

Effects of an external nasal dilator on increased nasal resistance caused by mucosal changes

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SUMMARY

The external nasal dilator "Airplus" was tested on 10 normal persons without nasal symptoms using histamine challenge test to evaluate the effect under experimentally induced nasal stenosis. With increasing concentration of histamine, increasing nasal resistance was found. After application of the nasal dilator the nasal resistance was significantly reduced by 40%-51%. The external nasal dilator "Airplus" improves both the inspiratory and the expiratory nasal airway patency under conditions of experimentally induced allergic reactions and can be considered for further use if it can be tolerated cosmetically.

INTRODUCTION

Devices for nasal dilation have been known for many years. A United States patent was issued in 1919 for an external nasal dilator suggested for use in patients with nasal stenosis as in hay fever(1). External devices have gained increasingly public awareness since the use by athletes in recent big sport events. They have also been subjects for testing in laboratories and results have shown an improved airflow and decreased nasal resistance in normal persons(2,3). In patients most trials using nasal dilators, have been on sleep-related disorders (4). We have studied the external nasal dilator "Airplus" in normal persons without

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nasal symptoms using histamine challenge test to evaluate the effect under conditions of experimentally induced nasal stenosis.

MATERIALS AND METHODS

In the study 10 normal persons without nasal symptoms and without known allergy were investigated. 6 men and 4 women aged 20- 45 years were included after written and informed consent. A nasal examination was performed to rule out any structural abnormality. Measurements of nasal airway resistance (NAR) were performed in both nasal cavities before challenge using the RM 2100 (RhinoMetrics, Lynge, Denmark). The NAR was measured at a pressure of 75 Pa. To avoid errors resulting from change in nasal cycle the total NAR (tNAR) was calculated using the formula: $\text{Total NAR} = 75 / ((75/\text{NAR}_{\text{left}}) + (75/\text{NAR}_{\text{right}}))$.

The histamine nasal challenge test was performed using aqueous solutions of histamine of 0,125 mg/ml. and 0,5 mg/ml. A dose pump delivering 140 mikrolitre pr. spray was used. One dose of histamine 0,125 mg/ml was sprayed in each nasal cavity. After 10 minutes measurements were repeated without the nasal dilator, the nasal dilator was applied and the NAR was determined again. After 15 minutes the procedure was repeated using the 0,5 mg/ml histamine solution. Measurements were again performed after 10 minutes. Non-parametric statistics were used to test the results and 0.05 was used as level of significance. This Danish developed device is made of a plastic material with adhesive tape on both ends. It is fixed on the external side of the nose over isthmus part (Fig.1). The elastic property of the material creates a lateral pull on the alae. This force enlarges the most narrow part of the nasal cavity, hereby facilitating the breathing



Fig.1: The Nasal Dilator "Airplus".

RESULTS AND CONCLUSIONS

Before challenge the mean inspiratory tNAR was 0.27 PaS/cm³ (range 0.12-0.48 PaS/cm³) and the mean expiratory tNAR was 0.30 PaS/cm³ (0.18-0.70 PaS/cm³).

After the first challenge the mean inspiratory tNAR was increased 22 % to 0.33 PaS/cm³ (0.19-0.75 PaS/cm³). The mean expiratory tNAR was 0.30 PaS/cm³ (0.17-0.76 PaS/cm³). After the application of the nasal dilator, the mean inspiratory tNAR was reduced 42% to 0.19 PaS/cm³ (0.10-0.40 PaS/cm³) and the mean expiratory tNAR was reduced 40 % to 0.18 PaS/cm³ (0.09-0.31 PaS/cm³), p=0.002 in both cases. After the second challenge the mean inspiratory tNAR increased 29% to 0.35 PaS/cm³ (0.15-0.71 PaS/cm³). The mean expiratory tNAR was unaffected 0.30 PaS/cm³ (0.18-0.80 PaS/cm³). After the reapplication of the nasal dilator the mean inspiratory tNAR was reduced 51% to 0,17 PaS/cm³ (0.18-0.39 PaS/cm³) p=0.008. The mean expiratory tNAR was reduced 43% to 0,17 PaS/cm³ (0.10-0.31 PaS/cm³) p=0.0156 (Table 1).

Table 1: The results before and after the histamine challenge test on the total nasal airway resistance during inspiration and expiration with and without "Airplus"

	Total R _{nas} -AP	Total R _{nas} +AP	Total R _{nas} -AP	Total R _{nas} .AP
Before challenge	0.27 (0.12-0.48) PaS/cm ³	---	0.30 (0.18-0.70) PaS/cm ³	---
1. challenge	0.33 (0.19-0.75) PaS/cm ³	0.19 (0.10-0.40) PaS/cm ³	0.30 (0.17-0.76) PaS/cm ³	0.18 (0.09-0.36) PaS/cm ³
2. challenge	0.35 (0.15-0.71) PaS/cm ³	0.17 (0.10-0.39) PaS/cm ³	0.30 (0.18-0.80) PaS/cm ³	0.17 (0.10-0.31) PaS/cm ³

Allergy and related diseases have become a rising health problem in the last decades. Nasal allergic symptoms are dominated by nasal stenosis, nasal secretion, itching and sneezing. Medical treatment such as antihistamines, steroids and cromolyns topical and/or systemic can effectively control most of these symptoms(5). It has been speculated that nasal dilators can be effective in relieving the patient from these symptoms (1). We have tried to evaluate their effect under experimental conditions with induced mucosal congestion. We have used a histamine challenge test as it tends to provoke allergy like symptoms moreover a metacholine test which produces a larger glandular response (6). In our setup we have used increasing concentration of histamine to develop nasal stenosis corresponding to an increase in musosal congestion. The external nasal dilator is only active in the most anterior part of the nasal cavity, especially in the area of the nasal valve. In a previous study we have shown that the minimal cross sectional area is enlarged in average around 50% (7). The histamine acts on the entire nasal mucosa by creating congestion. Our results show that despite a 29 % increase in tNAR it is possible for the simple external nasal dilator to compensate this and achieve an average of 42%- 50% reduction in inspiratory nasal resistance. The reason for this effect is due to the site of action by the nasal dilator which is at the nasal valve area, the most narrow part of the nose. This area contributes with more than half of the entire nasal resistance (8). In our study we do not find any increase in expiratory tNAR after the two provocations but the expiratory tNAR is reduced 40-42% after the application of the nasal dilator. The nasal dilator has no or only slightly effect on other allergic symptoms besides nasal stances.

Conclusion: The external nasal dilator "Airplus" improves both the inspiratory and the expiratory nasal airway patency under settings with nasal stenosis, due to swollen mucosa with mean reduction in resistance between 40% to 52%. It is possible to alleviate the induced nasal stenosis without medication. Mechanical nasal dilators show significant effects and can be considered for further use if they can be tolerated cosmetically.

CONCLUSION

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