



# Cytological and histological alterations in the nasal mucous membrane during experimental obstruction of nasal openings

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## SUMMARY

*In an attempt to determine the respiratory nasal mucous membrane response, a complete surgical obstruction of both nasal openings was experimentally done in four dogs. The fifth animal served as a control. After a 5 month period, the mucous membrane was cytologically and histologically examined. The findings obtained pointed to the development of degenerative alterations involving all the mucous membrane layers. The authors have thus concluded that stimulation of the respiratory mucous membrane by air stream is the most important factor associated with its multiple functioning. The results obtained in the experiment have been related to the daily clinical routine.*

## INTRODUCTION

Respiratory mucous membrane of the nose conditions the air inhaled and protects the lower respiratory tract and lungs from bacteria, viruses, cancerogenic and other substances (Cvetnić et al., 1978; Drettner, 1979; Kosoković et al., 1972). This is achieved by warming, moisturizing and cleaning the inhaled air. The protective mechanism consists of the local mucous membrane immunity, phagocytosis and bacteriologic action of the nasal secretion enzymes. Particular attention has been paid to the mucociliary apparatus (Forsgren, 1983; Ginzel et al., 1980; Schorn et al., 1976; Toremalm et al., 1975; Toremalm, 1983; Proctor et al., 1976; Mercke et al., 1976). All these activities can be performed by the respiratory mucous membrane owing to its histological construction, providing the nose has not been blocked and a close contact between air stream and mucous membrane has been allowed (Drettner, 1979). Air stream is the physiological stimulation required for the mucous membrane activity. Therefore, we decided to embark upon an experiment in dogs, in an attempt to determine the respiratory nasal mucous membrane response to air stream obstruction.



Figure 1. Experimental animal with both nostrils surgically obstructed.

#### MATERIAL AND METHODS

Dogs were chosen for the experiment, primarily because their respiratory nasal mucous membrane does not essentially differ from that in humans. The experiment was carried out in four dogs, whereas the fifth dog served as a control. The animals were aged 2-3 years and weighed 12-13 kg.

In four dogs, both nasal openings were surgically obstructed. During a 5 month period, the animals were allowed to breathe by mouth. After that period, the nasal cavity was re-opened and a smear for cytological examination taken, whereas the lower nasal concha was histologically examined. The same procedure was carried out in the control animal at both the beginning and end of the experiment (Figure 1).

Cytological preparations were coloured by the May-Grünwald-Giemsa (MGG) and histological preparations with hemalaun-eosin (HE) methods.

#### RESULTS

##### *Cytological findings*

In the first experimental animal, a low columnar cilium-free epithelium was cytologically found to predominate, with occasional cells of cubical epithelium.

Scarce cells of high columnar ciliated epithelium were also observed. Cellular cytoplasm exhibited degenerative changes, with a certain degree of metaplasia. In the second experimental animal, the cells of low columnar epithelium, both with and without cilia, were found to predominate, with parabasal cells also present. Occasional cells of high columnar ciliated epithelium were detected. Visible signs of degenerative alterations could be found in the cellular cytoplasm. In the third experimental animal, the cells of low columnar ciliated epithelium were observed to predominate. Some cells of high columnar cilium-free epithelium were found. Signs of degenerative alterations were present in the cellular cytoplasm.

In the fourth experimental animal, the cells of high and low columnar epithelium with and without cilia were observed. Signs of degenerative changes were present in the cytoplasm (Figures 2 and 3).

In the control animal, identical results were obtained both at the beginning and the end of the experiment, i.e., well-preserved cells of high columnar ciliated epithelium and scarce cubical cells. In the cytological preparations, erythrocytes could be seen owing to the nasal cavity recanalization.

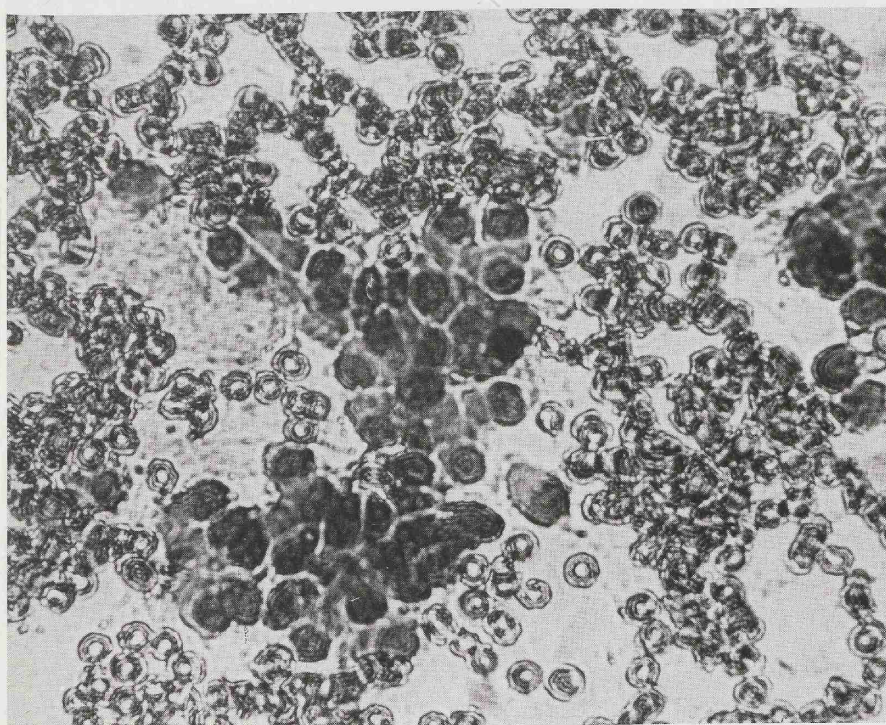


Figure 2. Low columnar epithelium with and without cilia. Erythrocytes. MGG. Animal No. 2.

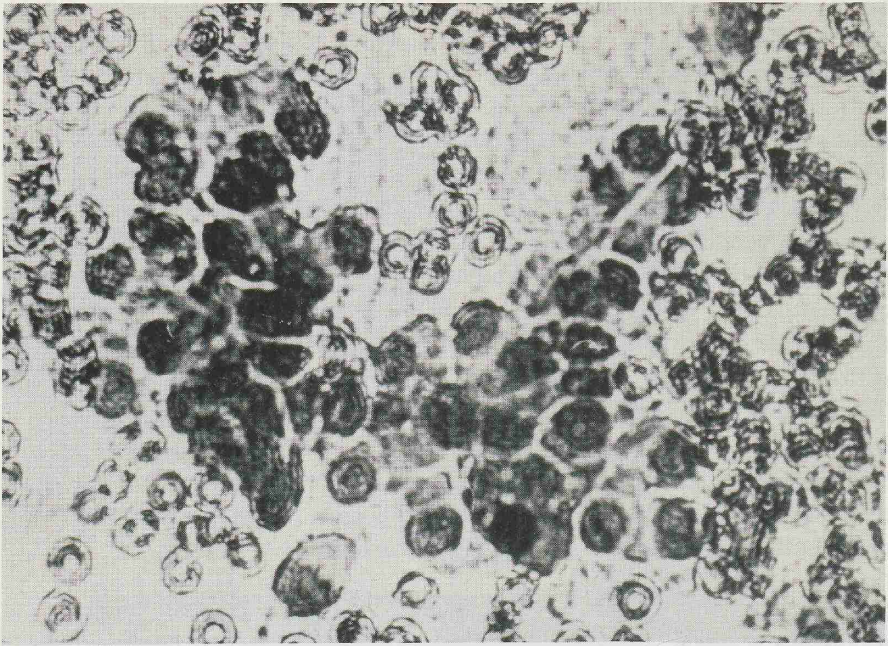


Figure 3. Cells of low columnar epithelium with cilia predominate. Erythrocytes. MGG. Animal No. 3.

#### *Histological findings*

In serial sections of the lower nasal concha, alterations were found in all experimental animals. The changes varied according to the location and extensiveness in relation to the whole concha inferior. The changes can be briefly described as follows:

- scattered visible atrophy of columnar epithelium;
- reduction of goblet cells, little or no mucous visible on the epithelium surface;
- cilia preserved at some sites; and
- in some of the mucous membrane areas, the epithelium reduced to a single layer of cubical cells.

Lamina propria at some sites swollen due to the connective tissue expansion, capillaries dilated, thickening of some blood vessel walls observed (Figures 4, 5, and 6).

#### DISCUSSION

The nasal function was experimentally cut off by surgical obstruction of both nasal openings. The highly differentiated columnar epithelium was thus deprived of the constant physiological stimulation exerted by air stream.

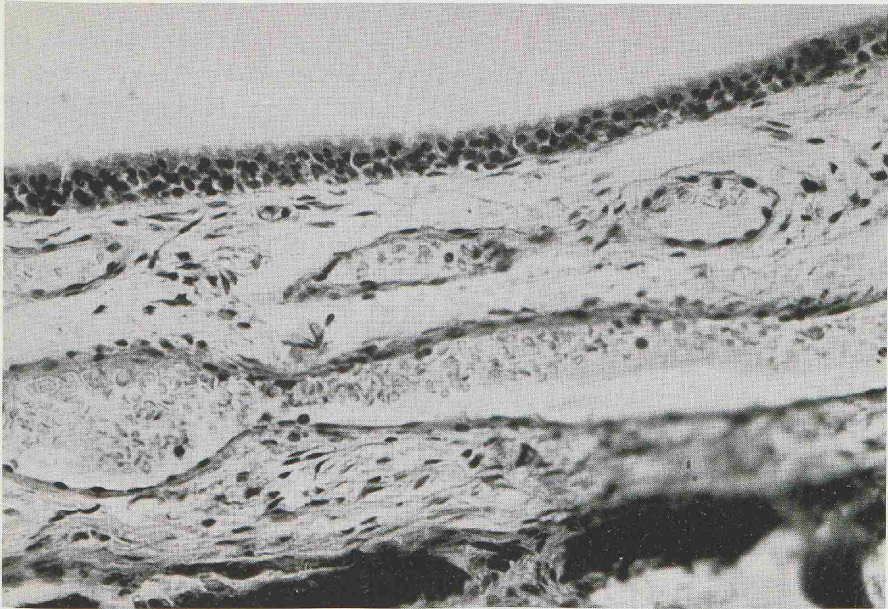


Figure 4. Mucous membrane of the low nasal concha in dog No. 1. On the surface, slightly changed stratified epithelium without goblet tells. In the lamina propria, wide blood filled veins, reduced glands. HE.

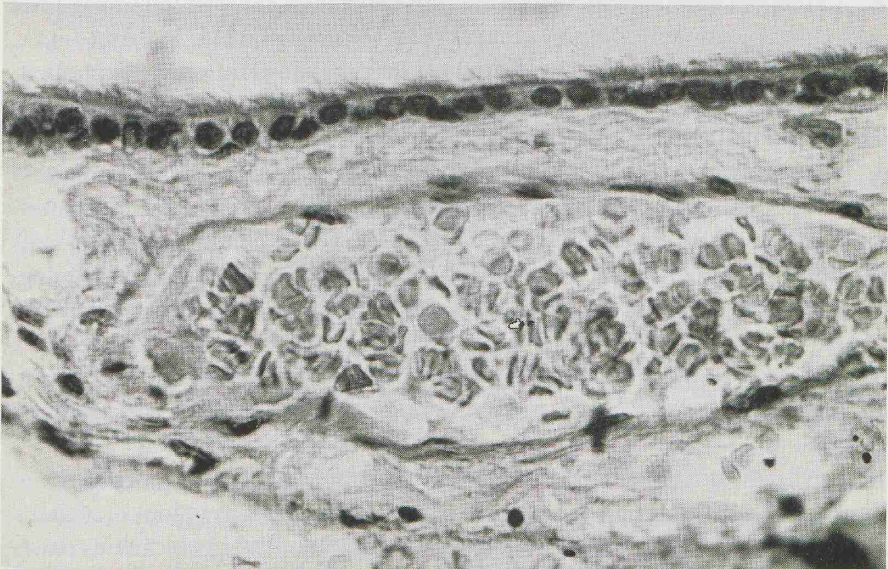


Figure 5. Mucous membrane of the lower nasal concha in dog No. 2. On the mucous membrane surface, low cubical ciliated epithelium. In the lamina propria, wide blood filled veins. HE.

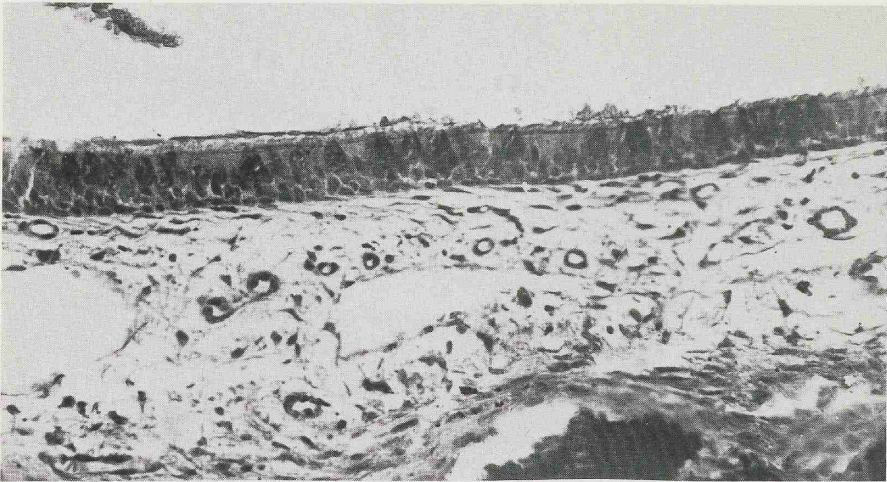


Figure 6. Mucous membrane of the lower nasal concha in control animal. Columnar epithelium with goblet cells. HE.

The described cytological and histological alterations indicated a gradual degenerative process to have occurred in all mucous membrane layers. The respiratory nasal mucous membrane vitality can be cytologically assessed on the basis of the finding of columnar ciliated epithelium and goblet cells, which was not the case in our experiment (Bogaerts et al., 1981; Holopainen, 1976; Bickmore et al., 1976). In our experiment, on the contrary, a strikingly small number of columnar ciliated and goblet cells was found. A similar finding was also obtained in laryngectomized patients, even after 10–15 years following laryngectomy (Cvetnić et al., 1986). Concerning the histological changes, atrophy of the columnar epithelium and reduction of goblet cells are worth mentioning as the most evident alterations in the entire concha. In some sections, however, columnar ciliated cells were found to remain preserved, pointing to the consistency between the cytological and histological findings. If our results are compared to those reported by others (Proetz, 1953; Tos et al., 1979), no substantial differences can be seen, even if various approaches are taken into account. There is no controversy concerning the fact that nasal obstruction leads to alterations in the nasal mucous membrane.

In conclusion, it has been confirmed that the respiratory nasal mucous membrane can fulfill its multiple function under the continuous physiological stimulation of air stream, providing a perfect aerodynamics of the nasal cavities exists (Cvetnić et al., 1976; Cvetnić et al., 1978; Forsgren, 1983; Kosoković et al., 1972). This justifies the importance of functional surgery of the nasal septum in human pathology to be particularly emphasized.

## ZUSAMMENFASSUNG

An vier Hunden führten die Autoren das Experiment der kompletten Obstruktion der beiden Nasenöffnungen chirurgisch durch, um festzustellen, wie sich die respiratorische Schleimhaut unter solchen Bedingungen verhalten wird. Das fünfte Tier diente als Kontrolltier. Nach fünf Monaten wurde die Schleimhaut zytologisch und histologisch untersucht. Die Befunde wiesen auf die Entwicklung degenerativer Veränderungen in allen Schichten der Schleimhaut in. Daraus war zu schließen, daß die Luftstromreizung der respiratorischen Schleimhaut der wichtigste Faktor für ihr vielfaches Funktionieren ist. Die Autoren verbanden die Experimentergebnisse mit der alltäglichen Praxis.

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