# Establishment of Education «International Sakharov Environmental Institute»



# ACTUAL ENVIRONMENTAL PROBLEMS

Proceedings of the X International Scientific Conference of young scientists, graduates, master and PhD students

> November 19–20, 2020 Minsk, Republic of Belarus

## **The general editorship:** D.Sc. in Physics and Mathematics, Professor Sergei Maskevich Ph.D. in Agriculture, Associate Professor Victor Lemiasheuski

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The conference proceedings include the theses submitted at the X<sup>th</sup> International scientific conference of young scientists, PhD students, Master's degree students, and students «Actual environmental problems» in English, which was held in November 19–20, 2020 at the International Sakharov Environmental Institute of Belarusian State University.

The proceedings are reffered to a wide range of expert, lecturers of higner and secondary educational establishments, PhD students, Master's degree students and students.

The conference proceedings are published with the information support of the Ministry of Education of the Republic of Belarus and with the financial support of the UNESCO National Project «School-laboratory for pupils is the instrument for implementing the agenda 2030 in the Republic of Belarus»

**ISBN** 

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Keywords: Morbidity, homeostasis, coronavirus, biochemical parameters, complications.

The aim of the study was to detect the biochemical changes in the homeostasis of patients with COVID-19. The study of biochemical parameters of homeostasis was carried out using an automatic biochemical analyzer BA400 (Spain) with the use of reagent kits from the manufacturer Biosystems (Spain). Statistical data processing was performed using the Microsoft Office Excel software package.

A retrospective analysis of the biochemical parameters of homeostasis in patients with the development of a systemic inflammatory process caused by coronavirus was performed. The study was conducted at the «Republican Clinical Hospital for Disabled Great Patriotic War Veterans named after P. M. Masherov». The patients were divided into three groups. The study group included patients with confirmed coronavirus who received the necessary treatment. The control group included clinically healthy people, and the comparison group included patients who were treated before the pandemic.

The results of the study revealed that the biochemical parameters of patients in the study group significantly exceed those in the other two groups. The average value of aspartate aminotransferase (ASAT) in the study group of patients was 55.23 U/l, which exceeded similar indicators in the comparison groups by 2.7 times, and the upper threshold of the norm (40 U/l) – by 1.4 times. The content of alanine aminotransferase (Alat) in the control group was 19.8 U/l, and in the comparison group – 24.55 U/l. In both cases, the results did not exceed the limits of the established norm and were 2.1 and 1.7 times lower than the indicators of the study group, respectively. Comparative analysis of creatine phosphokinase (CC) and cardiac fraction of creatine phosphokinase (CC-MV) did not reveal significant differences in the studied groups of patients. The concentration of ferritin in patients of the study group significantly exceeded the norm (485.5 mcg/l and 45.4 mcg/l, respectively) by 10.7 times. The content of highly sensitive C-reactive protein in the study group of patients revealed its high level (35.27 mg/l at normal – up to 5 mg/l) – 7.0 times higher than normal values. In the control and comparison groups, the C-reactive protein was within the normal range (1.54 and 0.59 mg/l, respectively). The results of the performed studies haven't detected any significant differences in the content of transferrin in all the study groups.

Thus, clinical and laboratory diagnostics of a new COVID-19 and the effectiveness of disease therapy are associated with the development and implementation of diagnostically significant indicators that characterize the severity of the patient's condition and the choice of an adequate amount of pathogenetically justified therapy. Informative criteria for assessing the severity of the disease will allow predicting the course of the disease, its outcome, and the amount of treatment required.

#### **BIBLIOGRAPHY**

1. *Guan, W*. Et al. Clinical characteristics of coronavirus disease 2019 in China / W. Guan // New England Journal of Medicine. 2020.

2. *Wang D*. Et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus- infected pneumonia in Wuhan, China / D. Wang //Jama. 2020.

## BIOELECTRICAL IMPEDANCE DETERMINING BODY COMPOSITION AND HARDWARE-SOFTWARE RECORDING OF HEART RATE VARIABILITY DURING AN OBJECTIVE STRUCTURED CLINICAL EXAMINATION AS A DIAGNOSTIC TOOL

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*Annotation:* The purpose of the publication is to determine the clinical diagnostic potential and the appropriateness of applying the computerized methodology for a short record of heart rate variability and the body impedance measurement technique as an instrumental Objective Structured Clinical Examination.

*Keywords:* Bioelectrical impedance determining body composition, Hardware-software recording of heart rate variability, Non-communicable diseases, Objective Structured Clinical Examination.

This research work is a fragment of the initiative research project "Development of algorithms and technology for introducing a healthy lifestyle in patients with non-communicable diseases based on the study of psycho- emotional status" (State registration No. 0116U007798, UDC 613:616-052:159.942:616-03).

The aim is to determine the clinical diagnostic potential and the feasibility of Objective Structured Clinical Examination (OSCE) patients of assessing heart rate variability (HRV)-short recording of and of Bioelectrical Impedance method (BIM) determining body composition as a tool procedure in functionally healthy individuals. Materials and methods. The results of an open, non-randomized, controlled study of 82 functionally healthy people (group n1=60 athletes, average age –  $20.5\pm4.7$  years, men – 100%; control group n2=23, average age –  $24.8\pm2.0$  years, men – 78%) were taken. The formula of the methodology included the following methods of multiparameter diagnostics: 1) testing according to an adapted questionnaire with the determination of the psychological type of attitude towards a healthy lifestyle with the identification of predictors of the occurrence of NCDs; 2) BIM determining body composition was performed on a Body Composition Monitor (model HBF- 500-E, Omron Healthcare, Japan); 3) HRV-short recording (background recording - 5 minutes and Orthostatic test - 3 minutes) was assessed using a complex (model Poly-Spectr, Neurosoft Company, Ivanovo, Russia).

Review. The averaged anthropometric data for the groups are given in Table1 and significant differences in the power of spectral characteristics for all indicators of the frequency spectrum were established by us (Table 2).

Table 1

	Group n1=60	Group n2=23
Weight (kg)	73.54±9.22	74.48±12.07
Height (cm)	182±6.7	176.6±7.8
Body Mass Index (BMI)	22.76±2.92	23.98±2.48
Skeletal Muscle Percentage (SMP, norm 42-54 %)	41.54±5.88	37.37±5.72*
Body Fat Percentage (BFP, norm 8-19,9%)	15.87±3.74	22.65±7.27*
Visceral Fat Level (VFL, norm 1-9 level)	4.27±1.10	6±2.42
Resting Metabolism (RM, kcal)	1742±67	1671±207

General Characteristics of the body composition

*Note* \* - *the difference is reliable at p*<0,05 *between the characteristics Group n1, Group n2.* 

Table 2

General indicators of Spectral Characteristics of the Heart Rate Variability

	Group n1=60		Group n2=23	
	Background recording	Orthostatic test	Background recording	Orthostatic test
ТР (мс <sup>2</sup> )	24173±71872	7333±11772	2918±2042*	2614±1955**
VLF (мс <sup>2</sup> )	8442±32908	3269±8946	935.5±858.2*	880,4±818,3**
LF (мс²)	7369±29211	2918±3429	1080±808,7*	1413±1218**
НF (мс <sup>2</sup> )	8362±14530	1146±2326	902.4±759.2*	320±251.7**
LF/HF ratio	1.024±1.071	6.656±5.078	1.433±0.925	6.003±5.591

Note \* - the difference is reliable at p < 0,0001 between the indicators Background recording, \*\* the difference is reliable at p < 0,0001 between the indicators Orthostatic test.

Conclusions: Indicators of spectral analysis of HRV and body composition (BFP, SMP) differ significantly at different levels of physical activity. This confirms the clinical value and objectivity of methods in examining the human body as screening markers of health and metabolic/energy status.

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Boron neutron capture therapy is a promising application for the treatment of cancer. The benefits of BNCT are the ability to destroy cancer cells without causing damage to normal tissues. Boron neutron capture therapy is carried out using special drugs and boron delivery vehicles.

Keywords: Boron neutron capture therapy, Boron-10, Peptide transporter-1, Boron phenylalanine

Neutron radiation, a type of corpuscular radiation, is a stream of neutrons with relative biological efficiency with values from 1 to 10. Neutron radiation has a small dose of absorption and is an inductor of DNA chain rupture. The appearance of ruptures is caused by the influence of activated radicals formed by the interaction of atoms. Neutron radiation has a high linear transmission of energy and is capable of disrupting basic nuclear interactions. Therefore, the probability of recovery of the damage to the tumor cell is extremely small. [1]

Of particular importance is the neutron-capture therapy based on nuclear particle capture and fission reactions when the boron is exposed to neutrons with the formation of an alpha particle and lithium nucleus.

The first stage is the introduction of a drug containing non-radioactive boron-10, which is localized in the tumor. It captures slow neutrons with energy of less than 0.1 keV, then the cell saturation occurs. Neutrons begin to lose their energy and penetrate into the tissues where the boron-10 is absorbed. The second stage is nuclear capture and fission reactions with the formation of high-energy alpha particles. Their effects are devastating to cancer cells. [2]

The medication is a boron containing agent. It consists of complexes that have an increased affinity for tumor growth factors. Boron is bonded by hydrolytic bonds. Additional components are high molecular weight and low molecular weight agents. [2] The high molecular weight agents are mainly monoclonal and bispecific antibodies, their fragments, lipid bilayer vesicles and lipoproteins. The low molecular weight agents are phosphates, amines, amino acids containing boron, sugar, DNA binding elements and porophines having low toxicity and uniform distribution in the tumor cell. Biochemical and molecular differences between tumor and healthy cells play a large role in creating a certain composition of the drug, which served the development of computer modeling technology for the corresponding drugs. [3]

Delivery of boron agents is carried out by intravenous injection of the medication into the artery that feeds the tumor cells. However, the path is currently being improved to enhance the delivery of agents. Various artificial transporters can be used to deliver Boron-10, but the issue of their effectiveness and further implementation into clinical practice remains open. The assessment was carried out according to their preclinical models. Such transporters are disodium mercaptoclose-undecahydrododecaborate ([B12H11SH]2-2Na+) and boron phenylalanine. PepT-1 oligopeptide transporter is activated in cancer and participates in the transfer of boron associated with dipetids of borono-1-phenylalaene, which accumulates in tumors, and tyrosine. With the introduction of BPA, there was an increase in the expression of PEPT-1 in the cancer cells of the pancreas of the mouse and the accumulation of boron in the tumors. Thus, the mechanism of delivery of the boron to the tumor by MEANS PEPT-1 is established. It is concluded that the number of transporters not only glucose and amino acids, but also oligopeptides is increasing in the conditions of metabolic need. Accordingly, the task is to use the cancer mechanism of regulation of various transport molecules in order to deliver boron compounds to the tumor. In addition, the transport of the drug can be strengthened by acidification of the drug. [1]

Traditionally, BNCT has been used to treat gliomas, and head and neck tumors, but it is currently actively used in the treatment of genital cancer and melanomas. Despite the fact that BNCT is in the experimental phase, the safety of boron neutron capture therapy compared to standard radiotherapy has been proven. The advantages of therapy are biological and physical orientation, the ability to destroy tumor cells without affecting healthy tissues, a relatively small dose of radiation along with high efficiency. Methods are being developed to use controlled nanoparticles that focus the drug's effect on the tumor. These particles are transported with phagocytes. Exposure to the magnetic field localizes the toxic effect of therapy, so the effectiveness and safety of BNCT will increase. Improving the delivery mechanisms and combination of boron agents can improve the effectiveness of boron neutron capture therapy.

#### BIBLIOGRAPHY

1. *Yuan*, *T.-Z*. Boron neutron capture therapy of cancer: Critical issues and future prospects/ T.-Z. Yuan, S.-Q. Xie, C.-N. Qian// Thoracic Cancer. 2019. V.10. №. 12. P. 2195-2199.

### CALCIUM EXCHANGE MODIFICATIONS IN RAT PLATELETS DURING THE POST-RADIATION PERIOD

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This work presents the results of a study using platelets from irradiated and non-irradiated rats (dose 1 Gr). The studies were carried out on the 3rd, 10th, 30th, 90th day after irradiation. On the third day, there was an increase in ADP-induced platelet aggregation; however, Ap4A was able to reduce the increased content of calcium ions in platelets in rats.

*Keywords:* platelet, calcium metabolism in platelets, ionizing radiation, Ca2 + channel.

Fresh platelet transfusion is included in the list of therapeutic agents in many recommendations for the treatment of radiation sickness in humans, since it leads to an increase in the resistance of the vascular walls, a decrease in bleeding, an increase in blood clotting, the consumption of prothrombin during blood clotting and blood clot retraction.

Along with quantitative, morphological changes in platelets in acute radiation sickness, violations of their functional properties occur: adhesive exchange decreases and aggregation properties weaken, the rate of the aggregation process slows down, the degree of aggregation decreases, and disaggregation of platelet aggregates increases.

In rats, exposure to low doses of radiation resulted in thrombocytosis and exposure to large doses resulted in thrombocytopenia. Thrombocytopenia in acute radiation sickness is caused by impaired proliferation of megakaryocytes in the bone marrow and inhibition of thrombocytopoiesis. A decrease in the content of cells of the megakaryocytic lineage of the bone marrow and thrombocytopenia are permanent and characteristic signs of acute radiation sickness. The degree of their reduction depends on the type of ionizing radiation, its dose and power, as well as the type of animals

After irradiation of animals at a dose of 1 Gr, the number of platelets in the blood did not change (3, 10, 30); therefore, this factor is not critical for any changes in platelet-endothelial relationships during the rehabilitation period. However, on the 3rd, 30th day in animals there is an increased aggregation activity of platelets, which increases the risk of platelet aggregates formation in the vascular bed and ischemic organ damage. After irradiation of platelets, a violation of the receptor-dependent regulation of the level of calcium ions in the cytoplasm of cells occurs. Thus, the ADP-stimulated intake of calcium ions into the cytoplasm of platelets in irradiated animals increased 2.3 times on day 3, and 1.5 times on day 10 due to an increase in the transmembrane intake of these ions from the outside. On the 30th day after irradiation, no significant changes in the concentration of calcium ions in the platelets of the irradiated rats were found in response to the ADP action as compared to the control group. It was revealed that acute irradiation at a dose of one gray did not affect the number of platelets in the peripheral blood of rats, but on the 3rd and 30th days after irradiation, an increase in the degree of ADP-induced platelet aggregation was found in some individuals as compared to the control. Experiments have shown that in the short term after irradiation, the content of cytoplasmic calcium in rat platelets increased both without calcium and in a calcium-containing medium, which indicates a dysfunction of the molecular systems located in the plasma membrane and intracellular deposit structures that regulate the influx into the cytoplasm and outflow from her calcium ions. ADP-stimulated intake of calcium ions into the cytoplasm of platelets of irradiated animals on the third day increased two, three times. Ap4A was able to reduce ADP-induced increase in the content of calcium ions in the cytoplasm of platelets in control and trained animals in vitro experiments. On the third day of the post-

radiation period 50% inhibition was achieved, on the 10th day inhibition ran up to 80%.

#### BIBLIOGRAPHY

1. *Covington, E.D.* Essential role for the CRAC activation domain in store-dependent oligomerization of STIM1 / E. D. Covington // Mol Biol Cell. 2010. V. 99. № 21. P.1897–1907.

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