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Objective measurements differ for perception of left and right nasal obstruction☆

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ABSTRACT

Objective: Nasal obstruction is one of the most common sensation complaints of nasal disease in clinical practice. It is a subjective sensation of nasal airflow. Objective assessment of nasal patency and nasal physiology includes the use of rhinomanometry and acoustic rhinometry. The perception of nasal obstruction changes as the alternating of nasal airway resistance and nasal airflow. However, there were limited studies reported whether the perceptions of the left and right nostrils are similar. We examined the relationship between subjective and objective parameters of the nasal airway in the left and right nostrils.

Methods: A prospective study of 101 patients with a deviated nasal septum and chronic hypertrophic rhinitis was conducted for subjective and objective nasal airway evaluation. Patients were then divided into three groups based on the visual analog scale. Associations between measures were evaluated with analysis of variance, *f* tests and simple regression.

Results: Among three patient groups with different subjective sensations of nasal obstruction, there were significant differences among three patient groups according to the objective measurements of airflow resistance on the right side ($p = 0.0002$ for inspiration right mean resistance; $p = 0.0049$ for expiration right mean resistance), and for the minimal cross-sectional area ($p = 0.030$) and nasal cavity volume ($p = 0.028$ for 0–3.3 cm left nostril; $p = 0.047$ for 2–4 cm left nostril) on the left side. This indicates that nasal flow resistance is an important determinant for right side nasal obstruction. Nasal minimal cross-sectional area and nasal cavity volume are an important determinant for left side nasal obstruction.

Conclusion: Our study indicates the important role of rhinomanometry in objective measurement of right side nasal obstruction and acoustic rhinometry in objective measurement of left side nasal obstruction. Thus, human perception of right and left nostrils may be different and requires further study.

1. Introduction

Nasal obstruction involves a subjective sensation of impaired nasal patency. Objective methods for quantitative evaluation of nasal obstruction should be used in the clinic. Rhinomanometry and acoustic rhinometry procedures, which are noninvasive, easily used, rapid, and convenient, were used for objective assessment of nasal obstruction. The perception of nasal obstruction changes as the alternating of nasal airway resistance and nasal airflow. However, there were limited studies reported whether the perceptions of the left and right nostrils are similar. The aim of this study was to investigate the subjective and objective correlation of nasal airway sensation between the left and right nostrils.

2. Materials and methods

2.1. Patients

Patient characteristics are presented in Table 1. Between November 2008 and July 2009, 107 patients, aged 15–69 years, were prospectively and consecutively enrolled. Six patients were excluded because of personal and technical problems. The study

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Table 1
Patient characteristics ($n = 101$).

Patient	n (%)	Median	Range
Age (years)		31.5	15–69
Gender			
Male	67 (66.34)		
Female	34 (33.66)		

included 101 consecutive patients. The patient population consisted of 67 men (66.34%) and 34 women (33.66%), with an average patient age of 31.5 years. Patients diagnosed with nasal obstruction, deviated nasal septum, and chronic hypertrophic rhinitis who were able and willing to complete the study were included. Deviated nasal septum and chronic hypertrophic rhinitis were diagnosed using anterior rhinoscopy, revealing the invisible nasopharynx on at least either side of the nasal cavity. These patients were prepared for septomeatoplasty. A deviated nasal septum is a condition in which the nasal cartilaginous or bone ridge leans towards the left or right nasal cavities, which could cause obstruction of the nasal passages. Septomeatoplasty is a surgical method to correct the abnormal nasal septum and inferior turbinate. Patients with prior nasal surgery or destructive nasal procedures were excluded. Patients with symptoms of nasal or eye pruritus, sneezing, and rhinorrhea were excluded. Questionnaire self-perception ranking data, rhinomanometry, and acoustic rhinometry data were obtained at the same time to decrease the influence of the nasal cycle before surgical intervention. Basic data including age, gender, and medical history were recorded. A well-trained technician performed rhinomanometry, acoustic rhinometry, and questionnaire collection. This study was approved by the Institutional Review Board of our institution, and informed consent was obtained from each patient.

2.2. Subjective ranking scale

Before the objective measurements, patients evaluated their current nasal obstruction condition. The visual analog scale [1] is a simple and quantitative method that was used for the self-perception ranking scale. The ranged between no (0 mm) and total (100 mm) nasal obstruction. Patients were then divided into three groups based on the severity of nasal obstruction: mild (Group 1; 0–30 mm), moderate (Group 2; 31–70 mm), and severe (Group 3; 71–100 mm) as described in EP3OS 2007 [2,3].

2.3. Rhinomanometry

This study was performed using an NR6 rhinomanometer (GM Instruments, Ltd., Kilwinning, UK) calibrated by the manufacturer. Rhinomanometry is an objective method for measuring nasal airway resistance and assessing nasal patency. Nasal resistance (Pa cm^{-3} s^{-1}) is calculated from the relationship between pressure and nasal airflow. The measurement parameter included inspiration and expiration resistance. Patients sat upright with their head in a neutral position. A mask was used that had no air leaks and did not result in deformation of the nose.

2.4. Acoustic rhinometry

This study was performed using an A1 acoustic rhinometer (GM Instruments, Ltd.) calibrated by the manufacturer. Acoustic rhinometry is an objective method for measuring nasal cross-sectional area, minimal cross-sectional area, and nasal cavity volume. It uses reflected sound waves to obtain an area-distance graph. Patients sat upright with their head in a neutral position. The measurement was repeated at least four times until two similar curves were obtained.

2.5. Statistical analysis

The differences between the subjective perception divided into three groups based on nasal obstruction visual analogue scale. To evaluate the geometric difference between the severity of nasal obstruction, analysis of variance, f tests and simple regression were used. Values of $p < 0.05$ were considered statistically significant. 95% confidence interval was calculated for the variable. In addition, parameters such as mean and standard deviation (S.D.) were used for descriptive analysis. Statistical analysis was performed using SPSS v.13.0 for Windows (SPSS, Inc., Chicago, IL, USA).

3. Results

Group 1 consisted of 34 patients. Group 2 consisted of 48 patients. Group 3 consisted of 19 patients. The statistical differences in inspiration and expiration resistance, nasal cavity volume, and minimal cross-sectional area among the mild, moderate, and severe groups of perceived nasal obstruction are presented in Tables 2–4. The difference between the mean value of the objective measure in each of the three nasal obstruction visual analogue scale groups were statistically significant. The three groups were significantly different for the objective parameters of right nostril inspiration and expiration resistance, but not for left nostril resistance. Each regression coefficient (β) data was shown in the Tables 2–4. A positive estimate of beta [β] showed that increasing in resistance was associated with an increase in nasal obstruction visual analogue scale. The association between nasal obstruction visual analogue scale and inspiration right mean resistance ([β] = 0.74; 95% CI: 0.27–1.21) and expiration right mean resistance ([β] = 0.95; 95% CI: 0.26–1.64) showed that a increase in inspiration right mean resistance and expiration right mean resistance of 1 cm^3 corresponded to an increase in nasal obstruction visual analogue scale of 0.74 and 0.95 points. Nasal cavity volume and the perception of left nasal obstruction were significantly different among the mild, moderate, and severe groups, showing significant differences at distances between 0–3.3 cm and 2–4 cm. A negative estimate of beta [β] showed that decreasing in nasal cavity volume was associated with an increase in nasal obstruction visual analogue scale. The association between nasal obstruction visual analogue scale and 0–3.3 cm left nasal cavity volume ([β] = −0.19; 95% CI: −0.34 to −0.03) and 2–4 cm left nasal cavity volumn ([β] = −0.25; 95% CI: −0.47 to −0.34) showed that a decrease in left nasal cavity volume of 1 cm^3

Table 2
Rhinomanometric correlations between subjective nasal obstruction and nasal resistance.

Pa cm^{-3} s^{-1}	Mild		Moderate		Severe				
	Mean	S.D.	Mean	S.D.	Mean	S.D.	p-value	[β]	95% CI
Insp L MR	0.863	0.86	1.415	1.84	1.4458	1.37	0.35	0.18	−0.06 to 0.42
Exp L MR	1.187	1.51	2.118	4.12	1.4023	1.24	0.48	0.00	−0.51 to 0.52
Insp R MR	1.055	1.69	1.204	1.55	4.4037	5.12	0.0002	0.74	0.27 to 1.21
Exp R MR	1.077	1.59	1.356	1.81	5.0544	7.89	0.0049	0.95	0.26 to 1.64

Insp = inspiration; Exp = expiration; L = left; R = right; MR = mean resistance; CI = confidence interval; [β] = regression coefficient.