Rhinology, 36, 184–187, 1998

The role of acoustic rhinometry in the pre- and postoperative evaluation of surgery for nasal obstruction*

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SUMMARY

This is a prospective study evaluating the role of acoustic rhinometry (AR) in the measurement of nasal patency before and after surgery for nasal obstruction. We examined 27 patients before and 2 to 6 months after septoplasty associated with turbinoplasty, cauterisation of the inferior turbinates, rhinoplasty or uvulopalatopharyngoplasty in some cases. Surgery was performed for subjective nasal obstruction and indication based on symptoms and clinical findings. AR was performed after indication was made. Patients were evaluated for this study by marking subjective global nasal obstruction on a visual analogue scale and by AR before and after decongestion. All patients noted an improvement of subjective nasal patency after surgery. Mean unilateral minimal cross-sectional area (MCA) of the preoperatively narrower side and total MCA both increased but showed wide ranges with also negative results. The total volume of the nasal fossae did not increase. The volume of the preoperatively narrower nasal fossa increased with surgery, but there are enormous ranges. We could not find any correlation between the MCA of the preoperatively narrower side or the total MCA and subjective nasal patency, neither before nor after surgery. The same was the case for the volume of the nasal fossae. In our opinion AR is not a valuable method for the indication or evaluation of surgery for nasal obstruction.

Keywords: acoustic rhinometry, nasal obstruction, septoplasty

INTRODUCTION

Nasal obstruction as felt by the patient is a subjective symptom. This symptom is well known to have many possible origins. These can be anatomical obstruction with a real impairment of nasal patency such as septal deviation, conchal hyperplasia or nasal polyposis. Another group of subjective nasal obstruction shows no objective signs of nasal obstruction by means of rhinoscopy or nasal air flow measurement. Among these are contacts between mucosal surfaces, polyposis limited to the upper part of the nasal cavity, viscous nasal secretions or dryness of the nasal mucosa. Objective measurements of nasal patency are thus of interest in evaluating the indication and results of any operation aiming at improving nasal patency. Active anterior rhinomanometry before and after nasal decongestion is an established and well standardised measurement of nasal aerodynamic resistance. Its major drawback is its inability to localise an aerodynamic stenosis. Since 1989 acoustic rhinometry (AR) is available; it gives a geometric measurement of the nasal cavity. Its principle and physical limitations have been described in other articles (Hilberg et al., 1989: Lenders et al., 1992). It was hoped that this method would improve the objective assessment of nasal patency. Several articles try to precise the role of AR in the indication and evaluation of surgery for nasal obstruction (Grymer et al., 1989; Grymer et al., 1993; Grymer et al., 1996; Marais et al., 1994). Marais et al. (1994) show a good correlation between the pre- to postoperative changes in subjective nasal patency and the minimal cross-sectional area (MCA) measured by AR or between the MCA and nasal peak flow measurements. Other authors discuss AR without or only with a vague reference to subjective nasal patency (Grymer et al., 1989, 1993, 1996).

The objective of this study is to investigate the correlation between data of AR and subjective nasal patency before and after surgery for nasal obstruction since the success of any surgery for nasal obstruction must finally be measured by patients' satisfaction.

* Received for publication December 2, 1997; accepted July 15, 1998

MATERIALS AND METHODS

Twenty-seven consecutive patients, 23 males, 4 females, median age 32 years, all underwent septoplasty for nasal obstruction. They were evaluated pre- and postoperatively. Evaluation for the protocol of this study included estimation of global nasal obstruction on a visual analogue scale by the patient and acoustic rhinometry of each side before and 10 minutes after nasal decongestion by a novesin-adrenaline spray. This evaluation was done in the outpatient clinic where the indication for the operation was made and again 2 to 6 months after surgery. Indication for surgery was based on history and rhinoscopy and AR was performed subsequently. All patients had clear anterior deviation. Sixteen patients underwent septoplasty only, and 11 patients had septoplasty with another procedure (unilateral or bilateral electrocauterisation of the inferior turbinate, inferior turbinoplasty, rhinoplasty, uvulopalatopharyngoplasty). AR was performed using a Stimotron® - acoustic rhinometer and the Rhinoclack® 2.0 software. A round plastic nosepiece of 13 mm inner diameter with an opening of 7 mm was used. Each side of the nose was measured taking care to fit the nosepiece tightly to the nostril without distorting the anatomy. One series of 3 measurements at 0.2 second intervals was performed on each side. The measurements were considered valid, if the three curves showed no deviation from each other from the nostril to the end of the C-notch, a divergence of maximally 20 % from the middle curve at the posterior end of the curves and no crossover. The middle curve was then registered. After measurement of both sides the two nasal fossae were sprayed with a novesine/adrenaline mixture and the measurements were repeated 10 to 15 minutes later. The patient marked on a visual analogue scale (VAS) the subjective global nasal obstruction: “0” for no obstruction at all; “10” for total obstruction. When the patient marked the postoperative subjective obstruction on the scale he saw his preoperative mark. “Subjective nasal patency” was defined as 10 – (obstruction score marked on the VAS). The side with the smaller preoperative minimal cross-sectional area (MCA) before decongestion (nMCA) was considered as the preoperatively narrower side before decongestion. The side with the smaller preoperative MCA after decongestion (dMCA) was considered the preoperatively narrower side after decongestion. The total MCA (TMCA) was defined as the sum of the MCA of each side before decongestion (nTMCA) and after decongestion (dTMCA).

We evaluated the average preoperative and postoperative nTMCA and dTMCA and their pre- to postoperative differences. We further evaluated the average preoperative and postoperative nMCA of the preoperatively non-decongestioned narrower side before decongestion (nMCA) and the pre- to postoperative differences of these data. The same was done after decongestion (dMCA) for the preoperatively narrower decongested side. We proceeded in an analogue way for the volume of the nasal fossae: total nasal volume (TNV) before (nTNV) and after (dTNV) decongestion, volume of the preoperatively narrower side (NV) before (nNV) and after (dNV) decongestion. Volumes were calculated from the nostril 7 centimetres towards the choanae. In this way the C-notch was completely included in the volume calculated. Correlations between subjective nasal patency and measurements by AR were calculated by linear regression.

RESULTS

All patients showed a subjective improvement of nasal patency as shown by an improvement on the visual analogue scale (Table 1). Medium improvement was 5.0 score points on the 10 score point scale with a range from 1.0 to 9.0 points. The total minimal cross-sectional area before decongestion (nTMCA) showed a medium improvement of 0.13 cm^2 (range –0.17 cm^2 to +0.58 cm^2), after decongestion (dTMCA) a medium improvement of 0.07 cm^2 (range –0.17 cm^2 to +0.55 cm^2) (Table 2). The MCA of the side which showed the smaller preoperative MCA increased by 0.11 cm^2 (–0.08 to +0.45 cm^2) before decongestion (nMCA, Table 3) and by 0.09 cm^2 (–0.07 to +0.43 cm^2) after decongestion (dMCA, Table 3). The total nasal volume did not increase significantly, neither before (nTNV) nor after (dTNV) decongestion (Table 5). The nasal volume of the preoperatively narrower side showed an medium improvement of 4.72 cm^3 without (nNV) and of 5.36 cm^3 with (dNV) decongestion (Table 6) but there are enormous ranges. The data show clearly, that there is no correlation between the total minimal crossectional area (TMCA) (neither in the non-decongestion [nTMCA] nor in the decongestion state [dTMCA] and neither preoperatively nor postoperatively) on the one hand and the subjective nasal patency on the other hand. Neither is there any correlation between the preoperative change in the nTMCA or dTMCA and the subjective change in nasal patency (Table 4). The lack of correlation between the nMCA or dMCA of the preoperatively narrower side and subjective nasal patency, either preoperatively or postoperatively, is also evident as well as that of pre- to postoperative changes in the nMCA or dMCA and the changes in subjective nasal patency (Table 4). The same holds for the volumes of the nasal fossae, be it the total nasal volume or the nasal volume of the preoperatively narrower side. No correlation exists between the acoustic-rhinometric measurements and the subjective nasal patency (Table 7).

Table 1: Subjective nasal obstruction on a visual analogue scale (VAS). “0” = no obstruction, “10” = total obstruction.

	mean	range
preoperative	6.7	(3.0 -10.0)
postoperative	1.7	(0.0 - 5.5)
difference	5.0	(1.0 - 9.0)

Table 2: Total MCA (cm^2) before (nTMCA) and after (dTMCA) decongestion.

	non-decongested		decongested	
	mean	range	mean	range
preoperative	1.05	(0.55 - 1.38)	1.10	(0.60 - 1.38)
postoperative	1.18	(0.79 - 1.58)	1.17	(0.82 - 1.34)
difference	0.13	(–0.17- 0.58)	0.07	(–0.17- 0.55)

Table 3: MCA (cm^2) of the preoperatively narrower side before (nMCA) and after (dMCA) decongestion.

	non-decongested		decongested	
	mean	range	mean	range
preoperative	0.47	(0.13 - 0.66)	0.49	(0.13 - 0.69)
postoperative	0.58	(0.32 - 0.79)	0.58	(0.41 - 0.71)
difference	0.11	(–0.08 - 0.45)	0.09	(–0.07 - 0.43)

Table 4: Correlation between VAS and nTMCA, dTMCA, nMCA, dMCA. Correlation coefficients "r"

VAS vs.	nTMCA	dTMCA	nMCA	dMCA
preoperative	0.18	0.15	0.14	0.20
postoperative	–0.05	0.01	0.03	0.01
differences	–0.12	0.02	–0.19	0.14

Table 5: Total nasal volume (TNV) (cm^3) before (nTNV) and after (dTNV) decongestion

	nTNV		dTNV	
	mean	range	mean	range
preoperative	34.30	(14.30- 82.51)	42.38	(21.48 - 80.78)
postoperative	36.33	(19.49 - 69.16)	43.06	(25.54 - 80.67)
difference	2.03	(–52.89 -31.80)	0.68	(–40.16 - 29.44)

Table 6: Nasal volume (cm^3) of the preoperatively narrower side (NV) before (nNV) and after (dNV) decongestion

	nNV		dNV	
	mean	range	mean	range
preoperative	12.94	(4.56 - 28.93)	16.22	(4.97 - 28.10)
postoperative	17.67	(6.66 - 34.56)	21.58	(11.99 - 40.30)
difference	4.72	(–12.72 - 21.32)	5.36	(–9.06 - 23.17)

Table 7: Correlation between total nasal volume (TNV), nasal volume of the preoperatively narrower side (NV) and VAS before (nTNV, nNV) and after (dTNV, dNV) decongestion. Correlation-coefficients "r".

	nTNV	nNV	dTNV	dNV
preop.	0.28	0.19	0.14	–0.02
postop.	0.16	0.06	0.02	–0.06
difference	0.14	0.01	–0.08	–0.29

DISCUSSION

All patients experienced a subjective improvement of their nasal patency and there were no complications. Surgery was thus successful and indications seemed correct. The mean MCA before and after decongestion of the preoperatively narrower side as well as the TMCA before and after decongestion all improved. The pre- to postoperative changes of these measures showed, however, wide ranges including narrowing of the preoperatively narrower MCA or the TMCA postoperatively in some cases. The mean total nasal volume showed no pre- to postoperative changes. The volume of the preoperatively narrower nasal fossa increased with surgery. But also here very wide ranges were seen including narrowing of these fossae. Comparison between subjective nasal patency and measurements by AR showed a complete lack of correlation, preoperatively as well as postoperatively and as well for the pre- to postoperative changes. One could argue that surgery improved nasal patency at another location than the MCA and therefore does not result in a corresponding improvement of the MCA. However, we have not seen any extreme isolated posterior obstructions. And even in some cases with important posterior obstructions the correlation coefficient should be much better. The volumes of the nasal fossae that include a larger area show no correlation with subjective nasal patency either. One could argue that surgery eliminated other factors of subjective nasal obstruction than real anatomic obstruction. But all patients had clear anterior septal deviation. The total nasal volume showed no pre- to postoperative changing. The nasal volume of the preoperatively narrower side showed a postoperative improvement but the range was enormous. There is also here an absolute lack of correlation between the acoustic rhinometry measurements and subjective nasal patency. The enormous variations in nasal volumes may in some cases be due to the inability of acoustic rhinometry to measure the nasal cavity reliably posteriorly to severe stenoses, which is a known drawback of AR (Hilberg et al., 1989). Widening of a very narrow MCA may alter posterior measurements resulting in different volumes pre- and postoperatively of the nasal cavity. It is, however, difficult to indicate a limit for the MCA below which more posterior measurements remain reliable because the shape of the MCA matters as well as its size (Hilberg et al., 1989). This makes measurements behind the MCA unreliable in some cases. Thus AR failed to correlate with subjective nasal patency. This holds pre- and postoperatively, and also for the pre- to postoperative changes. We therefore cannot confirm the results of a few other studies showing such correlations (Marais et al.). Other authors mention a lack of correlation between subjective nasal patency and AR measurements (Grymer et al., 1993, 1996). Yet these same authors consider AR a valuable means in the pre- and postoperative evaluation of patients undergoing surgery for nasal obstruction. In our opinion the success of surgery for nasal obstruction must be measured by the judgement of the patient, if we do not want to operate on the basis of acoustic rhinometry or rhinomanometric curves. Thus, because of the lack of its correlation with subjective nasal patency, we do not consider AR as valuable in helping to indicate nasal surgery or in its evaluation.

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