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Original article

Evaluation of halitosis using OralChroma™ in patients with allergic rhinitis

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ABSTRACT

Objective: The objective of this study was to evaluate the occurrence of halitosis in patients with allergic rhinitis (AR).
Materials and methods: In this study, we enrolled 53 patients with AR and 34 participants as controls. Halitosis was evaluated by measuring volatile sulphur compound (VSC) levels. VSCs, which consist of hydrogen sulphide (HS), methyl mercaptan (MM), and dimethyl sulphide (DMS), were measured using a portable gas chromatograph (OralChroma™; AbiMedical, Osaka, Japan).
Results: Patients with AR exhibited significantly higher levels of MM and DMS that did control subjects. Specifically, MM levels showed a greater increase than DMS levels in patients with AR than in controls. We observed no significant changes in the levels of HS between the groups.
Conclusion: This study demonstrated that AR is likely to result in halitosis. Several studies have overlooked the relationship between halitosis and AR. In light of our results, we suggest that halitosis should be further investigated in patients with AR.

1. Introduction

Allergic rhinitis (AR) is a common inflammatory disease that affects 10 to 25% of the population worldwide [1]. Patients with AR experience a decreased quality of life associated with typical AR symptoms (i.e., sneezing, pruritus, nasal obstruction, and rhinorrhoea) and issues such as smell-taste disorders, halitosis, fatigue, malaise, and possible neurocognitive deficits [2,3].

Halitosis is an unpleasant, offensive odour spreading from the oral cavity and is commonly known as 'bad breath'. It is a very common complaint among patients who visit otolaryngology clinics. When severe or long-standing, it may lead to personal discomfort and social embarrassment, thus impacting the quality of life in a negative manner. The causative agents of halitosis are the oral cavity (90%), the respiratory tract (8%), and the gastrointestinal tract, including other organs (2%) [3]. Halitosis associated with the oronasal cavity may be due to post-nasal drip, pharyngitis, tonsillitis, deep crypts of the tonsils, sinusitis, a foreign body in the nasal or sinus cavity, and ozena. These pathologies cause halitosis because of bacteria, which cause putrefaction of the tissues and production of volatile sulphur compounds (VSCs), the main components of human oral malodour [4]. Several studies have noted the association between AR and halitosis. Nasal allergies cause excess mucus production in the nose and sinus cavities, which leads to post-nasal drip. It is hypothesised that as nasal discharge slides down the back of the throat, it can give oral bacteria a place to multiply, leading to the characteristic 'bad breath' [3,5]. However, few studies have supported or refuted this conjecture. Therefore, the goal of this study was to determine the potential effects of AR on oral malodour production using a portable gas chromatograph (OralChroma™; AbiMedical, Osaka, Japan) [6]. To the best of our knowledge, this is the first study to investigate halitosis in patients with AR.

Both halitosis and AR can negatively affect the quality of life of an individual. We believe that these conditions have been understudied. Therefore, in this study, we decided to evaluate the occurrence of halitosis in patients with AR.

2. Materials and methods

2.1. Subject selection

This study involved 87 subjects (53 patients with AR and 34 participants as controls), with a mean age of 36 ± 1 years (range:

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Table 1
Descriptive statistics of the study groups.

	Allergic rhinitis, $n = 53$	Control group, $n = 34$	*P*-value
Age	36.9 ± 1.2	36.5 ± 1.5	0.6
Gender (F/M)	33/20	20/14	0.5
Hydrogen sulfide level	14.4 ± 19.9	17.2 ± 22.2	0.6
Methyl mercaptan level	121.5 ± 116	2.6 ± 5.5	< 0.001
Dimethyl sulfide level	6.6 ± 11.1	0.3 ± 1.2	< 0.001

18–47 years). All participants confirmed that they were not suffering from any known diseases and that they were not receiving any medical treatment. Participants with a previously diagnosed systemic disease and an additional disease that may cause halitosis, such as radiotherapy to head and neck, chemotherapy, major head and neck surgery, chronic sinusitis, nasal polyposis, or clinically significant nasal septal deviation, were excluded from this study. For all patients, a standardised oral examination was performed by the same dentist. Patients with obvious gingival inflammation, gingivitis, advanced periodontitis, active or severe caries, substantial false dentition, and oral thrush were excluded. The age- and sex-matched control groups comprised individuals who were admitted to the otolaryngology clinic for other reasons, but still met the above criteria (Table 1).

The survey was conducted according to the principles expressed in the Helsinki Declaration and was approved by the Clinical Trials Committee of the Gaziosmanpaşa Taksim Training and Research Hospital. The details of the study protocol were explained to all subjects, and written informed consent was obtained prior to participation.

2.2. Assessment of allergic rhinitis

The study group, namely patients with AR, were enrolled in the Department of Otorhinolaryngology of the Gaziosmanpaşa Taksim Training and Research Hospital (İstanbul, Turkey). All patients had the following characteristics: a diagnosis of AR based on history, physical examination and allergy tests, and sensitivity to at least 1 or at most 3 of the tested allergens. The individuals in the control group had a similar allergy exam, but tested negative for allergies. All patients using any AR medication, including intranasal steroid or antihistaminic drugs, were excluded from the study.

2.3. Measurement of sulphur compound levels

VSCs comprise hydrogen sulphide (HS), methyl mercaptan (MM), and dimethyl sulphide (DMS) and were measured using a portable gas chromatograph (OralChroma^{TM}; AbiMedical, Osaka, Japan) [7,8]. All participants were instructed about the procedure involved in this study. The participants were required to avoid foods associated with oral malodour (i.e. garlic, onions and spicy food) 1 day prior to the study. Twelve hours before we VSC measurements were obtained, the participants had to refrain from drinking alcohol or coffee and from smoking. On the evening prior to the day of testing, the participants were instructed to perform their normal oral hygiene routine. The morning of their assessment, patients were required to avoid food intake as well as chewing gum, mints, drops, scents, and mouth rinses. Alternatively, tooth brushing with water was permitted to avoid morning 'bad breath'. All measurements were recorded in the morning between 8:30 and 11:30 AM by the same breath specialist. Exhaled gas samples were collected with disposable syringes (1-ml plastic syringes), which were inserted into the volunteers' oral cavities. Subjects had to close their mouth for 30 s prior to the sample collection. A volume of 0.5 ml of mouth air was injected into the inlet on the main unit of the OralChroma^{TM}. Measurements were started automatically; the process was completed after 8 min, and the concentrations of the three gases were displayed in units of either ng/10 ml or ppb (nmol/mol). All the measurements were repeated for 3 times to improve the reliability of the study, and also each concentration measured by the OralChroma^{TM} was finally determined with analysis software (OralChroma^{TM} Data Manager, AbiMedical, Osaka, Japan) for the validation of data.

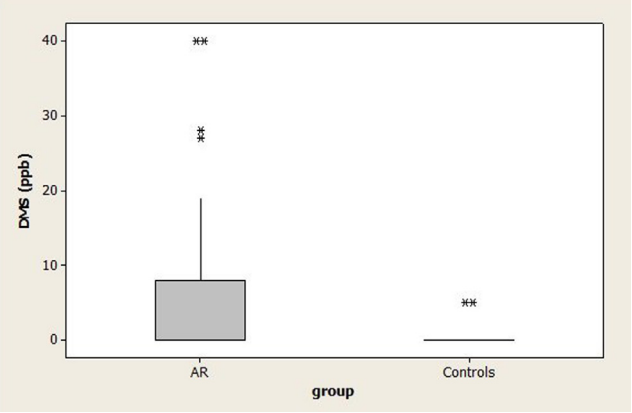

Fig. 1. Box plot model graphing of dimethyl sulfid (DMS) levels according to the study groups. There was a significant difference between the study groups in terms of DMS levels ($P < 0.001$).

2.4. Statistical analysis

Data analyses were performed using the Statistical Package for the Social Sciences, version 21.0 (SPSS; IBM Corp., Armonk, NY, USA). The normal distribution of the considered variables was first evaluated using the Shapiro–Wilk test. The data are presented as the mean with standard deviation for continuous variables and as the number of cases for categorical variables. The differences between the groups were analysed by a *t*-test or the Chi^2 test, as appropriate.

3. Results

In this study, we enrolled 54 patients with AR. There was no significant difference in age or sex between the AR and control groups (Table 1). The skin prick test results were evaluated for patients with AR. The prick test evaluated the following six main allergens: *Alternaria* spp. (mould fungus), members of the Oleaceae family (olive tree), *Secale cereale* (rye), *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae* (dust mites), and graminoids (grasses). Among all patients with AR, 46% were allergic to *D. pteronyssinus*, 34% were allergic to *D. farinae*, 38% were allergic to *Alternaria* spp., and 31% were allergic to graminoids.

As shown in Table 1, we observed significantly higher levels of DMS and MM in the patients with AR than in the control subjects (Figs. 1 and 2). This increase was most significant for the MM levels (Fig. 2). No significant changes in the HS levels were detected between the two groups (Fig. 3).

4. Discussion

AR is a global health problem. Several studies have indicated an increase in the prevalence of AR over the last four decades. This increase has been mostly observed in both industrialised and developing countries [9]. The World Health Organization estimates that approximately 20% of the world's population suffers from AR. Furthermore, it can be a considerable source of morbidity in poorly managed patients. AR can impair social and work functions and