

Rhinomanometry, sinus CT-scan and allergy testing in the diagnostic assessment of chronic nasal obstruction†*

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SUMMARY

In order to assess how effective a combination of diagnostic methods, each addressing specific aetiopathogenic aspects, would be in uncovering the cause of common chronic nasal obstruction, we evaluated 45 consecutive adult subjects. They were submitted to rhinomanometry testing, sinus CT-scans and RASTs to prevalent allergens. Most, but not all, patients ended up showing abnormal results in at least one of the diagnostic procedures. Sinus pathology was, by far, the most frequent diagnosis, while allergy took second place, with a number of atopic subjects displaying sinusitis as well. On the other hand, septal deviations with a significant effect on nasal resistance were only seldom found to be the cause of chronic nasal obstruction.

Key words: chronic nasal obstruction aetiopathogenesis, rhinomanometry, sinus CT-scans, allergy testing

INTRODUCTION

Rhinomanometry is the method of recommendation in the assessment of nasal resistance, both in clinical practice and research (Clement, 1984). However, rhinomanometric results have been shown to correlate poorly to the overall complaint of chronic nasal obstruction (Naito et al., 1988), a possible reason which may, ultimately, have prevented the procedure from attaining a wider clinical use.

There are reasons to believe that, at least in the adult population, rhinomanometry addresses mainly the anatomical and physiological aspects of the anterior one-third of the nasal cavity (Haight and Cole, 1983; Cole et al., 1988; Chaban et al., 1988). In fact, a good correlation has been found between rhinomanometric data and stenotic lesions of the anterior nose, such as septal deviations (Broms et al., 1982; Jessen and Malm, 1984). Other causes of nasal obstruction do not seem to correlate as well to the results of rhinomanometry.

Sinus CT-scans are widely employed as an imaging method to diagnose sinonasal and nasopharyngeal disease, which commonly cause chronic nasal obstruction. Usually, middle meatal and other sinus inflammatory pathology, in spite of causing subjective complaints of obstruction, seldom increase nasal resistance, unless they produce important mechanical impairment (i.e. nasal polyps). CT-scans, however, frequently depict septal deformities which require judgement regarding its functional significance.

Rhinomanometry was found to be valuable in that circumstance (Broms et al., 1982; Jessen and Malm, 1984). As such,

there seems to exist a rationale for the diagnostic combination of both methods.

Nasal allergy, on the other hand, is another common cause of chronic nasal obstruction. But, as we know, allergic rhinitis can co-exist, or not, with simultaneous sinus disease and/or increased nasal resistance.

In order to assess the diagnostic value of a combination of these three specific methods, each addressing a particular aspect of chronic nasal obstruction aetiopathogenesis, we set up the present clinical investigation.

MATERIAL AND METHODS

Forty-five consecutive adult subjects, referred to our clinic for rhinomanometry, were enrolled in the study. They were sent in by several ENT clinicians while under investigation for complaints of chronic nasal obstruction. Their mean age was 35.3 years (range: 13-72 years), 21 being males and 24 females. Recent upper respiratory infections, history of nasal trauma and smoking habits were not considered as exclusion criteria. No patient had previously undergone nasal surgery.

To establish if, as a group, they were representative of the overall characteristics of the subjects usually sent in for this type of examination, they were compared with the 240 preceding patients, over 12 years of age, also submitted to the same diagnostic procedure. For the parameters age, sex, height, rhinomanometric diagnosis, and total nose resistance at the 150-Pa pressure point, no statistically significant difference was found,

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making, in fact, the study population a representative sample of the subjects usually referred to our clinic for rhinomanometry. The active anterior rhinomanometric technique was employed, with all International Standardization Committee requirements fulfilled (Clement, 1984). Data were collected with the subjects in the sitting position for both the untreated and decongested nose states. The equipment used was Rhino-Comp (Cintec, Sweden). The normative criteria employed throughout the study were the following: (1) for the untreated nose, values of the total nose resistance at the 150-Pa pressure point (R_{150}) up to 0.25 Pa/cm³/s (Cole, 1987); and (2) after decongestion, the reference values, according to patients' body heights, for individual nasal cavities' resistances at the radius-2-circle interception (Broms, 1982; Jessen and Malm, 1988). Basically, all the results would fit in one of the following rhinomanometric patterns: (A) *normal*, with normal total nose R_{150} resistance in the untreated nose state, and normal individual cavities' resistances after decongestion; (B) *skeletal stenosis*, with increased nasal resistance in individual nasal cavities after decongestion; and (C) *hypertrophy of the mucosa/secretions*, with increased total nose resistance (R_{150}) in the untreated state, but normal individual resistances after decongestion.

After rhinomanometry, patients' permission was obtained for their study enrolment, which included subjects to be in addition submitted to sinus CT-scans and RAST tests to prevalent allergens. These further diagnostic procedures would have to be performed, in order to allow study admission, immediately during the following weeks, up to no more than 2 months, after rhinomanometry, as all the examinations and tests took place during the late fall or early winter months. The investigators did not initiate or change previous medical treatment prior to any examination.

Table 1. Sinus CT-scan abnormalities

	number of patients
normal (no sinusitis; no anatomical abnormalities)	10
anatomical abnormalities with no sinusitis (i.e. concha bullosa)	10
ethmoidal sinusitis with or without pathology in the dependent sinuses (maxillary; frontal)	23
sinusitis in the dependent sinuses without ethmoidal pathology	2
isolated posterior ethmoid and/or sphenoid sinus pathology	0
diffuse polypoid disease (pan-sinusitis)	0
other	0

Coronal sinus CT-scans were performed according to standardized requirements (Zinreich et al., 1987). Table 1 illustrates the classification used to define the sinus pathology encountered.

The septal abnormalities found on the scans were addressed separately, and classified as anterior deviations, if occurring in the anterior one-third of the nose (and including the nasal vestibule and the nasal valve), and posterior deviations, if occurring in the caval portion of the nasal cavity, posterior to the piriform aperture.

Allergy testing employed the 5-classes-modified RAST (Nalebuff, 1994) to prevalent allergens causing perennial symptoms, namely house dust and house-dust mites. In spite of the fact that class 1 already represents a low-level positive score, the criteria used in the study considered the patient as non-allergic

if the RAST levels were all up to, and including, class 1, and allergic if the scores were class 2 and above.

In the statistical analysis the following tests were employed: the chi-square test, the t-test, and the Kruskal-Wallis test. For all tests the significance level was set at <0.05.

RESULTS

As expected, most patients displayed abnormal results in at least one of the diagnostic procedures; only five subjects (11.1%) failed to display abnormal results in at least one of the diagnostic procedures.

Regarding the rhinomanometric results, 39 subjects (86.7%) showed a normal pattern, three subjects (6.7%) had skeletal stenosis, and three subjects (6.7%) had mucosal hypertrophy/secretions. Abnormal patterns were found to be more common amongst young people, albeit with no statistical significance, and there were no sex differences in pattern distribution. No relation was found between rhinomanometric patterns and presence or absence of CT-scan abnormalities (or specific sinus pathology, for that matter), and presence or absence of allergy. In only one patient did an abnormal rhinomanometric result (skeletal stenosis pattern) come forward as the only anomaly in the battery of diagnostic procedures.

Sinus abnormalities were found in 35 (77.8%) subjects. (Table 1 shows how they were distributed with regard to the different types of sinus pathology.) More than half of the study population, i.e. 23 subjects (51.1%), displayed an ethmoidal sinusitis pattern, with or without pathology in the dependent (maxillary, frontal) sinuses. In 23 subjects, sinus abnormalities were the only anomaly encountered in the three tests' results. No age differences were found in the distribution of the sinus pathology. Anatomic sinus abnormalities with no sinusitis (i.e. concha bullosa) were more common in females, while ethmoidal sinusitis, with or without dependent sinus pathology, was more frequently found in males.

Regarding septal deviations, 25 (55.5%) patients showed some type of nasal septum deformity on their sinus scans. Twenty of those (44.4%) were of the posterior type, all with normal rhinomanometric results except one, who revealed a mucosal hypertrophy/secretions pattern. Anterior deformities were diagnosed in five (11.1%) subjects, being three of them the patients who displayed a skeletal stenosis pattern on rhinomanometry. Of the other two, one had normal results, while the other had a mucosal hypertrophy/secretions rhinomanometric diagnosis.

Allergy was diagnosed in 13 (28.9%) subjects. It was significantly more common in young people ($p=0.03$) and in males ($p=0.05$). Allergic rhinitis more often than not would display a normal rhinomanometric pattern; 11 subjects had a normal pattern, while only two showed a hypertrophy of the mucosa/secretions pattern. Although statistically the association is weak between the variables allergy and CT-scan abnormalities, eight out of the 13 subjects (61.5%) with allergic rhinitis were associated with a particular type of sinusitis: ethmoidal disease (with or without dependent sinus pathology). In 30.7% of the cases, allergy did not co-exist with CT-scans or rhinomanometric abnormalities.

DISCUSSION

Although no patients with nasal polyposis were involved in the study – probably because the referring otolaryngologists did not regard rhinomanometry as a diagnostic option in that type of pathology – we can otherwise accept that this population constitutes a fairly representative cross-section of patients in ENT outpatient clinics with the complaint of chronic nasal obstruction. Pre-selection by the referring clinicians assured that atypical or less frequent causes of chronic nasal obstruction were eventually ruled out, leaving out the patients with the commonest form of a symptom which, in spite of being one of the most frequent in everyday practice, still keeps puzzling otolaryngologists everywhere.

The combination of rhinomanometry, sinus CT-scan and allergy testing was able to uncover chronic nasal obstruction etiopathogenesis in the vast majority (almost 90%) of the patients.

Since most subjects ended up with normal rhinomanometric results we can safely assume that the method does not seem to fully address the overall symptom chronic nasal obstruction. The results from rhinomanometry certainly failed to relate to the pattern of recurring or alternating (from one side to the other) nasal obstruction. Sinus pathology and nasal allergy also did not relate to abnormal rhinomanometric patterns, supporting the hypothesis that the method underestimates pathology that does not cause skeletal or mucosal stenosis of the anterior nose (Haight and Cole, 1983; Cole et al., 1988; Chaban et al., 1988). On the other hand, in all but one subject the imaging diagnosis of anterior septal deviation (corresponding to the subjective complaint of unilateral persistent obstruction) had rhinomanometric confirmation that the condition significantly affected the nasal resistance.

As expected, most anterior septal deviations carried a rhinomanometric diagnosis of skeletal stenosis. In a further patient, we can probably accept the hypothesis that the septal deformity did only disturb nasal resistance in the undecongested state (Cole et al., 1988; Chaban et al., 1988), as decongestion brought previously increased resistance values within normal range. Rhinomanometry was, however, unable to detect alterations in nasal resistance in one case of anterior septal deformity. This may be due to the fact that the plane by plane reconstruction of the nasal cavity processed by CT-scanning has shortcomings in asserting how the nasal valve, a dynamic three-dimensional segment of the nasal airway (Haight and Cole, 1983), is affected by certain anatomical deformities of the anterior nose. Therefore, the need for a simultaneous functional assessment, such as that provided by rhinomanometry. However, it should be kept in mind that it addresses essentially one particular aspect of the multifactorial chronic nasal obstruction aetiopathogenesis, the functional morphology of the anterior nose. Failure to recognise this can only lead to significant frustration of researchers and clinicians alike and undeserved discredit of the method. The fact that most patients in our study had normal rhinomanometric results and that septal deformities were detected in more than half of the subjects, should be regarded as proof that stenotic lesions that significantly affect nasal resistance are in fact not so common. As it has been shown that unnecessary septal surgery can be avoided when rhinomanometry is used (Jessen et al.,

1989), the most important clinical contribution of the method may well be helping us to differentiate the septal deviations that have a functional significance from those that have not.

Sinus pathology was the single most frequent diagnosis in this population. There were no differences in age distribution, which stresses the fact that it must be suspected as a frequent (or most common) cause of chronic nasal obstruction in both young and old. Due to the fluctuations that the inflammatory processes affecting the sinus mucosa may display on CT-scans (Gwaltney et al., 1994), there may be reasons to believe that at least some of the subjects with negative results in this combination of diagnostic methods may eventually suffer from recurring sinusitis.

Allergy was the second most common diagnosis in this population. Allergic rhinitis was shown to cause chronic nasal obstruction *per se*, but not rarely it was associated with a specific pattern of sinus pathology: ethmoidal disease with or without (most frequently with) involvement of the dependent sinuses. Eventually this may lend support to the theory that allergy may in some way influence the pathogenesis of that particular type of sinusitis (Slavin et al., 1988).

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