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Decongestion test in patients with allergic rhinitis: Functional evaluation of nasal airflow

Giorgio Ciprandi, M.D.,* Ignazio Cirillo,# Andrea Vizzaccaro,# Eugenio Pallesstrini,* and
 Maria Angela Tosca§ (Italy)

ABSTRACT

Background: Rhinomanometry measures nasal airflow that is frequently impaired in allergic rhinitis. Decongestion tests consist of spraying an intranasal vasoconstrictor drug to evaluate the reversibility of nasal airflow limitation. The aim of this study was to evaluate the decongestion test in patients with seasonal allergic rhinitis (SAR) caused by pollen sensitization, perennial allergic rhinitis (PAR) caused by sensitization to perennial allergens only, or mixed allergic rhinitis (MAR) caused by sensitization to both allergens.

Methods: One hundred twenty-three subjects (112 men and 11 women, mean age, 22.9 ± 5.7 years) were studied; 40 subjects had PAR, 43 subjects had MAR, and 40 subjects had SAR. Total symptom score (including: nasal itching, sneezing, rhinorrhea, and nasal obstruction) was assessed. Rhinomanometry and decongestion tests were performed in all subjects.

Results: Nasal symptom severity was superimposable in the three groups (p was not significant). After decongestion tests, an increase of nasal airflow and a decrease of nasal resistance was shown in PAR ($p < 0.01$), MAR ($p < 0.001$), and SAR subjects ($p < 0.001$). The intergroup analysis showed that SAR patients had less reversibility than PAR ($p < 0.01$).

Conclusion: This study provides the first evidence of the different response to decongestion tests, taking into consideration the causal allergens. (Am J Rhinol 20:1-00, 2006)

Allergic rhinitis is a common chronic condition that affects up to 21% of the general population in the United States.¹⁻³ Nasal obstruction constitutes annoying symptom in patients with rhinitis and is related to allergic inflammation.^{4,5} Recently, relationships among nasal obstruction, Th2-dependent inflammation, and airflow limitation has been evidenced both in adults and in children suffering from allergic rhinitis.^{6,7} Actually, this symptom may be measured objectively by rhinomanometry.⁸

As bronchodilation test using β_2 -agonists is considered the main step in asthma diagnosis; a decongestion test has been proposed as a prognostic test in allergic rhinitis.⁹ Decongestion tests consist of evaluating the percentage of reversibility of nasal airflow limitation after administering intranasal vasoconstrictor (such as α -adrenoreceptor stimulants).⁹ Nevertheless, no study investigated this test considering the causal allergens. Previously, we classified allergic rhinitis based on causal allergens in three types: seasonal allergic rhinitis (SAR) caused by pollen sensitization only, perennial allergic rhinitis (PAR) caused by sensitization to perennial allergens only, and mixed allergic rhinitis (MAR) caused by sensitization to both kind of allergens.¹⁰ Thus, the aim of this study was to evaluate the a decongestion test in patients with SAR, PAR, or MAR.

METHODS

Study Design

The study was conducted during the time of peak of pollen counts (*i.e.*, April–May in our geographic area). We included

subjects with allergic rhinitis. Among all subjects seen at the Navy Hospital of La Spezia (Italy), we enrolled in this observational study only those reporting symptoms of rhinitis with skin sensitization to pollens, perennial allergens, or both. Those subjects reporting actual or past asthma symptoms (one or more of persistent cough, wheezing, dyspnea, and shortness of breathing, either diurnal or nocturnal) were excluded. Equally, subjects with acute upper respiratory infections; anatomic nasal disorders (*i.e.*, septum deviation); nasal polyps; and using nasal or oral corticosteroids, nasal or oral decongestants, and antihistamines within the previous 4 weeks were excluded.

The diagnosis of allergic rhinitis was made based on a history of nasal symptoms and positive skin-prick tests according to validated criteria.¹¹ Based on the sensitizing allergen we subdivided the patients into three groups:

- Sensitized to pollens only, SAR group
- Sensitized to perennial allergens only, PAR group
- Sensitized both to pollens and perennial allergens, MAR group

In our geographic area, the most relevant pollens are *Parietaria judaica*, grasses, olive, birch, and hazel, whereas the most important perennial allergens are house-dust mites, cats, and dogs.^{6,7,8,10}

Skin-prick tests, symptom assessment, anterior rhinoscopy, rhinomanometry, and decongestion tests were performed in all subjects. The study was approved by the Navy Hospital Institutional Review Board and an informed consent was obtained from patients.

Patients

One hundred twenty-three patients with allergic rhinitis were prospectively and consecutively evaluated: 112 men and 11 women, mean age, 22.9 ± 5.7 years. All of the subjects were Navy soldiers who were referred to the Navy Hospital for periodic fitness visit.

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Skin-Prick Test

Allergy was assessed by the presence of sensitization to the most common classes of aeroallergens by performing a skin-prick test.¹²

Nasal Symptoms

The following symptoms were assessed by the patient, answering the questions asked by the investigator, before and after treatment: 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 have interfered with normal daily activity or sleep). The total symptom score—the sum of each individual symptom—was considered also.

Rhinomanometry

Nasal airflow was measured by active anterior rhinomanometry. Patients wore a tight-fitting facemask, and with the mouth closed, breathed through one nostril. A sensor, placed in the contralateral nostril, recorded data on pre- and postnasal pressures *via* airflow and pressure transducers. The instrument (ZAN 100 Rhino Flow Handy II, ZAN; Messgeraete GmbH, Oberthulba, Germany) was connected to a personal computer. The instrument characteristics are differential pressure measurement by mobile diaphragm, range between 0 and 15 L/s, maximal linearity with software linearization <3%, flow resistance <0.03 kPa/L per second, and effective dead space <50 mL. Calibration is performed every 100 measurements and the instrument is checked by an expert technician every 6 months.

The signals of transnasal airflow and pressure were amplified, digitized, and saved for statistical analysis. We considered both nasal airflow and resistance according to validated criteria.^{13,14}

Decongestion Test

A decongestion test was performed as previously described.^{7,8,10,14} Briefly, after baseline rhinomanometry, two sprays of naphazoline (0.1%) were then applied per nostril. This drug is a potent α -adrenostimulator inducing quick vasoconstriction. Rhinomanometry was evaluated 10 minutes after application. Total nasal airflow resistance and percentage of reversibility were evaluated.

Statistical Analysis

Statistical analysis was performed using Pearson's *R* test and χ^2 test, values of $p < 0.05$ were considered statistically significant. Data are presented as means $\pm$ SD.

RESULTS

Subjects

Forty (32.5%) subjects suffered from PAR, 43 (35%) subjects suffered from MAR, and 40 (32.5%) subjects suffered from SAR. Thus, the three groups were homogeneous.

Rhinoscopy

Hypertrophy of turbinates was present in 67% of PAR subjects, 70% of MAR subjects, and 55% of SAR subjects. Therefore, SAR subjects showed lower prevalence of turbinates hypertrophy than PAR ($p = 0.04$) and MAR ($p = 0.038$) subjects.

Nasal Symptoms

All subjects were symptomatic and there was no significant (NS) difference among the groups concerning both total symptom score and each single symptom as reported in Table 1.

Rhinomanometry

At baseline, nasal airflow and resistance values were not statistically different among the three groups (Figs. 1 and 2).

Decongestion Test

All groups showed a significant increase of nasal airflow (PAR group, $+39.7 \pm 31.8\%$, $R = 58\%$, $p = 0.002$; MAR group, $+17.1 \pm 22.1\%$, $R = 77\%$, $p < 0.001$; SAR group, $+13.5 \pm 25.1\%$, $R = 80\%$, $p < 0.001$; Fig. 1) and a decrease of nasal resistance (PAR group, $-37 \pm 4\%$, $p < 0.01$; MAR group, $-21 \pm 12\%$, $p < 0.001$; SAR group, $-16 \pm 4\%$, $p < 0.001$; Table 2 and Fig. 2). The intergroup analysis showed that there was a significant difference between PAR and SAR subjects ($R = -40\%$, $p = 0.003$), whereas there was no difference between PAR and MAR ($R = 15\%$, $p = \text{NS}$) groups and between MAR

Table 1 Nasal Symptoms in Patients with PAR, MAR, and SAR

	PAR	MAR	SAR
TSS	8.32 ± 1.47	9.09 ± 1.33	8.35 ± 1.25
Sneezing	1.92 ± 0.57	2.39 ± 0.58	2.27 ± 0.73
Itchy nose	1.62 ± 0.58	1.9 ± 0.6	1.92 ± 0.75
Rhinorrhea	2.12 ± 0.48	2.13 ± 0.67	1.97 ± 0.61
Obstruction	2.65 ± 0.35	2.66 ± 0.34	2.17 ± 0.74

TSS = total symptom score.

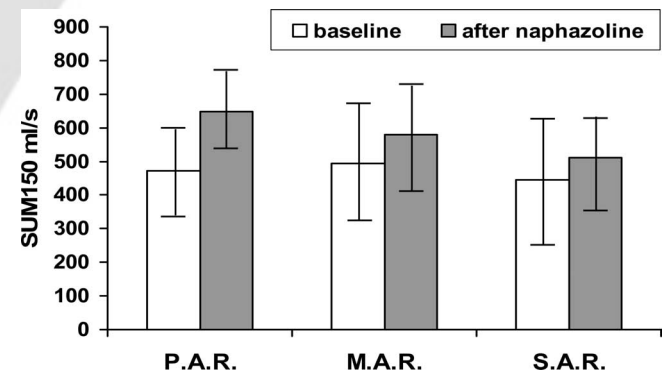


Figure 1. Nasal airflow (expressed as total volume mL/s) evaluation before and after decongestion testing (gray) in patients with PAR, MAR, and SAR. Data are expressed as means $\pm$ SD.

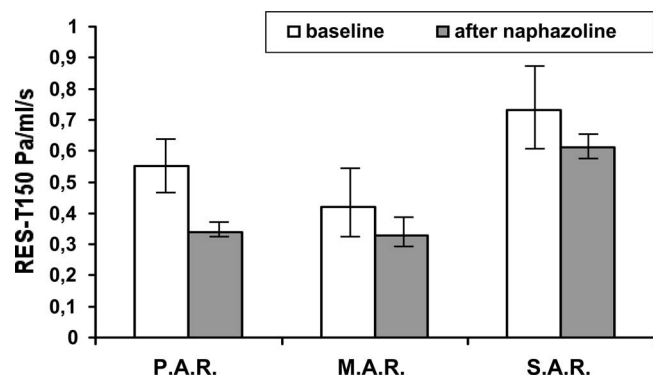


Figure 2. Nasal resistance (expressed as Pa/mL per second) evaluation before and after decongestion testing (gray) in patients with PAR, MAR, and SAR. Data are expressed as means $\pm$ SD.

Table 2 Nasal Resistance at Baseline and after Decongestion in Patients with PAR, MAR, and SAR

Group	RES-T150		
	Baseline Pa/mL per Second	Postnaphazoline Pa/mL per Second	$\Delta\%$ Baseline
PAR	0.55 $\pm$ 0.09	0.34 $\pm$ 0.02	-37 $\pm$ 4
MAR	0.42 $\pm$ 0.12	0.33 $\pm$ 0.05	-21 $\pm$ 12
SAR	0.73 $\pm$ 0.14	0.61 $\pm$ 0.03	-16 $\pm$ 4

RES-T150 = XXXXX.

and SAR ($R = -0.2\%$, $p = \text{NS}$) groups concerning nasal airflow and resistance.

DISCUSSION

Allergic rhinitis is characterized by inflammation that accounts for occurring nasal symptoms, mainly concerning nasal obstruction.^{6,7} Nasal obstruction constitutes a crucial symptom as it may affect quality of life, bronchial hyperreactivity, and ostiomeatal complex and Eustachian tube patency.¹⁵ The pathogenesis of nasal obstruction is very complex and consists of three main events: inflammatory mucosal edema, vascular congestion, and mucus hypersecretion.¹⁴

A decongestion test provides evidence about the quote of reversibility of both nasal airflow and resistance after vasoconstrictor drug. Managing patients with rhinitis, the percentage of reversibility accounting for medical or surgical options as absent or poor response is suggestive for surgical approach.⁹ However, no study investigated the response to decongestion tests considering the causal allergens.

In this study, we provided evidence that significant reversibility was achieved in all groups, but it was more evident in the PAR group. SAR and MAR patients were exposed to pollens; thus, acute allergic inflammation was present because the study was performed during the peak of pollen season. In fact, during pollen exposure SAR and MAR patients showed more intense inflammation than patients sensitized to peren-

nial allergens only.¹⁰ Thus, the response to the decongestion test might mean a different grade of allergic inflammation. Additional studies should address this issue to relate reversibility to inflammatory parameters. Another interesting area of research may be represented by investigating the effects of treatments on reversibility to establish decongestant activity.¹³ Moreover, from a practical point of view, reduced reversibility may account for prescribing anti-inflammatory drugs such as intranasal corticosteroids. In conclusion, this study provides the first evidence of different responses to decongestion testing taking into consideration the different sensitiza-

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