

Nasal airway resistance in perennial non-allergic rhinitis

Postural variations and effects
of topical application of terbutaline

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SUMMARY

The nasal airway resistance in various positions of the body was investigated in 24 patients with perennial non-allergic rhinitis and in 10 normal subjects. No difference in nasal airway resistance between inspiration and expiration was found. The patients had higher resistance than the controls, a difference providing an anatomical explanation of their complaint of nasal obstruction.

When the patients changed from the recumbent to the sitting position, the resistance did not decrease until after about one hour. The corresponding time for the controls was 10 minutes. This difference suggests that oedema is a more important cause of nasal swelling in the patients than in normal subjects. Local treatment of the patients' nasal mucosa with terbutaline revealed no clear oedema-reducing effect to the drug.

Neither the etiology nor the pathophysiology of perennial non-allergic rhinitis is properly understood. Sneezing attacks, nasal secretion and obstruction are the well-known symptoms. Some patients with this type of rhinitis suffer preponderantly from nasal obstruction. The question is if these patients do have higher nasal airway resistance than normal subjects or if the obstruction only is a subjective symptom.

A decreased nasal patency might be caused by an increased mucosal blood content and an increased interstitial tissue fluid (oedema). Both dilated blood vessels and oedema have been found at electron microscopic examinations of the nasal mucosa from patients with perennial non-allergic rhinitis (Jahnke et al., 1977). From a therapeutical point of view knowledge of the relative importance of the two factors would be of interest. It might be possible to distinguish between them by studying the nasal airway resistance in the sitting and the recumbent positions with special reference to the difference in the time of occurrence of the resistance changes. Changes in the blood content most probably occur faster than those in the interstitial fluid content. Therefore the influence of postural varia-

tion on the nasal airway resistance in patients with perennial non-allergic rhinitis as well as in normal subjects was investigated.

If both dilated vessels and oedema are of importance in perennial non-allergic rhinitis two different pharmacologic treatments are indicated *viz.* with vasoconstrictory and with oedema-reducing substances. Vasoconstrictory drugs increase the nasal patency in perennial non-allergic rhinitis (Benson, 1971), but no investigation is available of the effect of oedema-reducing drugs on this affection. Beta₂-adrenoceptor stimulating substances can reduce oedema formation in animals (Green, 1972; Svensjö et al., 1977; O'Donnell and Persson, 1978; Persson et al., 1978; Persson et al., 1979). In an endeavour to find out whether such substances might be of value in this type of rhinitis terbutaline, a beta₂-agonist, was given to patients. Topical application was chosen to secure a high local concentration of the substance.

MATERIAL AND METHODS

Material

The material consisted of 24 patients with perennial non-allergic rhinitis and 10 normal controls. The patients (12 males and 12 females) aged 19–65 (average 30 years) had perennial nasal obstruction for at least one year, especially when recumbent. Allergologic examination including skintesting, and RAST proved negative. All the patients were free from drugs for at least two days before the investigation.

Rhinoscopy and the nasal airway resistance after a standardized physical exercise (Broms, 1981) excluded obstruction owing to deformity of the nasal cartilages or bones. Ten of the patients (5 males and 5 females), aged 19–39 (average 28 years), were randomly selected for comparison with 10 normal subjects. The controls (5 males and 5 females), aged 20–43 (average 31 years), had never had symptoms suggesting perennial non-allergic rhinitis, and the nasal airway resistance after an exercise test was normal.

Pharmacological agent

The preparation under investigation was the beta₂-adrenoceptor stimulating drug, terbutaline sulphate (Bricanyl®). The dosage was 0.02 mg/kg bodyweight (1–1.5 mg) administered to the nasal mucosa as nose drops. The doses were based on experiences from routine treatment of bronchial asthma with terbutaline (Jack et al., 1978).

Rhinomanometry

Anterior rhinomanometry during spontaneous respiration was used. Pressure-flow curves for both nasal cavities were recorded *X–Y* wise on an oscilloscope. The nasal airway resistance of the separate cavities and of the total nose was cal-

culated according to Broms et al. (1981). The resistance of the total nose was derived from data of the two cavities and was expressed as an angle v_2 for statistical comparisons. The corresponding clinically relevant parameter is a resistance value R_2 ($R_2 = 5 \times \tan v_2$ for the total nose).

Before the experiments all participants rested sitting 50 minutes in the testing room for acclimatization and to get accustomed to the rhinomanometric routine. Rhinomanometry was performed every 10 minutes with the subject recumbent or sitting (Figures 1 and 2). The controls were observed for 60 minutes. The 10 patients selected were examined for 190 minutes and the remaining patients for 90 minutes. Terbutaline was given to the patients after 90 minutes. The blood pressure and pulse frequency were measured regularly every 30 minutes.

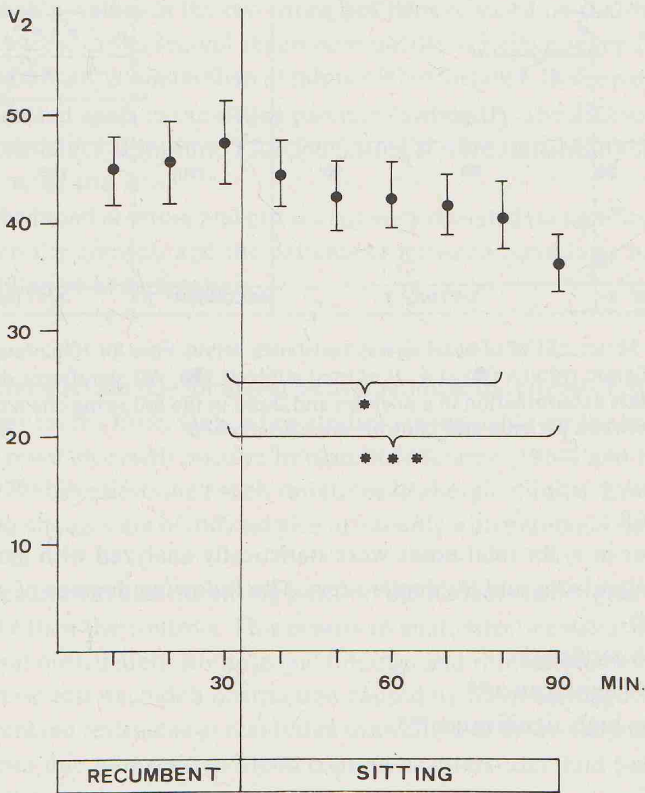


Figure 1. Mean \pm SEM of nasal airway resistance expressed as v_2 in degrees versus time for 24 patients with perennial non-allergic rhinitis. Significant differences between the last determination in the sitting position and those in the following position are marked.

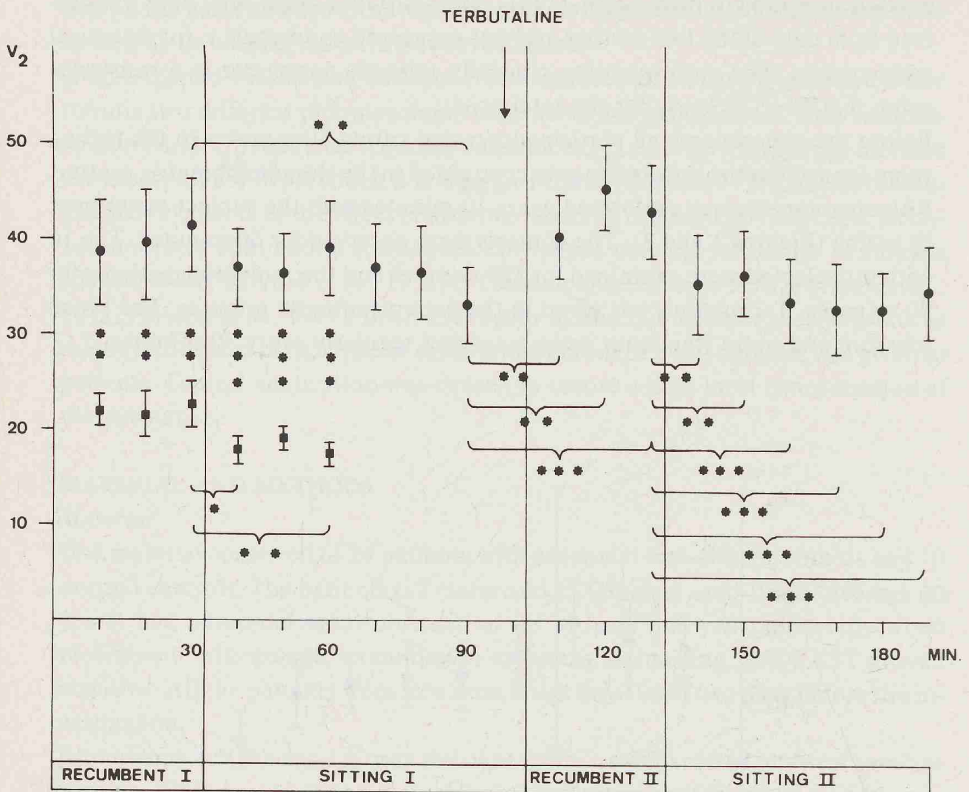


Figure 2. Mean \pm SEM of nasal airway resistance versus time for 10 patients with perennial non-allergic rhinitis (●) and 10 normal subjects (■). All significant differences between the last determination in a position and those in the following one are marked. Differences between patients and controls are also marked.

STATISTICS

Differences in v_2 for total noses were statistically analyzed with paired and unpaired comparisons and Student's *t*-test. The following degrees of significances were used:

$p \leq 0.05$ = tendency*

$p \leq 0.01$ = significance**

$p \leq 0.001$ = high significance***

RESULTS

The mean values of inspiratory v_2 for the 24 patients were generally somewhat higher (< 3%) than those of their expiratory v_2 , but the differences between the two phases of respiration were not significant. The following calculations and

figures are therefore based on a v_2 , which is mathematically deduced from both respiratory phases.

Figure 1 gives the mean \pm SEM of v_2 for various positions of the patients. When they changed from the recumbent to the sitting position, v_2 was not significantly decreased until after 50 minutes.

The corresponding values for the 10 selected patients and the 10 controls are given in Figure 2. The mean values for the selected patients were lower than those for the total group of patients, but the differences were not significant. In all positions v_2 was significantly higher in the patients than in the controls. When the controls changed from recumbency to the sitting position v_2 was significantly decreased after 10 minutes. In the 10 patients a significant reduction of v_2 required about one hour.

Figure 2 also shows the mean \pm SEM of v_2 for the patients before and after the instillation of terbutaline. Comparisons of the v_2 -values in the two recumbent positions as well as of v_2 -values in the two sitting positions revealed no statistically significant differences. In the second recumbent position (Recumbency II) the v_2 -values were significantly higher than at minute 90 in Sitting I. In the patients the v_2 -values decreased again in the sitting position (Sitting II). The differences in v_2 between Recumbency II (minute 130) and Sitting II were statistically significant within 10 minutes and later.

Analyses of the blood pressure and pulse frequency revealed no significant differences between the controls and the patients or between recordings before and after the instillation of terbutaline.

DISCUSSION

Rhinomanometry is valuable for objective evaluation of the effects of nasal surgery and of drugs on the nose. Only a few studies are available on the variation of nasal airway resistance with posture in man. Rundcrantz (1964) and Hasegawa and Saito (1979) have described such variations in allergic rhinitis. Evaluation of corresponding changes are of interest also in patients with perennial non-allergic rhinitis.

In both the recumbent and the sitting position the patients had higher nasal airway resistance than the controls. This means an anatomical explanation of their feeling of nasal obstruction. Rhinoscopic findings and rhinomanometric results after an exercise test excluded obstruction caused by nasal cartilages or bones. Thus, the increased resistance at rest is due to swelling of the nasal mucosa. This in turn is either due to increased blood content or interstitial fluid (oedema) or both factors simultaneously.

In a material of 37 healthy young men, Broms (1981) found that the nasal airways resistance significantly decreased within 10 minutes on change from recumbent to sitting position. The similar observation was made in our controls. In the

patients, however, the resistance did not diminish until after about one hour. This difference in time before the resistance decreased is so long, that it can indicate that oedema is a more important factor of the mucosal swelling in the patients than in the controls.

Terbutaline was given because of its possible oedema-reducing effect. Beta₂-adrenoceptor agonists are also reported to have a cardiovascular action and a dilatory effect on the nasal vessels (Malm, 1974; McLean et al., 1976; Hiley et al., 1978). The blood pressure and pulse frequency were not changed by the intranasally given terbutaline, and thereby argued against any disturbance of the general circulation by the drug. Only local effects of the substance need to be expected. No dilatory effect of terbutaline was seen in the present study, however.

This is in agreement with the results of instillation of terbutaline in normal subjects and asymptomatic patients with allergic rhinitis (Svensson et al., 1980). In the sitting position after recumbency, the resistance decreased sooner after instillation of terbutaline than before, thus arguing for an oedema-reducing effect of the compound. However, as no significant difference was found in the resistance between the two sitting positions, an anti-oedematous effect of the substance could not be demonstrated with certainty in man. Thus, intranasal instillation of terbutaline in the doses used by us, seems to be of no immediate value in the treatment of nasal obstruction in perennial non-allergic rhinitis.

RÉSUMÉ

La résistance nasale en différentes positions du corps humain a été examinée soit chez 24 malades ayant une rhinite vasomotrice soit chez 10 personnes normales. Aucune différence de la résistance nasale entre l'inspiration et l'expiration a été découverte. Les malades avaient une plus haute résistance que les autres, une différence qui serait une explication anatomique de leur plainte d'une obstruction nasale. Quand les malades changeaient de position horizontale à position assurant la résistance ne diminuait pas avant une heure. Le temps correspondant pour le group de contrôle était 10 minutes. Cette différence propose que l'oedème soit une cause plus importante du blocage nasal chez les malades que chez les personnes normales. Le traitement local de la muqueuse nasale des malades avec terbutaline ne donnait pas un effet clair de la drogue témoignant d'une réduction de l'oedème.

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