ORIGINAL ARTICLE

Assessment of Nasal Obstruction With Rhinomanometry and Subjective Scales and Outcomes of Surgical and Medical Treatment☆

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KEYWORDS
Rhinomanometry; NOSE scale; Visual Analogue Scale; Chronic rhinitis; Septal deviation; Septoplasty; Turbinoplasty; Nasal corticosteroids

Abstract
Introduction: Prospective study of patients with nasal obstruction (NO) in order to measure therapeutic success by anterior active rhinomanometry (AAR), Nasal Obstruction Symptom Evaluation (NOSE) scale and Visual Analogue Scale (VAS) and to establish the correlation between these tests.

Methods: Patients with NO, on whom we performed an AAR, NOSE and VAS scales at baseline and after medical treatment (topical nasal steroid) or surgery (septoplasty, turbinoplasty or septoplasty and turbinoplasty). The nasal flow obtained by the AAR and the score of both subjective scales (NOSE and VAS) were compared and analysed.

Results: A total of 102 patients were included in the study. Surgical treatment resulted in statistically significant differences with the AAR and the subjective scales. While in patients with medical treatment there was an increase in the AAR nasal flow but without statistical significance (P=.1363). The correlation between the AAR, the NOSE and VAS scales was measured finding a strong correlation between the NOSE and VAS scales only (r=.83327).

Conclusions: The patients with NO treated surgically have better results when these are evaluated by AAR or with subjective scales. There is no significant correlation between AAR, NOSE and VAS scales, this is considered to be because the AAR and subjective scales are complementary and measure different aspects of NO. The AAR and subjective scales are useful tools to be used together for the follow up of patients with NO.

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Evaluación de la obstrucción nasal mediante rinomanometría y escalas subjetivas y medición del éxito terapéutico médico y quirúrgico

Resumen

Introduction

Nasal obstruction (NO) is defined as the discomfort caused by an inadequate air flow or an increase in air flow resistance through the nostrils. One of the most common symptoms, NO can be caused by anatomic malformation, septal deviation or inflammatory processes such as chronic rhinitis.1-2

Objective assessment of the nasal respiratory tract can be useful in clinical evaluation of the NO symptom, for the evaluation of patients with sleep apnoea, for allergen challenge tests, for medical and surgical pre- and post-treatment approach and for nasal physiology research.1-5

Active anterior rhinomanometry (AAR) is an objective examination method for studying the mechanical resistance that the nostrils offer upon being penetrated by the air column during the different phases of breathing. Given that AAR measures nasal flow and pressure gradient that moves air flow during normal breathing, it offers a physiological quantification of nasal permeability. It is the method most often used for investigation and clinical evaluation of nasal flow resistance in breathing.6-8

The AAR procedure allows us to ascertain the relationship between anatomical malformations and their functional repercussion. This reduces both the error of overestimating clear septal deviations (from the anatomical point of view, but in which there are turbinate wall compensations that permit correct flow with nasal cycles within normality) and the error of underestimating specific septal deviations (which impact the valve area and have a strong functional repercussion as the vestibule fossa section varies). In addition, AAR makes it possible to study the effect of nasal hyperreactivity.3,7-11

In AAR, the diagnostic parameters of normality in baseline conditions depending on total nasal flow at 150 Pa of pressure is >700 cm³/s for men and >630 cm³/s for women. Nasal flow below this is classified into various levels of NO (mild, moderate, serious and severe) depending on the reduction in the sum of the flows in both nostrils6 (Table 1).

The Nasal Obstruction Symptom Evaluation (NOSE) scale (Table 2) is a disease-specific questionnaire that serves as an instrument to establish the state of symptoms in patients with NO. It is a sensitive, reliable and validated scale that is quick and simple to complete; Its use with adults with NO has potential in demonstrating adequate results in research

<table>
<thead>
<tr>
<th>Degree of Nasal Obstruction (NO) Among Men and Women.</th>
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<tbody>
<tr>
<td>Degree of nasal obstruction</td>
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<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Normal</td>
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<tr>
<td>Mild obstruction</td>
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<tr>
<td>Moderate obstruction</td>
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<tr>
<td>Serious obstruction</td>
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<td>Severe obstruction</td>
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Source: Fabra.6

Table 1
assessments. The NOSE scale consists of 5 items; each one of them uses a 5-point Likert scale, for a total score ranging from 0 to 100 points. The higher the score, the worse the NO symptoms.

The NOSE scale has been validated for use with groups of patients, not individually. Consequently, it can be used to compare specific health states among patient groups before and after treatment, or to compare the effect of different therapies. It can also be useful for approaching differences in results when various surgical techniques are utilised.

The objective of this study was to evaluate patients with NO by means of AAR, the NOSE scale and the visual analogue scale (VAS). In addition, based on these results, to measure the therapeutic success of the medical and surgical treatment of these patients and establish the correlation among the tests performed.

Methods

This was an analytical cohort study on patients with NO from the outpatient consultations of Otorhinolaryngology. The research protocol has been evaluated and approved by the Ethics Committee at our institution.

A sample of 100 patients allowed us an estimated error not exceeding 0.074 to estimate a correlation coefficient (r) with a 95% confidence interval (CI). To establish sample size, it is assumed that the correlation coefficient must be over 0.80 to be considered significant. The study patients were all those evaluated in the period between 15 November 2012 and 30 November 2013.

The criteria for inclusion were being a patient of over 18 years of age with nasal obstruction symptoms caused by allergic rhinitis, non-allergic rhinitis (vasomotor rhinitis, drug-linked rhinitis or other) or an anatomical defect (septal deviation).

Criteria for exclusion consisted of the presence of any of the following nasal diseases: acute rhinosinusitis, chronic rhinosinusitis with or without polyps, endonasal tumours, septal perforation or persistent adenoids. Septoplasty and turbinoplasty also constituted criteria for exclusion.

All the patients were administered an AAR with Homo09 Rhino4000M equipment, taking into consideration both the absolute numeric results and the categories of NO degree, and classifying them according to gender, because of the different cut-off points that are taken for men and women. As for the subjective evaluation, the patients were administered the NOSE scale (with an evaluation interval ranking from 0 to 100 points) and the VAS, which was evaluated with a 10-cm horizontal line, extrapolating the results with the same numeric interval as that of the NOSE scale (0–100 points). Both scales go from lower to higher degrees of NO symptoms.

The 3 tests (AAR and NOSE and VAS scales) were carried out before beginning each patient’s treatment, whether that was medical or surgical, to be able to have objective and subjective baseline values. After that, a new AAR was performed, and the subjective NOSE and VAS scales were repeated as follow-up at 2 months ± 5 days after treatment.

Patient demographic data and data obtained from the 3 tests were entered into a database and later analysed with the statistical software SPSS 20.0. Data were analysed with descriptive statistics (central tendency and scattering measurements) using parametric or non-parametric methods, depending on the type of distribution of the variables on the demographic characteristics of the patients. Likewise, we calculated the incidence of the proportion of the various aetiologies of nasal obstruction syndrome: allergic rhinitis, non-allergic rhinitis vasomotor rhinitis, drug-linked rhinitis or other types of rhinitis) and septal deviation.

The criteria for surgical treatment were as follows: severe septal deviation confirmed in the physical examination with nasal endoscopy or patients with a history of NO with an evolution of more than 6 months with persistent symptoms despite medical treatment of at least 4 weeks that included topical nasal corticoids (fluticasone at 55 μg in each nostril once a day or mometasone – 100 μg – in each nostril once a day) together with hypertonic nasal washes and oral antihistamines in the case of allergic rhinitis.

The correlations (Spearman correlation test) existing between the subjective tests (NOSE and VAS scales) and the objective test (rhinomanometry) were determined, as well as the correlation between the 2 subjective tests. Likewise, we measured the therapeutic medical and surgical success using analytical statistics (Student t-test) at 2
Results

The sample size analysed in the time period established consisted of 102 patients. Of these, 61.8% (63/102) were men and 38.2% (39/102) were women. Mean age was 44.89 ± 5.1 years. The incidence of nasal obstruction syndrome classified by aetiology was as follows: 62.7% (64/102) of the cases were caused by different variations of chronic rhinitis; allergic rhinitis was the most frequent, with 44%. Septal deviation was the diagnosis in 21.6% (22/102) and, lastly, the mixed cases—diagnosed with both chronic rhinitis and septal deviation—were 15.7% (16/102).

Within the patients with chronic rhinitis, the patients that received medical treatment with nasal corticoids had for baseline AAR results a mean of overall nasal flows of 619 ± 9 ml/s and of 652 ± 18 ml/s for the females and males, respectively. The patients in the group of chronic rhinitis that underwent turbinoplasty had mean overall flows of 590 ± 11 ml/s for females and of 630 ± 15 ml/s for males as baseline AAR results. In the case of the patients with septal deviation, who consequently required septoplasty as treatment, the women had an overall nasal flow of 553 ± 15 ml/s and the men, 627 ± 19 ml/s. Lastly, the patients with mixed disease (septal deviation along with chronic rhinitis), who were treated with septoplasty and turbinoplasty, had an overall flow of 492 ± 17 ml/s (females) and of 577 ± 20 ml/s (males).

As for the subjective tests administered, the results obtained from the patients with chronic rhinitis that received medical treatment with nasal corticoids were a mean of 42 ± 3 points on the NOSE scale and 46 ± 4 points on the VAS; the patients with chronic rhinitis that received surgical treatment with turbinoplasty had a mean of 48 ± 4 and 52 ± 5 points on the NOSE and VAS scales, respectively. In the patients with septal deviation that had a septoplasty, the NOSE scale results were a mean of 53 ± 5 points and the VAS results, a mean of 60 ± 4 points. Lastly, in the mixed diseases, the NOSE questionnaire yielded baseline results with a mean of 45 ± 4 points, while the mean for the VAS was 55 ± 3 points. Both the baseline data mentioned and the results obtained after treatment are shown in detail in Table 3, classified by aetiology and treatment given.

Turning to type of treatment, 56.9% (58/102) of the patients received surgical treatment (septoplasty, turbinoplasty or septoturbinoplasty). In contrast, 43.1% (44/102) of the patients chose medical treatment with topical nasal corticoids (fluticasone at 55 μg in each nostril once a day, or mometasone—100 μg—in each nostril once a day) together with hypertonic nasal washes and oral antihistamines for cases of allergic rhinitis.

In the group of patients that underwent surgical treatment, statistically significant differences were found in both the AAR results (P < .001) and the NOSE and VAS scales (P < .001) in the pre-treatment and after treatment tests. In contrast, in the group of patients that chose medical treatment, there were statistically significant differences in only the subjective tests, and in a much more reduced way: in the NOSE questionnaire (P = .011) and in the VAS (P = .0019); there

Table 3: Classification by NO Aetiology and Treatment Performed, Baseline Results and Results After Treatment for AAR and the NOSE and VAS Scales.

<table>
<thead>
<tr>
<th>NO aetiology, Total</th>
<th>N=102</th>
<th>AAR: active anteroposterior rhinomanometry; CR: chronic rhinitis; F: female; M: male; NO: nasal obstruction; NOSE: Nasal Obstruction Symptom Evaluation scale; SD: standard deviation, SepD:</th>
<th></th>
<th>Baseline</th>
<th>AAR after treatment</th>
<th>Baseline NOSE</th>
<th>NOSE after treatment</th>
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<td>CR n=64</td>
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<td>Medical Tx, n=44</td>
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<td>Surgical Tx, n=58</td>
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<td>Septoplasty, n=22</td>
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<td>Septoturbinoplasty, n=16</td>
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<td>Mixed pathology: CR+sepD n=16</td>
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months ± 5 days of follow-up, using the results of AAR and of the 2 subjective scales: VAS and NOSE.
were no significant differences in the AAR results: $P=.1363$ (Fig. 1A–C).

Another of the statistics analysed was the correlation between rhinomanometry and the 2 subjective scales, with a very weak correlation between the results of the sum of rhinomanometry flows and the score on the NOSE scale ($r=0.07100$) and on that of the VAS ($r=0.09126$). However, there was a strong correlation between the 2 subjective tests: the NOSE and VAS scales ($r=0.83327$) (Fig. 2A and B).

**Discussion**

Consensus is growing as to the need for objective evaluation of patients with NO.\textsuperscript{1,3,16} The Committee for International Standardization and Objective Evaluation of Nasal Air Flow recommends performing AAR in the clinical approach for NO.\textsuperscript{6} However, NO must be considered as a multifactorial concept incorporating physical, mental and social patient conditions. Consequently, patient evaluation should be modified, and the tradition way of handling it should change towards a more integrated approach that includes measurement by quality of life scales such as the NOSE and VAS.\textsuperscript{12,15,16}

The objective AAR test and the subjective NOSE and VAS scales are useful tools for evaluating the medical and postoperative treatment of the patients with NO. This study show a statistically significant difference in the subjective (NOSE and VAS scales) and objective (AAR) results in patients treated surgically with respect to the others treatment medically. This is considered to be due to the fact that medical treatment depends on patient adherence and correct application of the topical nasal steroid, as well as to patient group differences: most patients under medical treatment are patients with a diagnose of chronic rhinitis, which is a disease with fluctuating exacerbations that vary depending on environmental setting and clinical state of the patient;
in contrast, the cases that receive surgical treatment correspond to patients with an anatomical defect corrected with a surgical procedure that is independent from these variables.

It has been demonstrated that there is no statistically significant correlation between the objective test (AAR) and the subjective tests: NOSE and VAS scales. We consider this to be due to the fact that AAR and the subjective scales are complementary and measure different aspects of obstructive nasal syndrome. Turning to another point, the temporality of the tests can also be considered an important factor, because the subjective scales refer to the symptoms over the last 4 weeks while AAR is a test that tells us about nasal flow at a specific moment. These results agree with those obtained by Yepez-Nuñez et al.\textsuperscript{2} and Lam et al.\textsuperscript{17}

There is strong correlation between the 2 subjective scales (NOSE and VAS). Because of this, either of them can be used to subjectively measure the degree of impact provoked by NO. In spite of this, the NOSE scale is preferable to the visual scale because it is a disease-specific, reliable and validated instrument.

Study strengths are the sample size, the cut-off point established to determine a positive correlation coefficient (>0.8), as well as the evaluation of the medical and surgical treatment using an objective tool and 2 subjective scales about NO that have not been published in the literature before. The study limitation is the short-term follow-up that the patients had.

Conclusions

The patients with NO surgically treated have better results when these are evaluated using AAR or with subjective scales.

There is no statistically significant correlation between AAR and the NOSE and VAS scales. This is considered to be due to the fact that AAR and the subjective scales are complementary and measure different aspects of NO.

The subjective scales and AAR are useful tools to use jointly in the diagnosis and follow-up of patients with NO, given that an objective evaluation along with the feeling of patient satisfaction are obtained in this manner.

Conflict of Interests

The authors have no conflicts of interest to declare.

References