ORIGINAL CONTRIBUTION

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Nasal peak inspiratory flow and clinical score in children and adolescents with allergic rhinitis*

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SUMMARY

Objective: *To assess the correlation between nasal inspiratory peak flow (NIPF) and clinical scoring in patients with allergic rhinitis (AR).*

Methods: *A concurrent cohort study was carried out with 52 randomly selected patients aged six to 16 with moderate and severe persistent allergic rhinitis, and followed up for eight weeks. Measurements of NIPF and clinical score for AR were evaluated in a blinded manner. Correlations between NIPF and clinical scoring were obtained from linear regression using the Pearson's correlation coefficient (r). Significance level was $p < 0.05$.*

Results: *Moderate but statistically significant correlation between NIPF and clinical scoring was found ($r = -0.44$; $p \leq 0.001$) and nasal obstruction alone ($r = -0.438$; $p \leq 0.001$) were found.*

Conclusion: *Results confirm data from studies conducted with adult patients that found weak correlation between allergic rhinitis symptoms and objective measurements of nasal obstruction as NIPF. NIPF and the clinical scoring are complementary tools to evaluate AR patients.*

Key words: rhinitis, nasal, flow, score, children

INTRODUCTION

Allergic rhinitis (AR) is an inflammatory process of the nasal mucosa, induced by IgE after allergen exposure. Watery rhinorrhea, nasal obstruction, sneezing and an itchy nose are the main symptoms [1,2].

According to *International Study on Asthma and Allergies in Childhood* (ISAAC), the prevalence rate of AR ranges widely and is increasing worldwide. In Brazil, ISAAC has shown that the prevalence rate of symptoms related to AR was 29.6% among adolescents and 25.7% among school children, one of the highest rates in the world. AR is a worldwide public health problem and is among the ten most usual reasons for seeking primary care assistance [3-5].

In the majority of patients AR is diagnosed by careful clinical history and nasal examination. Still, the use of clinical scores may be useful in diagnosing and following up patients. Although clinical evaluation of the patients with AR is enough on a day-to-day basis, whenever possible, objective measurements such as rhinomanometry and the nasal inspiratory peak flow (NIPF), which quantify the degree of nasal obstruction, are recommended for diagnosis, follow-up and to assess the therapeutic response.

In adults, Wilson and coworkers ascertained the correlation between nasal symptoms and the daily measurements of NIPF both in the morning ($r = -0.42$, $p < 0.01$) and in the evening ($r = -0.48$, $p < 0.01$).

In literature reviewed, we have not found any articles where a correlation between NIPF and subjective measures of nasal obstruction and AR between children and adolescents has been evaluated. This study aims to correlate the NIPF measurements and clinical scoring of AR in children and adolescents.

MATERIALS AND METHODS

A concurrent cohort study was carried out in a paediatric pulmonology outpatient clinic. Participants were randomly selected from July 2005 to July 2006 and followed up for eight weeks.

Inclusion and exclusion criteria

The study enrolled patients aged 6 to 16 with AR diagnosed according to ARIA [5] and a positive skin prick test on admission.

We excluded those that received any of the following: intranasal corticosteroids, as well as topical and systemic vasoconstrictors and/or nasal disodium cromoglicate four weeks prior to the beginning of the study; antihistamines two weeks prior;

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leukotriene receptor antagonists eight weeks prior and specific immunotherapy three months prior. We also excluded patients with bacterial sinusitis diagnosed in clinical grounds, deviated septum, nasal polyps and upper respiratory tract infection.

Definitions

Diagnosis of persistent AR was based on the presence of one or more of the following six signs or symptoms for 4 or more days per week and more than 4 weeks before their admission: pharyngeal pruritus, sneezing, watery rhinorrhea, itchy nose, itchy eyes and nasal obstruction [2]. The clinical score described by Wilson et al. [8] was modified for the assessment of AR severity upon admission and at each follow-up visit. Each of the aforementioned symptoms received a number of points ranging from 0 (best) to 3 (worst). Thus, 0 point reflected the absence of a given symptom; 1 point indicated the sign/symptom as mild, well tolerated, not interfering with sleep or daily activities; 2 points indicated the sign/symptom as well-defined, discomforting, interfering only with activities that demanded a higher degree of concentration, and finally, 3 points accounted as a symptom of high intensity, very bothersome, barely-tolerated, hindering the patient's sleep and daily activities. The score ranged from zero to 18 points, allowing the assessment of AR severity as mild, moderate, and severe if rated 1–6, 7–12, and 13–18 points, respectively.

Skin prick tests to evaluate sensitivity to usual aeroallergens were performed according to the European Academy of Allergy and Clinical Immunology recommendations. Tests were conducted and interpreted prior to group assignment. The following allergens were tested: *Dermatophagoides farinae, Dermatophagoides pteronyssinus, Blomia tropicalis, Aspergillus fumigatus, Penicilium notatum, Alternaria alternata, Cladosporium herbarum, Canis familiaris, Felis domesticus* and *Periplaneta americana.*

Follow-up

After admission, patients were followed up for 8 weeks, when clinical score of AR and the degree of nasal obstruction were evaluated using NIPF. The clinical functional assessment was repeated every two weeks.

For the functional evaluation NIPF (In-check®- inspiratory flow meter, Clement Clarke, Harlow, UK) was checked at admission and during each of the four subsequent visits. Before NIPF was checked, patient would proceed with a usual nasal hygiene, blowing his/her nose gently to eliminate nasal secretions, after which he/she was instructed to breath in through the nose, using a maximal inspiratory effort. At least three measurements were obtained, the highest of which was recorded. All measures were obtained in standing position.

The clinical scoring and the NIPF assessments were obtained by independent examiners who were blinded to study aims.

All patients were treated with fluticasone propionate 100 μg/day. No specific recommendation regarding allergen avoidance and immunotherapy was given to patients during the study.

Statistical analysis

Descriptive analysis was used to characterize the studied population. Linear regression was used to assess the correlation between the variables studied, i.e. clinical scoring, nasal obstruction of the clinical score item, NIPF. A p value was considered significant if it was lower than 0.05.

Ethics

The study protocol and the written informed consent were approved by the Committee for Ethics in Human Research of the Federal University of Minas Gerais.

RESULTS

In total, 52 patients were enrolled. Mean age was 11.96 years (SD ± 2.88). Table 1 presents the demographical, clinical and functional characteristics of the studied patients at admission and during the follow up.

We observed a decrease in the score AR scoring from admission to week 8, and an increase in NIPF mean values in the same period probably due to efficacy of intranasal fluticasone propionate. Upon admission, patients had three to five of the six previously reported symptoms, each ranging from two to

Table 1. Demographical and clinical and functional characteristics of the patients at admission and during follow up (n=52).

Variables	**n**	**%**
Sex		
Male	34	65.4
Female	18	34.6
Ethnic group		
White	40	76.9
Others	12	23.1
Family History of atopy		
Positive	43	82.7
Negative	9	17.3
Positive skin prick test		
More than 1 allergen	51	98.0
1 allergen	1	2.0
AR severity		
Moderate persistent	41	78.8
Severe persistent	11	21.2
AR scoring system (points)	**Mean**	**SD**
Admission	10.8	2.02
Week 2	6.25	4.18
Week 4	6.00	4.09
Week 6	5.76	3.93
Week 8	5.72	4.02
NIPF (L/min)	**Mean**	**SD**
Admission	65.76	20.99
Week 2	79.02	30.34
Week 4	86.66	33.74
Week 6	85.29	33.60
Week 8	85.88	36.06

Table 2. Correlations between AR clinical scoring and nasal obstruction with NIPF.

AR clinical soring and NIPF				
Admission	0.089	−0.191 to 0,356	0.08	0.535
2nd week	−0.079	−0.347 to 0.201	0.006	0.583
4th week	−0.448	−0.644 to 0.197	0.201	0.001
6th week	−0.398	−0.607 to −0.138	0.159	0.004
8th week	−0.418	−0.622 to −0.161	0.175	0.002
Nasal obstruction and NIPF				
Admission	−0.032	−0.305 to 0.245	0.01	0.821
2nd week	−0.280	−0.516 to −0.005	0.078	0.047
4th week	−0.418	−0.622 to −0.161	0.175	0.002
6th week	−0.421	−0.624 to −0.165	0.177	0.002
8th week	−0.438	−0.637 to −0.185	0.192	0.001

three points. The average score (10.8 ± 2.02) indicates that the study population had moderate persistent AR.

Table 2 presents the inverse correlation between values of NIPF and AR clinical scoring and the correlation between the degree of nasal obstruction an item of the same clinical scoring and the NIPF. The negative value indicates that the higher the NIPF, the lower the value of AR, i.e., an inverse relation, as illustrated in the dispersion diagram (Figure 1). The value of r^2 (0.183) indicates that only 18% of the variation of AR score can be accounted for NIPF variation.

Figure 2 presents the correlations between the values of the item nasal obstruction of the clinical score and NIPF. Similarly to the correlation between NPFI and clinical score, the correlations obtained were also inverse and of weak intensity.

We carried out another correlation analysis between the variables NIPF vs. AR score and NIPF vs. Nasal obstruction, considering the variation between baseline and each of the four subsequent assessments of NIPF, and of AR score and of the NIPF, and the item obstruction of the clinical score of AR from one week to another.

When the variation of the NIPF and AR score was assessed, a weak correlation ($r = -0,29$; $p = 0.039$) was found and between the variation of the NIPF, and the item obstruction of the clinical score of AR a moderate correlation was found ($r = 0.509$; $p < 0.001$).

Additional analyses were performed aiming to compare NIPF and AR score according to time (before and after the 4th week) and age group (up to 10 and more than 10 years old). The highest 'r' value was obtained from children aged less than 10 years in the fourth week of the follow up ($r = -0.55$, 95% CI, -0.79 to -0.16, $p = 0.009$).

DISCUSSION

Diagnosis of AR is done basically on clinical grounds considering that objective measures of nasal obstruction as NIPF, rhinomanometry and acoustic rhinometry, are hardly available on outpatient clinic settings. Usually these methods are limited to the clinical research, especially rhinomanometry and acoustic rhinometry. The latter analyzes ultra sound waves reflected of the nasal cavity to calculate the cross section cut area at any point of the nasal cavity, and is an objective method to measure nasal obstruction. The former, on the other hand, consists of a dynamic test that enables to assess nasal patency through an objective measure of the nasal airway resistance. They are, however, time-consuming, requires an experienced laboratory assistance and the equipments are quite expensive [8-10].

Some studies have demonstrated that NIPF and rhinomanometry correlate well [11,12]. Holmström et al. assessed 22 adult patients and found a moderate correlation ($r = 0.35$, $p < 0.01$) between NIPF and rhinomanometry in the assessment of nasal patency [13]. Similar results were found in a study conducted by Wihl and Malm, in 12 adult patients ($r = -0.53$, $p < 0.01$) [14]. Such findings are interesting because NIPF is a quick, practical and low cost method when compared with rhinomanometry, facilitating its access in primary care settings [14].

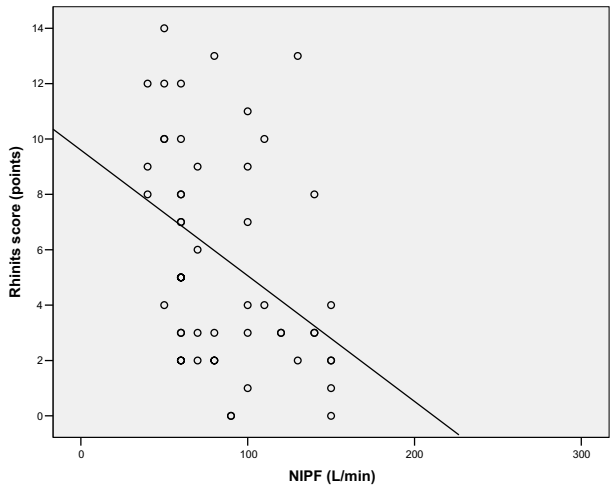

Figure 1. Scattergram plotting the correlation between values of NIPF and AR clinical scoring.

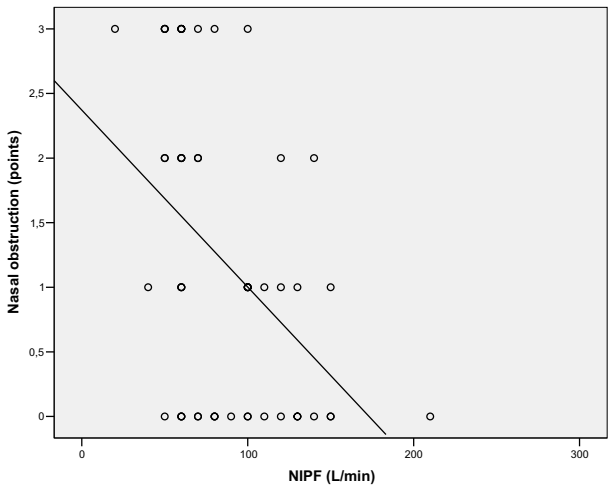

Figure 2. Scattergram plotting correlation between the values of the item nasal obstruction of the clinical score and NIPF.

Correlations between NIPF and clinical scoring were previously evaluated by other authors. The study conducted by Fairley et al. [15] showed correlation between subjective nasal patency and the NIPF, contradicting previous studies that did not find any correlation between subjective and objective measures of nasal obstruction. That study, however, was carried out with only five adults, each submitted to 25 and 44 evaluations.
On the other hand, it is worth emphasizing that, despite being more practical, NIPF presents some limitations when compared to rhinomanometry. Clarke and Jones [16], studying the NIPF of 20 adults, concluded that small changes in nasal resistance measured by rhinomanometry after low doses of histamine were not detected by the NIPF. Significant changes in nasal resistance after high doses of histamine showed few alterations in the NIPF. Thus, the NIPF can be used as a static measure of nasal obstruction but is inferior to rhinomanometry to accurately detect nasal patency dynamics. The importance of objective airway measurements in children – who often breathe orally from habit even when the obstruction is removed – should be stressed.

Ottaviano et al. [17,18] evaluating 137 patients from 16 to 84 years proposed normative NIPF values for a healthy adult population and provided charts relating measurements with age, height and sex. These values can be used as a reference for any doctor attempting to study nasal patency in a Caucasian population. Studies on this subject on pediatric population are envisaged and should be encouraged. Unfortunately the number of subjects analyzed in our work prevented us from creating reference values for NIPF in this age group.

Moderate correlation between NIPF and clinical scoring obtained in the present study suggests that clinical evaluation alone is insufficient to estimate the degree of nasal obstruction. Similar correlations between the NIPF and the item nasal obstruction of the same scoring system seem to corroborate this argument, i.e., some patients may present a more significant nasal obstruction than they complain to. The subjectivity of the assessment of reported symptoms especially in children may be a possible explanation for such findings. The clinical applicability of NIPF is obvious, especially within the pediatric age group, where information is often subjective due to lack of a faithful perception of symptoms.

The results found in the present study are similar to those obtained by Wilson et al. who evaluated the response to treatment in AR patients, by means of NIPF measurements in 38 adults patients [6]. They were divided into three groups, who received different types of treatment for AR (cetirizine + placebo or cetirizine + intranasal mometasone furoate or cetirizine + oral montelukast) for four weeks. Two daily NIPF measurements were done, in the morning and in the evening. In addition, patients filled in daily tables of clinical scoring, in which they described the occurrence of symptoms and the impact on their daily activities. There was a significant correlation ($p < 0.01$) between the nasal symptoms and the daily measures of NIPF in the morning ($r = -0.51$) and in the evening ($r = -0.56$). Moreover they assessed the impact of the symptoms on their day-to-day activities and the morning NIPF ($r = -0.42$) and the evening NIPF ($r = -0.48$).

Even though the correlations have been statistically significant, the correlation was moderate and, therefore, the results lack clinical relevance signifying that NIPF does not replace the use of AR clinical scoring, but rather complements it. As a consequence, both methods should be used in the evaluation of children and adolescents with AR in order to improve their management.
It is worth pointing out that the NIPF results depend on the child's cooperation and the impression of the examiner, who will determine the reliability of the maneuver carried out by the patient. The fact that it assesses only one of the symptoms of AR – nasal obstruction – is a relative limitation of NIPF. Due to the simplicity, by which it can be used, it can be a valuable tool to pediatrician as it optimizes the evaluation of nasal obstruction since AR symptoms can be underestimated by patients and their parents. The objective measurement of nasal patency through the NIPF can also be helpful to patient education, especially to those who have adapted to AR chronic symptoms. The remaining symptoms can be evaluated by clinical scoring and quality of life evaluation. In addition, adenoid hypertrophy can contribute to upper airway obstruction and can be evaluated by NIPF. A child with near normal NIPF is unlikely to have severe adenoid obstruction [19,20]. In addition, as AR is frequently associated to asthma, the pulmonary peak expiratory flow and forced spirometry are relevant and should also be measured.

In conclusion, NIPF is an effective, simple and useful tool that can complement clinical evaluation of AR patients. This is especially valuable to children and adolescents due to the subjectivity of clinical information, including the possibility of them underestimating their symptoms, especially in cases where they have no previous history of "normal breathing" for comparison.

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ANNOUNCEMENT