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Nasal airway resistance after decongestion with a nasal spray or a bellows device*

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SUMMARY

Two methods for decongestion of the nasal mucosa were compared, a conventional nasal spray and a bellows device, the reproducibility of rhinomanometric measurements being investigated in both cases. Nasal airway resistance (NAR) was measured in 18 patients (during late autumn) before, 10 min, and 20 min after decongestion with an oxymetazoline solution from a bellows device, and the measurements were repeated one week later. About three months later (during spring) the measurements were repeated in the same 18 patients, but with a xylometazoline nasal spray being used for decongestion. With neither method were any differences in NAR found between 10 and 20 min after decongestion, or between any of the values (before or after decongestion) and the respective values obtained after one week. The NAR values of the undecongested total nose and the wider nose cavity were significantly higher during the late autumn than during the spring, as were also a few values after decongestion. We found no evidence that the bellows method is superior to the spray method in reducing NAR.

Key words: rhinomanometry, decongestion, xylometazoline, oxymetazoline, bellows device

INTRODUCTION

Rhinomanometry, after proper decongestion of the nasal mucosa, enables the outcome of septoplasty to be assessed objectively (Jessen and Malm, 1989). Determination of nasal airway resistance (NAR) is also a good objective aid in the selection of patients suitable for septoplasty (Broms et al., 1982b; Jalowayski et al., 1983).

The variation in unilateral NAR of non-decongested nasal mucosa due to the nasal cycle is well known (Stoksted, 1952), as are the effects on NAR of different reflexes and emotions. Obviously, the lesser the effect the mucosa has on the measurements, the better the NAR will indicate the presence of a nasal obstruction caused by bone or cartilage. It is therefore important to find as effective and simple a method as possible for decongestion of the mucosa.

A bellows device containing 0.025% oxymetazoline has been developed, according to the principle described by Greiff et al. (1990). The expectation with the bellows device method was to get a more superior decongestion of the nasal mucosa than with conventional nosedrops or sprays. It seems reasonable that when the entire nasal mucosa is covered with oxymetazoline the decongestion would be superior to the effect achieved with two or three squirts from a nosespray. The liquid from the spray will only cover a part of the nasal mucosa.

A solution containing 0.01% oxymetazoline instilled into the entire nasal cavity with the bellows device has been tried in the treatment of sinusitis, and it has been demonstrated that the ostium of the maxillary sinus was more dilated with this method of decongestion than with nose drops administered by spray (Jannert et al., 1993).

The aim of the present study was to ascertain whether the bellows device was more effective in decongesting the nasal mucosa and reducing NAR in patients with nasal obstruction than the pharmacological method previously found to be most effective, i.e. a nasal spray with 0.1% xylometazoline (Jessen and Malm, 1988), and to compare the degree of decongestion 10 and 20 min, respectively, after the decongestion procedure. In order to draw conclusions from the study, the reproducibility of our rhinomanometric method was also investigated.

MATERIAL AND METHODS

Patients

The series consisted of 18 patients (both men and women), aged 18–50 years, consulting the ENT Department in Malmö because of troublesome nasal obstruction. All had a septum deviation.

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Rhinomanometry

Nasal airway resistance (NAR) was measured by active anterior rhinomanometry using a computerized rhinomanometer, described in detail by Jonson et al. (1983). Before decongestion, NAR was measured after the patient had rested for 20 min in a sitting position. The total investigation time was about 50 min at each occasion. Nasal airway resistance measurements were made at four occasions.

Decongestion with xylometazoline hydrochloride (0.1%) nasal spray

Two squirts of the spray (0.28 ml) were given in each nasal cavity, followed by another spraying (0.14 ml) in each nasal cavity, 7-8 min later. In total, 0.42 ml was given in each nasal cavity, containing 420 µg xylometazoline hydrochloride.

Decongestion with oxymetazoline chloride (0.025%) in a bellows device

The patients tilted their heads forward so that their chins reached the chest, remaining in that position throughout the decongestion procedure. Then one nasal cavity was filled with oxymetazoline from the bellows device containing 25 ml (Figure 1). When the solution began to run out through the other nasal cavity, no more solution was infused. The solution was retained in the nasal cavity for 30 s, after which the bellows device was removed and the solution allowed to run out. The other nasal cavity was then decongested in the same manner. The bellows device contained 6,250 µg oxymetazoline chloride.

Design of the study

The study comprised two sections:

1. Comparison of the two different methods of decongestion:

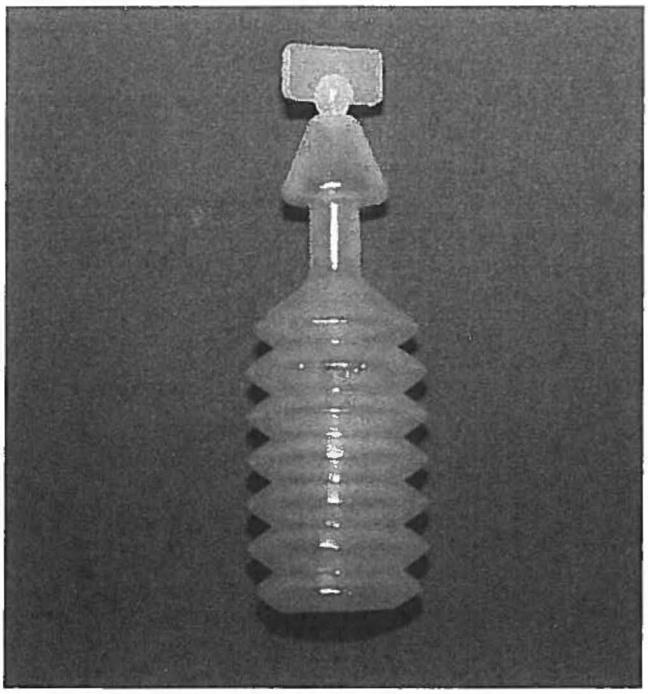

Figure 1. The bellows device.

(a) decongestion with the oxymetazoline bellows device, NAR being measured in 18 patient before decongestion, and 10 and 20 min after. The measurements were made during October, November or December (i.e, during the late autumn); (b) decongestion with the xylometazoline nasal spray, NAR being measured (in the same 18 patients as in 1a) before decongestion, and 10 and 20 min after. The measurements were made during April and May, which is springtime in the region where the investigation was done.

2. Reproducibility studies: day-to-day variation with versus without decongestion. Decongestion and measurements (as described under 1a and 1b) were repeated about one week later in the same 18 patients.

Statistical analysis

The rhinomanometric values were calculated from v_2 values, as described in detail by Broms et al. (1982a). Results are given as mean v_2±SD. R_2 is the relevant clinical measure of resistance at a circle with a radius of 200 Pa at the pressure axis or 200 cm^3/sec at the flow axis. For the single nasal cavity, the relationship between R_2 and v_2 is:

$$R_2 = \tan v_2$$

Student's t-test was used for paired comparisons between groups, the significance level being $p < 0.05$, or $p < 0.01$. The standard deviation (SD) of the method was calculated as follows:

$$SD = \sqrt{\sum d^2/2n}$$

where "d" is the difference between duplicate measurements and "n" the number of duplicate measurements (Holmström and Kumlien, 1988); and the standard error of the difference (SED) is calculated as follows:

$$SED = SD/\sqrt{n}$$

RESULTS

Comparison of two different application methods

NAR values (mean R_2 and mean v_2±SD) before and after decongestion obtained with the two methods and on both occasions one week apart are given in Table 1.

All NAR values for the narrower side and for the total nose after decongestion, and almost all values for the wider side were significantly lower ($p < 0.01$) than the corresponding values before decongestion (significance of differences not given in Table 1). NAR for the total nose was significantly more reduced by decongestion with the bellows device (during the late autumn) than with the nasal spray (during the spring). After decongestion no difference was found for the total nose between the two methods of decongestion.

The significance of differences given in the table represents differences between the two methods of decongestion (i.e. in the horizontal plane of Table 1). Almost all mean values before and after decongestion with the bellows device were higher than the

Table 1. Rhinomanometric measurements before and 10 and 20 min after decongestion with a xylometazoline spray (during the spring) versus an oxymetazoline bellows device (during the late autumn).

		xylometazoline spray			oxymetazoline bellows device	
		I	II		I	II
before decongestion						
narrower side	v_2	43.4±24.4	45.0±24.6		51.9±24.8	45.3±25.2
	R_2	0.95	1.00		1.28	1.02
wider side	v_2	11.9±6.8	11.7±5.7	**	17.2±9.3	17.1±8.9
	R_2	0.21	0.21		0.31	0.31
total nose	v_2	18.3±8.0	19.5±9.4	*	29.0±13.2	25.2±11.6
	R_2	0.17	0.18		0.28	0.24
10 min after decongestion						
narrower side	v_2	14.6±13.5	15.6±15.6		17.6±14.7	16.5±13.6
	R_2	0.26	0.28		0.32	0.30
wider side	v_2	8.3±2.9	8.6±3.2	*	9.1±4.2	11.1±4.3
	R_2	0.15	0.15		0.16	0.20
total nose	v_2	10.1±5.1	10.7±5.7		12.3±7.6	12.3±4.2
	R_2	0.09	0.09		0.11	0.11
20 min after decongestion						
narrower side	v_2	13.6±12.9	13.3±13.4	**	19.3±17.5	18.2±15.7
	R_2	0.24	0.24		0.35	0.35
wider side	v_2	8.1±2.7	9.3±4.5		9.1±3.3	9.1±3.4
	R_2	0.14	0.16		0.16	0.16
total nose	v_2	9.6±4.0	10.1±5.8		11.1±5.0	11.3±4.9
	R_2	0.08	0.09		0.10	0.10

I: first occasion; II: second occasion, one week later.The asteriks refer to the statistical difference in mean values between the spray occasions and the bellows device occasions (*: $p < 0.05$; **: $p < 0.01$).

corresponding values for the nasal spray, the difference being significant in four of the nine comparisons.

Reproducibility

Values for SED of the duplicate measurements one week apart, calculated according to Holmström and Kumlien (1988): The mean SED (n=6) before decongestion was 8.9, and the mean SED (n=12) after decongestion was 2.7.

DISCUSSION

In the Committee Report on the Standardization of Rhinomanometry, no recommendations were made as to how decongestion ought to be performed (Clement, 1984). In a previous study of rhinomanometry we found that an effective way of decongesting the nasal mucosa was to use a 0.1% xylometazoline solution administered by nasal spray, two sprayings being given in each cavity, followed by one spraying in each cavity, 7-8 min later. This method was superior to physical exercise, to 0.1% xylometazoline solution sprayed once in each nasal cavity, to three drops of the same solution given in each cavity at one occasion, or to three drops of 0.05% oxymetazoline solution in each cavity at one occasion (Jessen and Malm, 1988).

In an effort to achieve even better decongestion, a bellows device is now compared with the best spray method. Both methods gave excellent decongestion of the nasal mucosa. The maximum decongestion effect was achieved at least 10 min after application, no further decongestion being found 20 min after application. No difference was found when the measurements were repeated about one week later.

During the autumn when the bellows device was tested, some NAR values before decongestion were higher than these obtained during the spring. It is possible that this is due to a higher frequency of infectious rhinitis during the autumn. None of our patients were clinically suffering from infectious rhinitis or another infectious disease at the time before the rhinomanometric measurement. That a few comparisons for the narrower or wider cavity after decongestion also showed higher NAR in the autumn lends support to the idea that infectious oedema anyhow was present in some patients. This underscores the importance of ensuring that the patient is not suffering from a common cold or has suffered from a common cold recently, if the aim of rhinomanometry is to control or select septoplasty patients.

We did not compare oxymetazoline in a bellows device with oxymetazoline nasal spray, because we wanted to compare oxymetazoline in the bellows device with the best found way in decongestion of the nasal mucosa, i.e. xylometazoline nasal spray. The equivalent amount of xylometazoline versus oxymetazoline is 1 mg to 0.5 mg (Meuman and Rantanen, 1975), so the oxymetazoline bellows device had a potentially 30 times stronger decongestant effect than the xylometazoline spray. However, the quantity of oxymetazoline necessary to decongest the nasal mucosa varied from patient to patient.

The normal dose of oxymetazoline hydrochloride (Astra, Sweden) is two sprays at the same time, i.e. 0.1 ml. Had we used the normal adult dose of 0.5 mg/ml, we would have exposed the patient to 250 times the normal dose, which was not acceptable. Instead we chose the dose of 0.25 mg/ml. The period between the measurements with the bellows device and the nasal spray was three months. The reason was that we wanted to finish and calculate the bellow measurements before the spray measurements were started, and that we did not want to make measurements during the winter months, because of the increased risk for the patients to suffer from upper respiratory tracts infections.

The reproducibility of rhinomanometric measurements has been studied by several investigators with different techniques (Ingelstedt et al., 1969; Broms, 1982; Jones et al., 1987; Sandham, 1988). Holmström and Kumlien (1988), using duplicate measurements, found the standard error of the difference (SED) to be 3.8 before decongestion and 2.7 after decongestion, and concluded that the error of the method was small enough to justify rhinomanometry for inter-individual comparisons. In our patients, measured one week apart, we found the same SED after decongestion. Before decongestion, however, the SED in our investigation was about twice the value found by Holström and Kumlien (1988). The low SED before decongestion is not surprising, as they made the duplicate measurements immediately after the first measurements, whereas we made them a week later. One week after the first measurement, the condition in the nose may be quite different. Due to the reproducibility of our rhinomanometric measurements we can conclude that a bellows device able to cover the entire nasal mucosa with a solution containing oxymetazoline is not superior to a spray method in decongesting the nasal mucosa.

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