Short communication

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Gender differences in blood parameters (ALT, AST) in people with cardiovascular diseases and their relationship to the level of total mercury in the hair

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ABSTRACT. Large industrial enterprises are located on the territory of the city of Cherepovets, which are potential sources of mercury entering the environment. The study involved residents of the Vologda Oblast without cardiovascular diseases (men n = 82; women n = 266) and with cardiovascular diseases (men n = 192; women n = 309). The average mercury content in the hair of the study participants was 0.572 ± 0.686 mg/kg. In healthy men and men with cardiovascular diseases, the indicators of alanine aminotransferase, aspartate aminotransferase are statistically significantly (on average 1.2-1.5 times) higher than in women. A significant correlation was established between the concentration of ALT, AST from the amount of mercury in the hair of the study participants: in men ALT - RS = 0.168, p ≤ 0.008 and AST- RS = 0.183, p ≤ 0.004, respectively; in women ALT: RS = 0.121, p ≤ 0.007, AST is not statistically significant RS = 0.035 p ≤ 0.442. The increase in mercury affects the human body with cardiovascular diseases, increasing the enzymatic activity of alanine aminotransferase, aspartate aminotransferase. The causes of gender differences in CVD are: different reproductive function; different prevalence of autonomous regulation of vascular functions and stress; different features of the development and prevalence of coronary atherosclerosis.

Keywords: mercury, ALT, AST, cardiovascular system, Vologda region

1. Introduction

Large industrial enterprises are located on the territory of the city of Cherepovets, which are potential sources of mercury entering the environment.

It is known that fish consumption is the main source of mercury intake into the human body. Fish from reservoirs of the Vologda region, from remote industrial centers, may contain high concentrations of mercury in muscles that exceed regulatory levels (Komov et al., 2004).

Increased mercury content in the body increases the risk of developing cardiometabolic syndrome (Ivanova et al., 2021). It can be assumed that in the Vologda region there is an alarming situation with the health of the population.

Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are used as markers of cardiovascular diseases (CVD). Due to the fact that the degree of changes in general metabolism differs in individuals of different sexes, it can be assumed that blood counts (ALT and AST) differ.

Thus, this work is aimed at identifying gender differences in blood parameters (ALT, AST) in people with cardiovascular diseases and their relationship with the level of total mercury in the hair.

2. Materials and methods

The study involved residents of the Vologda Oblast without cardiovascular diseases (men n = 82; women n = 266) and with cardiovascular diseases (men n = 192; women n = 309).

Hair samples from the study participants were collected from the back of the head in the form of strands several millimeters thick. The mercury content in the hair was determined without preliminary sample preparation using the mercury analyzer RA-915M with the prefix PYRO-915 + (LLC "Lumex", St. Petersburg, Russia). The blood test was carried out on an automatic biochemical device BioSystems A-15 (Spain) using standard test kits from BioSystems, Vector-Best.

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3. Results

The average mercury content in the hair of the study participants was 0.572 ± 0.686 mg/kg. There were no statistically significant differences between the amount of metal in the hair of men (0.615 ± 0.731 mg/kg) and women (0.552 ± 0.662 mg/kg).

It was found that the mercury content in the hair of study participants with CVD (0.646 ± 0.727 mg/kg) was significantly higher, on average 1.5 times higher than in conditionally healthy (0.459 ± 0.589 mg/kg).

It was found that the mercury content in the hair of people (correlation coefficient $R_S = 0.336$, $p \leq 0.000$) who consume fish up to 1000 g per month, the amount of metal in the hair is 2-3 times lower than in the study participants whose fish in the diet is more than 2000 g per month.

In men and women with cardiovascular diseases, the concentration of liver enzymes (ALT, AST) in the blood is more than 2.5 times higher than in healthy people. In healthy men and with CVD, ALT and AST indicators are statistically significantly (on average 1.2-1.5 times) higher than in women.

A significant correlation was established between the concentration of ALT, AST from the amount of mercury in the hair of the study participants: in men ALT - $R_S = 0.168$, $p \leq 0.008$ and AST- $R_S = 0.183$, $p \leq 0.004$, respectively; in women ALT: $R_S = 0.121$, $p \leq 0.007$, AST is not statistically significant $R_S = 0.035$ $p \leq 0.442$.

It was noted that the average values of mercury content in human hair are higher in study participants with increased aminotransferase activity. At the same time, such differences are statically significant for ALT (Table).

4. Discussion

The mercury content in people's hair depends on the amount of fish in their diet. Frequent consumption of fish from local reservoirs can create a risk of mercury accumulation in the body of the population with negative health consequences.

The mechanism of mercury's effect on the cardiovascular system is associated with increased oxidative stress, decreased oxidative protection, endothelial dysfunction and thrombosis (Genchi et al., 2017). Chronic exposure to mercury affects heart rate variability, parasympathetic activity of the heart (Choi et al., 2009) and intima thickness of the carotid arteries (Choi et al., 2009). Exposure to mercury is associated with an increased risk of hypertension.

It was found that per 100 thousand of the population from cardiovascular diseases, the mortality rate of men is higher than among women. The causes of gender differences in CVD are: conditions inherent in only one sex (reproductive function): erectile dysfunction, preeclampsia/hypertension of pregnant women; different prevalence of autonomous regulation of vascular functions and stress: pulmonary hypertension, migraine; associated with the peculiarities of development and prevalence of coronary atherosclerosis: local – in men and diffuse – in women with the involvement of microcirculation (Oganov and Maslennikova, 2012).

It is known that cardiovascular diseases lead to an increase in the concentration of aminotransferases in the blood. Men smoke, drink alcohol more and more often than women. Women are characterized by a greater tendency to a sedentary lifestyle and obesity, but have healthy eating habits. The presence of a sexual gradient of dyslipidemia, hyperuricemia in different age groups also makes a significant contribution to increased cardiovascular risk. The development of primary and repeated cases of CVD in men is surpassed more often. Differences in psychosomatic regulation in men and women under stress cause a difference in the response of the regulatory systems of the body and in the levels of cardiovascular morbidity (Shapovalova et al., 2019).

The established relationship between the amount of mercury in the body and the concentration of aminotransferases in the blood is consistent with the results obtained in South Korea. Low levels of mercury in the blood may pose a risk of mild liver dysfunction (Lee et al., 2014).

5. Conclusions

Thus, the increase in mercury affects the human body with CVD, increasing the enzymatic activity of ALT, AST. Blood enzymes (ALT, AST) are an important factor in the long-term prognosis and prevention of vascular diseases. These indicators can be used as a predictor in predicting the risk of vascular diseases from the toxic effects of mercury.

Conflict of interest

The authors declare no conflict of interest.

Table. The average mercury content in the hair of people with different concentrations of aminotransferases

Blood indicator	Hg, mg/kg Q blood indicator				R_S, p
	1st Q	2nd Q	3rd Q	4th Q	
ALT	0.418[a] 2-13.1	0.49[ab] 13.2-19.6	0.584[b] 19.7-29	0.67[b] 29.1-1837	$R_S = 0.142$; $p = 0.000$
AST	0.473 7-17.6	0.454 17.7-21.9	0.631 22-31	0.615 31.1-1876	$R_S = 0.084$; $p = 0.023$

H-test (a, b) – values of mercury content in human hair differ statistically significantly at $p \leq 0.05$ (Kruskal-Wallis test)

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