

Histopathology of the nasal mucosa in furniture workers

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Until quite recently very little was known about the histology of the nasal mucosa of furniture workers. The objective of this presentation is to give a brief summary of the present knowledge concerning the histological changes of the nasal mucosa in furniture workers and to discuss the significance of the possible precancerous lesions and the histogenesis of nasal carcinoma.

In original epithelium of the nasal mucosa is a pseudostratified columnar epithelium. This epithelium is composed of four types of cells: basal cells, indifferent cells, ciliated cells and mucus producing or goblet cells. The ciliated cells appear to be most susceptible to injury. As they disappear, they are replaced by goblet cells, resulting in an epithelium with goblet cell hyperplasia. Gradually the epithelium becomes stratified, composed of cuboidal cells only. This type of epithelium has been called stratified cuboidal epithelium, and is the first stage in the sequence of metaplastic transformation. Transmission electron microscopy revealed that the superficial cells in this epithelium contain mucous granules and consequently it is believed that these cells represent modified goblet or mucus producing cells (Boysen, 1982). Depending on the degree, duration and type of exposure to exogenic factors, the epithelium undergoes further changes. The superficial cells flatten and through an intermediate stage, mixed stratified cuboidal/stratified squamous epithelium, fully developed metaplastic squamous epithelium arises (Figure 1). Transmission electron microscopy has shown that the almost fully developed squamous epithelium still is capable of producing mucus (Boysen, 1982).

In addition to the various types of metaplastic epithelium biopsies from furniture workers show dysplastic changes and two types of dysplastic nasal epithelium have been observed, the squamous and cuboidal type. The former type is similar in morphology to dysplasia of for example the cervix and lower airways where this type of epithelium is considered preneoplastic (Figure 2). This type of dysplasia was usually seen in direct continuity with squamous epithelium suggesting that squamous metaplasia is a mandatory stage in the transformation to dysplasia. The

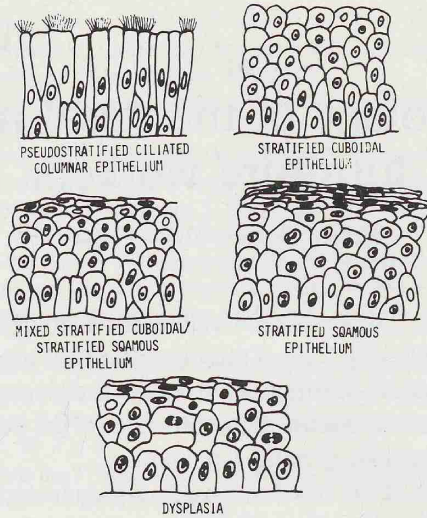


Figure 1. Schematic presentation of the various types of metaplastic nasal epithelium and dysplasia (squamous type) encountered in the nasal mucosa.

preneoplastic character of nasal squamous dysplasia has, however, not yet been proved as we lack the final proof, that is the direct transition of dysplasia to carcinoma in situ and carcinoma.

From Table 1 it can be seen that squamous metaplasia was more frequently found in furniture workers than in controls. Among furniture workers 14 cases of dys-



Figure 2. Dysplasia of the squamous type in the nasal mucosa. The epithelium shows disturbed polarity with cellular and nuclear pleomorphism $\times 400$.



Figure 3. Dysplasia of the cuboidal type in the nasal mucosa. The epithelium is composed of large atypical cuboidal cells $\times 350$. With courtesy of dr. B. Wilhelmsson.

Table 1. Histological findings in furniture workers and controls.
Types of nasal epithelium.

	no.	pseudo stratified epithelium	stratified cuboidal epithelium	mixed stratified cuboidal/stratified squamous epithelium	stratified squamous epithelium	dysplasia
furniture workers	113	13	20	21	45	14
controls	54	11	15	18	9	1

plasia (13%) was observed compared to only one (2%) in controls. A similar study performed by Wilhelmsson and Lundh (1984) disclosed one case of dysplasia and a frequency of metaplasia similar to that of the controls, but there was a significant increase of cuboidal metaplasia in the wood dust exposed group. The discrepancy between these two studies may be explained by a somewhat different sampling technique and by the fact that the workers in the former study had a longer and possibly higher degree of exposure. Recently we have observed the same type of dysplasia in furniture workers exclusively exposed to softwood (Boysen et al., unpublished results).

On examining biopsies and operation specimens of woodworkers with adenocarcinoma Wilhelmsson et al. (1984) observed another type of dysplasia, - the cuboidal type (Figure 3). In 10 cases this type of dysplasia was seen in direct continuation with adenocarcinoma (Table 2). It thus seems highly probable that the cuboidal type of dysplasia is a precancerous lesion.

Attempts have been made to analyse the significance of other factors that might influence the nasal epithelium. It seems that the degree of metaplastic transformation is more pronounced in higher age groups and in smokers (Boysen and Solberg, 1982). The incidence of dysplasia was, however, not higher in smokers than in non-smokers. Similar observations have been made in nickelworkers which is another occupational group with increased incidence of nasal carcinoma (Torjusson et al., 1979; Boysen et al., 1984). The lacking association between nasal dysplasia and smoking is surprising in view of the well known relationship between

Table 2. Histopathological findings in non-tumorous nasal mucosa in woodworkers with adenocarcinoma of the ethmoids.
Types of epithelium observed.

no. of adenocarcinoma examined	cuboidal metaplasia	cuboidal metaplasia with dysplasia	cuboidal dysplasia in continuity with the tumor	squamous cell metaplasia
22	19	16	10	5

smoking and preneoplastic lesions and carcinoma of the bronchial epithelium. In Figure 4 the probable sequence of histological changes and the histogenesis of nasal malignancies in workers occupationally exposed to wood-dust are summarized. Following the development of cuboidal epithelium two alternatives are possible. The epithelium can either be transformed to metaplastic squamous epithelium and further to dysplasia and carcinoma, preferentially squamous cell carcinoma. Direct transition of stratified cuboidal epithelium to cuboidal dysplasia and adenocarcinoma also seems possible. As mentioned previously mucous granules have been demonstrated in almost fully developed squamous epithelium. This epithelium thus has the characteristics both of squamous and mucous producing epithelium. This means that the undifferentiated dividing cells of this epithelium are biphasic. Consequently dysplasia of the squamous type may be of importance not only in the histogenesis of squamous cell carcinoma, but also for adenocarcinoma. Further studies both in humans and experimental animals should be performed in order to clarify this issue.

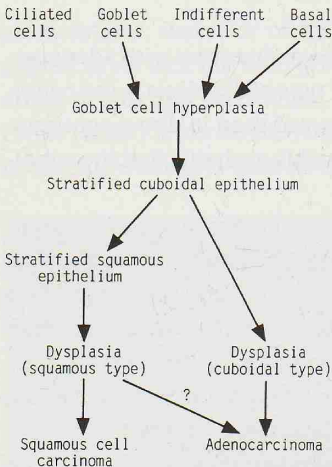


Figure 4.
Hypothetical histogenesis of nasal carcinoma.

Acceptance of nasal epithelial dysplasia as a precancerous stage, implies that the presence of this lesion may be used as an indicator of exposure to carcinogens and that workers with this lesion have an increased risk of developing nasal carcinoma. Moreover it appears that epidemiological studies by means of small nasal biopsies are useful in identifying groups of workers with increased risk of nasal carcinoma.

REFERENCES

1. Boysen M. The surface structure of the human nasal mucosa. 1. Ciliated and metaplastic epithelium in normal individuals. A correlated study by scanning/transmission electron and light microscopy. *Virchows Arch (Cell Pathol)*, 1982; 40:279-94.
2. Boysen M, Solberg LA. Changes in the nasal mucosa of furniture workers. A pilot study. *Scand J Work Environ and Health* 1982; 8:273-82.
3. Boysen M, Solberg LA, Torjussen W, Poppe S, Högetveit AC. Histological changes, rhinoscopical findings and nickel concentration in plasma and urine in retired nickel workers. *Acta Otolaryngol (Stockh)* 1984; 97:105-15.
4. Torjussen W, Solberg LA, Högetveit AC. Histopathological changes of the nasal mucosa in active and retired nickel workers. *Br J Cancer* 1979; 40:568-80.
5. Wilhelmsson B, Hellquist H, Olofsson J, Klintenberg C. Nasal cuboidal metaplasia with dysplasia - Precursor to adenocarcinoma in wood-dust-exposed workers? *Acta Otolaryngol (Stockh)*. In press.
6. Wilhelmsson B, Lundh B. Nasal epithelium in woodworkers in the furniture industry. A histological and cytological study. *Acta Otolaryngol (Stockh)* 1984; 98:321-34.

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