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ORIGINAL RESEARCH ARTICLE

Evaluation of Olfactory Thresholds in Patients of Allergic Rhinitis: Pre and Post Intranasal Steroid Therapy

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ABSTRACT

Introduction: Allergic rhinitis is a heterogenous disorder characterized by one or more symptoms, including sneezing, itching, nasal congestion and rhinorrhoea along with usual symptoms, and there is generally a decrease in the nasal airflow therefore decrease in nasal air exchange, thereby decreasing the rate of olfactory nerve ending stimulation hence decreasing the perception of smell. We assessed the olfactory thresholds in patients of allergic rhinitis using n-butanol solutions and the impact of intranasal fluticasone furoate therapy on olfaction.

Materials and methods: One hundred fifty patients with allergic rhinitis in the age group of 18 to 65 years were included. A total of 150 people from the general population as controls. In 6 weeks of fluticasone furoate nasal spray was administered for 6 weeks and olfactory threshold changes were observed at the end.

Results: A significant change in n-butanol olfaction levels after steroid therapy was observed (*p-value* < 0.05).

Conclusion: Intranasal steroid therapy shows remarkable benefit in the improvement of allergic rhinitis and thereby improving olfaction.

Keywords: Allergic rhinitis, n-butanol, Fluticasone furoate.

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INTRODUCTION

Allergic rhinitis is characterized by inflammatory changes in the nasal mucosa caused by exposure to inhaled allergens. By definition, it is described as having two or more symptoms of anterior or posterior rhinorrhoea, sneezing, nasal blockage and/or itching of the nose during two or more consecutive days for more than one hour on most days. Usually, there is a decrease in nasal air flow therefore, there is a decrease in olfactory molecules reaching the olfactory mucosa thereby decreasing the rate of olfactory nerve-ending stimulation. This, in turn, decreases the perception of smell. Clinically it is induced after allergen exposure causing an IgE-mediated inflammation.

The prevalence of allergic rhinitis varies widely around the world. The International Study on Asthma and Allergy in Childhood showed that rhino conjunctivitis's prevalence varies between 0.8 and 39.7% in different populations. Countries with a low prevalence of asthma (<5%) such as Indonesia, Romania and Greece, had a low prevalence of allergic rhinitis. Conversely, countries with a high prevalence of asthma (>30%) such as the United Kingdom, Australia and New Zealand, had a high prevalence of rhinitis (15–20%).[1]

Allergic rhinitis has been attributed to nasal obstruction leading to impairment of transport of odorants to the olfactory epithelium or to inflammation in the olfactory cleft.[2]

Allergic rhinitis causes olfactory dysfunction and taste disorders. In allergic rhinitis, hyposmia has a high prevalence with an underestimated role in affecting the patient's quality of life. The most common mechanisms involved in the appearance of smell disorders in allergic rhinitis are nasal obstruction and histopathological changes in the nasal mucosa. In this study we evaluated the effect of 6 weeks of intranasal fluticasone furoate therapy on olfaction in patients with allergic rhinitis.

MATERIAL AND METHODS

A prospective observational study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery at a Tertiary Care Institute of North India between 1 February 2021 to June 2022. A total of 150 patients were selected from 18 to 65 years age group. Patients diagnosed as allergic rhinitis were included in the study fulfilling ARIA guidelines. Patients with history of head injury, hypothyroidism, neurological disorder, olfactory dysfunction at birth, past nasal surgery, gross DNS, nasal mass or patients who lost on follow up or who did not consent for the study.

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Further detailed ENT examination was carried out followed by a 3 pass diagnostic nasal endoscopy and an absolute eosinophil count and n-butanol threshold test among the patients and were graded accordingly.

n-butanol (Rankem Chemicals: Batch Number: R120A05, CAS number: 71-36-3) was diluted in 12 serial dilutions (0–11) using pure distilled water. Each threshold level was serially diluted from 100% n-butanol to lowest concentration 0.04% n-butanol. Distilled water was used as a control. A total of 12 PVC tubes (5 mL) were filled with each solution alongside a control tube of pure distilled water. Test (n-butanol) tubes [in ascending levels of concentration, i.e., from the lowest concentration of butanol 0.045% (0) to 100% butanol (11)] were placed 2 cm away from each nostril alongside a control tube and the patient was asked to sniff from both the test tubes one after the other blindfolded in a forced-choice paradigm for 3 to 4 seconds. A gap of 30 seconds was followed after every sniff. The test was repeated 3 times to remove any bias. The grading of olfaction was interpreted.

The results were collected, evaluated and tabulated, correlation between various parameters were studied. The collected data was entered in MS Excel software. Frequency and percentage were used to describe general subject and characteristics. Statistical analysis was done using SPSS software.

RESULTS

Majority of the patients of allergic rhinitis had normal anatomical findings on anterior rhinoscopy (46.6%) followed by inferior turbinate hypertrophy (26%), with bluish turbinates accounting for 10.6%. Pale mucosa accounted for 6% and middle turbinate hypertrophy was seen in 10% of patients (Figure 1).

On the basis of olfactory threshold grading we can see that 76% belonged to grade 0, depicting normosmia. In 14% patients had olfactory threshold grade I (mild hyposmia) followed by 4% of patients belonging to grade II (moderate hyposmia), and 2.7 % of the patients in grade III (severe hyposmia), followed by 3.3% of the patients in grade IV (anosmia). This was compared with that of general population (controls) where all the patients belonged to grade 0 category (normosmia) (Table 1).

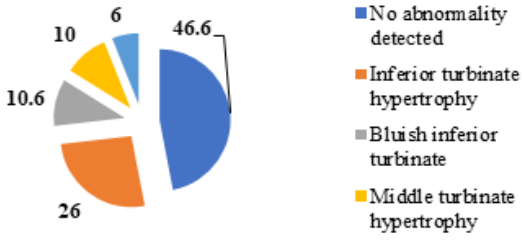

Figure 1: Various findings on anterior rhinoscopy and diagnostic nasal endoscopy in patients with allergic rhinitis

The mean butanol olfaction level decreased significantly between pre-steroid to post-steroid therapy. The mean n-butanol olfaction level in pre-steroid therapy was 2.17, with a standard deviation of 2.79. The mean n-butanol level post-steroid was 1.68 with the standard deviation being 2.56. *p-value* was 0.001 (<0.05) on applying paired t-test and the result was significant difference was seen between the two parameters (Table 2).

Mean n-butanol levels in patients with normal absolute eosinophil count (n = 127) was 2.118, whereas patients with raised absolute eosinophil count (n = 23) was 2.478. *p-value* was 0.579 (>0.05) which was insignificant (Table 3).

DISCUSSION

Allergic rhinitis (AR) is one of the most common manifestations of IgE-mediated inflammation after allergen exposure of the nasal mucosa. It is clinically defined as a symptomatic disorder of the nose characterized by the association of rhinorrhoea, sneezing, nose stinging and nasal congestion also frequently associated with symptoms such as conjunctival/pharyngeal stinging, eye redness and decreased olfaction. IgE mediation causes edema due to inflammation of the nasal mucosa after the exposure of allergen to the nasal mucous membrane. This causes anatomical hypoventilation, leading to anosmia due to mechanically obstructing air from the respiratory area dealing with olfaction.[3] We found that the majority of the patients were students who mainly attribute to the younger age

Table 1: Categorization of olfactory threshold grading in the patient with allergic rhinitis vs the general population

n-butanol olfaction level groups	*Olfactory threshold grading*	*Number of patients N(%)*	*Number of control (%)*
0–3 (normosmia)	0	114(76%)	150(100%)
4–5 (mild hyposmia)	1	21(14%)	0
6–8 (mod hyposmia)	2	6(4%)	0
9-10 (severe hyposmia)	3	4(2.7%)	0
11 (anosmia)	4	5(3.3%)	0
Total		150	150

Table 2: Mean n-butanol threshold levels in pre and post-steroid therapy

Case group	*Mean ± Std. Deviation*	*p-value[a]*
n-butanol olfaction level pre steroid	2.17 ± 2.79	0.001**
n-butanol olfaction level post steroid	1.68 ± 2.56	

aPaired t-test Significant difference (p< 0.05)*

Table 3: Relation between absolute eosinophil count and n-butanol olfaction levels

AEC	N	Mean butanol level pre steroid	Std. Deviation	p-value[b]
AEC (40-440 IU/ML)	127	2.118	2.796	0.579[NS]
AEC (>440 IU/ML)	23	2.478	2.826	

[b]*Karl-pearson correlation test,* [NS]*Non-significant*

group of 18–25. Hence we could say allergic rhinitis is primarily a disease of the young.

In our study we found that there was a higher olfactory threshold level in patients of allergic rhinitis when compared with that of the general population. While the cases were majorly in the category of normosmia (76%). Mild to moderate hyposmia was seen in 14 and 4%, respectively. Only a few patients had severe hyposmia and complete anosmia. The controls were tested and found to be normosmic. Yildrim *et al.* in his study using n-Butanol olfactory threshold test classified the patients with allergic rhinitis into various categories such as normosmia, mild, moderate and severe hyposmia which is similar to our olfactory grading and found majority of the study population to be normosmic.[4] Similar results were found in the study of Byong k *et al.* and Kyung H *et al.* where they tested butanol sniffing sticks in regular population and found majority of the cases were of the normosmic to mild hyposmic level.[5,6] Apter *et al* in his study also concluded significant olfactory dysfunction in patients with allergic rhinitis.[7] Guilemany *et al* in his study concluded significant self reported olfactory loss in patients of persistant allergic rhinitis.[8] Beverly J Cowart concluded allergic rhinitis as a significant factor for hyposmia when compared the olfactory thresholds with a control group who did not have any history of atopy or nasal symptoms.[9]

Kumar S *et al.* found congested bluish nasal mucosa in only 10 % of the patients.[10] Contrary to this Han DH *et al.* demonstrated that pale mucosa was nearly 4.5 times in allergic rhinitis patients when compared to healthy population.[11] Cury R *et al.* demonstrated in their study that inferior turbinate hypertrophy caused by allergic rhinitis was seen in 79.9% of the cases.[12]

Neelima G *et al.* who reported in their study that there is no relation between eosinophilia in patients with allergic rhinitis and decreased olfaction.[13] Similar results were obtained in the study conducted by Patel AK and Nagpal TP who concluded that absolute eosinophil count does not contribute in the diagnosis of allergic rhinitis.[14,15] We saw a significant improvement in n-butanol olfaction levels in the patients of allergic rhinitis after 6 weeks of topical steroid therapy when compared with baseline n-butanol olfaction levels. The results were consistent with the study done by Okubo k *et al.* who evaluated the improvement in total nasal symptom scores in patients of allergic rhinitis after subjecting the patients with 55 μg of fluticasone furoate daily as topical sprays for two weeks.[16] He displayed immediate results within 2 days of start of therapy and further improvement in symptoms of self informed olfaction and other symptoms associated with allergic rhinitis.

CONCLUSION

In our study, most patients had normal nasal anatomy on anterior rhinoscopy and diagnostic nasal endoscopy. There was no significant relation between AEC levels with that of olfactory thresholds. The majority of the cases had a normal range of olfaction followed by grade I hyposmia. There was a significant difference in the n-butanol olfaction levels after 6 weeks of intranasal steroid administration. Thus we concluded that there was a significant improvement in olfaction after steroid therapy in patients with allergic rhinitis.

Compliance with Ethical Standards

Ethical clearance was given by the institutional ethics committee for this study. Written informed consent was taken by all study participants taking permission for participation and publication of their data.

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