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Influence of vapours on the nasal mucosa among industry workers

L. M. Ödkvist, C. Edling and H. Hellquist, Linköping, Sweden

The increasing concern about various health hazards in industry has lead to a situation where patients more frequently visit a physician because of different symptoms allegedly caused by occupational exposure. In ENT practice we often see patients complaining of nasal problems which, according to the case histories, could be related to environmental pollution. Chemical agents in occupational setting have been implicated in the causation of various disturbances of the nose and paranasal sinuses. Certain nickel compounds have shown to be rather powerful carcinogens in animals (Gilman, 1962; Heath and Daniel, 1964; Heath and Webb, 1967) and an increased risk for nasal carcinoma in nickel workers has been shown in epidemilogical studies (Doll et al., 1970; Pedersen et al., 1973). Attention has also been drawn to other agents, i.e. wood dust (Acheson et al., 1968; Hadfield, 1970; Andersen et al., 1976), coal, coke dust and leather (Acheson et al., 1981). Histopathological changes of the nasal mucosa have been reported among nickel workers (Torjussen et al., 1979; Boysen et al., 1980a, b, 1982) and furniture workers (Boysen and Solberg, 1982; Wilhelmsson and Drettner, 1984). This study was performed to evaluate to which extent alterations of the nasal mucosa were present among workers, occupationally exposed to different airbone substances, e.y. oil mist, styrene, solvents and formaldehyde.

MATERIAL AND METHODS

Group I (Oil mist)

Six turners, 31-64 years (M = 46) were examined. Exposure time varied between 4-29 years (M = 15). Four were smokers. All six performed tasks on eleven automatic lathes in a metal-shop. The cutting oils in use for the last few years were of a mineral type with less than 6% aromatic hydrocarbons and hardly any additives. Measurements made by the factory inspectorate showed low oil mist values, around 1.3-2.5 mg/m^3, to be compared with the Swedish threshold limit value (TLV) of 5 mg/m^3).

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Group II (Oil mist)
Fifteen wire-drawers aged between 23–62 years (M = 40), exposed to oil mist while pulling metal threads, were examined. Exposure time was between 1–15 years (M = 8). Nine were smokers. The levels of oil mist in air were 0.1–0.3 mg/m^3 which is well below TLV.

Group III (Styrene)
Eleven ship builders aged 26–57 years (M = 39), took part in this survey. They where building yachts using reinforced styrene plastic. Exposure time was 1–16 years (M = 7 years). Six were smokers. Air levels of styrene in the plant were in the range of 200–250 mg/m^3, whilst the TLV was 210 mg/m^3.

Group IV (Solvents)
Ten paint-sprayers aged 23–45 years (M = 32), who had worked for 1–26 years (M = 7), were examined. Seven out of 10 were smokers. Air-sampling disclosed different organic solvents and pigment-containing dust. The number of solvents in use were 13 but most of them were found in only small amounts and the main solvents were toluene and isobutylacetate. The exposure levels, however, were low in comparison to the threshold limit values in Sweden, and also the threshold limit of the mixture was low (0.3). The dust contained mainly chromium oxide and zinc oxide. Even here were noted only small amounts with good margins to the TLV, both for the separate matters and for the total amount.

Group V (Formaldehyde)
Twenty workers processing particle board participated. Their age was 22–51 years (M = 37). Exposure time was 4–9 years (M = 7). Seven were smokers. Hygienic measurements had revealed levels of formaldehyde in air in the range of 0.1–1.1 mg/m^3 which is to be compared to the TLV of 1.0 mg/m^3.

Group VI (Referents)
A reference group of 25 men were selected with regard to age and smoking habits and without any industrial exposure. They were 25–60 years old (M = 35) and 12 were smokers.

METHODS
By a careful history the duration and intensity of different symptoms from the respiratory tract were noted. Changes from normal evaluated in a clinical examination of the nose and nasopharynx.
Nasal biopsies were taken under local anesthesia from the mucosa of the inferior turbinate 1 cm behind its anterior edge. The biopsy specimens were fixed in 10% neutral-buffered formalin and embedded in paraffin, cut at various levels and

stained with haematoxylin and eosin. The sections, with covered labels, were examined twice and without access to clinical or occupational information. The morphological grading was carried out according to a scoring system proposed by Torjussen et al. (1979) (Table 1).
Difference between the groups were tested by a non-parametric test (Wilcoxon).

Table 1. Histologic characteristics and scores used for grading of the nasal mucosa (modified after Torjussen et al., Cancer 1979, 44:963.

histological characteristics	points score
normal respiratory epithelium	0
loss of cilia	1
mixed cuboid/squamous epithelium, metaplasia	2
stratified squamous epithelium	3
keratosis	4
"budding" of epithelium	add 1
mild or moderate dysplasia	6
severe dysplasia	7
carcinoma	8

RESULTS

The histories disclosed nasal symptoms e.g. rhinitis, crusting, in 5 (83%) workers in group 1, 6 (40%) in group 2, 2 (18%) in group 3, 7 (70%) in group 4, and 14 (70%) in group 5.

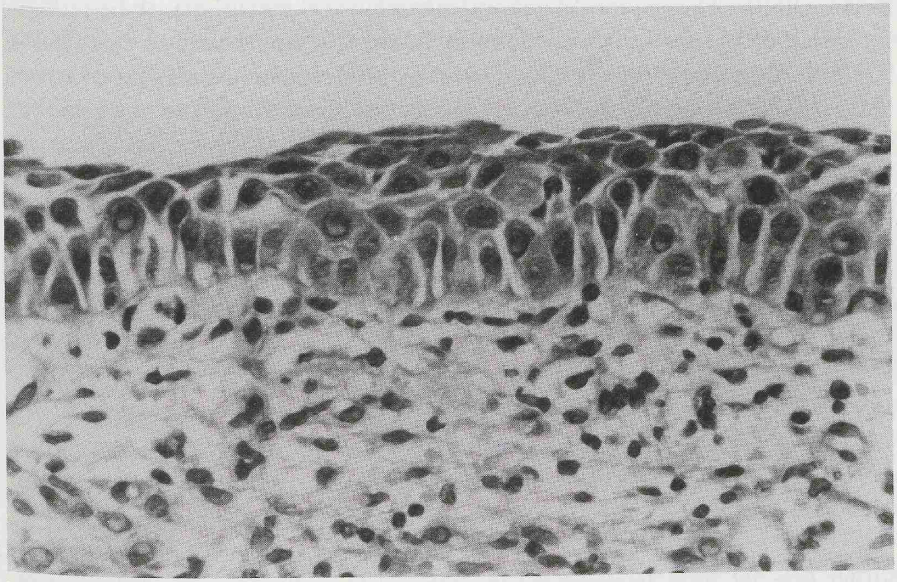

Figure 1. Microphotograph of a nasal mucosa showing mixed cuboid/squamous cell metaplasia. Note loss of cilia. Points score = 2. (H & E, ×520).

Figure 2. Microphotograph of a nasal mucosa showing squamous cell metaplasia with budding of the epithelium. Points score: 4(3 + 1). (H & E, × 130).

The histological examination of the nasal mucosa from the exposed workers only occasionally revealed a normal, ciliated pseudostratified epithelium. Loss of cilia, goblet cell hyperplasia, mixed cuboid/squamous cell metaplasia, and stratified squamous all epithelium were common findings. Not infrequently there was a budding of the epithelium (Figures 1 and 2). Mild squamous cell dysplasia was observed in a few specimens, but in no cases could severe dysplasia or carcinoma be detected.

Table 2 displays the mean histology scores for the differences groups. The most severe findings were made among the solvent exposed, while the styrene group and the group exposed to low concentration oil mist have to be regarded as nor-

Tabel 2. The exposure for the different groups is given and its intensity compared to threshold limit value. The number of persons and their mean score in the histological grading.

exposure	n	age (mean)	exposure years (mean)	exposure level (mg/m^3)	TLV (mg/m^3)	histology score (mean)
1. oil mist	6	46	15	1.3–2.5	3.0	3.0 $p < 0.05$
2. oil mist	15	40	8	0.1–0.3	3.0	2.4
3. styrene	11	39	7	200–250	210	2.2
4. solvents	10	32	7	30% of TLV		4.0 $p < 0.05$
5. formaldehyde	20	36	7	0.1–1.1	1.0	2.9 $p < 0.05$
6. referents	25	35	–	–	–	1.8

mal. There were statistically significant ($p < 0.05$) difference of the means for the turners (oil mist) spray-painters (solvents) and particle-board workers (formaldehyde) compared to the non-exposed.

DISCUSSION

The present investigation might be looked upon as series of pilot studies. The cross sectional design inherits certain limitations for the interpretation of the results e.g. severely disturbed workers may have left the factory, resulting in an underestimation of an environmental influence on the nasal mucosa or only employees with symptoms take part, resulting in an overestimation of positive findings. Although we have not been able to include former employed, the drop-outs among the present workers were limited which suggests that the results are representative for the current situation. Taken together the differences in histological findings between the studied groups and the co-variation between the findings and the symptoms points to an environmental influence on the respiratory epithelium of the workers.

Regarding the complaints of nasal problems, it is easy to understand that loss of goblet cells and cilia leads to symptoms like dry rhinitis and crustings, both being symptoms of a decreased mucociliary function.

Milder changes in the nasal mucosa lead to more or less severe symptoms but no serious illness, while higher degrees of alterations in the mucosa i.e. dysplasia should be considered to be a pre-cancerous lesion, (Boysen et al., 1982). In our series very few specimens were classified as dysplasia so we may deduct that in the studied environments, with exposure levels around and below TLV, there is no great risk for malignancies. The differences in scores between the groups could be explained by differences in exposure levels and exposure time, e.g. the difference between group I and II (Irander, 1980), or differences in physical properties, e.g. if the toxic substance is carried to the nasal mucosa in a gaseous form or carried by particles. The latter will result in a longer contact time between the substance and the mucosa. When spray-painting, the solvents are carried to the nasal mucosa as droplets (Hellquist et al., 1983) whereas styrene, in yacht-buildings, is in a purely gaseous form. Considering formaldehyde, we noticed in another study of a small group of pathologists that although exposed to formaldehyde they had no changes in the nasal mucosa biopsies. The findings in particle-board workers could indicate that formaldehyde carried to the nasal mucosa by dust particles preferably wood dust have a longer contact with the nasal mucosa and thus the noxious effect becomes noticeable. It could also be discussed if wood-dust per se has a noxious effect on the nasal mucosa (Boysen and Solberg, 1982; Wilhelmsson and Lund, 1984).

However the wood used in the particle-board factories is of the soft nature (spruce and pine), which is looked upon as less harmful than hard wood dust

(Engzell et al., 1978). Smoking might cause similar alterations on the nasal mucosa (Boysen and Solberg, 1982) but the frequency of smokers was about the same in the exposed groups and the referent group or even fewer smokers, as among the formaldehyde exposed. Therefore differences in smoking habit could not explain the obtained results.

In conclusion the results of this study indicate a relationship between degree of exposure and nasal disturbances and suggest that alteration of the nasal mucosa might be at hand although the exposure is kept at acceptable levels, compared to TLV:s. Nasal biopsies may also prove valuable for the recognition of occupational hazards.

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L. M. Ödkvist, M.D.
Dept. of Otorhinolaryngology
University Hospital Linköping
S-581 85 Linköping
Sweden

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