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HYDROCHEMICAL FACTORS AND MALIGNANT NEOPLASMS OF THE URINARY SYSTEM IN RESIDENTS OF THE PRILENSKY ZONE OF YAKUTIA

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In the Republic of Sakha (Yakutia), the incidence of malignant neoplasms of the urinary system from 2001 to 2015 increased by 1.9 times. The quality of the surface waters of the Lena River and its basin is affected by the economic activities of mining, energy, utilities, water transport, oil depots, agriculture with direct discharge of wastewater into them, as well as due to the ingress of pollutants into the adjacent settlements. territories. The purpose of the study is to assess the relationship between the incidence of malignant neoplasms of the urinary system organs and hydrochemical factors polluting the aquatic environment in the Prilensky zone of Yakutia. Correlation analysis was performed on the data on the incidence of MNs in the organs of the urinary system of the population (2001-2015) and the data on the chemical composition of water in the Prilensky zone of Yakutia (1979-1985). The results of the analysis indicate that Yakutia belongs to the territories with a rather pronounced contrast in terms of the incidence of cancer of the urinary system. It can be assumed that the territorial variability in the number of people with cancer of the urinary system organs may well be a reflection of the correlation of the incidence rate, both exogenous and endogenous "risk factors". During the analyzed period, strong direct correlations were established between the parameters of the urinary tract organs with the level of chlorides and synthetic surfactants (surfactants). Correlations of average strength with the level of nitrites, magnesium, transparency, color and mineralization of water in the territories of the Lena zone for 1979-1985 were also revealed.

Keywords: cancer, organs of the urinary system, hydrochemical factors, Republic of Sakha (Yakutia).

Introduction. Urinary tract cancer is common and includes a range of lesions ranging from small benign tumors to aggressive neoplasms with high mortality. The predominant malignant neoplasm (MN) of the urinary tract is bladder cancer [11]. Bladder cancer is the 10th most common cancer in the world and its incidence is steadily increasing worldwide, especially in developed countries [6]. According to GLOBOCAN, 550,000 people were diagnosed with bladder cancer in 2018. This represents approximately 3% of all new cancer diagnoses. The region with the highest rate of bladder cancer among women is Southern Europe (same as among men), where it is estimated that 26.5 men per 100,000 and 5.5 women per 100,000 of the population develop the disease each year [5]. The regions with the lowest incidence of bladder cancer are Central and West Africa, Central America with a below-average Human Development Index, possibly due to lower exposure to industrial chemicals and limited access to tobacco [6]. Urothelial cells lining the bladder and urinary tract are constantly exposed to potentially mutagenic environmental agents that are filtered into the urine by the kidneys [9]. In Russia, bladder cancer ranks 8th in the structure of oncological pathology in men and 18th in women [4]. The increase in the incidence of bladder cancer is associated primarily with the difficult diagnosis of the disease in the initial stages, due to the asymptomatic course, or the similarity of the clinic and symptoms with other diseases of the genitourinary organs. Most cases of bladder cancer are associated with the effect of carcinogenic substances excreted in the urine on the urothelium [1]. In the Republic of Sakha (Yakutia), the incidence of malignant neoplasms of the urinary system from 2001 to 2015 increased by 1.9 times. In particular, this pathology in men was 8.92%, in women 5.57% of all MNs in 2015 (Table 1) [2].

In Yakutia, the quality of drinking water is one of the key problems of preserving the gene pool, improving the healthcare system and promoting a healthy lifestyle for the population. One of the key objectives of research carried out in the RS(Y) is the identification of hydro-, biogeochemical environmental factors in the permafrost zone, which are important in the formation of high incidence rates of malignant neoplasms in the population. On the quality of surface waters of the river. The Lena and its basins are affected by the economic activity of mining, energy, utilities, water transport, oil depots, agriculture with direct discharge of wastewater into them, as well as due to the ingress of pollutants into the territories adjacent to settlements. Taking into account the insufficient knowledge of the role of hydrosphere factors in the pro-

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Table 1

Dynamics of the incidence of malignant neoplasms of the urinary system by five-year periods (2001-2015)

Years	Both sexes		Men		Women	
	n	%	N	%	n	%
2001	95	5.07	61	6.59	34	3.57
2005	106	5.43	72	7.27	34	3.54
2010	118	5.81	70	7.05	48	4.83
2015	181	7.16	107	8.92	74	5.57

cesses of carcinogenesis, we made an attempt to compare the incidence rates of the urinary system organs with the chemical factors of the aquatic environment.

The purpose of the study was to assess the relationship between the incidence of malignant neoplasms of the urinary system organs and hydrochemical factors polluting the aquatic environment in the Prilenskaya zone of Yakutia.

Material and research methods. We analyzed the annual reporting data of the State Budgetary Institution of the Republic of Sakha (Yakutia) "Yakutian Republican Oncological Dispensary" and materials on the chemical composition of the water of the river. Lena "Ministry of Nature Protection of the Republic of Sakha (Yakutia)". Aggregate data on the incidence of malignant neoplasms of the urinary system of the entire population (per 100 thousand) of three subzones (Nizhnelenskaya, Srednelenskaya and Verkhnelenskaya) of the Prilenskaya zone (II) of the Republic of Sakha (Yakutia) for the period 2011-2015 and the concentration of water chemicals in those same subzones of the Prilenskaya zone for the period 1979-1985. Taking into account the data of a number of studies that revealed the relationship of bladder cancer with harmful substances in drinking water, where the duration of their exposure was considered from 30 [7] to 40 years [10], we adopted a period and exposure of pollutants in water up to 30 years.

To determine the strength of the influence of polluting components of drinking water on the incidence of cancer of the urinary organs, we calculated the coefficients of pair correlation. Statistical data processing was carried out using the SPSS Statistics 19 application package. To study the relationships between variables, the procedure of the paired correlation method was used using the Pearson test, where r is the correlation coefficient. The Pearson correlation coefficient (r-Pearson) is used to study the relationship between two variables measured in metric scales on the same sample. The article presents the data of correlation analysis, the critical values of the significance level (p) of which were less than 0.05.

Results and discussion. The results of studies of other medical-geographical zones of Yakutia, taken into account on the basis of the involvement of their territories in the basins of the largest rivers, showed that high levels of growth in the general oncological incidence of the population are found along the riverbed of the Aldan (150%), Amga (116%) and Vilyui 113%. Compared to these zones, the same indicator in the Prilenskaya zone was 105%, in particular, in the Nizhnelenskaya subzone - 102%, Srednelenskaya - 117% and Verkhnelenskaya - 96%. The leaders in the growth rate for MN in the Prilenskaya zone are Megino-Kangalassky (158%), Zhigansky (123%) and Khangalassky (120%) districts. In men, the maximum rate of increase in the incidence of MN is observed in the Zhigansky district (175%), in women - in the Megino-Kangalassky district (154%) (Table 2). In the Russian Federation in 2010, 18.7 thousand patients with newly diagnosed kidney cancer were identified, which accounted for 3.6% of all MNs registered in the same year. For the period from 2001 - 2010. there was a significant increase in the incidence of kidney cancer, both in the male (from 3.6 to 4.3%) and female (from 2.6 to 3.0%) population. In 2010, the "rough" incidence rate of the entire population was 13.2 per 100 thousand people, which is 36.1% higher than in 2001 (10.2), including 15.7 in men, women - 11.1$^0/_{0000}$. The levels of standardized incidence rates for the male and female population were 12.1 and 6.6$^0/_{0000}$, respectively, and the average annual growth rate was 3.1 and 2.1%, respectively. The maximum incidence occurs in the age group of 70 years and older [3, 4].

For the period 2001-2015. in the Prilensky zone, the total number of patients registered with the first-ever diagnosed MN was 5953 patients, of which 467 patients had cancer of the urinary system, which accounted for 7.8% of the total number of registered patients and the overall incidence rate was 18, 8 per 100000 population. The most affected group in both populations was formed by people over 50 years old (73.6%). There were 29 children between the ages of 0 and 14 years old, which accounts for about 0.1% of cases of kidney cancer in the republic on average per year (in the Russian Federation in 2010 - 0.97%). An active increase in the incidence is observed starting from 40-49 years old, reaching a maximum (33.8) in the age group of 50-59 years, due to a high increase in the incidence rate, both in men (38.5%) and in women (30.8%). During the analyzed period, the consolidated incidence of cancer of the urinary system tended to increase (from 18.0 to 22.7$^0/_{0000}$) with an average annual growth rate of 4.75%. Thus, among the 10 administrative territories located along the Lena River, the Verkhnelenskaya subzone of 23.9% (from 7.6 to 22.2$^0/_{0000}$) stands out with the highest average annual rate of increase in incidence, where the gas and oil industries are developed, followed by followed by Srednelenskaya

Table 2

Dynamics of incidence rates of malignant neoplasms in the population of the Prilensky zone for five-year periods (per 100,000 population)

Territories			Both sexes			Men			Women		
Zone (subzone)		District	2001-2005	2011-2015	темп роста	2001-2005	2011-2015	темп роста	2001-2005	2011-2015	темп роста
Prilensky zone	Nizhnelenskaya	Bulunskiy	168.5	135.4	0.80	136.0	100.7	0.74	203.7	173.5	0.85
		Zhigansky	201.8	248.4	1.23	163.3	286.8	1.75	238.6	211.4	0.89
	Srednelenskaya	Gorny	147.2	146.7	1.00	150.3	158.9	1.06	144.3	135.1	0.94
		Kobyaisky	198.1	177.4	0.90	208.2	168.0	0.81	188.2	186.3	0.99
		M-Kangalassky	175.6	227.7	1.58	168.2	273.3	1.62	183.6	283.1	1.54
		Namsky	145.7	176.0	1.21	158.5	179.4	1.13	133.8	172.9	1.29
		Khangalassky	189.1	227.7	1.20	215.3	253.7	1.18	164.1	202.6	1.23
		Yakutsky	214.5	243.5	1.14	215.9	234.4	1.09	213.3	251.8	1.18
	Verkhnelenskaya	Lensky	252.9	207.6	0.82	260.6	187.2	0.72	245.1	228.0	0.93
		Olekminsky	243.6	265.0	1.09	276.0	279.5	1.01	211.8	250.7	1.18

(agriculture) - 3.05% (respectively from 19.8 to 23.0‰) and Nizhnelenskaya - 1.45% (from 14.7 to 15.8‰). One of the key tasks of onco-epidemiological research is to identify risk factors that are important in the formation of high incidence rates of cancer of the urinary system in some selectively taken climatic and geographical zones of the territory of Yakutia. An analysis of the annual indicators of the chemical composition of water in the territories of the Prilensky zone for 1979-1985 indicates a significant mosaic of the hydrochemical characteristics of the aquatic environment of the subzones of the Lena River (tabl.3).

Among the selected medical-geographical territories, the Verkhnelenskaya subzone stands out in terms of the level of pollution of the aquatic environment, belonging to the territories of intensive industrial development with the involvement of shift workers for work, where the infrastructure of diamond, oil, and gas production is predominantly developed. On the territories of the Upper Lena, which is part of the Irkutsk region (Vitim, Ust-Kut), there is the base of the Lena Shipping Company, which is one of the leading transboundary polluters of the Lena River. So, in the zone of the upper reaches of the Lena River (subzone of South Yakutia), the indicators of: bichromate oxidizability, the content of suspended solids and phenol are 4 or more times higher than those of the lower reaches (Arctic subzone) of the Lena River. From 3 to 4 times exceeded the indicators of contamination with oil products, mineral and total phosphorus, water-soluble CO_2 and nitride nitrogen. From 2 to 3 times the content of chlorides, total mineralization, magnesium, synthetic surfactants and from 1.2 to 2 times the content of silicon, calcium, sulfates, carbonates and biochemical oxygen consumption for 5 days. A relatively low content of zinc, water-soluble oxygen, iron and copper was found.

Our correlation analysis of the morbidity of the population of MNs of the urinary system (2011 and 2015) with hydrochemical factors in the subzones of the Prilensky zone (1979-1985) revealed the presence of strong direct relationships (at the level of p≤0.01) with the level of chlorides (r=0.996; p=0.004) and synthetic surfactants (surfactants) (r=0.997; p=0.007). Also, correlations of medium strength (at the level of p≤0.05) with the level of nitrites (r=0.972; p=0.028), magnesium (r=0.983; p=0.017); transparency (r=0.971; p=0.029), color (r=0.956; p=0.044) and mineralization of water (r=0.951; p=0.049).

Table 3

Comparative characteristics of the annual indicators of the chemical composition of water in the territories of the Lena zone for 1979-1985

Chemical factors	Total in the Prilenskaya zone	Subzones:			Ratios indicators	
		A-Nizhnelenskaya	B-Srednelenskaya	C-Verkhnelenskaya	A : B	A : Б
Suspended solids	15,1	5,9	12,8	25,8	4,4:1,0	2,2:1,0
Transparency	61,7	17,2	70,2	80,5	4,7:1,0	4,1:1,0
Acidity	7,26	7,38	7,29	7,11	1,0:1,0	1,0:1,0
Carbon dioxide	9,4	3,4	12,1	10,7	3,1:1,0	13,6:1,0
Oxygen	10,1	11,6	9,2	10,0	0,9:1,0	0,8:1,0
Bichromate oxidizability	34,7	8,7	43,7	49,9	5,7:1,0	5,0:1,0
Five-day biochemical oxygen demand	1,93	1,74	2,01	2,03	1,2:1,0	1,2:1,0
Chroma	35,0	22,8	40,3	38,4	1,7:1,0	1,8:1,0
Oil products	0,191	0,062	0,19	0,22	3,5:1,0	3,1:1,0
Phenols	0,006	0,002	0,004	0,008	4,0:1,0	2,0:1,0
Synthetic surfactants	0,044	0,022	0,049	0,043	2,0:1,0	2,2:1,0
N ammonium	0,13	0,1	0,17	0,1	1,0:1,0	1,7:1,0
N nitride	0,06	0,02	0,07	0,05	3,1:1,0	4,4:1,0
N nitrate	0,02	0,05	0,02	0,01	0,2:1,0	0,4:1,0
N common	0,27	0,29	0,33	0,21	0,7:1,0	1,1:1,0
Phosphorus mineral	0,032	0,005	0,066	0,018	3,6:1,0	13,2:1,0
Phosphorus total	0,051	0,011	0,091	0,037	3,4:1,0	8,3:1,0
Iron	0,15	0,35	0,16	0,13	0,4:1,0	0,5:1,0
Silicon	2,3	1,4	2,8	2,6	1,9:1,0	2,0:1,0
Copper	2,6	5,3	2,8	2,2	0,4:1,0	0,5:1,0
Zinc	12,3	14,1	11,9	12,0	0,9:1,0	0,8:1,0
Carbonate (HCO_3)	75,3	61,8	86,9	82,3	1,3:1,0	1,4:1,0
Sulfates	33,1	21,5	35,7	39,4	1,8:1,0	1,7:1,0
Chlorides	63,76	23,29	71,17	60,1	2,6:1,0	3,1:1,0
Calcium	32,32	19,16	33,13	35,84	1,9:1,0	1,7:1,0
Magnesium	9,32	4,54	9,57	9,64	2,1:1,0	2,1:1,0
Mineralization	276, 0	132,4	271,3	297	2,2:1,0	2,0:1,0
Hardness	1,88	1,33	2,16	2,06	1,5:1,0	1,6:1,0

Our findings of a strong association of chlorides with urinary tract malignancies are consistent with several epidemiological studies that have shown an association between bladder cancer risk and exposure to trihalomethanes, the main disinfection by-products of chlorinated water, with risks increasing significantly at exposure levels above 25 mcg/l and with more than 30 years of exposure to chlorinated water [10]. Surfactants are introduced into the reservoir in large quantities with domestic wastewater, with wastewater from industrial enterprises, with runoff from farmland. Over the past few years, there has been an increase in evidence of possible links between nitrate levels in drinking water and cancer risk. N-nitroso compounds are presumably carcinogens of the human bladder [8]. Assessing the role of individual hydrochemical environmental factors in the occurrence of cancer of the urinary system, it can be noted that under the influence of factors that often have a multidirectional effect on homeostasis, various pathophysiological, pathomorphological changes occur, leading to chronicity of diseases that are considered "precarcinogenic conditions".

Conclusion. The results of the analysis indicate that Yakutia belongs to the territories with a rather pronounced con-

trast in terms of the incidence of cancer of the urinary system. It can be assumed that the territorial variability in the number of patients with cancer of the organs of the urinary system of organs may well be a reflection of the correlation of the incidence rate, both exogenous and endogenous "risk factors".

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BIOCHEMICAL PARAMETERS OF THE BLOOD OF THE POPULATION IN THE ZONE OF INCREASED NATURAL RADIOACTIVITY

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An analysis of the main biochemical parameters of the population living in the territory with unfavorable natural radioactivity of 222Rn revealed changes in the biochemical spectrum of blood serum in the population of the Aldan region, indicating the presence of signs of disadaptation. Lipid profile changes are associated with gender and smoking. The shift of lipid metabolism towards atherogenicity is more pronounced in men due to an increase in the atherogenic fractions of lipids in the blood that are susceptible to peroxidation and a decrease in the level of the antiatherogenic fraction of lipids. The shift of metabolic flows towards catabolism, activation of glycolysis, dyslipidemia indicate the tension of carbohydrate and lipid metabolism, which is a sign of disadaptation of the body and the risk of developing environmentally conditioned diseases, including neoplasms.

Keywords: radon, metabolism, lipids, carbohydrates, disadaptation.

Introduction. One of the environmental risks for human health is the radiation hazard caused by the anomalous content of radioactive elements in nature. On the territory of the Republic of Sakha (Yakutia), the population of the Aldan region is exposed to a similar risk, where there is an increased natural radioactivity of the rocks of the Aldan shield and the close location of the Elkon uranium ore region, in which the main reserves of uranium in Russia are concentrated. From rock dumps, the decay product of uranium isotope radium radon (222Rn) enters water, soil and air. In the sources of drinking water supply and in the air of the premises of Aldan and Tommot, as well as nearby villages, its high content is often noted [1, 3].

Radon is considered a carcinogenic agent and is an element of risk to human health [12]. An indicator of negative environmental impacts on the body is the level of the state of health of the population with such the most objective indicator as mortality. The general death rates of the population of the Aldan region are high compared to the nationwide indicators (respectively 13.4-14.2 versus 8.6-7.8 per 100 thousand population). Mortality from diseases of the circulatory system occupies a leading place and exceeds more than 2 times the data for RS (Y) (741.7 versus 354.0 per 100 thousand population). The second place is occupied by mortality from neoplasms (in 2019 - 214.0 and in 2020 - 215.5 per 100 thousand population), the third - mortality from external causes (in 2019 - 146.9 and in 2020 . - 143.3 per 100 thousand population). In the structure of the general morbidity of adults for 2000-2018. diseases of the respiratory organs, the circulatory system, and the musculoskeletal system are of decisive importance [2].

Thus, in the conditions of unfavorable natural radioactivity in the Aldan region, the state of health of the population is characterized by a steady downward trend. And any shift from health to disease occurs on the basis of a gradual decrease in the adaptive reserves of the body associated with a violation of homeostasis, and the constancy of the internal environment of the body is achieved by biochemical adaptation, which allows maintaining the physiologically normal state of the body [6]. In this regard, the determination of biochemical parameters of blood serum is necessary not only to identify pathological processes occurring in the body, but also to assess the signs of disadaptation.

Target. Assessment of biochemical parameters of the adult population living

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