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Quantum Therapy in the Optimization of Non-Specific Adaptation Reactions of the Body of Athletes

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Abstract *Background*: The purpose of the work is to study the influence of low-intensity laser radiation (LILR) of quantum action on changes in the type of nonspecific adaptive reactions of the body (NARB) of athletes. *Material and methods*: for 50 young men of 20.45±0.82 years old (height: 176.32±2.45 cm; body weight: 76.21±1.32 kg), involved in judo (with qualification "Master of Sports"), NARB type was determined by leukogram. Then, all participants were randomly divided into two groups: control and experimental groups of 25 young men in each one. The athletes of the experimental group underwent a course of quantum LILR therapy for 10 days. The impact was carried out with the MUSTANG 2000 physiotherapy (PT) device to the areas of the carotid and subclavian arteries. The control group received a placebo effect (procedures with the device turned off). Then peripheral blood was taken again, and the nature of adaptation was determined by the magnitude of the resulting changes in the leukogram. *Results*: the studies have shown that under the influence of LILR, a change in NARB type occurs. Before exposure, 28-36% of athletes in both groups showed reactivation reactions. After 10 sessions of PT, a reaction of increased activation was recorded only in the control group (28%); reactions of training, calm and increased activation were determined in 71-100% of those examined in both groups. *Conclusions:* we can conclude that LILR has a corrective and stabilizing effect on the parameters of the blood system and NARB. Course use of LILR promotes the redistribution of NARB types with an increase in the proportion of training reactions, calm and increased activation, which will contribute to the success of their competitive activity.

Keywords Electromagnetic Low-Intensity Laser Radiation, Quantum Medicine, Blood System, Nonspecific Adaptive Reactions of the Body, Athletes

1. Introduction

In modern sports, the performance of athletes during a series of training loads depends on the mutual combination of the processes of fatigue and recovery. Active influence on recovery processes is no less important than the selection of optimal means and methods of training. In this regard, the modern concept of sports training considers the training load and subsequent special recovery measures as two integral parts of a single process [1]. Recently, medical and biological agents have been widely used in sports practice, including a large range of pharmacological preparations (carbohydrate gels, carnitine, gainers, multivitamins, iron supplements, Omega-3 fatty acids, etc.), PT procedures, products with increased energy intensity and protein supply, etc. [2]. Though PT methods, cryotherapy, magnetic therapy, electrical myostimulation, tekar therapy, high-pulse laser, etc. are the most commonly used [3,4]. All these methods have long been successfully used by sports medicine in the practice of restoring athletes, mainly after injuries, sometimes becoming firmly part of the internal training algorithm. However, they are practically not used for the prevention of diseases in

athletes. In this regard, the use of LILR of a quantum nature may be promising.

A number of studies have proven that at the cellular level, quantum therapy leads to an increase in energy metabolism in cells and tissues, activates protein synthesis (RNA and DNA), reduces the excitability of cell membrane receptors, improves metabolism in brain cells, normalizes the level of neurotransmitters and has a calcium-blocking effect [5,6].

At the organ level, quantum influence increases the speed of blood flow, producing rheological and microcirculatory effects [7].

At the level of systems and the body as a whole, specific and nonspecific immunity factors are stimulated, blood circulation improves, pain threshold and excitability of the autonomic centers decrease, and the conductivity of nerve fibers improves [5,6,7,8]. A.G. Samodelkin et al [8] proved that quantum radiation reduces glucocorticoid activity of the adrenal glands, the level of lipid peroxidation, affects the regulation of feedback loops and accelerates the production of enzymes and adenosine triphosphate. In addition to the above effects, the following are noted: lowering cholesterol levels, accelerating collagen synthesis, improving tissue trophism, enhancing the regeneration of epithelium and skin, normalizing and increasing the synthesis of prostaglandins, anti-inflammatory, decongestant, resolving, sanogenic, adapting, stress-limiting, hypolipidemic and antioxidant effects, etc. [9]. However, there is practically no information in the literature about the influence of LILR on the development of NARB of athletes.

The purpose of the study is to study the effect of LILR quantum action on changes in NARB of athletes.

2. Materials and Methods

2.1. Participants

The study involved 50 young men of 20.45±0.82 years old (height: 176.32±2.45 cm; body weight: 74.21±1.32 kg), practicing judo in the sports club of Moscow Aviation Institute, Moscow, Russia. All athletes were at the stage of improving sports skills and trained in accordance with the federal standard of sports training for judo, approved by the Ministry of Sports of the Russian Federation on June 29, 2022 [10]. The total number of training is 14 hours/7 sessions per week [10].

Criteria for inclusion in the study are:

- age of 19-21 years;
- sports experience of at least 8-10 years;
- weight category from 71 to 76 kg;
- sports qualification of Master of Sports.

The study was conducted in accordance with the Declaration of Helsinki "Ethical Principles of Medical Research Involving Human Subjects" and was approved by the Ethics Committee of the Federal Scientific and Clinical Center for Sports Medicine and Rehabilitation of the Federal Medical and Biological Agency of Russia No. 01-09 of September 04, 2019.

2.2. Procedure

All participants were randomly divided into two groups: control and experimental groups of 25 young men in each one. To study the indicators of the morphological composition of blood and the level of NARB, first, all subjects underwent a detailed clinical analysis of peripheral blood. Blood sampling was standardized and was carried out on the first and tenth day of the experiment in the morning on an empty stomach in the Medical Center of Moscow Aviation Institute. Clinical diagnostic blood analysis was carried out on a hematological analyzer Pentra XL 80 HORIBA ABX (France) in the BION laboratory.

Then, the athletes of the experimental group underwent a course of LILR quantum-action PT every day for 10 days, while the control group received a placebo effect (procedures with the device turned off). Then, all athletes had their peripheral blood taken again, and the nature of adaptation was determined by the magnitude of the resulting changes in the leukogram.

The exposure was carried out with an exposure of five minutes every day at the same time: from 9 to 13 o'clock: on the first, fifth and ninth day, to symmetrical biologically active points, GI 17 "Tian-ding", located at the posterior edge of the lower part of the sternocleidomastoid muscle, one and a half centimeters above the supraclavicular fossa at the level of the anterior the upper part of the thyroid cartilage with the additional use of pulsed red light, on the third and seventh days with the additional use of pulsed blue light, and on the second, sixth and tenth day on symmetrical biologically active points ST13 "Qi Hu", located at the lower edge of the clavicle [11] with the additional use of pulsed blue light, and on the fourth and eighth days with the additional use of pulsed red light (Table 1). Both points are located in the localization zone of large vessels, which are good conductors of electromagnetic radiation [11] (Figure 1). The exposure scheme is carried out in accordance with the medical instructions for the use of devices of the Mustang 2000 series [12].

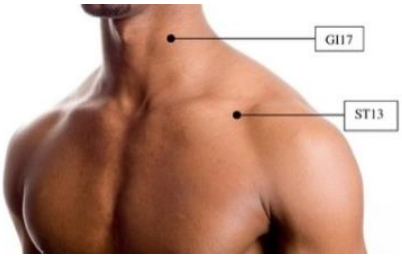

Figure 1. Locations of LILR impact points (according to G. Luvsan)

Table 1. Flowchart of LILR therapy

Days and types of exposure to the Mustang-2000 apparatus				
	GI17 «sinister»	GI17 «dexster»	ST13 «sinister»	ST13 «dexster»
Day 1	LILR+PRL	LILR+PRL	------	------
Day 2	------	------	LILR+PBL	LILR+PBL
Day 3	LILR+PBL	LILR+PBL	------	------
Day 4	------	------	LILR+PRL	LILR+PRL
Day 5	LILR+PRL	LILR+PRL	------	------
Day 6	------	------	LILR+PBL	LILR+PBL
Day 7	LILR+PBL	LILR+PBL	------	------
Day 8	------	------	LILR+PRL	LILR+PRL
Day 9	LILR+PRL	LILR+PRL	------	------
Day 10	------	------	LILR+PBL	LILR+PBL

Note: PBL – pulsed blue light, PRL – pulsed red light, sinister – on the left, dexster – on the right.

2.3. Equipment in the Study

The source of radiation was MUSTANG-2000 generator: autonomous PT multifunctional complex-impact device designed for the prevention and treatment of various diseases with LILR, low-intensity electromagnetic oscillations, PBL and PRL.

MUSTANG 2000 device was developed and manufactured by “Technika” research and production laser center (Moscow). This device has passed mandatory certification according to the requirements of the Federal Service for Surveillance in Healthcare (TU 9444-005-29230815-2008), is included in the list of the State Register of Medical Devices and Organizations engaged in the production and manufacture of medical devices (Registration Certificate FSR 2008/02872 of June 22, 2020).

KLO3-2000 emitting head with ZN35 mirror attachment was used in a contact-stable manner. Continuous radiation power is 3-5 mW, and modulation is 150 Hz.

2.4. Clinical Laboratory Blood Test

To monitor changes in the blood of athletes, leukemia formula indicators (LYM%, NEUT%, IMM%, MON%, EO%, BA%) were selected. Integral indicators that adequately characterize NARB type are the percentage of lymphocytes (LYM) and segmented neutrophils (NEUT) in peripheral blood, as well as their ratio (LYM / NEUT) [11]. Criteria for determining NARB are: stress response – no more than 0.3; training response – 0.31-0.5; quiet activation reaction – 0.51-0.7; reaction of increased activation – 0.71-0.9; reactivation reaction – more than 0.9 [13].

2.5. Statistical Analysis

Calculations and graphic design of the data obtained in the work were carried out using Microsoft Excel and the software package "STATISTICA – 10.0". The choice of criterion for testing statistical hypotheses and measures of central tendencies used to describe the data was carried out depending on the results of the distribution test, which was carried out using the Shapiro-Wilk test. To conduct a comparative analysis of the final results of the study, the nonparametric Mann-Whitney U test was used.

3. Results

As the studies have shown, in the experimental group of judo athletes, the initial level of adaptation processes was as follows: 14.5% of the total number of those examined showed a training reaction, 57% of those examined had a reaction of calm activation, 21.37% of those examined had a reaction of increased activation, 7.13% reaction of overtraining (overexertion) (Figure 2).

In the athletes of the control group, the initial level of adaptation processes was as follows: of the total number of examined 7% showed a stress reaction, 22% showed a training reaction, 49% showed a calm activation, 14% showed increased activation, 7% showed a reactivation (Figure 3). Thus, the majority of the subjects (63%) showed a reaction of calm and increased activation, although there were also extreme reactions: stress and overactivation.

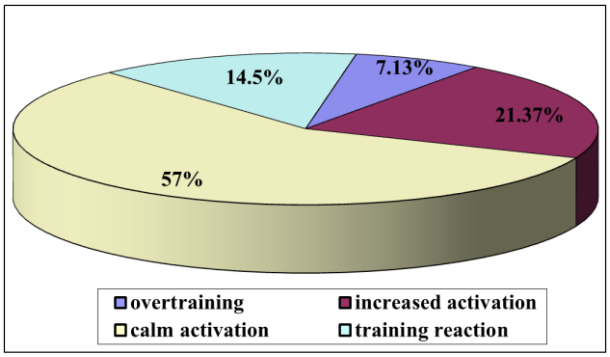

Figure 2. Quantitative distribution (number of people, %) of NARB types in the experimental group before PT

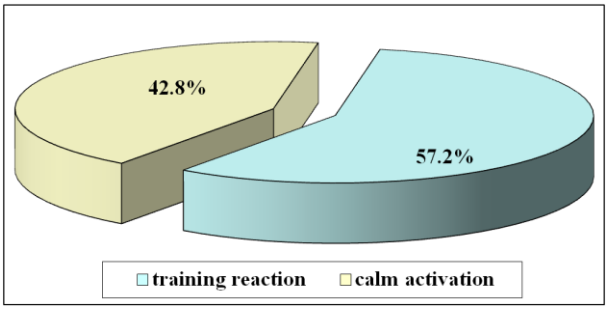

Figure 3. Quantitative distribution (number of people, %) of NARB types in the experimental group after PT

After 10 sessions of LILR exposure in the group of subjects in the experimental group, a change in the quality of NARB occurred: adaptive reactions of training and calm activation were determined in 42.8% and 57.2% ($p<0.05$), respectively. There were no reactivation reactions or increased activation observed in those examined (Figure 3).

Analysis of changes in some parameters of the leukocyte formula before and after exposure showed that in the experimental group the content of eosinophils decreased on average by 2.98%, the absolute content of band neutrophils decreased by 9.17% ($p <0.05$), and the number of segmented neutrophils increased by 8.41% ($p<0.05$). At the same time, the level of lymphocytes decreased by 10.29% ($p<0.05$). The LYM/NEUT ratio decreased by 13.88% ($p<0.05$).

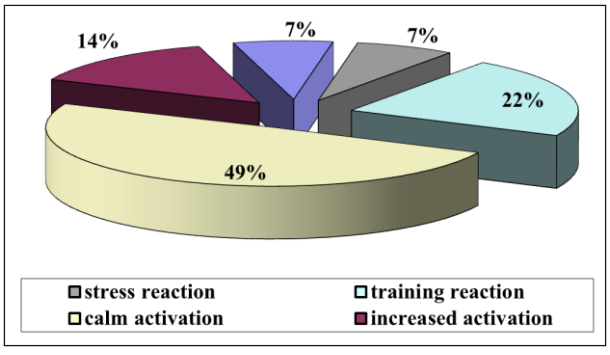

Figure 4. Quantitative distribution (number of people, %) of NARB types in the control group before PT

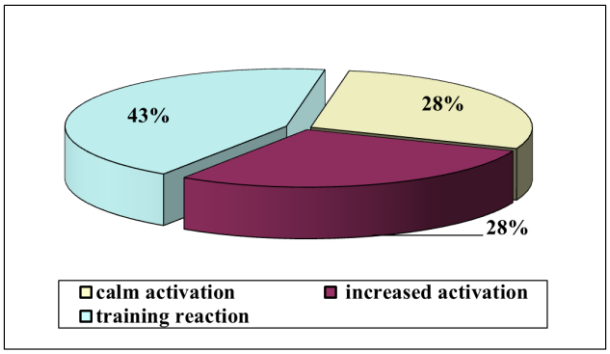

Figure 5. Quantitative distribution (number of people, %) of NARB types in the control group after PT

In the control group, after 10 sessions of LILR exposure, there was also a change in the quality of NARB: stress and reactivation reactions were not detected, training reactions were recorded in 43% ($p<0.05$), calm and increased activation reactions in 56% and 28% ($p<0.05$), respectively (Figure 4, Figure 5).

Analysis of the leukocyte formula data of athletes in the control group showed that the absolute content of eosinophils increased on average by 35.91%, band neutrophils increased by 14.66%, and segmented neutrophils did not increase significantly: by 1.28% ($p<0.05$). As for lymphocytes, their average value decreased by 9.46% ($p<0.05$). The LYM/NEUT ratio did not change significantly.

4. Discussion

The results we obtained can serve as evidence that the blood system not only takes a direct part in the energy supply of intense muscle activity, but also occupies one of the leading places in the complex of PT systems that form NARB. This is due to its ability to quickly respond to various influences by changes in its morphological composition due to the presence of reflex and humoral pathways for the regulation of hematopoiesis, significant cellular reserves, as well as the diverse functions of blood cells [14].

We determined that before the start of the research (in an intact state), the parameters of white blood in the examined groups of athletes were practically no different ($p>0.05$). However, in the control group, 14% of athletes showed stress and reactivation reactions (7% each one, respectively). According to L.Kh. Garkavi and E.B. Kvakina [13], such an adaptive reaction of reactivation indicates excessive activity of the central nervous system, endocrine system and cellular immunity system, as well as the fact that the rate of consumption of energy-releasing substrates significantly exceeds their reproduction and, ultimately, leads to depletion or blocking of their reserves in the body.

Evaluating the results obtained, it can be assumed that the use of quantum technologies (in our case, to highly qualified judo athletes) has a significant impact on the functional activity of the body and leads to the development, first of all, of adaptive reactions of calm and increased activation. This is confirmed by the fact that at the end of the course of LILR therapy, the athletes of the experimental group did not have any overstrain reactions, and the functional readiness in the form of a training response was 14.8% higher than that of the athletes in the control group, in which 28% retained the increased activation reaction. Our results are consistent with the opinion of a number of researchers who have proven that the reactions of training, calm and, especially, increased activation are anti-stress in nature and are characterized by the high functional activity of the thymic-lymphatic system and cellular immunity, endocrine glands and the central nervous system, especially with the initial increased activation [13,15].

The advantage of LILR quantum action is that this method does not contradict anti-doping legislation, is not included in the WADA prohibited list, and therefore can be used in sports [16].

Based on the results of the implementation of the studied method, we can say that among the athletes of the experimental group, the metabolism has acquired an anabolic nature, energy metabolism is characterized by high rates of metabolism of energy-releasing substrates with a good balance of their consumption and consumption.

5. Conclusions

We came to the conclusion that in the practice of sports medicine, the LILR method is effective for correcting overexertion and increasing adaptive potential. Quantum therapy does not carry an additional drug burden on the body, which is important for athletes for whom it is extremely undesirable to use pharmacological agents. The data obtained can be useful for the development of a standardized methodology for quantum photochemotherapy in sports medicine, which is currently missing, taking into account both the dosage values and the individual characteristics of the oxygen transport function of the blood of athletes.

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