# Nasal cytology as a nasal test

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SUMMARY

*For years the presence of eosinophils has been considered a reliable diagnostic sign in the detection of nasal allergy, but little attention has been paid to the occurrence of other cellular elements. A complete study of hematogenic and epithelial cellular elements gives valuable information about the character of the rhinitis; i.e. is it caused by allergy or infection, or by both? The vitality of the mucosa, i.e. hyperfunction and atrophy, can also be assessed.*

In exfoliative cytology of the lower respiratory tracts, diagnosis of tumours is one of the main considerations. Nasal exfoliative cytology, however, concentrates on the differential diagnoses between various forms of rhinitis. Nasal exfoliative cytology is well established as a method of investigation, because as early as 1889 Gollash found eosinophils in the nasal secretion of an asthma patient. Later many authors have either emphasized (Eyermann, 1927, Vaheri, 1956, Bryan et Bryan, 1959) or questioned (Goldman, 1954, Johnson, 1962) the value of nasal exfoliative cytology in allergy work. The studies carried out by the Bryans in the 1950s have significantly widened the use of nasal exfoliative cytology in diagnosis of various nasal diseases.

The most convenient method of obtaining a cytologic sample from the nose is to use a cotton wiper, with which the surface of the middle or inferior turbinate is wiped lightly. The cotton wiper should be used when an uncontaminated cellular sample is needed. We can also get the sample by blowing of the nose on to a plastic film. Children prefer this method, which is sufficient when we only want to study eosinophils in the smears.

The choice of staining method also depends on how exact an interpretation of the cellular morphology is required (Holopainen, 1967).

The cellular picture of the normal or so-called symptomless nose is dominated by columnar epithelial cells (Picture 1). Goblet cells may also be found in moderate numbers (Picture 2). Hematogenic cells, such as neutrophils and eosinophilic leukocytes rarely occur in samples taken from normal nose.

The significance of tissue eosinophilia, blood eosinophilia and secretion eosinophilia has been the subject of constant interest in diagnostic work in allergy. Hlavacek et al. (1963) regard tissue eosinophilia as a significant and reliable change in allergy of the nasal mucous membrane. The tissue eosinophils originate in the bone marrow where the eosinopoiesis largely takes place (only to a small

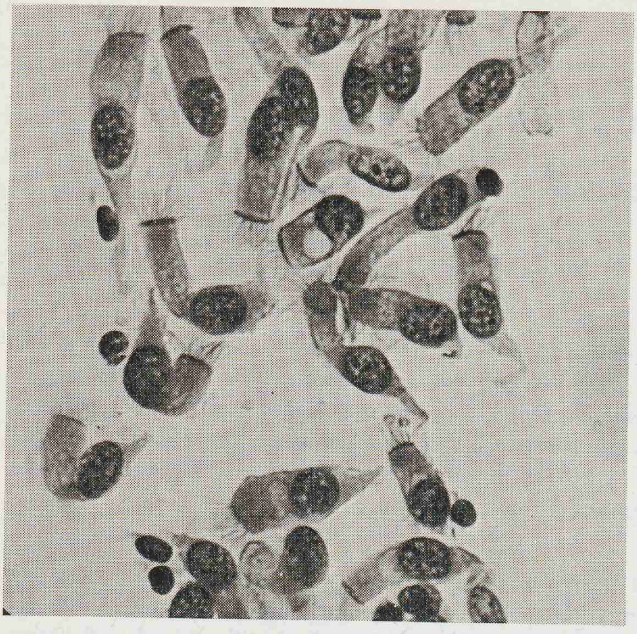

Figure 1: Ciliated epithelial cells in nasal smear Papanicolaou 520x.

extent in the spleen). From the bone marrow the eosinophils enter the blood circulation where they stay only for a short time (about 12 hours) and from there they enter the capillary net where they are stored. Through the walls of the

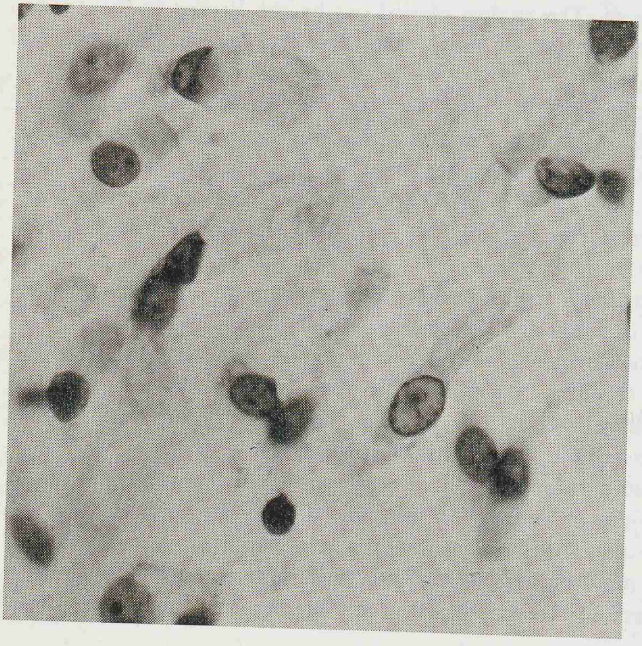

Figure 2: Nasal smear with goblet cells from normal nose Pananicolaou 520x.

capillaries they travel into the tissue where they are preserved for about 4 days, still functioning. A large part of the functioning mature eosinophils accumulate under the epithelium, from where the migration into the secretion takes place. The function of the eosinophils is not fully known, but it is assumed that they take part in the detoxication (peroxidase influence) and in the elimination of histamine. Parallel investigations of tissue and secretion eosinophilia have shown that their correlation is fairly good (Voorhorst, 1959, Holopainen, 1970). On the other hand, investigation of blood eosinophilia is not a reliable method of diagnosing allergy of the nasal mucous membrane (i.a. Palva et Palva, 1962).

What is then the final diagnostic value of secretion eosinophilia? From experience we know that eosinophilic cells (Picture 3) are without exceptions found in the secretion in clinically ascertained allergic reactions of the nasal mucosa (i.a. Hlavacek, 1963). On the other hand, it must be borne in mind that eosinophilic

Figure 3. Eosinophils. Eosin methylene blue 520x.

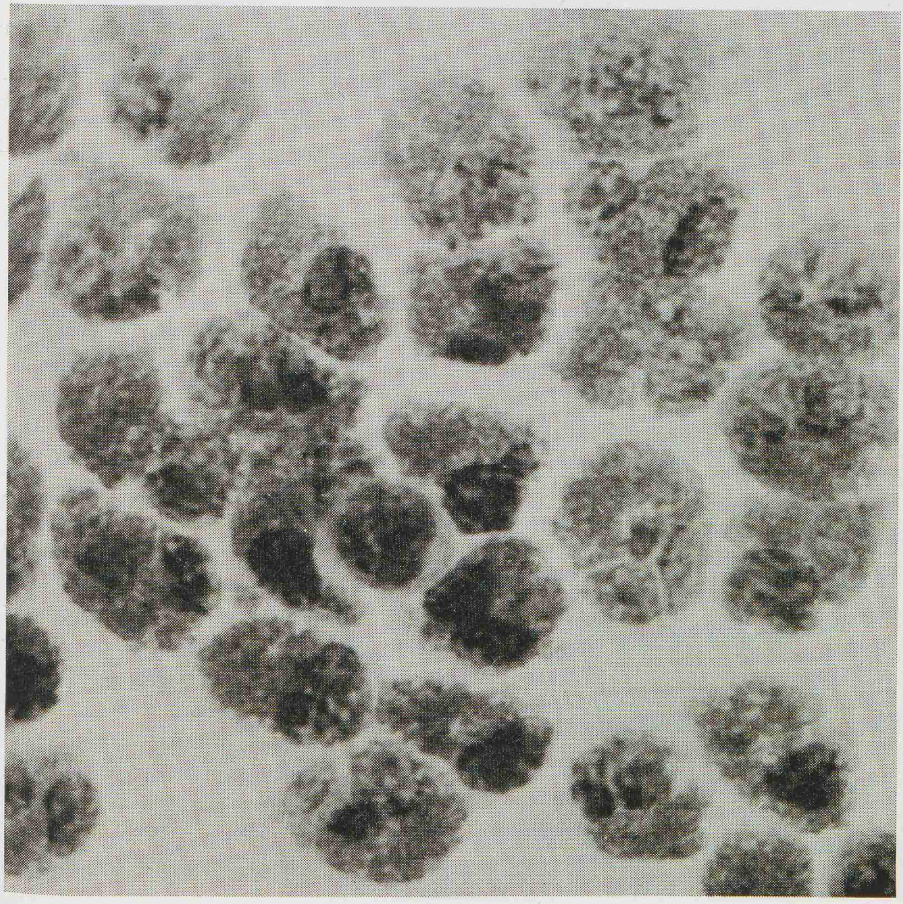

Figure 4: Mast cells in nasal smear Wright 1260x.

leukocytes occur in fairly large numbers in so-called intrinsic rhinitis, where the nasal mucosa is characterized by vasomotor lability (Kellner et al., 1970). Neither does the absence of secretion eosinophils eliminate the possibility of allergy, because superinfection, for instance, often masks secretion eosinophilia, so that

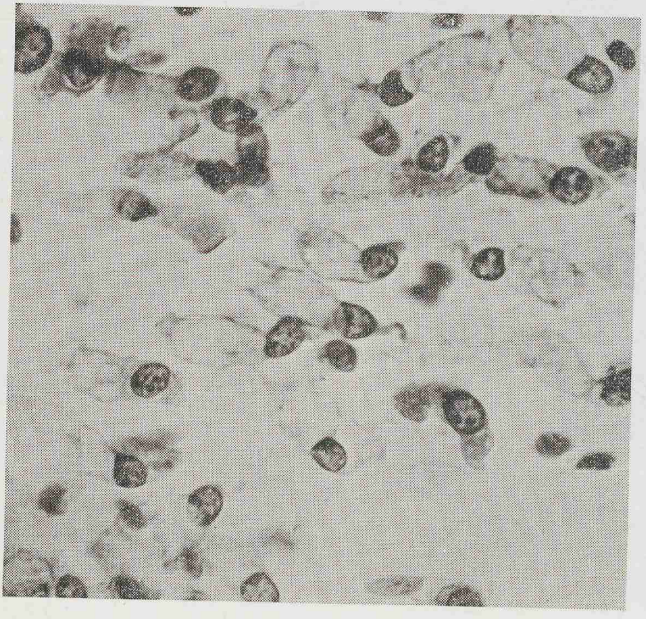

Figure 5: Nasal smear with abundant globet cells Papanicolaou 520x.

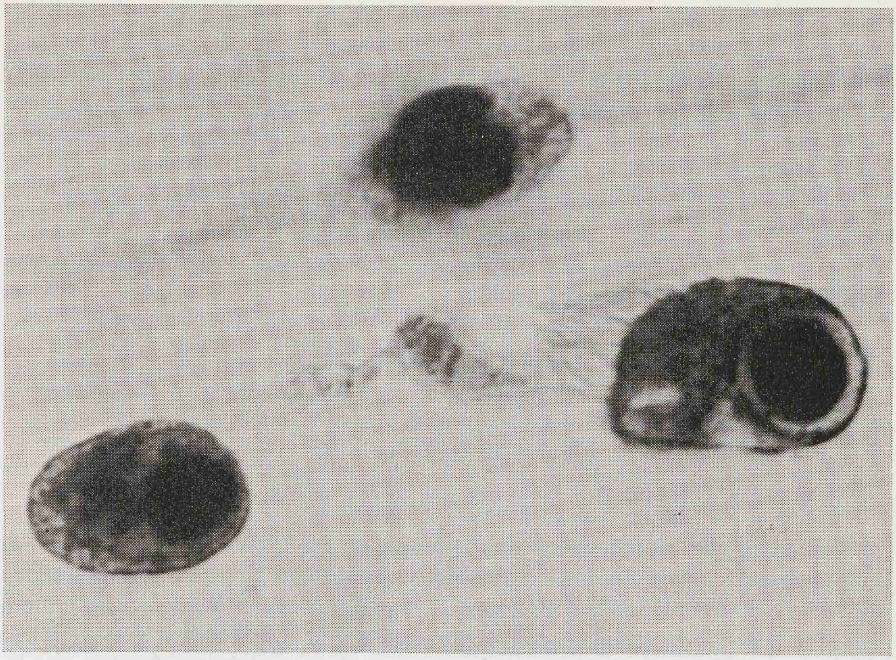

Figure 6. Viral Forms of epithelial cells (CCP cells) Papanicolaou 1260x.

eosinophils do not appear in the secretion until the infection is over. For this reason we need several samples, before the final diagnosis can be made.

According to the Bryans' investigations the occurrence of mast cells in abundant numbers in the nasal secretion indicates food allergy (Picture 4). The diagnostic significance of these cells has not been conclusively determined, however, although similar observations have been made by others (Shioda and Mishima, 1966).

The presence of ciliated columnar cells and goblet cells is a sign that the mucous membrane is functioning normally. If, however, the number of goblet cells increases so much that their number approaches 50 percent of all epithelial cells (Picture 5), this is an indication of the hyperfunction of the mucous membrane. Both allergy and vasomotor lability may cause an increase in the production of secreting goblet cells.

Differential diagnosis between repeated virus infections and recurrent allergic manifestations may cause difficulties, as the symptoms and clinical picture of the nose show great similarities in both disorders.

In viral infections degenerative changes appear in the nuclei of the epithelial cells of the nasal mucous membrane. These CCP cells (virus inclusions) (Picture 6) occur in large numbers during the first few days of the virus infection. When the infection changes into bacterial infection, the inclusions have already disappeared and the cellular picture is dominated by neutrophilic leukocytes, among which bacteria may also be visible. If the infection is chronic, the prolonged irritation

of the mucous membrane produces structural changes in the ciliated epithelial cells, and by means of metaplasia, islands of squamous epithelial cells are formed. Thus ozaena, which is the most advanced stage of atrophic rhinitis, can show a cellular picture where almost all epithelial cells are metaplastic cells or squamous epithelial cells (Picture 7), whereas ciliated columnar cells and goblet cells appear very sparsely.

Schematic presentation of information obtained in nasal exfoliative cytology:

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|---|---|
| INFECTION | CCP cells (virus inclusions) |
| | Neutrophils and bacteria |
| ALLERGY | Eosinophils |
| | Mast cells |
| VITAL MUCOSA | Columnar epithelial cells |
| | Goblet cells |
| ATROPHIC MUCOSA | Metaplastic cells |
| | Squamous epithelial cells |

ZUSAMMENFASSUNG

Seit Jahren ist das Vorkommen von Eosinophilen im Nasensekret als ein zuverlässiges diagnostisches Zeichen in der Feststellung von Nasenallergie angesehen worden. Dagegen sind andere Zellelemente weniger beachtet worden. Eind grundliches Studium der hämatogenischen Zellelemente und Epithelzellen gibt wertvolle Information über den Charakter der Rhinitis; d.h. kommt Allergie, Infektion, oder beide in Frage? Die Vitalität der Schleimhaut, d.h. Hyperfunktion und Atrophie, geht auch hervor.

Figure 7: Metaplastic cells from ozaena patient Papanicolaou 940x.

REFERENCES

1. Bryan, W. T. K. and Bryan, M. P., 1950: Structural changes in the ciliated epithelial cell during upper respiratory infection: a preliminary report. Laryngoscope, 60, 523-531.
2. Bryan, W. T. K. and Bryan, M. P., 1959: Cytologic diagnosis in otolaryngology. Trans. Amer. Acad. Ophthal. Otolaryng., 63, 597-612.
3. Eyermann, C. H., 1927: Nasal manifestations of allergy. Ann. otol. 36, 808-815.
4. Goldman, J., 1954: Bacteriologic and cytologic criteria for diagnosis in nasal and sinus disease. Trans. Amer. Acad. Ophthal. Otolaryng. 58, 68-72.
5. Gollash, 1889: Fortschritte der Medizin, 7, 361-365.
6. Hlavacek, V. et al., 1963: Mast cells in the mucous membrane of the upper respiratory tract during normal and pathological states. Acta otolaryng. (Stockholm), 56, 182-191.
7. Holopainen, E., 1967: Nasal mucous membrane in atrophic rhinitis with special reference to symptomfree nasal mucosa. Acta otolaryng. (Stockholm), Suppl., 227.
8. Holopainen, E., 1969: Exfoliative nasal cytology in atrophic rhinitis with reference to some other nasal diseases. Int. Rhinol., 7, 92-94.
9. Johnson, K., 1962: Mast cells and eosinophils in food and inhalant allergy. Ann. allerg., 20, 657-660.
10. Keller, G. et al., 1970: Die Bedeutung der Zytodiagnostik für die Differentialdiagnose zwischen vasomotorischer und allergischer Rhinopathie. Mschr Ohr Hk (Vienna), 104, 358-364.
11. Palva, T. and Palva, A., 1962: Allergic changes in the mucosa of the chronically infected maxillary sinus. Pract. otorhinolaryng. (Basel) 24, 1-16.
12. Shioda, H. and Mishima, T., 1966: The significance of mast cells in nasal smears from patients with food allergy. J. allerg. 37, 321-328.
13. Vaheri, E., 1956: Nasal allergy with special reference to eosinophilia and histopathology. Acta Allerg. (Copenhagen), 10, 203-211.
14. Voorhorst, R., 1959: Verschiedene Ursachen der Eosinophilie. Allerg. Asthma (Leipzig), 5, 276-283.

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