

LEVEL OF ADAPTIVE TENSION AND CELLULAR REACTIVITY IN PATIENTS WITH CORONAVIRUS DISEASE

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Abstract

Coronavirus disease is one of the dramatic problems of modern medicine. Nature presented mankind with a threatening message that the evolution of life on Earth is not over and ecological disturbances have disastrous consequences. Scientists of the world are faced with a task that, if successfully resolved, will in some way depend on the continued survival of humanity. A new disease that is spreading rapidly is characterized by several peculiarities. This rapid fluidity of the virus, high prevalence rate, specific pathogenesis, and clinical manifestation, etc.

Despite the obvious severity of the situation, the combined efforts of scientists in the fight against the pandemic of coronavirus infection will already lead to a significant success: Detailed characterization of the causative agent, determining the mechanism of infection spread, grounded and put into practice methods of laboratory diagnostics, created a base of production doses of commercial test systems, most importantly, over a remarkably short period created, tested vaccines, which made it possible to substantiate promising approaches to therapeutic tactics and prophylaxis. At the same time, variability of clinical manifestation requires the study of pathogenetic mechanisms of disease manifestation, especially at the initial stages. It is important to establish the adaptation-compensatory mechanisms and related cellular reactivity of the organism of patients, which not only need to be used to solve diagnostic problems, treatment, and determination of the prognosis of the disease course.

Coronavirus disease is a severe respiratory viral infection with airborne transmission caused by a new coronavirus (SARS-CoV-2), which affects people of different ages and occurs in the form of asymptomatic, mild, and severe forms with the development of atypical pneumonia, severe acute respiratory syndrome, which can lead to death. Based on the examination of absolute and relative numbers of the main populations of immunocompetent cells of peripheral blood to determine the level of adaptation pressure and cell reactivity of the organism of the patients with coronavirus disease on admission to hospital treatment.

It is important to establish the adaptation and compositional mechanisms and associated cellular reactivity of the body of patients, which not only need to be used to solve diagnostic problems, treatment, and determination of the prognosis of the disease course. Coronavirus disease is associated with an 86.96% increase in the level of adaptive tension in the relative number of immunocompetent cells and a 56.86% increase in the absolute number of immunocompetent cells.

Keywords: coronavirus disease, adaptive process, cell reactivity.

Introduction

The presence of coronavirus infection was verified by clinical manifestation, results of PCR, instrumental methods of examination, and other laboratory tests included in the protocol of diagnostics and treatment tactics accepted at the state level.

Blood was taken from the finger of the sick and practically healthy people on an empty stomach (7-8 a.m) and carried out clinical and general blood analysis. Based on the results of the clinical blood analysis, we calculated immunohistological coefficients and indices, which determined the level of adaptive tension of the body and the type of individual tension of each patient. The level of cellular reactivity associated with the adaptive tension of the organism of patients with coronavirus disease was determined by the index of cellular reactivity and confirmed absolutely by immunohistological leukocyte indices of Calf-Calif, Reiss, Chimich, Intoxication Index, modified leukocyte Intoxication Index, hematologic Intoxication Index by Vasilievich, and others.

To establish the immunoenzyme changes of the mentioned indicators as possible prognostic factors we determined: the degree of disturbance of the level of adaptive tension and cellular reactivity of the organism of patients with coronavirus disease according to the formula: Degree of impairment of immuno-hematological index = (index of the patient/index of thee controlled practically healthy person) $-1 \times 100\%$. In the case of deficit, the indices were negative (-), the sign (+) indicates hyperfunctioning of the system. The result value within the range 1-33% is interpreted as the first (I) level of disorders, 34-67% - the second (II) level, over 67% - the third (III) level of disorders.

Statistical evaluation of the numerical results was carried out according to standard methods of variation statistics with the establishment of

arithmetic average values (M) and standard error ($\pm m$). Reliability of the results of the study for independent samples was calculated by Student's t-coefficient (by the distribution of arrays close to normal. The variability of differences was considered to be $P < 0.05$

Methods

Clinical and laboratory tests were performed on 20 patients with coronavirus disease in the infectious disease department of Regional Clinical Hospital "Chernivtsi", all patients agreed to participate in clinical and laboratory tests.

The results of clinical and laboratory examinations of 30 practically healthy persons of the same age (average age 63.17 ± 3.17 years, the average age of those who had coronavirus disease was 64.57 ± 4.27 years) were used for the study comparison.

The majority of patients had a moderate course of the disease, and only 7% of patients had a severe course of the disease. Every patient admitted to the hospital was diagnosed with bronchial and lung lesions, which were confirmed by X-ray and computer tomography (CT). In the structure of diagnosed pneumonia, bilateral lung damage prevailed (98.3%). Symptoms of gastrointestinal tract involvement were observed in 11 patients (16.9%).

The diagnosis was confirmed by nasopharyngeal smears, which were taken by dacron swabs with subsequent placement in a transport medium for respiratory smears. Biological material was collected in the first 24 hours from the moment of hospitalization of patients with signs of ARVI and suspicion of COVID-19 and examined by PCR method. All patients obtained positive results.

Results

the blood system plays a leading role in ensuring the adaptive capacity of the organism. This role is determined, first of all, by its function of transport of vital nutrients and acid-

carrying energy sources for cells and tissues of the body. The blood system is also one of the most important carriers of information about the processes that take place at the level of cellular and tissue structures, and immunocompetent blood cells (lymphocytes, monocytes, macrophages, leukocytes, and others) constantly function and are highly sensitive to changes both in the external (surrounding) environment of work and life and in the internal state of the organism. Studying the level of adaptive tension and related cellular reactivity of human organisms is carried out by examining the absolute and relative number of the main populations of immunocompetent cells (Table 1).

The number of neutrophilic granulocytes was shown to increase by 9.75% with a significant increase in the absolute and relative number of band cells by 5.05 times in patients with coronavirus disease (CVC) and myelocytes were found in 35% of the patients. At the same time, the total number of eosinophilic granulocytes decreased by 55.94% while maintaining their absolute number. The total number of granulocytes in peripheral blood of patients decreased by 14.23%, which form a specific immune response and antigen. There is a significant decrease of relative (2.25 times) and absolute (330 times) monocytes, macrophages, which perform at least the protective, antigen-presenting and secretory functions.

Discussion

Today there are suggested simple criteria for the evaluation of general adaptive reactions that develop in the body due to the influence of external and internal subunits. These methods can be used to assess the nature of non-specific action of various agents, pathogens, and others, as well as to determine the efficacy of targeted activation therapeutic practice and to predict the course of the disease. Adaptation reaction in patients with coronavirus infection

was determined by the relative and an absolute number of leading populations of immunocompetent cells of peripheral blood and the results are shown in Table 2.

Coronavirus disease is associated with an increase in the level of adaptive tension by 86.96% in the relative number of immunocompetent cells and by 56.86% in the absolute number of immunocompetent cells. The types of adaptation reactions (stress, training reaction, calm activation, increased activation, and overactivation) that occur in patients with coronavirus disease illustrate the results shown in Table 3.

The adaptation of the human body to any extreme conditions - stresses, illness, injuries, operational stresses is ensured by its reserves. Based on the ideas of G. Selye about the reaction of nonspecific adaptive stress syndrome, the existence of the occurring nonspecific adaptive reactions of the organism in succession is presented and it is established that the action of each of them is the level of the value of the adaptive coefficient of performance. The prognostic value of the adaptation coefficient is determined, and the prevalence of some other non-specific adaptation reactions of the organism is detected. The following adaptive reactions of the organism were determined: stress, training, calm activation reaction, increased activation, and overactivation. Adaptation index is used as an integrated test, calculated by the ratio of the absolute and relative number of lymphocytes and segmented neutrophils. Adaptation index increases in the direction of "stress" → "training" → "calm anactivation reaction" → "elevated activation reaction" → "overactivation", thus high values of the adaptation index correspond to a more favorable prognosis of disease progression. The majority of Patients with Coronavirus disease (45%) showed increased activation and overactivation, which was confirmed by the following observation. All of the patients

recovered and started a traditional way of life, and the patients who were found to be stressed were on artificial pulmonary ventilation, and the course of activation was normal.

Adaptive reactions of the human organism is closely connected with the cellular reactivity of the organism, the level of which is determined by the indices of the absolute and relative number of the main populations of immunocompetent cells in the peripheral blood. Components that characterize cell reactivity are leukocyte indexes of intoxication, hematologic index of intoxication according to V.S. Vasilievich, nuclear index of the degree of endotoxemia, lymphocytic-granulocytic index, and the index of the ratio of the absolute number of leukocytes to the sed rate.

It was shown that in patients with coronavirus disease reduced the level of activity by 82.98%, as evidenced by the increase in the value of the leukocyte index of intoxication by Calf-Calif by 97.35%, the index of total intoxication - in 129 times the hematological index of intoxication by V.S. Wassilievich - in 12,88 times, the nuclear index of the degree of endotoxemia - in 57 times and formed a stable tendency to increase the leukocytic index of intoxication for Reis - by 26,99%, for Khimich - by 19,35%, the modified index of intoxication - by 28, 92,% and the decrease in the index of the ratio of the absolute number of leukocytes and erythrocyte sedimentation rate by 5,47 times for the stable lymphocytic-granulocytic index, which characterizes the presence of both infectious and autoimmune intoxication with a certain prevalence (by 7.64%) of infectious.

Acknowledgments

1. the level of adaptive tension in patients with coronavirus disease increased by 86.96% and by 56.86%, which characterizes the positive prognosis of the disease prevalence (all patients recovered). The majority (60%) formed

an increased activity (30%), overactivation (15%), and calm activation (15%) of nonspecific adaptive reactions.

2. Associated with adaptive reactions, the cellular reactivity of the body of patients with coronavirus disease decreases by 82.98%, as evidenced by the increase in leukocyte indexes of Intoxication by Cal-Calif (by 97, 35%), Reis (by 26,99%), the index of total intoxication (by 129 times), the nuclear index of the level of endotoxemia (by 57 times), the hematologic index of intoxication by V. S. Vasilievich stability of granulocytic index characterizes the presence of intoxication caused by autoimmune immunopathological processes and infectious mechanism. The latter has a significant (by 7.64%) advantage.

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Table 1: Absolute and relative numbers of the main populations of immunocompetent cells of peripheral blood in patients with coronavirus disease

Populations of immunocompetent cells	Measurement units	Patients with Coronavirus disease (n=20) M±m	Practically healthy people (n=20) M±m	Stages of immune disorders(+, -)	P
Leukocytes	x·10 ⁹ /l	5,49±0,55	4,98±0,47	+I	>0,05
Granulocytes	%	68,65±2,37	64,19±2,07	+I	>0,05
	x·10 ⁹ /l	3,77±0,38	3,20±0,29	+I	>0,05
Neutrophilic granulocytes (NG)	%	68,00±2,05	61,96±2,02	+I	<0,05
	x·10 ⁹ /l	3,73±0,37	3,09±0,27	+I	>0,05
Segmented neutrophils	%	51,95±2,63	58,78±2,07	-I	<0,05
	x·10 ⁹ /l	2,85±0,29	2,93±0,24	-I	>0,05
Band cells	%	16,05±0,11	3,18±0,47	+III	>0,001
	x·10 ⁹ /l	0,88±0,09	0,16±0,01	+III	<0,01
Myelocytes	%	1,00±0,01	0		
	x·10 ⁹ /l	0,05±0,001	-		
Eosinophilic Granulocytes	%	1,43±0,02	2,23±0,21	-II	<0,05
	x·10 ⁹ /l	0,08±0,01	0,11±0,01	-I	>0,05
Agranulocytes	%	31,35±1,07	35,81±1,17	-I	<0,05
	x·10 ⁹ /l	1,75±0,17	1,78±0,18	-I	>0,05
Lymphocytes	%	28,75±1,04	29,17±1,09	-I	>0,05
	x·10 ⁹ /l	1,58±0,16	1,45±0,15	-I	<0,05
Monocytes	%	2,60±0,05	6,64±0,57	-II	>0,001
	x·10 ⁹ /l	0,01±0,01	0,33±0,02	-III	<0,001
Sed rate	ml/hour	35,95±0,39	6,07±0,37	+III	<0,001
Average age	years	64,57±4,27	63,17±3,17		

Table 2: Adaptation level of the organism of patients with coronavirus infection

index	Patients with Coronavirus disease (n=20) M±m	Practically healthy people (n=30) M±m	Stages of adaptation disorders	P
Adaptation index by the relative ratio	0,86±0,09	0,46±0,05	+III	<0,001
Adaptation index of the absolute ratio	0,80±0,09	0,51±0,05	+II	<0,05

Table 3: Differentiation of Patients by the Type of Inflammation in Coronavirus Disease Patients

Adaptation types	Patients with Coronavirus disease (n=20)		Practically healthy people (n=30)		Stages of adaptation disorders	P
	Aбс.	Nº	Aбс.	%		
Stress	6	30,0	0	-	-	-
Recitation on the training	2	10,0	11	36,67	-III	<0,05
Calm activity	3	15,00	14	46,67	-III	<0,05
Elevated activity	6	30,00	5	16,66	+III	<0,05
Overactivation	3	15,00	0	-	-	-

Table 4: The level of cellular reactivity in patients with coronavirus disease

Immuno-hematological index	Evaluation of the measurement	Patients with Coronavirus disease (n=20) M±M	Practically healthy people (n=30) M±M	Stages of adaptation disorders	P
The Index of cellular reactivity	y.o.	38,13±0,39	69,77±0,57	Stages of adaptation disorders	<0,001
Leukocytic Intoxication Index by J.J. Calf-Calif	y.o.	2,23±0,23	1,13±0,11	Stages of adaptation disorders	<0,01
Leukocytic Intoxication Index by B.A. Rayson	y.o.	2,07±0,19	1,63±0,17	Stages of adaptation disorders	>0,05
Leukocyte Intoxication Index by Khimich	y.o.	0,37±0,04	0,31±0,03	Stages of adaptation disorders	>0,05
Intoxication Index	y.o.	4,40±0,37	0,34±0,04	Stages of adaptation disorders	<0,001
Modified Intoxication Index	y.o.	2,14±0,21	1,66±0,17	Stages of adaptation disorders	>0,05
Total index of differentiation of intoxication	y.o.	4,34±0,43	5,36±0,52	Stages of adaptation disorders	>0,05
Hematological index of intoxication according to V.S. Vasilievich	y.o.	440,13±4,37	34,16±0,33	Stages of adaptation disorders	<0,001
Nuclear index of the level of endotoxiosis	y.o.	0,309±0,003	0,054±0,01	Stages of adaptation disorders	<0,001
Leukocyte correlation index Sed rate	y.o.	0,15±0,02	0,82±0,07	Stages of adaptation disorders	<0,01
Lymphocytic-granulocytic index	y.o.	4,19±0,42	4,54±0,37	Stages of adaptation disorders	>0,05