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CONTENT OF BLOOD PLASMA MICROELEMENTS IN HEMORRHAGIC FEVER WITH RENAL SYNDROME OF WORKERS IN INDUSTRIAL ENTERPRISES OF UFA CITY

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Summary. *The content of microelements in blood plasma in hemorrhagic fever with renal syndrome was studied in workers of industrial enterprises of Ufa city. There was a pronounced dysmicroelementosis, which was not completely eliminated even in the period of convalescence.*

Key words: *hemorrhagic fever with renal syndrome, blood plasma levels of lead, mercury, cadmium, zinc, copper, and selenium.*

Hemorrhagic fever with renal syndrome (HFRS) is the leading natural focal infection in the regional pathology of the Republic of Bashkortostan (RB). A characteristic feature of the incidence of HFRS in the Republic of Bashkortostan is the predominance among the diseased urban population (70.2% for the entire observation period), and more than half of those who came through HFRS there are residents of the capital (50.6%). Workers predominate among HFRS patients (44.6%), including workers of industrial enterprises [5].

Ufa is the most saturated with industrial enterprises city in the Republic of Bashkortostan, which accounts for about 40% of all products manufactured there. Over 700 enterprises that emit pollutants into the atmosphere are located in Ufa city. Leading industries are oil refining, which includes three oil refinery

plants; mechanical engineering and metalworking; chemical, forestry and wood processing industries, many enterprises of light and food industries [2]. The republican car fleet totals about 1148 thousand units of motor vehicles. In 2007 the volume of pollutant emissions into the atmosphere amounted to 327.0 thousand tons in Ufa city, including stationary sources - 154.1 thousand tons, and vehicles - 172.9 thousand tons [2].

Given the high prevalence of HFRS, the absence of a tendency to its reduction, as well as the ecological situation of a large industrial city, we set a goal to study the content of microelements in the blood plasma of industrial workers suffering from HFRS in Ufa city depending on the period of the disease.

Materials and methods

The content of microelements in blood plasma was studied in 42 men having HFRS. They were workers of industrial enterprises (UMPO OJSC, Ufaorgsintez OJSC, Ufa Hydraulics AP Federal State Unitary Enterprise) undergoing treatment at the Municipal Clinical Hospital No. 13, and then follow-up monitoring during the year in clinics No. 1 and No. 2 of this hospital. The age of the examined persons is from 20 to 59 years. 22 people were patients with HFRS of moderate severity, 20 people had its severe form. The control group included 26 practically healthy individuals of the corresponding age who did not have contact with heavy metals in their production activities. The diagnosis of HFRS was established on the basis of clinical, epidemiological and laboratory data. Only samples obtained from persons with a serologically confirmed diagnosis of HFRS using the MFA reaction were subject to study in the main group.

Plasma concentrations of lead, strontium, mercury and cadmium were estimated using mass spectrometry with inductively coupled plasma (ICP-MS; Elan-9000, PerkinElmer, USA) and atomic emission spectrometry with inductively coupled plasma (ICP-OES; Optima-2000 DV, PerkinElmer, USA).

The study was conducted in the testing laboratory of ANO «Center for Biotic Medicine».

Statistical processing of the material was carried out by the method of variation statistics using Student's t-test on MS Exel 2000 software.

Results and Discussion

The results of our studies indicate a significant change in elemental status at various stages of HFRS. The data are presented in table 1.

The concentration of lead in the oliguric phase is significantly higher than in the control group (0.193 ± 0.02 mg / L and 0.02 ± 0.007 mg / L, respectively, $p < 0.01$). In the polyuric phase, the concentration of lead decreases, but remains significantly greater than in the control group, $p < 0.05$.

The cadmium concentration in patients with HFRS in the oliguric phase is 1.15 ± 0.03 μg / L, which is statistically significantly higher than in the control group, $p < 0.01$. In the polyuric phase its content in the blood plasma decreases, but nevertheless, it remains significantly larger than in the control group. The cadmium concentration did not significantly differ from the control group only a year after HFRS.

The plasma mercury content in the oliguric phase is 5.98 ± 0.15 mg / l, which is statistically significantly higher than in the control group, $p < 0.01$. In the phase of polyuria the mercury concentration decreases, but, like the other toxic micronutrients studied, it remains significantly higher than in the control group.

The accumulation of toxic metals during the oliguric phase of HFRS can be explained by the fact that one of the main pathways of micronutrient excretion, the kidney, is impaired [3]. In turn, all studied metals possess nephrotoxicity [6, 7] and enhance oliguria. So, Pb directly affects the epithelium of the renal tubules [1], while the proximal tubules are damaged mainly [8], which is noted by a decrease in tubular reabsorption [9].

Intensive infusion therapy for the treatment of moderate and severe HFRS promotes improving kidney function and removing heavy metals from the body. Therefore, the amount of such toxic metals as lead, cadmium, and mercury in blood plasma decreases during the polyuric phase. However, the level of these microelements rather slowly comes to acceptable indicators. Their concentration is significantly higher than in the control group even during the period of convalescence, $p < 0.05$. Perhaps this is due to the fact that the kidneys are the main way to remove lead and strontium from the body, and kidney function is not fully restored by the period of convalescence.

Table 1

The content of microelements in blood plasma of the patients with HFRS, industrial workers (M ± m)

Element	Oliguric phase	Polyuric phase	Period of convalescence	Control Group
Lead mg/l	0.193 ±0.02**	0.153 ±0.03**	0.086 ±0.01*	0.02 ±0.007
Cadmium µg/L	1.15 ±0.03**	0.96 ±0.02**	0.41 ±0.03*	0.05 ±0.002
Mercury µg/L	5.98 ±0.15*	3.17 ±0.22*	2.32 ±0.06*	0.41 ±0.03
Zinc mg/l	0.53 ±0.05*	0.74 ±0.02*	0.75 ±0.03*	0.89 ±0.01
Copper mg/l	0.81 ±0.04*	0.74 ±0.01*	0.82 ±0.04*	1.23 ±0.04
Selenium µg/L	32.5 ±0.12**	48.2 ±0.22**	51.5 ±0.8**	85.2 ±0.15

* - reliability when compared to the same indicator in the control group, $p < 0.05$
** - reliability when compared to the same indicator in the control group, $p < 0.01$

The change in the content of essential microelements in blood serum in different periods of HFRS is also presented in table 1. The concentration of copper and selenium in the is statistically significantly reduced, $p < 0.05$. The decrease in selenium concentration at the height of HFRS can be explained by its increased consumption. Intensification of lipid peroxidation processes is observed in patients with HFRS. This fact leads to an increased consumption of

antioxidant enzymes, for example, glutathione peroxidase. And selenium is included in the active center of glutathione peroxidase, which ensures the destruction of excess peroxides in the body.

The concentration of another essential microelement - zinc in the oligoanuric period of HFRS, also decreases statistically significantly. Glucocorticoids, which are often used in the treatment of HFRS especially in severe cases of the disease, have a certain effect on a decrease in the concentration of zinc in blood plasma. In addition, zinc concentration is reduced due to increased consumption. Zinc is necessary for the synthesis of the antioxidant enzyme superoxide dismutase, which is intensively consumed in the reaction of neutralization of the primary free radical of superoxide.

According to the literature, zinc and lead homeostasis are interconnected. Zinc deficiency determines an increased lead output from the renal parenchyma due to competitive interactions [4]. In the phase of polyuria, the concentration of the studied essential microelements increases, but even in the period of convalescence their concentration is statistically significantly lower than in the control group. Identified changes in the microelement status require additional therapy to correct the revealed violations.

Conclusions

1. In the midst of HFRS, the concentration of toxic microelements: cadmium, mercury and lead in the blood plasma is significantly higher than in the control group. Their level decreases in the polyuric phase, but the concentration of toxic microelements in the blood plasma of industrial workers is significantly higher than in the control group even a year after the disease.

2. The concentration of essential microelements such as copper, zinc and selenium statistically significantly decreases at the height of the disease, then increases during the polyuria phase, but remains statistically significantly lower a year after HFRS in industrial workers than in the control group.

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