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Anterior and posterior rhinomanometry

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SUMMARY

Three rhinomanometric techniques for detection of transnasal pressures were compared by computer aided plethysmographic rhinomanometry. Mean unilateral resistances were measured in the decongested nose of an experienced subject by traditional anterior (sealed anterior catheter) and posterior (perorally by mouthpiece) rhinomanometry and also by a fine catheter inserted pernasally to the nasopharynx. No significant differences in magnitude ($N=25$, $p=73$, mean $Rn=0.345$ $Pa/cm^3/sec$) were found. Dimensions of an #8F catheter were adequate for conduction of transnasal pressures and the catheter placed along the floor of a decongested nasal cavity was found not to increase resistance to airflow significantly. Posterior pernasal catheter measurements were less variable than either traditional posterior (peroral) or anterior rhinomanometry. In 35 consecutive patients untreated by decongestant there were no significant differences in magnitude or variation between resistances of the combined nasal cavities immediately following insertion of the catheter and those obtained 5 minutes later (initial mean $Rn=1.66+0.49$, 5 min mean $Rn=1.70+0.50$) and in these naive subjects posterior rhinomanometric resistances averaged 9% greater than those in whom resistances were measured pernasally.

INTRODUCTION

The investigations described in this presentation were undertaken in order to determine and compare the reliability of common alternatives in rhinomanometric technique.

The International Committee on Standardization of Rhinomanometry recommends that nasal patency be expressed as resistance to respiratory airflow and determined from the ratio between concomitant measurements of transnasal pressure and flow of respiratory air. Transnasal airflow measurement by facial masking and by body plethysmography has been examined previously (Cole et al., 1988) and the investigations described below are concerned with different methods of transnasal pressure measurement.

METHODS

Subjects: Healthy volunteer laboratory personnel and consecutive referred patients in the course of clinical assessment of nasal disease in whom no obstructive pathology had been detected.

Experiments:

1. Comparisons between anterior and posterior rhinomanometry and a posterior pernasal catheter method:

The nasal cavities of a healthy subject were decongested by topical application of 0.1% xylometazoline spray. A fine catheter (Infant Feeding Tube #8F) was placed with its tip in the left nasal vestibule and secured in position by adhesive tape which occluded the nostril (anterior rhinomanometry). Unilateral nasal airflow resistances were obtained by computer assisted plethysmographic rhinomanometry (Cole et al., 1988) in consecutive groups of five measurements to a total of 25 in each experiment. Values which exceeded the mean of each group of five measurements by a coefficient of variation $> 5\%$ were rejected and repeated. Unilateral resistance values were obtained by:

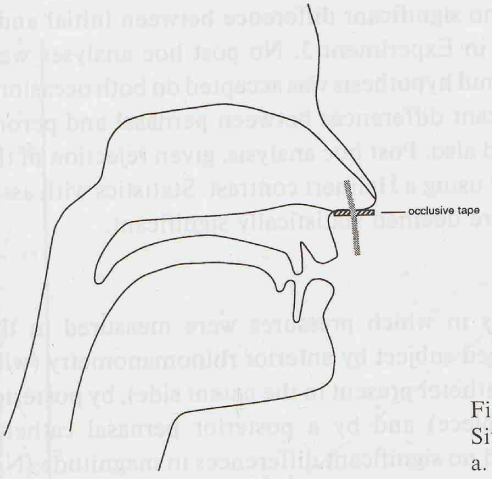
(i) anterior rhinomanometry (Figure 1a);
(ii) as (i) with a pernasal catheter lubricated with lidocaine gel inserted 8 cm in the patent side to determine if its presence alters resistance;
(iii) posterior rhinomanometry (via a mouthpiece) (Figure 1b);
(iv) via a pernasal catheter to the nasopharynx inserted as in (ii) (Figure 1c).

2. Effect on resistance of duration of nasal catheterization:

Thirty five consecutive patients with unremarkable clinical findings were tested. They breathed through the combined nasal cavities while averaged nasal resistance measurements were made by pernasal catheter immediately following insertion and again 5 minutes later as the catheter remained in situ.

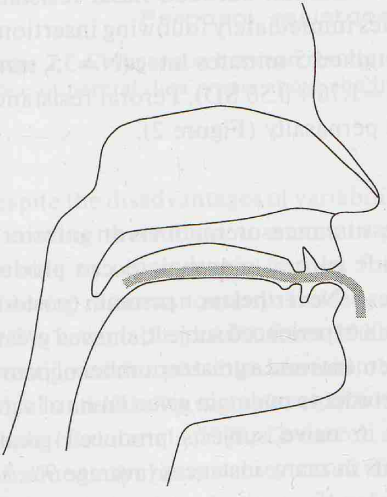
3. Comparison between resistances measured by traditioal posterior rhinomanometry and those in which transnasal pressures were detected by means of a pernasal catheter inserted 8 cm to the nasopharynx:

The same 35 patients as in Experiment 2, whose noses had been treated by decongestant were tested. They breathed through the combined nasal cavities while five measurements were averaged from both peroral and pernasal methods in each case and results diverging by a coefficient of variation from the mean of five measurements by $> 8\%$ were rejected and repeated. (The subjects were clinic patients undergoing rhinomanometric tests in which an 8% coefficient of variation was accepted).

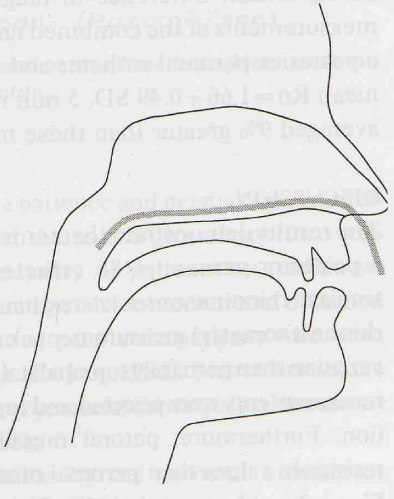


1a.

Figure 1.
Site of pressure detection tubing:
a. anterior rhinomanometry;
b. posterior rhinomanometry;
c. pernasal rhinomanometry.



1b.



1c.

Statistical analysis:

A repeated measures analysis of variance was applied to test the nul hypothesis of no significant differences (Cary, 1982) between the results of Experiment 1, i–iv as well as the nul hypothesis of no significant difference between initial and 5 minutes pernasal measurements in Experiment 3. No post hoc analyses were required for these two tests as the nul hypothesis was accepted on both occasions. The nul hypothesis of no significant differences between pernasal and peroral results of Experiment 2 was tested also. Post hoc analysis, given rejection of the nul hypothesis, was accomplished using a Helmert contrast. Statistics with associated p-values of 0.05 or less were deemed statistically significant.

RESULTS

Mean unilateral nasal resistances in which pressures were measured in the decongested nose of an experienced subject by anterior rhinomanometry (with and without a posterior pernasal catheter present in the patent side), by posterior rhinomanometry (with a mouthpiece) and by a posterior pernasal catheter (Experiments 1 (i) to (iv) exhibited no significant differences in magnitude ($N=25$, $p=0.73$, mean $Rn=3.45$ to 3.50). Thus, the dimensions of an #8F catheter were adequate for conduction of transnasal pressures and the presence of a catheter, lubricated with lidocaine gel and placed along the floor of a decongested nasal cavity, did not increase airflow resistance significantly. Posterior pernasal catheter measurements were less variable than either anterior or posterior rhinometric measurements. Naive subjects untreated by decongestant demonstrated no significant difference in magnitude or variation between nasal resistance measurements of the combined nasal cavities immediately following insertion of a posterior pernasal catheter and those obtained 5 minutes later ($N=35$, initial mean $Rn=1.66+0.49$ SD, 5 min mean $Rn=1.70+0.50$ SD). Peroral resistances averaged 9% greater than those measured pernasally (Figure 2).

DISCUSSION

The results demonstrate that transnasal pressure measurement via an anterior or a posterior pernasal #8F catheter or a wide peroral mouthpiece can produce similar rhinomanometric resistance values. Nevertheless, peroral (posterior rhinomanometry) measurements, even with an experienced subject, showed greater variation than pernasal (suprapalatal) measurements and a greater number of peroral measurements were rejected and repeated in order to maintain given limits of variation. Furthermore, peroral measurements in naive subjects produced greater resistance values than pernasal measurements in many instances (average 9%, see Figure 2 and Jones et al., 1987). These differences of magnitude and variation are not surprising when mobility of the tongue, palate and pharyngeal wall and the effects it might have on patency of the palato-pharyngeal aperture are considered.

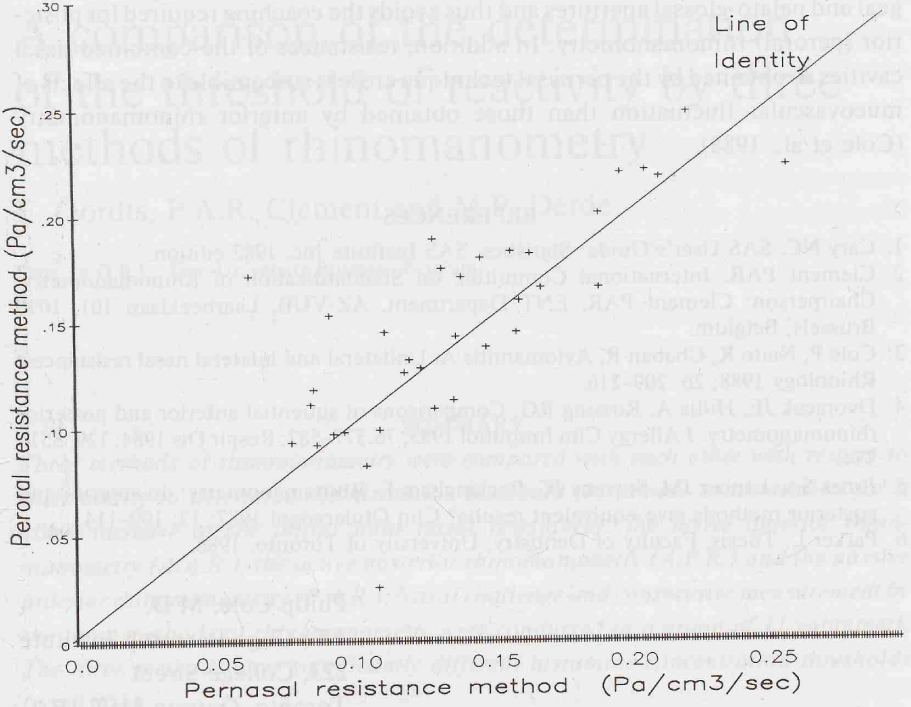


Figure 2. Comparison between results of peroral and pernasal methods. Note predominance of peroral data points above the line of identity.

Despite the disadvantages of variability and the patience and persuasion required in coaxing the subject to maintain patency of the palato-glossal aperture it is possible to obtain useful results from the majority of patients by traditional posterior rhinomanometry. Indeed, a skilled and persistent technician obtained >98% acceptable results from 1000 consecutive paediatric patients who were investigated for possible adenoid obstruction (Parker, 1986). Nevertheless the risk of unreliability is greater than with posterior pernasal supra-palatal measurements (Cole et al., 1988; Dvoracek et al., 1985).

Infrequent spurious values result from irritation by the pernasal catheter or lubricant (as occurs occasionally also with topical decongestant) but these are minimized by insertion of the catheter without hesitation along the floor of the nose and obtaining the measurements without undue delay.

It is concluded that in airflow resistance measurements of the nasal cavities, pressure detection by a fine pernasal catheter (# 8F Infant Feeding Tube) passed along the floor of the nose to the nasopharynx, provides a practical technique. The method circumvents problems associated with control of the palato-pharyngeal and palato-glossal apertures and thus avoids the coaching required for posterior (peroral) rhinomanometry. In addition, resistances of the combined nasal cavities as obtained by the pernasal technique are less susceptible to the effects of mucovascular fluctuation than those obtained by anterior rhinomanometry (Cole et al., 1988).

REFERENCES

1. Cary NC. SAS User's Guide: Statistics. SAS Institute Inc. 1982 edition.
2. Clement PAR. International Committee on Standardization of Rhinomanometry. Chairperson: Clement PAR, ENT Department, AZ-VUB, Laarbeeklaan 101, 1090 Brussels, Belgium.
3. Cole P, Naito K, Chaban R, Ayiomamitis A. Unilateral and bilateral nasal resistances. Rhinology 1988; 26: 209–216.
4. Dvoracek JE, Hillis A, Rossing RG. Comparisons of squential anterior and posterior rhinomanometry. J Allergy Clin Immunol 1985; 76:577–582; Respir Dis 1984; 129: 351–354.
5. Jones SA, Lancer JM, Stevens JC, Beckingham E. Rhinomanometry: do anterior and posterior methods give equivalent results? Clin Otolaryngol 1987; 12: 109–114.
6. Parker L. Thesis, Faculty of Dentistry, University of Toronto, 1986.

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