ORIGINAL ARTICLE

Olfactory Dysfunction in Allergic Fungal Rhinosinusitis

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Objective: To correlate patient reports of olfactory dysfunction after surgical intervention for allergic fungal rhinosinusitis (AFRS) with endoscopic findings, psychophysical testing, and quality-of-life scores.

Design: A prospective cohort study.

Setting: A tertiary care rhinology clinic at St Paul's Hospital, Vancouver, British Columbia, Canada.

Patients: Eighty-one patients with AFRS seen at routine postoperative follow-up.

Main Outcome Measures: The Sniffin' Sticks test and a visual analog scale for the perceived olfactory ability of patients with AFRS were administered, along with a 36-Item Short-Form Health Survey. An endoscopic staging score was assigned for each patient.

Results: Forty men and 41 women with AFRS underwent olfactory testing; 52 of these individuals completed all parts of the assessment. The mean threshold, discrimination, and identification score was 19 (hyposmic), with a significant correlation between patients' performance on the Sniffin' Sticks test and endoscopic staging, as well as their reported olfactory ability ($P < .001$ for all 3 tests). The mean score for the 36-Item Short-Form Health Survey was 71, but there was a poor correlation between it and the threshold, discrimination, and identification score; visual analog scale; and endoscopic scores ($P > .05$ for all 3 tests).

Conclusion: All patients with AFRS should be evaluated with olfactory testing and treated according to the results.

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LOSS OF OLFACTORY PERFORMANCE is a diagnostic criterion for chronic rhinosinusitis[1] but is not considered part of the diagnostic criteria for "allergic" fungal rhinosinusitis (AFRS).[2] However, despite thorough surgical debridement and adequate postoperative control of recurrent disease, many patients in our center report poor olfactory function. The quality-of-life issues related to olfactory disturbances have been well documented and include depression, anorexia, and domestic safety issues.[3-5] To our knowledge, there have been no studies documenting olfactory dysfunction in AFRS despite its similar characteristics to chronic rhinosinusitis, for which several studies[6-9] have been performed. The objective of this study was to look at endoscopic staging, subjective assessment, and olfactory test performance, along with quality-of-life assessment, to determine whether they have any correlation with each other.

METHODS

A prospective study at a tertiary care rhinology center was initiated by recruiting patients who were diagnosed with AFRS, using the criteria laid out by Bent and Kuhn[2] in the following tabulation:

No.	Criteria
1.	Type I hypersensitivity confirmed by history, skin tests, or serology
2.	Nasal polyposis
3.	Characteristic computed tomographic scan (double-density sign)
4.	Eosinophilic mucus without fungal invasion into sinus tissue
5.	Positive fungal stain of sinus contents removed intraoperatively or during office endoscopy

However, we modified the criteria to replace *type 1 hypersensitivity* with *immunocompetence*. The study was approved by the ethics board at the University of British Columbia. Patients with AFRS are routinely monitored at 6- to 8-week intervals at St Paul's Sinus Centre. These patients had all undergone endoscopic sinus surgery (including total uncinectomies, total ethmoidectomies, sphenoidotomies, and frontal sinusotomies) at varying intervals be-

Table 1. Philpott-Javer Staging System for Allergic Fungal Sinusitis

Sinus Cavity	Possible Grade[a] Right	Mucin	Left	Mucin
Frontal	0-9	1	0-9	1
Ethmoid	0-9	1	0-9	1
Maxillary	0-9	1	0-9	1
Sphenoid	0-9	1	0-9	1
Total	**40**		**40**	
Bilateral Total	**80**			

[a]Grading scores are as follows: 0 indicates no edema; 1 to 3, mucosal edema (mild/moderate/severe); 4 to 6, polypoid edema (mild/moderate/severe); and 7 to 9, frank polyps (mild/moderate/severe).

Figure 1. The Sniffin' Sticks.

Table 2. Summary Statistics for Pearson Correlation Coefficients

Test	Correlation Coefficient	*P* Value
TDI and VAS	0.71	<.001
TDI and ES	–0.50	<.001
VAS and ES	–0.51	<.001
TDI and SF-36	0.05	.36
VAS and SF-36	0.15	.09
ES and SF-36	–0.11	.15

Abbreviations: ES, endoscopy; SF-36, 36-Item Short-Form Health Survey; TDI, threshold, discrimination, and identification; VAS, visual analog scale.

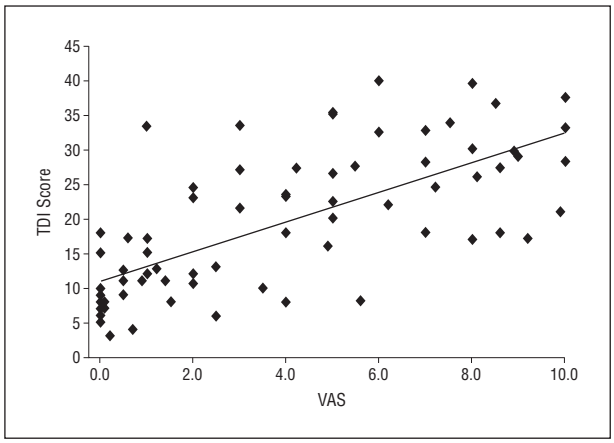

Figure 2. Correlation between visual analog scale (VAS) and threshold, discrimination, and identification (TDI) scores.

fore recruitment. Postoperative care for these patients was, however, standardized in that they were seen 1 week and 4 weeks postoperatively and then at 6-week intervals thereafter. Postoperative medical management includes twice-daily irrigations with an alkaline douche (240 mL) containing budesonide (0.5 mg/2 mL). This preparation was administered to all patients as a baseline treatment.[10,11] They were routinely examined endoscopically, and staging was performed using the newly developed Philpott-Javer[12] scoring system for AFRS, which gives a maximum score of 10 for each sinus cavity bilaterally (possible maximum score, 80) (**Table 1**). Patients were then asked to complete a visual analog scale (VAS) to rate their sense of smell that day. After this, the Sniffin' Sticks olfactory test was performed (with both nostrils simultaneously) to obtain the threshold, discrimination, and identification score (TDI) score for each patient (**Figure 1**). Sniffin' Sticks is a well-validated test that examines olfactory threshold (1-butanol), discrimination, and identification with good test-retest reliability ($r=0.72$).[13,14] Finally, the patients were asked to complete a 36-Item Short-Form Health Survey (SF-36).[15] The 4 scores (TDI, VAS, SF-36, and endoscopic staging were then evaluated with a Pearson correlation coefficient test and *P* values were calculated.

RESULTS

Eighty-one patients (40 men and 41 women) with AFRS underwent olfactory testing in 6 months; only 52 of these patients returned the SF-36 questionnaire. The age range of the patients was 25 to 71 years (mean, 52 years). The mean TDI score for the group was 19, with only 11 patients registering as normosmic on the Sniffin' Sticks test. The mean VAS for subjective olfactory performance was 3.9, the mean endoscopic staging score was 24, and the mean SF-36 score was 71; the summary statistics are provided in **Table 2**. Calculation of the Pearson correlation coefficient showed a significant ($r=0.71$; $P<.001$) (**Figure 2**) correlation between subjective (ie, VAS) scores and TDI scores. Endoscopic staging showed a significant negative correlation with increasing TDI and VAS scores ($r=-0.50$ and -0.51; $P<.001$) (**Figure 3**). The SF-36 scores did not correlate significantly with the endoscopic staging, VAS, or TDI scores ($P>.05$ for all).

COMMENT

Overall, the low mean scores for both the Sniffin' Sticks test and VAS indicate that, despite the mean endoscopic staging being 28 (moderate edema), olfactory dysfunction is a significant source of morbidity for these patients, even when mucosal edema in the sinus cavities is at a minimum. The correlations between subjective score, psychophysical testing, and objective endoscopic staging indicate that, for AFRS, all 3 modalities can predict the relative degree of olfactory dysfunction. In healthy individuals, correlation between perceived olfactory ability and test performance has been shown to be poor.[16] The findings reported herein are also in contrast to most

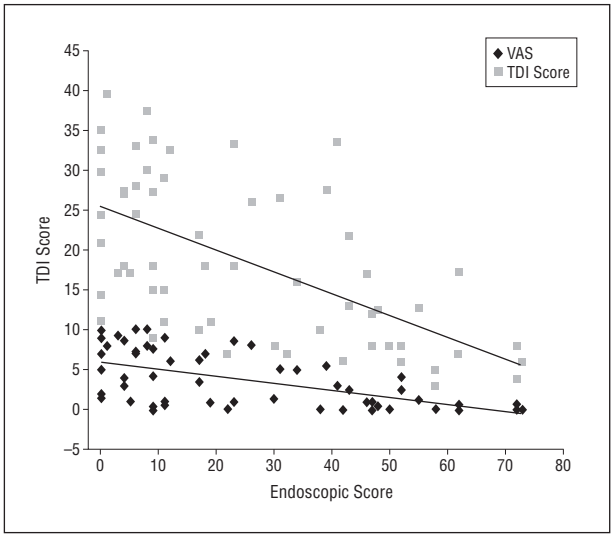

Figure 3. Correlation of endoscopic scores with visual analog scale (VAS) and threshold, discrimination, and identification (TDI) scores.

other studies[7,8] in rhinologic disease cohorts with olfactory impairment, with subjective scoring correlating poorly with olfactory test scores, with the exception of the study by Welge-Luessen et al,[17] which looked at both healthy people and those with olfactory disorders and found a good correlation. It is clear, however, that these measures are not predictive of the effect of olfactory dysfunction on quality of life; therefore, quality of life needs to be assessed individually. We do, however, concede that the SF-36 is a generic quality-of-life assessment tool; a specific tool for this purpose is under development.

The threshold score in this study was the Sniffin' Sticks test component on which patients scored lower than average: 3.49 as opposed to 7.02 and 8.33 for discrimination and identification, respectively. Olfactory thresholds have been shown in a recent study by Lötsch et al[18] to be the most reliable component of the test battery.[18] As is seen here, olfactory dysfunction can cause significant ongoing problems for patients with AFRS and, although postoperative medical therapy is targeted toward resolution of edema in the sinus cavities, the olfactory cleft is often overlooked. Indeed, the current endoscopic staging system in use at our center did not consider rating the olfactory cleft in terms of edema and mucin, and a modification of this system has been implemented. The other notable observation from this study is that the average age of the patients was 51 years; 60 years is the age that decline in olfactory acuity begins, but some of the participants may have begun to experience presbyosmia.[19,20] Nonetheless, it is likely that a large conductive component was responsible for the olfactory deficits seen here, but an inflammatory component in the olfactory neuroepithelium cannot be excluded as an additional factor, although mechanical obstruction has been shown[21] to be the key factor in orthonasal olfaction. Our findings also closely mirror those found[9] in a more general population of patients with chronic rhinosinusitis.

We recognize that having a preoperative baseline TDI score would have been preferable. However, all these patients had undergone sinus surgery at least 3 months earlier, and therefore any residual effects (ie, edema) of that surgical intervention can be discounted.

CONCLUSIONS

Use of routine olfactory testing such as the Sniffin' Sticks can help to document the impact of inflammatory disease on this sensory modality and target treatment toward it; this may include the use of corticosteroid drops in the head-down position or the placement of temporary nasal packing (Pope wicks) to help direct delivery of topical corticosteroids to the olfactory cleft. Only 11 of our 81 patients (14%) were classified as normosmic, and in 7 of those patients, the endoscopic score was less than 10 of 80. Given the propensity for recurrence with AFRS, all patients should be considered at risk of olfactory dysfunction, even when sinus cavity edema is optimized, and should be given appropriate counseling and adjunctive therapy as needed.

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