, facial pain, or pressure. Our rationale was that the SNOT-5 domains are more specific for CRS as per EPOS2020 and our clinical observations. Finally, we did not include any physiological measurement of nasal airway obstruction such as peak nasal inspiratory flow.

In conclusion, we advocate for the use of a more rhinology-specific SNOT-5 questionnaire because, unlike SNOT-22, it was significantly associated with objective measures of CRSwNP. Nevertheless, PROM questionnaires should not be used as a replacement for nasal endoscopy and/or CT sinus scan for diagnosis and assessment of CRSwNP. We appreciate that it might lose its QoL assessment properties, becoming more of a symptom-based questionnaire.[22] Furthermore, prospective intervention studies are required to assess the SNOT-5 including establishing the minimal clinically important difference in CRSwNP; therefore, we would propose to prospectively validate the abbreviated SNOT-5 vs SNOT-22 scores in terms of predicting the success of surgery and/or biologics for CRSwNP with or without asthma/AERD.

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