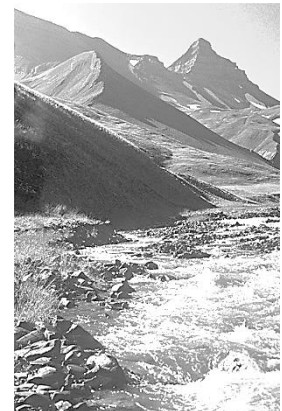


Ecological aspects of toxoplasmosis

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Objective: to study the effect of high altitude on toxoplasma infection and immunological parameters of women of reproductive age with toxoplasma invasion.

Material and methods. A survey of 380 patients of reproductive age with a chronic form of toxoplasmosis from high-mountainous regions and 260 patients from lowland areas was examined. In the study of the cellular and humoral parts of the immune system, phagocytosis indices and immunoglobulin classes M, G, A were determined by the Mancini method of radial immunodiffusion.

Results. Patients of reproductive age revealed a distinct relationship between infection with toxoplasmosis and high altitude. When analyzing the climatic conditions, the characteristics of the economic activity and life of residents of different settlements of the republic, the dependence of the level of Toxoplasma infection on such factors as the influence of the sea and mountain climate and occupation is revealed. It was found that in patients from high mountain regions, the average percentage of blast formation is 2 times less than this indicator in patients from lowland areas (2.8 ± 0.3 and 5.7 ± 0.7 ; $p < 0.05$). The average percentage of agglomerated leukocytes in individuals from high mountain regions was 16.7 ± 1.2 , and in women from lowland regions - 10.5 ± 1.1 . The difference in leukergy indices was significant ($p < 0.05$).

Conclusion. The results of the studies indicate the inhibitory effect of the high mountain climate on the cellular and humoral parts of the immune system. The infection of patients with toxoplasmas from highlands is 2 times higher than among women from lowland areas.

Keywords: highlands, plain, women, reproductive age, toxoplasmosis, immunity

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Toxoplasmosis is a zoonotic infection, the main sources of which are domestic and farm animals. The Republic of Dagestan is a region where animal husbandry is a leading sector in the develop-

ment of the national economy. The study of toxoplasmosis in Dagestan has both clinical and epidemiological prerequisites. Our republic is a natural laboratory where all

climatic zones are represented - from highlands to plains.

Our study presents data regarding the effect of high altitude on toxoplasmosis infection. These living conditions, apparently, are the environment with the maximum stress impact for a person. Unlike other factors, this form of exposure is permanent, unchanging and not amenable to transformation. Despite this, millions of people live and work at altitudes exceeding 3500 m and even 4500 m in conditions of severe hypoxia and very low barometric pressure, which gives rise to numerous pathophysiological problems [5]. Persons permanently residing in conditions of high altitude above sea level have the ability to more effectively use the oxygen of inhaled air compared to persons acclimatized to life in high altitude conditions. At the same time, the level of working capacity of permanent residents is within the same limits as those of people living in low-lying areas [4].

In recent years, a lot of sanitary-hygienic and clinical-laboratory studies have been published devoted to studying the adverse effects on the body of various anthropogenic environmental factors [3].

Considering that the conditions of high altitude are an important feature of the natural environment, we set a goal - to determine the influence of the alpine belt of the Republic of Dagestan on the immunobi-

ological parameters of the adult population with toxoplasmosis.

Toxoplasmosis is a ubiquitous protozoan infection, which is one of the diseases that cause significant harm to society. The situation is exacerbated by the growing HIV epidemic. Recently, toxoplasmosis is considered as AIDS-associated infection [1, 2].

Objective: to study the effect of high altitude on toxoplasma infection and immunological indicators of women of reproductive age with toxoplasma invasion.

Material and methods

A comprehensive study of the T- and B-units of specific immunity and non-specific resistance of the body was carried out in 380 patients with a chronic form of toxoplasmosis from high mountain regions and in 260 patients from lowland areas.

Clinical and epidemiological and immunological studies were processed using generally accepted methods of variation statistics with the calculation of the Student-Fisher criterion. The titers of specific antibodies were expressed in geometric mean units.

Results and its discussion

The frequency of infection of patients living in different climatogeographic zones of the republic is analyzed. The data presented in table 1 showed that the infection of patients from the highlands was 84.4%, and from the lowland areas - 31.3%.

Table 1. The frequency of infection with toxoplasma in various climatic and geographical areas of the Republic of Dagestan

Landscape-climatogeographic regions	Number of women	Of them infected	
		Absolute number	%
Flat	201	63	31,3
Seaside	59	13	22,0
Foothill	84	31	36,9
High mountain	296	250	84,4
Total	640	357	55,7

Studies have shown almost widespread infection with toxoplasmosis, characterized by the uneven distribution of it in different settlements.

Using correlation analysis, it was found that one of the reasons for the unevenness of parasitosis is the peculiarities of wetting the terrain, soil temperature, and air. When

analyzing the climatic conditions, the characteristics of the economic activity and life of residents of different settlements of the republic, the dependence of the level of infection with toxoplasmas on such factors as the influence of the sea and mountain climate, occupation - vegetable growing, gardening, animal husbandry, etc. was revealed.

Considering that chronic infectious diseases are accompanied by secondary immunodeficiency, we carried out a comprehensive study of the T- and B-units of immunity and nonspecific resistance of the body in 380 patients with a chronic form of toxoplasmosis from high mountains and 260 - from the lowland areas. It was found that in patients from high mountain regions the average percentage of blast formation is 2 times less than in patients from lowland

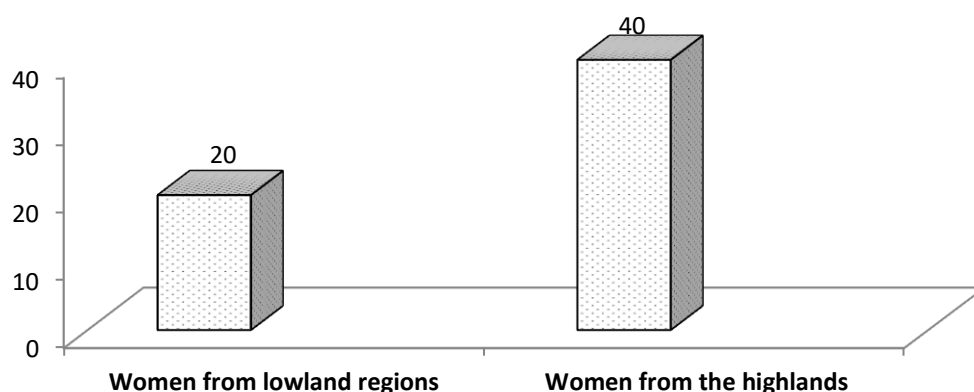
areas (2.8 ± 0.3 versus 5.7 ± 0.7 ; $p < 0.05$). The average percentage of agglomerated leukocytes in individuals from high-mountainous regions was 16.7 ± 1.2 , and in patients from lowland areas - 10.5 ± 1.1 . The difference in leukergy indices is significant ($p < 0.05$).

The content of E-ROCK in the blood in patients from lowland areas was 18.01 ± 0.75 , and in patients from high mountains it was 14.05 ± 0.7 ($p < 0.05$).

The level of class G antibodies to *Toxoplasma gondii* in patients from various climatic zones is shown in the figure.

As can be seen from the data presented in the figure, the level of class G antibodies is 2 times higher in patients from highlands. These antibodies are markers of the chronic form of toxoplasma infestation.

Ig G r/l



Picture. The content of class G immunoglobulins in women from the highlands and lowlands.

The study of the immune status showed the presence of secondary immunodeficiency in patients with a chronic form of toxoplasmosis from the alpine zone (Table 2). The indicators presented in the table indicate a decrease in the total content of

T-lymphocytes (CD3+), an increase in the level of cytotoxic cells (CD8+), a decrease in the immunoregulatory index (IRI), and an increase in the content of B-lymphocytes (CD19+), which indicates about secondary immunodeficiency.

Table 2. Indicators of T- and B-cell immunity in patients from the high mountain zone of the republic

Immunological indicators	Absolute values			Relative values		
	Toxo	Control	P	Toxo	Control	P
White blood cells, $10^9 / L$	6,19	$7,5 \pm 0,5$	$<0,01$	-	-	-
T-Lymphocytes, $10^9 / L$	$2,19 \pm 0,54$	$2,6 \pm 0,3$	$>0,05$	31.86 ± 1.2	36.8 ± 2.8	$>0,05$
CD3+	$0,95 \pm 0,29$	$1,5 \pm 0,2$	$>0,05$	5.4 ± 2.0	55.3 ± 3.2	$>0,05$
CD4+	0.59 ± 0.14	1.2 ± 0.14	<0.05	31.52 ± 1.1	38.3 ± 1.8	>0.001
CD8+	0.45 ± 0.08	1.79 ± 0.1	<0.05	1.53 ± 0.5	1.59 ± 0.1	>0.005
IRI (CD4+ / CD8+)	0.63 ± 0.05	1.79 ± 0.1	<0.05	1.53 ± 0.5	1.59 ± 0.1	>0.005
B-lymphocytes, $10^9 / L$	0.07 ± 0.01	0.05 ± 0.01	$>0,05$	3.75 ± 0.33	2.06 ± 0.24	<0.001

IRI – immunoregulatory index.

When studying the level of phagocytic activity, a decrease in the percentage of phagocytic cells and digestion index was found in 65% of women from high mountain regions and 34% in patients from lowland areas.

In patients with toxoplasmosis, a decrease in the titers of complement, normal hemolysins, hemagglutinins and the general hepatic blood activity of the blood was detected at an early stage of the disease, and the degree of their severity is directly dependent on the phase of the development of the pathological process, which is especially noticeable in patients from the mountainous areas. This suggests that in the formation of chronic toxoplasmosis, along with other factors, the inhibition of the natural mechanisms of resistance is of some importance.

It should be noted that so far there is no official statistical accounting for toxoplasmosis among people in our region. The study of the distribution and characteristics of epidemiology, ecology in the territory of the republic was carried out by us for the first time. The results of the conducted studies substantially supplement the data on nosogeography of toxoplasmosis in our country and reveal the patterns of the spread of this infection, depending on natural and social factors. For the first time, the parameters of the influence of climatic conditions on the prevalence of toxoplasmosis

in the Republic of Dagestan are established.

Conclusion

The results of the studies indicate the inhibitory effect of the high mountain climate on the cellular and humoral immunity links of patients with toxoplasmosis. It is possible that the reduction of non-specific cellular and humoral defense factors to a certain extent depends on the low partial pressure of oxygen, and the role of a higher intensity of ultraviolet radiation and ionizing radiation in high altitude conditions in the formation of this effect is not ruled out.

The data obtained are not only theoretical, but also practical in the development of preventive measures and the choice of tactics for managing these patients.

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The authors declare no apparent and potential conflicts of interest related to the publication of this article.

This study was conducted using personal means of the authors' team.

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