Assessment of chemosensory disorders in allergic rhinitis

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Allergic rhinitis (AR) has a substantial effect on quality of life (QOL). Approximately 25% of the world’s population is influenced by this condition.¹ In addition to the characteristic symptoms of the disease (sneezing, nasal obstruction, rhinorrhea, and pruritus), other atypical and less common symptoms may affect a patient’s QOL, including...
halitosis, fatigue, malaise, irritability, and smell-taste disorders.\(^2,\!^3\)

Smell and taste are important to our perception of the outside world, and the loss of smell and taste can be a deep blow to one’s QOL. Among AR patients, 21–23% suffer from olfactory disorders.\(^3\) Block of the airflow reaching the olfactory epithelium and allergic inflammation that damages the olfactory epithelium can cause reduced olfaction.\(^4\) Smell and taste are closely related senses; impaired olfactory function has a considerable effect on taste perception.\(^2,\!^3\)

Olfactory and gustatory complaints can affect the QOL of patients with AR. We believe that these problems have not been recognized adequately in the past. Thus, we decided to evaluate smell-taste disorders in patients with AR.

**Materials and Methods**

**Subject selection**

This study was conducted according to the principles of the Helsinki Declaration and was approved by the Clinical Trials Committee of our hospital (09/07/2014, no. 63). Details of the study protocol were explained to all subjects and written informed consent was obtained before participation.

In total, 54 patients with AR and 34 healthy controls were enrolled. A medical history was taken to assess the occurrence of systemic disorders. All participants verified that they were not suffering from any known disease and were not taking any treatment. Patients with additional anatomical or systemic diseases that might decrease olfactory function were not included in the study.

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The inclusion criteria were the diagnosis of AR based on history, physical examination, and allergy tests (sensitivity to at least one and maximum three of the tested allergens). The allergy (skin prick) tests involved six major allergens: *Alternaria* (a mold), *Oleaceae* (olive tree), *cereals* (rye), *Dermatophagoides farinae* (dust mite), *Dermatophagoides pteronyssinus* (dust mite), and *graminées* (grass). Individuals in the control group underwent the same allergy tests after their physical examinations to ensure that they were free from allergies. We excluded subjects using any AR medication, including intranasal steroids and antihistamines, during the study.

**Chemosensory assessment**

The validated “Sniffin’ sticks” test, in which odorants are presented in commercially available felt-tip pen-like devices (Sniffin’ sticks; Burghart, Wedel, Germany),\(^6\!^\text{-}^9\) were used to assess olfactory function. This test has been validated in a Turkish population\(^6\) and consists of one threshold and two suprathreshold subtests: a test for the threshold of phenyl ethyl alcohol, a test for odor discrimination (16 triplets with two different odors), and a test for odor identification (16 common odors, presented in a four-choice, forced-choice procedure).\(^7\) The maximum score for the subtests was 16, so the maximum composite score was 48 (threshold, discrimination, and identification [TDI] score). ‘Normal’ values for the TDI composite score are >30.3, with a cut-off between anosmia and hyposmia at 16.5.\(^7\)

“Taste strips” were used to assess taste\(^10\) (Taste strips; Burghart). This test consists of four concentrations each of the four basic taste qualities. Concentrations used for the taste strips were: 0.4, 0.2, 0.1, and 0.05 g/mL of sucrose (sweet); 0.3, 0.165, 0.09, and 0.05 g/mL of citric acid (sour); 0.25, 0.1, 0.04, and 0.016 g/mL of sodium chloride (salty); and 0.006, 0.0024, 0.0009, and 0.0004 g/mL of quinine hydrochloride (bitter). Distilled water was used as the solvent, and the taste solutions were prepared freshly at regular intervals. The left or right side of the anterior third of the extended tongue was tested using the strips, resulting in a total of 32 trials.\(^10\) The mouth was rinsed before each use of the strips. Increasing concentrations were used. Taste qualities were applied in a randomized fashion at each of the four concentration levels and alternating the side of the presentation. Patients had to identify the taste from a list of four descriptors: sweet, sour, salty, and bitter (multiple forced choice). To obtain an impression of overall gustatory function, the number of correctly identified tastes per side was added up to a “taste score.”\(^10\) A total threshold of <9 was classified as hypogeusia. Inter-test reliability has been shown to be high (r=0.68).\(^10\)
Statistical analysis
Data analyses were performed using SPSS software (ver. 21.0; SPSS Inc., Chicago, IL, USA). The normal distribution of variables was first evaluated using the Shapiro-Wilk test. Data are presented as means ± standard deviations for continuous variables, and the number of cases was used for categorical variables. Differences between groups were analyzed using t or χ² tests, as appropriate.

Results
The study cohort consisted of 88 subjects, 34 men and 54 women, with a mean age of 36 (range: 18 to 47; median: 36.9±13.3) years. There was no significant difference between the AR and control groups in terms of age or sex. Of the patients, 46% were allergic to *D. pteronyssinus*, 34% to *D. farinae*, 38% to *Alternaria*, and 31% to *graminées*.

As shown in Table 1, when the “Sniffin’ sticks” results were evaluated, patients with AR had significantly lower scores for odor threshold and identification subtasks (p<0.001 and 0.001, respectively), whereas there was no difference between the groups in the odor discrimination scores (p=0.3; Fig. 1). On evaluating the taste strip test results, taste scores were decreased significantly in patients with AR versus controls for sweet, salty, bitter, and sour tastes (Figs. 2 and 3).

Discussion
Allergic rhinitis is a global public health issue. It is a common condition, affecting more than 400 million people worldwide. High prevalence rates have been noted in both industrialized and developing countries. Moreover, recent reports have revealed an increase in the prevalence of AR over the last four decades.\(^{[1]}\) AR can be a substantial source
of morbidity in poorly managed patients. Although not
life-threatening, the symptoms of AR impair social and
work function and can affect patient QOL significantly. In
affected patients, one or more symptoms, including rin-
orrhoea, sneezing, nasal itching, and congestion, may
influence the QOL.\[12\]

AR may also be associated with smell-taste disorders.
Olfactory dysfunction is a common symptom in AR: up to
23% of patients suffer from a reduced sense of smell.\[11–13\]
Olfactory dysfunction in AR patients is believed to be
caused by block of the airflow to the olfactory epithelium,
secondary to nasal mucosal edema due to inflammation.
However, medical or surgical treatments that decrease
nasal blockage may not adequately treat hyposmia. These
conclusions, verified in numerous studies, suggest that
nasal blockade is not the individual mechanism of olfac-
tory dysfunction in patients with AR. Another mechanism is
the damage of the olfactory epithelium by allergic inflam-
mation, directly triggering olfactory dysfunction.\[4\]
Although it remains unclear, the pathogenesis of olfac-
tory dysfunction seems to involve obstruction and inflam-
ma

We used the “Sniffin’ sticks” test, which has been
approved by the German Olfactory and Gustatory
Committee. This test assesses the sense of smell quantita-
tively concerning threshold, discrimination, and identifi-
cation. It is a suitable and accurate method for analyzing
olfactory dysfunction, which may be linked to various dis-

cases. However, several factors can affect the test includ-
ing age, smoking status, and environment.\[11\] Thus, we
sought to exclude all variables that might affect perfor-
ance scores. We found that olfactory function was
decreased regarding threshold and identification in
patients with AR, whereas there was no significant change
in discrimination scores.

Most patients who complain of a loss of taste actually
have some degree of smell dysfunction as well. Most of a
food’s flavor comes from our ability to smell it. The
tongue can sense only salty, sweet, sour, bitter, and
umami. This is why it is difficult to sense a food’s flavor
when one has a stuffy nose. Most gustatory dysfunction is,
in fact, caused by smell disorders instead of taste percep-
tion. One of the foremost mutual reasons of olfactory
dysfunction is AR. However, any situation that causes in
a compromised situation for the chemosensory mediators
(e.g., neurotransmitters, neural pathways, oral mucosa,
saliva, and tongue) can result in impaired taste percep-
tion.\[14\] Thus, we excluded all other conditions that may

cause taste disorders. We found that gustatory function
was decreased in all parameters in patients with AR.
However, this decrease may not only be related to olfac-
tory dysfunction. Further research is needed to fully under-
stand taste dysfunction in AR.

Conclusion

Our study demonstrates clinically important chemosenso-
ry perception disorders in AR patients; these impairments
may cause a reduced QOL. Due to the chemosensory dis-
orders in AR, and particularly their impacts on QOL, they
have been ignored in the past, and our results propose that
chemosensory disorders would be part of the standard
evaluation of AR patients.

Conflict of Interest: No conflicts declared.

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