Effect of Long-term Exposure to Nitrogen Dioxide on Lung Glycoproteins Level

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Summary. The influence of nitrogen dioxide on glycoprotein level in lung tissue of guinea pigs was studied after 180 days (8 h per day) of exposure at a concentration of 2 mg/m³.

A long-term exposure induced a decrease of protein-bound hexosamines and an increase of sialic acid level in lungs.

Key words: Nitrogen dioxide - Glycoproteins - Lungs.

Nitrogen dioxide is an important toxic component of industrial and automobil exhaust gases and tobacco smoke [1,2]. It is well known that nitrogen dioxide stimulates the development of lung emphysema and cardio-vascular damage [11-15,20,24-26] and it is suggested that those injuries are produced by its effect on connective tissue. Kucharz et al. [19] and recently Dródz et al. [5,8] have found that chronic exposure to nitrogen dioxide induces a decrease of total collagen content in lung tissue.

After the discovery of structural glycoproteins and their relationship to collagen fibres they attracted increasing attention, particularly because they appear to play a role in tissue remodelling processes that occur under physiological and pathological conditions [3,4,18,22]. Studies of Dródz et al. [6,7] and Kucharz et al. [16,17] indicate that the level of protein-bound carbohydrates change under the influence of agents effecting the connective tissue; they may be used as a simple index for an assay of the structural glycoprotein level.

In our previous paper it has been shown that disturbances in serum glycoprotein concentration existed under conditions of chronic poisoning with nitrogen dioxide [9]. The study of the occurrence of changes in collagen metabolism in "the first contact" organ, i.e. lungs, during long-term exposure to nitrogen dioxide is the aim of the present paper.

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MATERIALS AND METHODS

Ninety male guinea pigs (body weight approx. 400 g) divided into experimental (60 animals) and control (30 animals) groups were used. Animals were exposed to nitrogen dioxide 8 h per day during 180 days in toxicological chambers. The concentration of nitrogen dioxide was 2 mg/m$^3$ and was monitored continuously. A volume of air introduced into the chamber, i.e. 9,000 dm$^3$/h, prevented the animals from asphyxia and accumulation of carbon dioxide in the chamber. Control animals inspired fresh air in toxicological chambers as well.

After the experiment the animals were killed by decapitation. Lungs were removed as fast as possible and weighed. The tissue were homogenized in distilled water using glass-glass homogenizer. Protein-bound hexoses were measured according to Winzler [28] as described by Schmidt [23], protein-bound hexosamines according to Rimington [21] and sialic acids with the thiobarbituric method of Warren [27]. The standard substances: glucose, glucosamine and N-acetylneuramic acid respectively (Sigma, USA) were used. The results obtained were analyzed according to normal distribution with Student's t-test.

RESULTS AND DISCUSSION

It has been found that intoxication of animals leads to the development of changes in glycoprotein metabolism. The results of glycoprotein estimation in lung tissue are shown in Table 1. The level of sialic acids has increased and protein-bound hexosamines content has decreased under conditions of nitrogen dioxide poisoning.

The results show evidently the influence of long-term exposure to nitrogen dioxide on connective tissue, particularly on glycoproteins. The mechanism of those changes is not well understood. As compared with the results described in a previous paper [9] the trend in serum and tissue glycoprotein level is similar. Changes in serum glycoprotein content may result from the effect of nitrogen dioxide on protein metabolism in the liver as supported by previous studies, which showed evident changes in liver enzyme activities [9]. Changes of glycoprotein content in lung tissue reveal that serum alterations may be induced by effect of nitrogen dioxide on tissues. Evident alterations in collagen metabolism described by Kucharz et al. [19] and Dróżdź et al. [5,8,10] may be connected with structural glycoprotein disturbances (for review see [18,22]). On the other hand it has been found that changes in intensity of tissue metabolism markedly effect glycoprotein level in tissue as well as cause a destructive action of nitrogen dioxide on denaturated