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Relationship between severity of rhinitis symptoms and nasal airflow*

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SUMMARY

Background: *Allergic rhinitis (AR) is characterized by inflammatory events that lead to the onset of typical nasal symptoms, including itching, sneezing, rhinorrhea and obstruction.*
Objective: *The aim of the study was to evaluate the relationship between nasal airflow and severity of nasal symptoms, in a cohort of patients with PER*
Methods: *312 patients with PER were prospectively and consecutively evaluated performing clinical evaluation and rhinomanometry.*
Results: *Significant relationship exists between severity of all nasal symptoms and degree of nasal airflow limitation ($p < 0.001$).*
Conclusion: *This study provides the first evidence that patients with PER show close relationship between severity of nasal symptoms and nasal airflow impairment.*

Key words: allergic rhinitis, nasal symptoms, nasal airflow

INTRODUCTION

Allergic rhinitis (AR) is characterized by an inflammatory response to allergen exposure. Indeed, it is well known that allergen exposure activates mast cells with consequent release of multiple mediators, mainly histamine and leukotrienes, as well as cytokines capable of inducing the recruitment and activation of inflammatory cells, including eosinophils, neutrophils, and Th2 lymphocytes [(1)]. These inflammatory events lead to the onset of typical nasal symptoms, including itching, sneezing, rhinorrhea and obstruction, which is the most important as it is directly related to allergic inflammation [(2)]. On the contrary, the former symptoms are mainly histamine-dependent and may be considered as "irritative" symptoms. In this regard, antihistamines are very effective in controlling the irritative symptoms [(3)]. Moreover, the relationship between nasal obstruction, Th2-dependent inflammation and nasal airflow has been recently proven both in adults and children suffering from allergic rhinitis [(4)].

Nasal obstruction may be roughly evaluated subjectively, by the perception of air passage throughout the nose, and objectively, by measuring the nasal airflow through rhinomanometry [(5)]. It has been shown that allergic inflammation markers, such as Th2-type cytokines and nasal eosinophils, correlate well with nasal airflow [(6)].

AR has been recently re-classified by the ARIA (Allergic Rhinitis and its Impact on Asthma) workshop [(7)]. The new classification of "intermittent" (ITR) and "persistent" (PER) considers the duration of symptoms (days/week and consecutive weeks), the symptom severity (mild or moderate-severe) and the impact on quality of life.

However, the relationship between nasal symptom severity and nasal airflow has been never investigated in patients with PER.

Therefore, the purpose of this cross-sectional study was to evaluate the relationship between nasal airflow and severity of nasal symptoms, in a cohort of patients with PER.

MATERIALS AND METHODS

Study design

Three hundred and twelve patients with PER were prospectively and consecutively evaluated: 234 males and 78 females. The mean age was 23.6 years (SD: 2.0) with a minimum age of 19 and a maximum of 30 years. The mean rhinitis duration was 6.8 years (SD: 3.2).

All of them were Navy soldiers who were referred to the Navy Hospital as part of their mandatory regular check up and an informed consent was obtained from each patient. A detailed clinical history was taken and complete physical examination and rhinomanometry were performed in all of them.

To be enrolled in the study patients were required to have moderate or severe nasal obstruction. Patients reporting current or past asthma symptoms (one or more of the following: persistent cough, wheezing, dyspnea, and shortness of breath, either diurnal or nocturnal) were excluded. Subjects with acute

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upper respiratory infections, anatomic nasal disorders (i.e. septum deviation), nasal polyps and patients using nasal or oral corticosteroids or decongestants, antileukotrienes and antihistamines within the previous 4 weeks were also excluded.
The diagnosis of PER was made on the basis of a history of nasal symptoms and positive skin prick test according to validated criteria [4].

Symptoms
The following nasal symptoms were assessed through questions made by the investigator: nasal obstruction, sneezing, rhinorrhea, and itchy nose. Each symptom was evaluated on the following scale: 0 = absent, 1 = mild (symptom was present but was not annoying or troublesome), 2 = moderate (symptom was frequently troublesome but did not interfere with either normal daily activity or sleep), and 3 = severe (symptom was sufficiently troublesome to interfere with normal daily activity or sleep).

Rhinomanometry
Nasal airflow was measured by active anterior rhinomanometry (ZAN 100 Rhino Flow Handy II, ZAN, Messgeraete Gmbh, Germany) as previously described [2,3,7,8]. Nasal airflow was reported as the sum of recorded airflow through right and left nostrils in milliliter per second at a pressure difference of 150 Pa across the nasal passage. Four or more airflow measurements were performed for each patient and the mean was recorded when reproducible values were achieved.

Statistical analysis and data definitions
Initially, descriptive statistics were performed and quantitative parameters were reported as means and standard deviations (SD) and as medians with minimum [min] and maximum [max] values. Qualitative data were reported as frequencies and percentages. Comparison of qualitative data (frequencies) among groups of patients was with the chi-square test (or by the Fisher's Exact test in case of expected frequencies less than five). Comparison of quantitative variables (nasal airflow values) between different groups of patients (patients with different symptoms scores) was made by means of the non-parametric Analysis of Variance (Kruskal-Wallis test); post-hoc comparisons were made by the Dunn's test.
All tests were two sided and a p-value less than 0.05 was considered statistically significant. The package "Statistica release 6" (StatSoft Corp., Tulsa, OK, USA) was used for all the analyses.

RESULTS

Three hundred and twelve patients, 234 males and 78 females, were included in the study. A complete description of the patients is reported in Table 1.
As shown in Figure 1, nasal airflow values were significantly and progressively lower in patients with progressively higher symptoms scores; as shown in figure 1 panel A, patients with severe sneezing (score = 3), had significantly lower nasal airflow values compared to patients with moderate sneezing (score = 2) ($p < 0.01$); patients with moderate sneezing (score = 2), had significantly lower nasal airflow values compared to patients without sneezing ($p < 0.05$). Patients with moderate itching (score = 2), had significantly lower nasal airflow values compared to patients with mild itching (score = 1) ($p < 0.01$); patients with mild itching (score = 1), had significantly lower nasal airflow values compared to patients without itching ($p < 0.01$) (Figure 1, panel B). As shown in Figure 1 panel C, patients with moderate rhinorrhea (score = 2), had significantly lower nasal airflow values compared to patients with mild rhinorrhea (score = 1) ($p < 0.01$) or without rhinorrhea ($p < 0.01$).

Table 1. Demographic and clinical parameters of the study patients.

	n = 312	
	n *(%)*	
Gender - Males	234 *(75.0)*	
Family history - Positive	221 *(70.8)*	
	Mean [SD]	**Median [Min-Max]**
Age at study visit (years)	23.6 [2.0]	24 [19-30]
Rhinitis duration (years)	6.8 [3.2]	7 [1-13]
Obstruction score	1.7 [0.8]	1 [1-3]
Total symptoms' score	5.6 [2.1]	5 [1-9]
Nasal airflow (ml/sec)	450.9 [144.5]	440 [233-878]

Figures in round parentheses are percentages calculated over the total number of subjects reported at top of the column.

Table 2. Association between rhinorrhea score and itching score.

	Nasal itching score			
Rhinorrhea score	**0**	**1**	**2**	**Total**
0	16 (40%)	24 (60%)	0 (0%)	40
1	12 (8.1%)	130 (87.2%)	7 (4.7%)	149
2	14 (11.4%)	25 (20.3%)	84 (68.9%)	123
Total	42	179	91	312

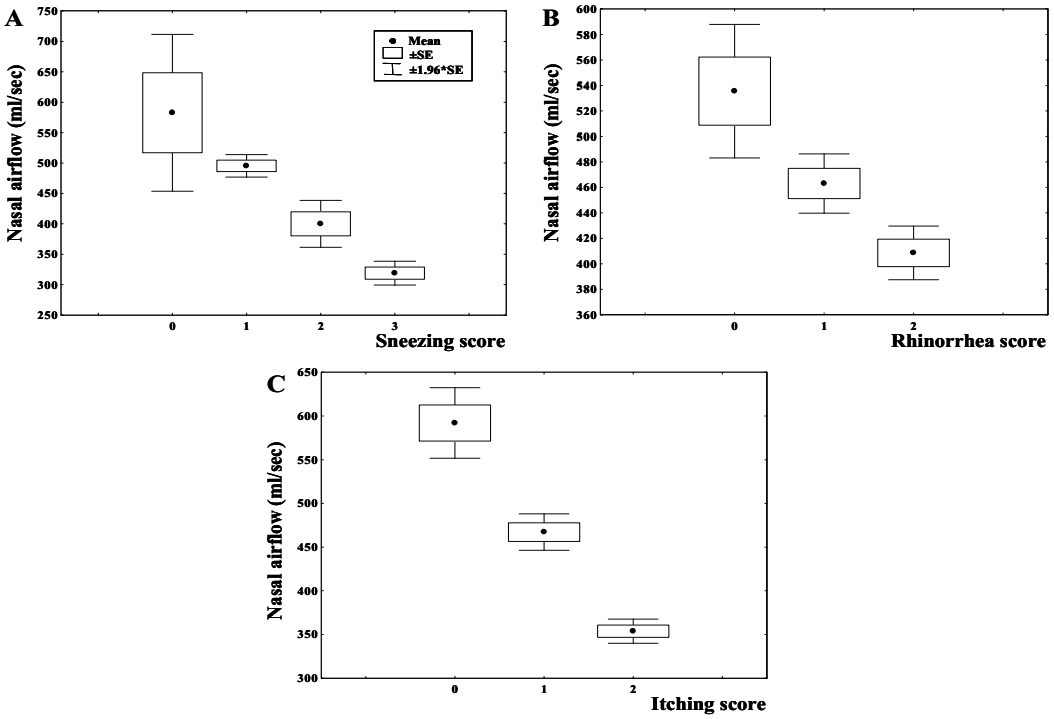
Figures in round parentheses are row percentages.

As shown in Figure 2, nasal airflow values were significantly and progressively lower in patients with progressively higher obstruction scores: patients with severe obstruction (score = 3) had significantly lower nasal airflow values compared to patients with moderate obstruction (score=2) ($p < 0.01$); patients with moderate obstruction (score = 2) had significantly lower nasal airflow values compared to patients with mild obstruction (score = 1) ($p < 0.01$).
As reported in Table 2, there was a significant association between rhinorrhea score and itching score: in fact, the percentage of patients with a moderate itching (score = 2) was significantly higher (68.9%) in patients with a moderate rhinorrhea (score = 2) as compared to patients with a mild rhinorrhea (score = 1) (4.7%) and patients without rhinorrhea (4.7%) ($p < 0.0001$).

DISCUSSION

Allergic rhinitis is characterized by an inflammatory response that leads to typical nasal symptoms. Particularly, nasal obstruction constitutes the symptom that is linked more direct-

Figure 1. Mean nasal airflow values (ml/sec) in patients with different sneezing scores (panel A), in patients with different itching scores (panel B) and in patients with different rhinorrhea scores (panel B).



ly to the allergic inflammation [9,10]. Indeed, it has been reported that nasal obstruction may be considered the most relevant symptom in allergic rhinitis as it reflects the eosinophilic inflammation [11]. Nasal obstruction may be evaluated both subjectively by symptom scoring and objectively by airflow measurement.

Previously, it has been shown that nasal obstruction, assessed either subjectively or objectively, is closely correlated with the severity of nasal allergic inflammation [4,11]. However, the relationship between other nasal symptoms and nasal airflow has never been investigated.

The first finding of this study clearly demonstrates that all the irritative symptoms correlate with nasal airflow. Indeed, for each symptom, it is shown that higher symptom scores are associated with a progressive impairment of nasal airflow. A possible explanation is that the degree of nasal symptoms may be closely dependent on the severity of nasal allergic inflammation.

Additionally, nasal obstruction severity is significantly related with nasal airflow limitation. This finding confirms previous studies showing a close relationship between nasal obstruction severity and airflow impairment [4,11].

Thirdly, there is a significantly association between the degree of two irritative symptoms, such as nasal itching and rhinorrhea. This finding underlines the close dependence between histamine release and its associated symptoms.

In conclusion, this study provides the first evidence that in patients with PER nasal airflow is correlated with the severity of nasal symptoms.

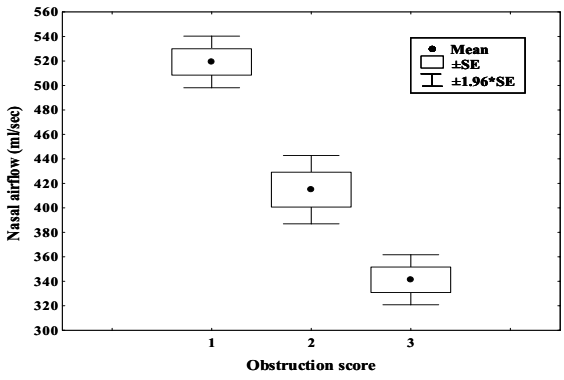


Figure 2. Mean nasal airflow values (ml/sec) in patients with different nasal obstruction scores.

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