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Does septal surgery influence submucous congestion?

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SUMMARY

Nasal obstruction is brought about by many factors. The degree of filling of the submucous vascular plexus represents and important factor in this, but it is subject to a variety of influences and it is quantitatively rather unknown. In this study the influence of submucous congestion on nasal airway resistance is investigated in patients with complaints of nasal obstruction before and after septal surgery. The submucous congestion appeared to be the major determinant and was remarkably reduced after surgery. Local anatomical factors apparently are able to influence the behaviour of the submucous tissues in the nose, possibly by a mechanism of reflex origin.

INTRODUCTION

Nearly a century ago the first attempt to measure nasal patency was made by Zwaardemaker (1889). Since that time numerous methods have been described for this purpose and many publications have appeared on this subject. Nowadays several methods are available to determine nasal patency. All these methods provide a certain numeral figure which expresses nasal patency, or more accurately conductivity or resistance. However, little is known how this nasal resistance is composed. What are its determinative and influencing factors?

Some data in literature

Each anatomical part of the nose has its own contribution to the resistance: the vestibule, the internal ostium, the septum, the turbinates etc. However factors determining nasal resistance can be divided into two groups: the constant and the variable ones.

Constant determinants are the bony and cartilaginous outlinings in the anatomy of the nose. Functional nasal surgery usually has the aim to correct these structures.

Variable determinants consist of the degree of filling of the submucous vascular plexus. This "submucous congestion" may vary considerably (Table 1) and constitutes possibly one of the most important factors in nasal resistance (Uddströ-

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Table 1. Factors known to influence the degree of filling of the submucous vascular plexus in the nose.

- infection and allergy	- nasal cycle
- autonomic innervation	- drugs
- inspiratory air	- body position
- age	

mer, 1940; Proetz, 1941; Stoksted, 1952; Nakano, 1970).

It is obvious that infection and allergy are important in producing submucous congestion. Each stimulus causing autonomic imbalance like stress, exercise (Richerson and Seebohm, 1968; Baumann and Masing, 1970; Masing, 1974) and emotional status (Stoksted, 1970) may give rise to a change in nasal resistance. Temperature (Drettner, 1967; Tagaki et al., 1969; Salman et al., 1971) and CO_2 content (Proctor et al., 1969; Principato and Ozenberger, 1970) of the inspiratory air may play a role. The role of submucous congestion in nasal resistance is more important in adults than in children (Polgar and Kong, 1965; Masing, 1974). The nasal cycle produces reciprocal changes in the patency of the right and the left side of the nose in such a way that the total resistance remains the same (Keuning, 1968; Williams, 1972; Büsser and Schibli, 1973; Kern, 1973). Antihypertensive drugs are known to give a substantial rise of submucous congestion (Conner et al., 1957) but presumably a number of other types of drugs might have a certain influence as well. The role of body posture in submucous congestion has been mentioned by many authors. However whether this phenomenon is due to hydrostatic forces or reflexes is still unknown.

Topical decongestive drugs are able to eliminate or diminish the influence of all these factors.

In conclusion it may be stated that nasal obstruction is only a symptom with a multifarious pathogenesis. So functional nasal surgery as the only therapy for nasal obstruction is bound to have the risk that a part of the pathogenetic factors are overlooked and misinterpretation of the results of this surgery may occur. Thus more insight is needed in how nasal resistance is brought about.

MATERIAL AND METHODS

The present series consists of 63 patients, who underwent functional nasal surgery because of major septal deformities. There was no history of recent infection or allergy in this group. The airway resistance was measured by means of the whole body plethysmograph, one of the most reliable and accurate methods available nowadays. Measurements were carried out during mouth and nose breathing before and after application of a decongestive nasal spray (Xylometazoline HCl 1‰). These measurements took place before and at least 4 months after surgery. The airway resistance was determined by means of a reference flow

of 0.25 lps. As the values showed a considerable spread the median instead of the average of at least 5 consecutive measurements was taken. Nasal airway resistance was calculated by substracting the values of nose and mouth breathing. The history of the individual patient may provide important data. Patients with nasal obstruction can be divided into two groups: those who have *constant* obstruction and those who have only *intermittently* complaints. In these both groups a different role of submucous congestion must be assumed. These 63 patients were divided into two groups. The first group of 30 patients had a history of intermittent obstruction. The second group of 33 patients had a history of a constantly blocked nose. The following two questions were investigated:

- what is the role of submucous congestion in these both groups?
- what is the change in submucous congestion after surgery?

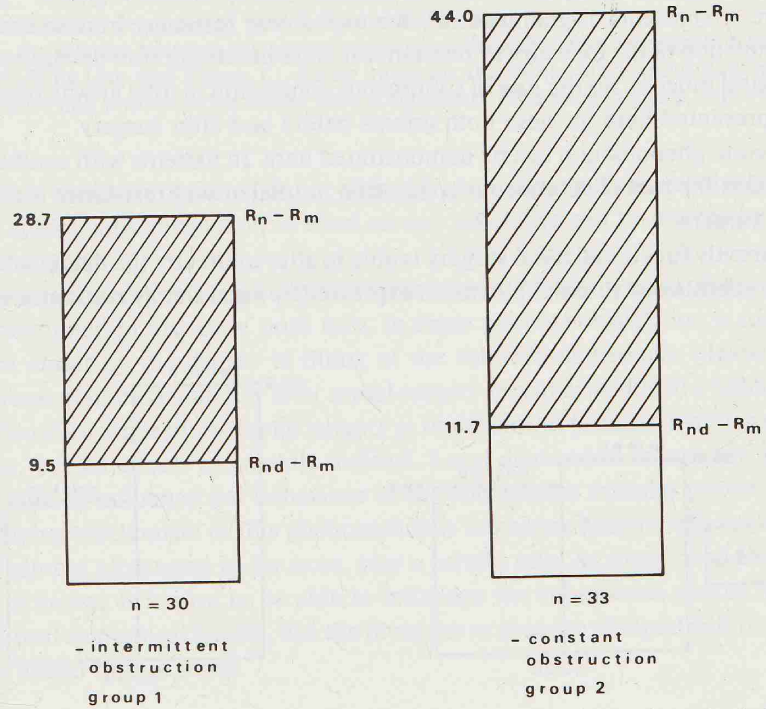

Figure 1. Nasal airway resistance in the groups with intermittent and constant obstruction.
R_m = airway resistance in mouth breathing
R_n = airway resistance in nose breathing
R_{nd} = airway resistance in nose breathing after decongestion
$R_n - R_m$ = nasal airway resistance
$R_{nd} - R_m$ = nasal airway resistance after decongestion .
The values are expressed in mm H_2O/lps. The differences represent the median of the calculated values. The difference between group 1 and 2 is significant ($p < 0.05$). The upper shaded area is the resistance caused by the submucous vascular plexus in the nose.

RESULTS AND DISCUSSION

Figure 1 shows the part of the submucous tissues in both groups. Apparently the submucous vascular plexus accounts for a major part of the nasal resistance, notably in those cases with constant obstruction. This is a remarkable finding, because it is to be expected that intermittent obstruction mainly is due to submucous congestion.

Figure 2 shows the values of the resistance brought about by submucous congestion in both groups before and after surgery.

In the first group with intermittent obstruction submucous congestion had changed only insignificantly after the operation, while in the second group a substantial reduction in the degree of filling of the submucous vascular plexus has taken place after surgery.

Figure 3 represents diagrammatically the total airway resistance in nose breathing as a function of the total airway resistance in nose breathing after decongestion of the nasal mucosa. So the *part* of submucous congestion in total airway resistance is represented here in these both groups before and after surgery.

The same phenomenon can be demonstrated here. In patients with constant obstruction the part of submucous congestion in total airway resistance is reduced after surgery.

Apparently functional nasal surgery is able to alter indirectly the degree of filling of the submucous vascular plexus, as expressed by nasal airway resistance values.

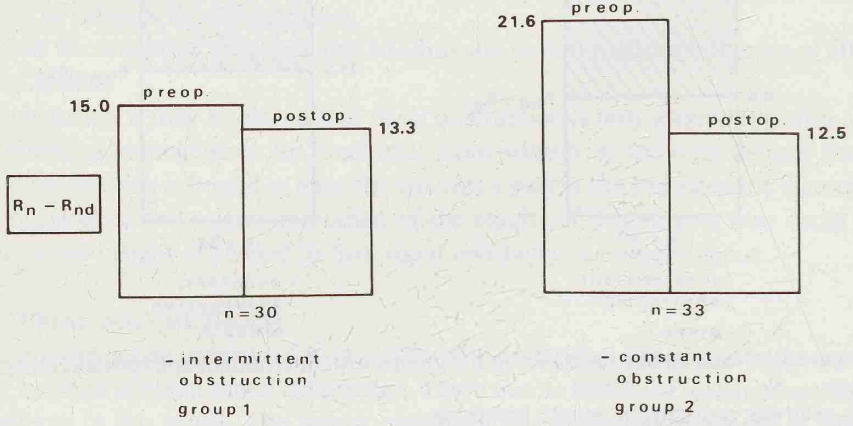

Figure 2. Airway resistances caused by submucous congestion in the groups with intermittent and constant obstruction before and after surgery.
$R_n - R_{nd}$ = the difference in airway resistance in nose breathing before and after decongestion of the nasal mucosa (see also Figure 1.).
The values are expressed in mm H_2O/lps. and the forementioned differences represent the median of the calculated values. The difference between the reduction in resistance between group 1 and 2 is significant ($p < 0.05$).

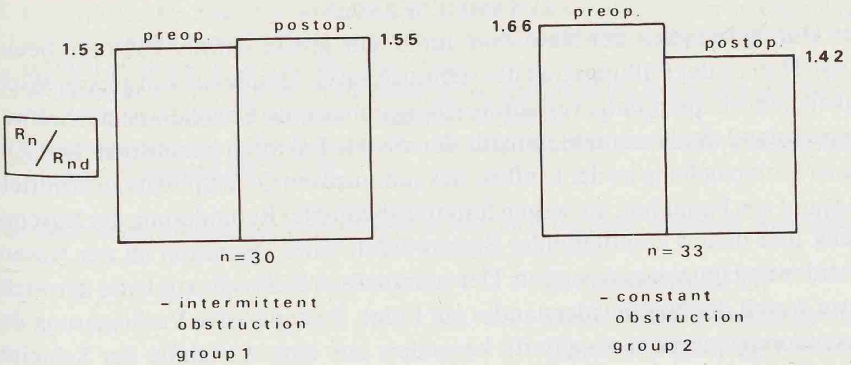

Figure 3. Airway resistance in nose breathing as a part of the airway resistance in breathing through the decongested nose before and after sugery.
R_n/R_{nd} = the relation between the airway resistance before and after decongestion during nose breathing (see also Figure 1.). Being quotients the values are without dimension. Preoperative and postoperative values show a significant difference in group 2 ($p < 0.05$).

The values which are obtained do not alter only absolutely, but also relatively: the part of submucous congestion in nasal airway resistance can be altered by this type of surgery.

Submucous congestion seems to play a more important role in nasal obstruction than mentioned in literature until now. In these patients obstruction is mainly brought about by the degree of filling of the submucous vascular plexus and improvement of nasal patency after septal surgery is primarily due to a reduction in submucous congestion. Septal surgery is important to produce a better nasal patency, but its effects are mainly indirect. Local anatomical factors are apparently able to influence the behaviour of the submucous vascular plexus. The underlaying mechanism of this phenomenon is unknown. Maybe reflexes, elicited by altered airstreams in the nose, play a certain role. As mentioned above a series of factors is known to be able to influence the submucous plexus in the nose. Local anatomical factors, like the presence or absence of septal deformities, can be added to this series.

CONCLUSIONS

In these patients with complaints of nasal obstruction the major part of nasal airway resistance is brought about by submucous congestion, especially in patients with a history of constant obstruction.

Septal surgery can indirectly influence the degree of filling of the submucous vascular plexus. To explain this phenomenon a mechanism of reflex origin can be assumed.

ZUSAMMENFASSUNG

Die Durchgängigkeit der Nase wird durch eine grosse Anzahl Faktoren beeinflusst. Hier ist der Füllungsgrad des submucösen Gefässplexus von grosser Wichtigkeit, jedoch quantitativ verhältnismässig unbekannt. Ebenfalls ist der Schwellungszustand der Nasenschleimhaut durch viele Faktoren beeinflusst. Das Ziel dieser Untersuchung ist der Einfluss des submucösen Gefässplexus zu ermitteln an Hand von Patienten, die wegen funktionsbedingter Behinderung der Nasenatmung und daraus resultierender Beschwerden einer Operation an der Nasenscheidewand unterzogen wurden. Der submucösen Gefässplexus hatte der wichtigste Anteil des Nasenwiderstandes zur Folge. Postoperative Verbesserung der Nasendurchgängigkeit resultierte besonders aus eine Abnahme der Schleimhautschwellung in der Nase. Lokale anatomische Verhältnisse sind offensichtlich in der Lage die Schleimhautschwellung auf indirecter Weise zu beeinflussen. Dieses Phänomen kommt möglicherwise von einem Reflex Zustande.

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The plethysmographic measurements were carried out at the Free University, Amsterdam.

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