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HARMFUL EFFECTS OF THE ENVIRONMENT XENOBIOTICS ON THE HUMAN BODY

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Chemical aggression of industry-related contamination of the environment, according to experts, is a leading risk-factor for population health. Ecological situation in industrial regions is characterized by a negative influence on the residents of widespread toxicants – heavy metals. The article presented analyzes data of complex researches, devoted to sanitary diagnostics of the environment. In order to assess the influence of lead and cadmium of industry-related origin on the organism of susceptible populations there was carried out analysis of the content of these metals in the environmental objects; biomonitoring in blood and urine of pregnant women – residents of the industrial city of Dnipropetrovs'k; determination of value of their total daily intake; calculation of conversion coefficients to characterize the possible relationship between external and internal exposures of xenobiotics.

Key words: *heavy metals, industry-related burden, relative coefficients.*

Introduction

Source of xenobiotics, among which heavy metals occupy the priority position, are anthropogenic processes which result in deterioration of the environment. Ukraine is one of the states with a sufficient industrial potential, and accordingly, with a high level of complex polyelemental metallization by the following link: sources of pollution (emissions, waste, effluent) – depositing (soil, ground expositions) and major life-supporting environment (air, water, food products) – human organism [2, 8]. The volume of heavy metals entry into the environment is significantly above their background concentrations due to the industry-related impact; this forms qualitatively new biochemical provinces, the area of a powerful industrial city of Dnipropetrovs'k being a striking example [1, 9].

The current state of affairs requires the need for scientific research to study the relationship between the human body and heavy metals of the environment for detecting and predicting changes in health status of the population of industrial areas and determining prenosologic indicators, criteria of danger of xenobiotic exposure, informative biological substrates, which regulate quantities of xenobiotics content in the indicative human environments [2, 3, 4]. This will make it possible to validate and implement appropriate preventive measures for maintaining and health promotion.

One of the major and promising areas of preventive medicine is improving environmental hygiene diagnostics in conditions of increasing "metal" burden upon the organism and deterioration of population health [3, 5]. However, analysis of characteristics of anthropogenic processes in ecologically unfavorable regions and evaluation of the obtained observation data testify, that there is a need for scientific research, with involvement of modern methods of quantitative and qualitative

analysis [1, 7]. Among these methods one should note the importance of indicative analysis that envisages the use of the maximum allowable (threshold) values of indicators, going beyond which testifies to development of risk in the researched field.

Research experience shows, that despite the fact that external exposure of heavy metals does not exceed the relevant normative values, their regular entry generates sufficiently great internal contamination of the human body and produces environmentally-caused changes in the human body – from physiological disorders to a disease. Among a variety of significance of metals, special place is occupied by lead and cadmium impact on human generative function, which is very complex and linked with other systems, being one of the most sensitive in the body [2, 9]. The negative effect of these metals is manifested not only due to increased intensity of factor, but due to decreased adaptive reserves, which first and foremost occurs in the most sensitive segments of the population – women during pregnancy, this factor changes reactivity of their organism and serves as a trigger of the damaging effect of xenobiotic metals [8, 9].

In this respect, our attention was attracted by the conversion rate (the relative coefficients) as a regulating criterion. A similar coefficient – conversion factor [6] has been proposed by experts of FAO/WHO on nutritional supplements and allows to calculate the concentration of lead in the blood, according to its actual content in the food ration.Therefore, we carried out determination of the total daily intake (TDI) of lead and cadmium and their content in the body to calculate "relative ratios" to characterize the probable interrelations of external and internal exposure.

Research methods

For the research two industrial areas of Dnipropetrovs'k were chosen. Town of Novomoskovs'k of Dnipropetrovs'k region was chosen as a control region. The research program envisaged assessment of Pb, Cd, Fe, Zn, Mn, Cu, and Cr content in the life-supporting objects of the environment and in blood and urine of pregnant women – residents of the researched area. Performed monitoring of lead and cadmium in the air, water and food made it possible to define TDI of these metals for residents of the investigated areas. 89 healthy women aged 20-25 years without occupational hazards, of somatic, hereditary diseases and bad habits with physiologically normal pregnancy in the second trimester were enrolled for biological monitoring. The women were divided into three groups according to the area of residence.

Results of investigation

The obtained results indicate that HM are constantly defined in the air, water, food products in comparison cities, their average concentrations mainly do not exceed maximum permissible concentrations (MPC). TDI of lead for residents of Dnipropetrovs'k is 0,14mg/day, which is below the allowable – 0.24 mg/day [9] but by maximal value lead almost meets TDI – 0.26 mg/day. These data coincide with the results of the similar studies performed in the industrial cities of Russia – 0,079-0,165 mg/day [8] but are higher than those for the population of Kiev and western part of Ukraine – 0,09-0,1 mg/day [5,7]. As for cadmium, its daily intake is 28 mg/day, which corresponds to the data of western regions of Ukraine – 30 mg/day and the data of Donets'k region – 0,3-95 mg/day, but by maximal values – 0.207 mg/day it exceeds permissible limits by 3 times. Daily entry of lead into organism of residents of the control town is by 30% (0,098 mg) less than in the researched areas of Dnepropetrovsk. TDI of cadmium (0.0278 mg/day) coincides with data for the industrial city, but by maximum value it is by 4 times less than in Dnipropetrovs'k.

The results of the monitoring and

their analysis testify that in the indicator biological substrates of pregnant women, residents of industrial areas, there were marked exceeding concentrations of toxic metals as compared with the relevant standards: lead in the blood – in 6,7-24% and in urine – in 40-44,8%, cadmium in urine – in 36-50% of the women surveyed. However, average values of lead in the blood of residents of industrial areas were 0,27 ± 0,017 and 0,35 ± 0,027 mkg/ml, which coincided with the similar data of industrially-related contaminated territories [8]. Alarming results were obtained while analyzing biological monitoring data of women without exceed of the normative values of metal-toxicants content in biological substrates: in 68% of the surveyed women of the industrial city there was defined carriage of lead in the blood and in 55% – carriage of cadmium. To find quantitative relationship of external and internal exposures of metals, correlation and regression analysis were used.

Mathematical and statistical analysis also made it possible to calculate the "relative coefficients" (conversion rates), the use of which will make it possible to tentatively define concentration of lead, cadmium, copper and zinc in human blood and urine by the results of their total daily intake. The values of these coefficients are presented in the figure. The obtained "relative coefficients" will make it possible by the data of external exposures of metals received by calculation method, hereafter to determine and provide hygienic assessment of their content in the body of residents of technologically contaminated areas. In its turn, the values of indices of internal pollution of body by metals as biomarkers of action in combination with biomarkers of effect, are the criteria which characterize the impact of heavy metals on population health.

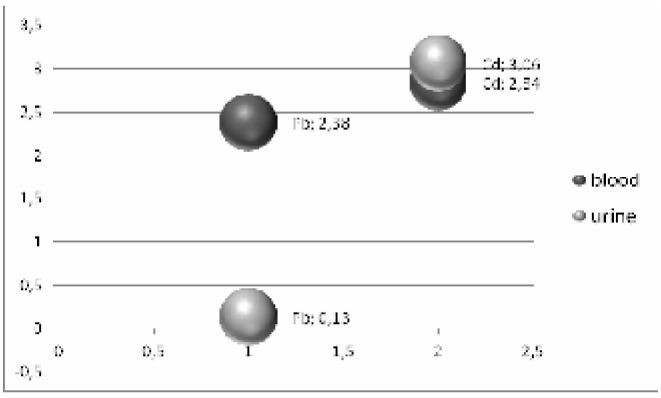

Fig. Relative coefficients of metals content in human blood and urine depending on the total daily intake (c.u.)

Conclusions and recommendations for further research in this area

Determination of HM concentration in the environment and their hygienic assessment indicates that in Dnipropetrovs'k region there is a complex systematic entry of HM with air, water, food products into human body. Despite the allowable average values of total daily intake of lead and cadmium, there was defined their significant content in the bodies of residents of industrial areas. Advanced mathematical and statistical analysis of the research data made it possible to calculate the conversion rates for the oriented determination of lead and cadmium concentrations in the blood and urine by the results of TDI. In its turn, values of indices of internal pollution of body with metals, as biomarkers of action, serve as the criteria for prognosis of their impact on population health, and are aimed at development and timely implementation of preventive measures.

In order to reveal negative effects of integrated and combined influence of heavy metals of the environment on the human body, to maintain the level of their danger, to study their cumulative properties as one of the universal criteria for assessing toxicity, there arises the need for further multifaceted hygienic researches to develop scientifically based proposals to tackle the threat of manifestation of eco-dependent and eco-induced diseases among the

residents of industrial areas. Ensuring the well-being of the environment and overcoming the negative tendencies in the health state of the nation needs to address a number of issues, including revision of ideas regarding the priority of medical and hygienic assessment of the impact of industrial toxins on the human body and determination of biological indicators of prenosologic harmful effects of xenobiotics to justify hygienic standards and harmonization of native regulatory framework with the existing international standards.

References

1. Onul N.M. "Comparative evaluation of microelement balance in the organism of fertile men on the eco-contrast territories". Environment and Health – no.3, 2015, pp. 17 – 22. (in Ukrainian).
2. Gil, F., Hernande, A. F., Marquez, C. et al. "Biomonitorization of cadmium, chromium, manganese, nickel and lead in whole blood, urine, hair and saliva in an occupationally exposed population, Science of the Total Environment, v. 409, 2011, pp. 1172 – 1180.
3. Andrusishina, I. M., Lampeka, O. G., Golub, I. O. et al. Methodical recommendations 72.14/133.14, 2014, "Assessment of mineral metabolism disorders in occupational contingents using a method of atomic absorption spectrometry with inductively connected plasma". Kyiv: Avicenna, 2014, 56 p. (in Ukrainian).
4. " National Report on the State of the Environment in Ukraine in 2011". [Ministry of Ecology and Natural Resources of Ukraine]. 2012, p.258. (in Ukrainian).
5. Trachtenberg I.M., Tychin V.A., Sova R.E et al. "Key indicators of the physiological norm in humans: A Guide for Toxicologists". Kiev: Avicenna, 2001, p.372. (in Russian)
6. "Evaluation of certain food additives and contaminants. [41 Report of the Joint FAO" 1994,] WHO Expert Committee on Food Additives. Ser. Tech. rep. WHO: 837, [WHO Expert Committee on Food Additives. Ser. Tech. rep. WHO: 837] Geneva: WHO, 1994, pp.50-55.
7. Trachtenberg I.M., Dmytrukh N.M., Korolenko T.K. et al. "Prevention of vocational and environmental caused heavy metals intoxications", Hygienic science and Practice: Contemporary realities: Proceedings of XV Congress of hygienists Ukraine, Lviv: Typography LNMU Danylo Galician, 2012, pp.122-123. (in Ukrainian).
8. Revich B.A. "Pollution of the environment and human health. Introduction to Environmental Epidemiology: Proc. Allowance", Moscow: MNEPU, 2001, p.264. (in Russian)
9. Serdyuk A.M., Belitskaya E.N., Paranko N.M., et al. "Heavy metals of the environment and their effect on reproductive function of women", Dnepropetrovsk: ARTPRESS, 2004, p.148. (in Russian)

Резюме

НЕБЕЗПЕЧНИЙ ВПЛИВ НА ОРГАНІЗМ ЛЮДИНИ КСЕНОБІОТИКІВ ОТОЧУЮЧОГО СЕРЕДОВИЩА

Головкова Т.А.

Хімічна агресія техногенного забруднення середовища існування людини, на думку фахівців, є провідним фактором ризику для популяційного здоров'я населення. Екологічна ситуація в промислових районах, характеризується негативним впливом на мешканців розповсюджених

токсикантів - важких металів. У зв'язку з цим, у роботі проаналізовані дані комплексних досліджень, присвячених гігієнічної діагностики навколишнього середовища. З метою оцінки впливу свинцю і кадмію техногенного походження на організм чутливих верств населення проведено: аналіз вмісту цих металів в об'єктах довкілля; біомоніторинг в крові та сечі вагітних жінок - жительок промислового міста Дніпропетровська; визначеня величини їх сумарного добового надходження; розрахування коефіцієнтів конверсії для характеристики можливих взаємозв'язків зовнішніх і внутрішніх експозицій ксенобіотиків.

Ключові слова: *важкі метали, техногенне навантаження, відносні коефіцієнти.*

Резюме

НЕБЕЗОПАСНОЕ ВЛИЯНИЕ НА ОРГАНИЗМ ЧЕЛОВЕКА КСЕНОБИОТИКОВ ОКРУЖАЮЩЕЙ СРЕДЫ

Головкова Т.А.

Химическая агрессия техногенного загрязнения среды обитания человека, по мнению специалистов, является ведущим фактором риска для популяционного здоровья населения. Экологическая ситуация в промышленных районах, характеризуется негативным влиянием на жителей распространенных токсикантов – тяжелых металлов. В связи с этим, в работе проанализированы данные комплексных исследований, посвященных гигиенической диагностики окружающей среды. С целью оценки влияния свинца и кадмия техногенного происхождения на организм чувствительных групп населения проведен: анализ содержания этих металлов в объектах внешней среды; биомониторинг в крови и моче беременных женщин – жительниц промышленного города Днепропетровска; определение величины их суммарного суточного поступления; рассчет коэффициентов конверсии для характеристики возможных взаимосвязей внешних и внутренних экспозиций ксенобиотиков.

Ключевые слова: *тяжелые металлы, техногенная нагрузка, относительные коэффициенты.*

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СВЯЗЬ ПОЛИМОРФИЗМОВ ГЕНОВ IL-1β И TNFRSF11B С БИОМАРКЕРАМИ МИНЕРАЛЬНОГО ОБМЕНА И КОСТНОГО МЕТАБОЛИЗМА ПРИ ВОСПАЛИТЕЛЬНЫХ ЗАБОЛЕВАНИЯХ ЧЕЛЮСТИ

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Проведенное исследование посвящено установлению связи полиморфных маркеров генов IL-1β и TNFRSF11B с биомаркерами минерального обмена кальцием (Са) и фосфором (Р) и костного метаболизма щелочной фосфатазой (ЩФ) и кислой фосфатазой тартратрезистентной (КФТ) при хроническом периодонтите (ХП). У больных ХП установлена связь полиморфизма гена TNFRSF11B с показателями КФТ и ЩФ ($p < 0,05$). Статистически значимых различий связи полиморфизма гена TNFRSF11B с показателями Са и Р не установлено. Статистически значимых различий полиморфизма гена IL-1β с показателями Са, Р, ЩФ, КФТ не обнаружено.

Ключевые слова: *ген IL-1β ген TNFRSF11B, маркеры костного метаболизма, хронический периодонтит*

Вступление

В структуре стоматологических заболеваний воспалительного генеза патология пародонта занимает одно из ведущих мест и в настоящее время имеет тенденцию к прогрессирующему росту. В патогенезе воспалительных заболеваний пародонта большую роль играет состояние местного иммунитета полости рта. Уровни тканевой реактивности закреплены генетически [1-3], следовательно, определяющее значе-