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# Rhinomanometric detection rate of rhinoscopically-assessed septal deviations

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SUMMARY

*Normal values for the flow at a transnasal pressure of 150 Pa were established with active anterior rhinomanometry (with decongestion) in a group of 33 normal subjects. These values were used to detect abnormalities in a group of 193 patients whose septum anatomy had been evaluated with rhinoscopy. About 25% of the rhinoscopically normal patients were found to have significantly low ("abnormal") flow values on one side. The same was true for patients with a small septal deviation restricted to one anatomical area. An abnormal flow was measured in about 35% of the patients with a moderate (restricted) septal deviation. In the patients whose septal deviation was not restricted to one anatomical area, about 45% had an abnormal flow. The highest detection rate was about 80% in patients with major deviations in the region of the vestibule and the valve. Such deviations were found only in a minority of the patients with complaints of nasal obstruction, which limits the importance of rhinomanometric evaluation in clinical practice.*

## INTRODUCTION

The development of new measuring devices over the past few years illustrates the renewed interest in methods of rhinomanometry. There is a variety of measuring procedures, most of which employ the simultaneous measurement of transnasal pressure and volume flow (Masing, 1967; Enzmann, 1983; Clement and Hirsch, 1984). Active anterior rhinomanometry has been recommended as a standard because it is the most "physiological" method (Clement, 1984).

This paper is on the correlation between rhinomanometric and rhinoscopical parameters, which was previously reported as being generally rather poor (McCaffrey and Kern, 1979; Czernic, 1981; Hardcastle et al., 1988). The present study showed that it is only possible to detect septal deviations satisfactorily in the case of substantial deviations in the flow-limiting part of the nasal passage. As has already been elaborated on by others, there is a plausible theoretical explanation for this observation.

## MATERIAL AND METHODS

Rhinomanometry was performed on two groups of subjects. One group consisted of 19 men (aged 24–67 years) and 14 women (aged 21–44 years) without nasal symptoms, with normal rhinoscopical examination results, and a negative history for any pathology of the nasal and paranasal cavities or nasal allergy. The other group comprised 193 patients with symptoms of nasal obstruction who were referred by ENT-specialists. For evaluating the septal deviation(s), one of the authors (RW) performed anterior- and posterior rhinoscopy before and after rhinomanometry. The site of the septal deviation was classified according to Kern (1980): area 1 (vestibule); area 2 (valve); area 3 (anterior-superior portion); area 4 (central portion); and area 5 (posterior portion) as well as to the size as small, moderate or large without total obstruction. After an acclimatization period of about 30 min, and 10 min after the insufflation of a 0.1% aqueous solution of xylometazolin.HCl, active anterior rhinomanometry was performed with the patient in a comfortable sitting position. The pressure probe was fixed to the nostril with adhesive tape, and an adapted "Panorama Nova" breathing protection mask (Drägerwerk AG, Lübeck) was used. The pneumotachygraph was calibrated at regular intervals. At least 10 closely similar rhinograms were X-Y recorded. For each nostril, the mean flow (l/s) was read from the rhinograms at a pressure of 150 Pa, as reported previously (Postema et al., 1980).

## RESULTS

In the normal subjects, the unilateral flow had a log-normal distribution. Normal values were obtained by interpolating the 5 and 95 percentiles in a probit analysis. Pooling of the data was permitted (according to the appropriate Student's t-tests) for inspiration and expiration, but not for the sexes. The lower confidence limit for the flow was 0.40 l/s for men and 0.30 l/s for women.

In the patients, the "detection rate" (percentage) for each parameter was defined as the number (percentage) of observations with abnormal flow values in proportion to the total number of observations. It appeared that pooling of the detection rate values was permitted for inspiration and expiration and for both sexes. Average values for inspiration and expiration were used (hence the decimal fractions of 0.5 in the figures). Of all the patients with normal rhinoscopy, 24% (24.5/100) had significantly low flow values (false positives). The detection rate for the group of patients whose septal deviation involved several areas, was 43% (58.5/135). The detection rates and percentages for the deviations restricted to one anatomical area are presented by site and size in Table 1. Analysis of the data

Table 1. The detection rate (indicated as a fraction) and percentages (indicated only for $n > 4$) for the flow by site and size of septal deviation. The mean for inspiration and expiration is presented.

| | size | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| site | small | | moderate | | large | | total | |
| area 1 | 3 /16 | (19%) | 3.5/16 | (22%) | 6.5/ 8 | (81%) | 13 /40 | (30%) |
| area 2 | 10.5/31.5 | (33%) | 4 /10.5 | (38%) | 1.5/ 2 | | 16 /44 | (36%) |
| area 3 | 2.5/21 | (12%) | 2 / 3 | | | | 4.5/24 | (19%) |
| area 4 | 2 / 8.5 | (24%) | 1 / 3 | | | | 3 /11.5 | (26%) |
| area 5 | 0.5/ 7 | (7%) | 2.5/ 4 | | 0 /0.5 | | 3 /11.5 | (26%) |
| total | 18.5/84 | (22%) | 13 /36.5 | (36%) | 8 /10.5 | (76%) | 39.5/131 | (30%) |

presented in this table ($X^2$ tests at a level of significance of $p = 0.05$) showed that size had a significant effect on the detection rate. The average detection rates of small, moderate and large deviations were 22%, 36% and 76%, respectively. Site did not have any significant effect (see row totals in Table 1). However, it should be noted that the high detection rate for large deviations was mainly due to area 1 (vestibule).

## DISCUSSION

In the patients with symptoms of reduced nasal patency, septal deviations restricted to one anatomical area, not unexpectedly, were predominantly found in the anterior areas. Areas 1–3 covered 82% and areas 1–2 covered 64% of the total number of observations (Table 1).

The site of the deviation had no significant influence on rhinomanometric detectability, whereas the size had. However, the significant effect of size was mainly due to the high detection rate of large deviations, the latter being found almost exclusively in the region of the vestibule and the valve (areas 1–2). Therefore, it can be concluded that substantial septal deviations in the region of the vestibule and the valve can be detected in most instances (80%).

A major part of the total nasal airflow resistance has been localized to the bony cavum in the vicinity of the piriform aperture by Haight and Cole (1983). This is the narrowest part of the nasal passage, i.e. the "isthmus nasi" (Bachmann and Legler, 1972). Following the approach favoured by Warren (1984), O'Neill and Tolley (1988) and Rivron (1990), we can utilize Bernoulli's equation to calculate the smallest effective cross-sectional area (A) for the present flow and pressure data. This applies to the physical model of a flow through an orifice. Using a value for the "discharge coefficient" (which accounts for nonuniformity of flow) of $k = 0.64$–$0.66$, as has been obtained from measurements on analogous models of the nasal passage by Warren (1984) and Rivron (1990), we arrived at a normal value of $A > 40$ $mm^2$ for men and $A > 30$ $mm^2$ for women. These values are in line with one particular measurement presented by Masing (1967) and the statistics on measurements in the valve area reported by Hardcastle et al. (1988). It seems likely that the clinical experience of the evaluating rhinologist favours his recognition of the deviations in this particular region, which usually lead to symptoms of nasal obstruction and, therefore, he may show the tendency to evaluate them as "large". Such a bias in the rhinoscopical evaluation may explain at least part of the significant size effect pertaining to this region.

The present data suggest that minor deviations may defy rhinomanometric detection as the detection rate (22%) was very similar to the percentage of false positives (24%). Other studies have also demonstrated discrepancies of this kind between rhinomanometric and rhinoscopical findings (McCaffrey and Kern, 1979; Czernic, 1981; Hardcastle et al., 1988). Although the results reported by Nicklasson and Sundén (1982) might suggest the existence of a close correlation between rhinomanometric and rhinoscopical assessments, it is impossible to compare them directly to the present results, because these authors did not specify any predefined rhinoscopical parameters. O'Neill and Tolley (1988) have argued that according to the concept of flow through an orifice (see above), it is because of the relatively large cross-sectional area of the nasal vault that septal deviations at this location hardly contribute to the overall nasal resistance, unless they are exceptionally large. This is in keeping with the findings reported by Haight and Cole (1983).

We conclude that only major deviations in the flow-limiting segment of the nasal passage can be detected reliably using rhinomanometry. Such deviations are found in only a minority of patients with complaints of nasal obstruction and these are obvious at rhinoscopical inspection. "What you see is what you get" is not an appraisal of the correlation between rhinoscopical and rhinomanometric assessments.

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