

MICROBIOLOGY AND IMMUNOLOGY

Immunological Reactivity under Conditions of Prolonged Exposure to Ozone

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Immune status of 158 workers exposed to ozone in a maximal permissible concentrations (0.1 mg/ml) for a long time was evaluated using a turbidimetric method. A tendency to decrease in IgA concentration in subjects with longer service was detected. The ranges of IgM and IgG levels were determined, which probably reflect individual differences. The concentration of circulating immune complexes in the blood was increased.

Key Words: ozone; immune status; ecological factors

Immunological mechanisms are involved in the development of virtually all diseases, being their cause or result, and lead to chronic diseases and complications [2,7].

Ecological factors form the immune status of normal subjects and determine the characteristic features of diseases developing in the presence of immune shifts [5,7]. The problem of immunological protection of humans exposed to a potent oxidant ozone acquires special importance [10,11].

We compared the characteristics of humoral immunity and production of effector and regulatory molecules: immunoglobulins A, M, and G and circulating immune complexes (CIC) in subjects engaged in the production of plastisizers occupationally exposed to ozone.

MATERIALS AND METHODS

Clinical and immunological studies were carried out in 158 workers (144 men and 14 women) divided into groups with different length of service (1-10 years and more). The reference groups consisted of healthy subjects working at the same plant ($n=8$) and residents of the city ($n=12$), where this petrochemical plant was

situated. The mean age of workers with service of 1-7 years was 36.5 years and of others 44.2 years. Serum immune parameters were evaluated by a turbidimetric method [6] with Orion Diagnostica kits at 340 nm. Blood was collected from the ulnar vein after overnight fasting. Ozone concentration in the working zone corresponded to the maximum permissible dose (0.1 mg/ml).

RESULTS

The immune status of subjects evaluated by IgA and taken as normal for this region (city control) corresponded to the lower boundary of physiological norm (Table 1). Such a decrease in this parameter is characteristic of large industrial centers with high technogenic pollution [2,3,7]. In workers with more than 2 years of service, IgA concentrations were within the same range, but lower in comparison with both control groups, particularly in subjects often suffering from acute respiratory viral infections with a history of chronic bronchitis; this is in line previously reported direct correlation between high morbidity and IgA deficit [3,8,9,11].

After 10 years of service in the plastisizer shop, serum level of IgA notably decreased (almost by half). It was previously demonstrated that similar immuno-

TABLE 1. Concentration of Ig and CIC in the Serum of Workers of Plastics Shop

Group	n	IgA	IgM	IgG	CIC, arb. units
		g/liter			
Control					
city	12	1.23±0.07	0.36±0.07	28.1±1.31	48.0±5.99
plant	8	1.17±0.09	0.38±0.03	30.2±2.71	52.0±6.07
Length of service, years					
1	10	1.16±0.07	0.46±0.07	29.6±1.72	58.0±4.01
2	9	2.17±0.94	0.65±0.10	34.9±2.68	62.0±6.89
3	14	1.18±0.08	1.06±0.22*	34.4±2.41	60.0±5.04
4	21	0.90±0.09	1.26±0.31*	35.2±1.66	65.0±3.27*
5	35	0.92±0.16	1.24±0.37**	35.1±1.26*	65.0±3.27*
6	13	0.84±0.14	1.89±0.75	36.4±3.92	67.0±3.77*
7	18	0.85±0.07**	1.86±0.83	38.1±2.09*	69.0±7.03
8	12	0.71±0.15*	1.98±0.65*	41.2±4.01*	72.0±5.02*
9	7	0.73±0.11**	1.98±0.77	52.2±9.69	70.0±8.87
10	8	0.74±0.17	2.33±0.39**	50.9±5.71**	72.0±6.78*
more than 10	11	0.60±0.11**	2.60±0.89*	53.0±9.98*	72.0±8.12

Note. * $p < 0.05$, ** $p < 0.01$ vs. plant control, n: number of examinees.

logical shifts were observed in other workers engaged in petrochemical and exposed to gases irritating the airways for more than 10 years.

Increased level of IgG in workers with more than 10-year service indicates enhanced antibody production in comparison with plant controls, whose IgG levels corresponded to the upper normal values. However, a deficiency of its subclasses is possible even in the presence of normal IgG level, which manifested by increased incidence of infections [5,7]. It should be noted that the immune system is characterized by high mobility, because all its main components are virtually always activated (or in a working state), and a certain activation is apparently normal for the immune system [7].

The ranges of IgM and IgG fluctuations were rather wide, which seems to reflect a higher range of individual differences. In contrast to IgG, whose maximum concentration in some workers with length of service more than 10 years surpassed the norm by 1.8 times, the range of IgM fluctuations was normal. Some authors [3] distinguish a group of subjects often falling ill for a long time among adult population, in whom the main parameters of the immune system are also normal.

Immunopathological shifts in the serum augmenting with increasing the length of service were characterized by higher levels of CIC in comparison with the city and plant controls (Table 1). Previous studies showed accumulation of lipid peroxidation products in the blood in workers with a history of chronic non-

specific diseases of the lungs [1], which augmented endogenous intoxication. Some stubborn inflammatory processes induce a complex of immunological shifts, determining a chronic course of the disease [4]. These processes are caused primarily by immunological insufficiency, induced by immunogenicity of toxins and morphological changes in involved tissues, which at some stage acquire the properties of autoantigens. This potentiates hyperfunction of the immune system and promotes accumulation of CIC [4].

Prenosological diagnosis of immune disorders allowed to identify stages of immune shifts in subjects exposed to chemical, biological, and physical factors for a long time [7]. Stage I is characterized by increased concentrations of IgA, stage II by increased levels of all Ig, while during stage III these levels return to normal or decrease. Stage IV is associated with further decrease in Ig levels [7].

These stages were observed in the present study. Stages I and II were characteristic of subjects working at the plant for 1-2 years, while stages II and III were typical of workers with longer service. The detected immune shifts (increased levels of IgG, IgM, and CIC) indicate that humoral immune reactions are involved in the immunopathological process and their efficiency is decreased. Increased production of IgM in patients with acute respiratory viral infections and chronic bronchitis predominating in the examined population (workers of plastics shop) can be a result of stimulation of the immune system by frequent

respiratory viral diseases [5,8]. Some authors attribute this decrease in the level of IgA in these patients in comparison with healthy subjects to its adsorption in the airway mucosa [3,4].

Hence, ozone, one of the most abundant and aggressive ecological factors, suppresses immunological reactivity. Early detection of immune imbalance is important for early immunoprophylaxis and immunocorrection.

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