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INFLUENCE OF ULTRA-SMALL PARTICLES (10-20 NM) IN THE ATMOSPHERIC AIR OF CHERNIVTSI DURING INTRAUTERINE DEVELOPMENT ON THE COURSE OF SEPSIS IN NEWBORNS

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Abstract

Unfavorable environmental factors that affect parents cause impaired programmed development, the fetus, especially in its sensitive period. Even environmental factors of low intensity due to the bioaccumulation of xenobiotics in maternal tissues and their release to the bloodstream during pregnancy can have a pathogenic effect on the fetus, especially during sensitive periods of its development. To analyze the influence of the content of ultra-small particles (10-20 nm) in the atmospheric air during prenatal development on the course of sepsis in newborns. Based on the results of the analysis of content in the atmospheric air, two

clinical observation subgroups were formed. The first subgroup included 17 patients with neonatal sepsis in whom the UFPs content in the air exceeded 1.0 in one of the periods. The second subgroup consisted of 35 newborns with sepsis in whom the content of UFPs 10-20 nm in the atmospheric air was less than 1.0 in one of these periods. The content in the atmospheric air of ultra-small particles (10-20 nm) during the sensitive period of pre-natal development did not significantly affect the gestational age of newborns, the content in their blood in the presence of sepsis of interleukins-6, -8, -10, pressepsin, procalcitonin, C-RP and immunoglobulins of classes A, G, M, as well as the duration of intensive care and inpatient care.

Key words: Neonatal sepsis; environmental factors; immunoglobulins; presepsin; interleukin-6,-8,-10; C-RP.

Introduction

Environmental pollution significantly increases the risk of preterm birth [1, 2], newborns with functional impairments and signs of intrauterine developmental delay [3-6]. Immunotoxicity of xenobiotics leads to damage to the functional state of innate and adaptive immunity, and impaired activation / suppression balance - to hypersensitivity reactions [7]. The risk of the pathogenic effect of adverse environmental factors is exacerbated by features of toxic-kinetics, changes in the functional state of the placenta and metabolism of xenobiotics in environmental pressures, where they act as factors of predisposition [8]. According to ideas about the biology of development and toxicology, the pathogenic effect of adverse environmental influences on the pre-natal development of the child is largely determined by the state of maternal health and fetal-placental interaction. Emerging developmental disorders are the result of biological-ecological interaction in which the genetic factors of the parents play a significant role [9-11]. It should be noted that impaired intrauterine development occur not only under the influence of pathogenic environmental factors on the mother's body, but also in the case when under this influence falls and the child's father. This is due to mutagenic or epigenetic mechanisms that affect sperm. Increased air content of small particles with a diameter of 2.5 μm (PM 2.5), which when inhaled immediately enter the bloodstream, is associated in adults with the incidence of pneumonia, bronchial asthma, cardio-vascular disease, as well as mortality from all reasons [12-15]. In addition, a number of authors have noted the causal role of small particles in the development of inflammation and oxidative stress in many organs [16, 17]. In the literature available to us, we did not find any publications on the effect of ultra-small pollutants (<100 nm) of

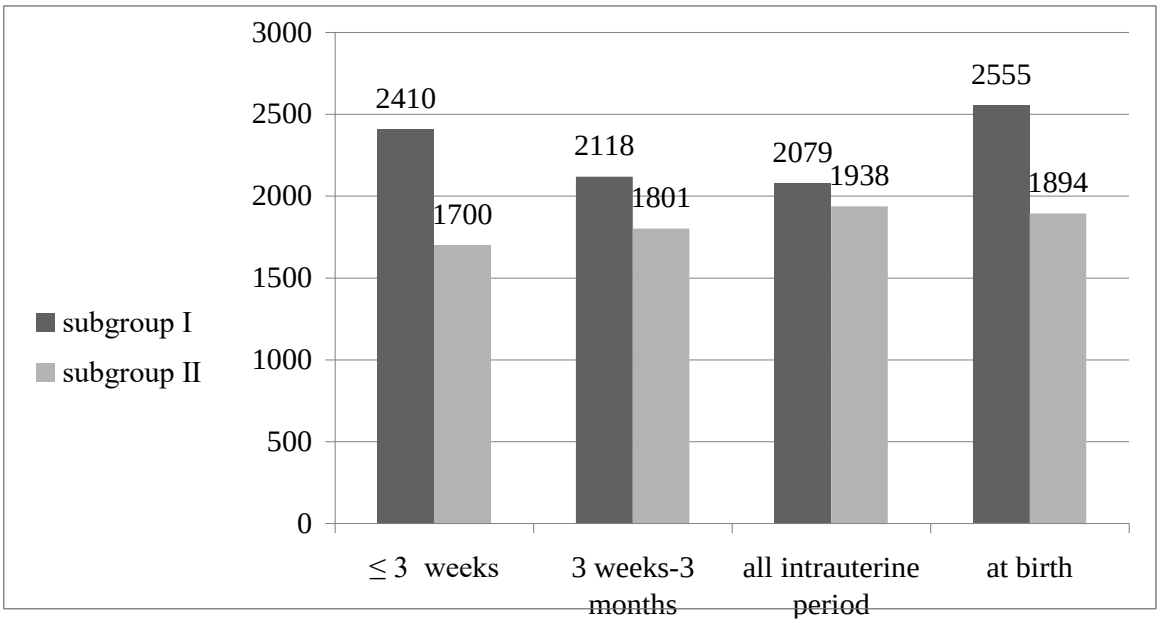
atmospheric air on the characteristics of neonatal sepsis. In this regard, this aspect has become a fragment of our research work.

The aim of this work was to analyze the influence of the content of ultra-small particles (10-20 nm) in the atmospheric air during prenatal development on the course of sepsis in newborns.

Material and methods

We have analized the key values of sepsis course to evaluate the influence of the content of ultra-small particles in the atmospheric air during intrauterine development of newborns who had the disease. The parameters of ultra-fine particles of PM sized 10-20 nm were selected for analysis, which, when inhaled by pregnant women, are able to penetrate into their bloodstream and, accordingly, into the fetal circulation system. As an integral indicator of the UFPs load on the body of pregnants we used the one that reflects the ratio of their content in the air during these periods of pre-natal development to the average over the 4-year study period. Exceeding this figure of more than 1.0 indicated an increase in the UFPs content in the atmospheric air in the current period of prenatal development. If this value was less than 1.0 it indicated that they had less load on the body. Based on the results of the analysis of content in the atmospheric air, two clinical observation subgroups were formed. The first subgroup included 17 patients with neonatal sepsis in whom the UFPs content in the air exceeded 1.0 in one of the periods. The second subgroup consisted of 35 newborns with sepsis in whom the content of UFPs 10-20 nm in the atmospheric air was less than 1.0 in one of these periods. The content of ultrasmall particles with a diameter of less than 10-20 nm in the atmospheric air was determined in the State Enterprise "L. Medvid Scientific Center for Preventive Toxicology, Food and Chemical Safety" at the department of medical and environmental problems (Head - Director, Prof. L.I Vlasyk). For this purpose, a spectrometer with a mobile device for differential or scanning dispersion of microparticles (DMPS / SMPS) was used. A comprehensive examination of the infants was performed in the neonatal wards after the diagnosis of sepsis on the 1st, 3rd and 7th day of the disease.

The results of the study were analyzed using the Statistica 6 software package Stat Soft and Excell XP for Windows on a personal computer using parametric and non-parametric calculation methods. The diagnostic value of the tests was determined taking into account their sensitivity, specificity, predicted value of positive and negative results, determining their 95% confidence intervals (95% CI).



Note:*-P<0,05

Fig. 1 desplays the content of UFPs 10-20 nm in the atmospheric air in the period of prenatal development of children with neonatal sepsis

Results. The findings show that the greatest load on the body of the newborn was observed in the first three months of prenatal development and at birth. On this basis, it could be predicted that the term of gestation would be reduced as a disturbance of adaptation to extrauterine life in children from subgroup I (table 1).

Table 1 - Gestational age of newborns and its assessment by Apgar and Downes score

Clinical subgroups	Number of patients	Gestational age(weeks)	Scores		
			Apgar		Downes
			1 minute	5 minutes	
subgroupI	17	34,23±0,86	6,3±6,3	5,9±0,6	2,6±0,4
subgroup II	35	33,17±0,51	5,4±0,2	6,2±0,2	2,3±0,4
P		>0,05	<0,05	>0,05	0,05

The above findings indicate that the content of 10-20 nm UFPs in the atmosphere in the period of prenatal development of children does not significantly affect their gestational term and acute adaptation to conditions of extrauterine life. Adverse environmental stimuli in any period of prenatal development can cause changes in the immune system of newborns. Based on this, one might think that the involvement of proper mechanisms in the body's inflammatory systemic response to infection in the comparison subgroup will differ.

Table 2 - Values of IL-6, IL-8, IL-10 and C-RP in serum of children in subgroups of comparison on the first day of neonatal sepsis disease.

Clinical subgroups	Number of patients	The content of interleukins, pg/ml			C-RP, mg/l
		Il-6	Il-8	Il-10	
I	17	5,5±0,72	29,7±1,1	7,2±1,6	21,9±3,6
II	35	8,1±1,7	28,1±0,9	30,3±9,2	20,3±2,2
p		>0,05	>0,05	<0,05	>0,05

Therefore, the children of the first subgroup had some imbalance of markers of systemic inflammatory response of the organism to infection in the form of a significant decrease in anti-inflammatory IL-10 (table 2). In these patients, increased serum content of prespepsin was observed, reflecting a decrease in phagocytic activity of phagocytes. For instance, in the subgroup I, the content of presepsin was 907.1 ± 198.2 pg / ml, and in the comparison group 672.6 ± 152, 4 pg / ml (p> 0.05).

Discussion

The serum content of immunoglobulins A, G, M in the comparison subgroups did not differ significantly. For example, Ig A content in patients of the first subgroup on the first day of sepsis disease was 1.26 ± 0.29 g / l, Ig G -5.54 ± 1.1 g / l and Ig M - 0.52 ± 1.1 g / l. In patients of the comparison group, the serum content of these immunoglobulins was: Ig A -1,1 ± 0,19 g / l, Ig G -4,69 ± 0,61 g \ l and Ig M - 0,49 ± 0,05 g / l (p> 0.05) respectively.

Adverse environmental factors during pre-natal development can cause structural changes in organs as well as metabolic disorders and epigenetic changes. All this contributes to a more severe disease in newborns. A relative confirmation of this can be a longer treatment in the hospital and longer inclusion of such elements as mechanical ventilation and β1-agonists in the complex. It was noted that while treating sepsis in the children of the first subgroup the mechanical ventilation was used 9.7 ± 0.3 (95% CI 6.5-13.0) days and inotropic drugs 2.4 ± 0.3 (95 % CI 1.6-3.1) days. In the comparison group, the duration of these intensive care treatments averaged 10.4 ± 1.9 (95% CI 6.1-14.7) children (p> 0.05) and 2.7 ± 0.3 (95% CI) 1,2-4,1) days (p> 0.05). The duration of treatment of newborns of these clinical groups in hospital was not significantly different and averaged in subgroup I 43.9 ± 6.2 days and in subgroup II 42, 2 ± 2.6 days (p> 0.05).

Conclusions

The content in the atmospheric air of ultra-small particles (10-20 nm) during the sensitive period of pre-natal development did not significantly affect the gestational age of newborns, the content in their blood in the presence of sepsis of interleukins-6, -8, -10,

pressepsin, procalcitonin, C-RP and immunoglobulins of classes A, G, M, as well as the duration of intensive care and inpatient care.

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