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The Immunodepressive Effect of Transcerebral Laser radiation

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A new physical agent - low-energy laser radiation (LLI) in the infrared [IR] band - has gained acceptance in modern physical therapy due to its various, for example, immunomodulative, effects [5,6]. Such investigations provide a basis for the use of laser in the correction of hormonal or immune disorders and offer wide opportunities for creating new therapeutic methods. It is now proven that the state of the endocrine and immune systems can be changed under the local influence of physical factors on the endocrine glands [1,7].

The aim of the present investigation was to study the effect of IR LLI on the immune response and on the state of the hypothalamic-hypophyseal-adrenal and endogenous opioid systems for transcerebral radiation of rabbits.

MATERIALS AND METHODS

The experiments were carried out on male rabbits weighing 2.8-3.2 kg. Ten times a day the animals were exposed to laser radiation from a contact radiator of LITA apparatus (radiation wavelength 0.89 μ, mean pulse power 25 W). The radiation dose received by the animals during one exposure was 0.08 J in the first group and 2.1 J in the second. The animals of the third group were exposed to continuous irradiation from AMLT-01 apparatus without a magnetic attachment (total output power of 7 mW). The radiation dose was 2.1 J per day. The control

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TABLE 1. Effect of Transcerebral Laser Radiation on the Functional State of the Immune, Endocrine, and Endogenous Opioid Systems in Rabbits ($M \pm m$).

Index	Control (n=12)	Transcerebral laser radiation		
		1st group (n=9)	2st group (n=8)	3st group (n=10)
Number of DHPC per 10^6 splenocytes	488.9±24.4	121.3±24.0*	135.2±9.7*	250.7±39.2*
Number of DHPC for the whole spleen $\times 10^3$	477.3±63.7	172.7±24.5*	144.6±12.3*	175.6±20.3*
Titer of serum HA, $\log_2$	3.7±0.2	2.1±0.2*	2.4±0.2*	3.0±0.2*
Triiodothyronine, nM	6.7±0.6	7.9±0.6	6.9±0.5	6.3±0.6
Thyroxine, nM	20.7±2.6	18.6±3.9	22.3±5.2	25.2±5.2
11–OCS, nM	273.1±2.1	312.3±16.2*	363.3±20.2*	368.6±25.1*
Concentration of peptidelike substances, nM	13.4±2.1	3.6±0.7*	7.3±3.4	6.4±1.2

Note: an asterisk means significant values in comparison to control ($p<0.05$).

animals were subjected to "sham" exposures with the apparatus turned off. Ten days after the completion of irradiation the animals were immunized i.v. with sheep erythrocytes (2×10^9). The animals were killed four days after antigen injection. The number of direct hemolysin-producing cells (DHPC) was determined in the spleen [9]. The serum hemagglutinin (HA) titer was analyzed by the method of consecutive double dilutions of serum.

Adrenal glucocorticoid production was assessed by the measurement of the 11-oxycorticosteroid (11-OCS) concentration in the serum using the fluorometric method.

The levels of thyroid hormones (triiodothyronine and thyroxin) were determined by radioimmune assay using Russian test-kits (Minsk).

The opioidlike active substances were examined in the serum by the radioligand technique using cell membranes of rat cerebral cortex and the selective labeled peptide ligand of the μ opioid receptors ^{3}H-DAGO-enkephalin [10].

RESULTS

It was found that transcerebral irradiation with IR LLT in rabbits results in a decrease of the number of DHPC in the spleen and of the HA titer in the serum (Table 1). The immunodepressive effect was more pronounced under pulse mode irradiation. Thus, the number of DHPC per 10^6 splenocytes was 121.3±24.0, 135.2±9.7, and 250.7±39.2 in the first, second, and third groups, respectively.

The observed decrease of the 11-OCS concentration in the serum is probably related to the stimulatory effect of IR LLI on the hypothalamic-hypophyseal-adrenal system. The concentration of thyrixine and triiodothyronine was not significantly affected. This fact is attributed to a sinusoidal variation of the hormone concentration with a tendency toward a decrease during the carry-over effect period [8].

It should be noted that more then 20 substances of an opioid nature were examined in the serum, including all μ ligands with various affinities and some κ and δ ligands. A diminution of serum opioids in the first group and a tendency toward a decrease in the second and third groups were revealed. These results are in agreement with the effect of IR LLI on the immune system and have the direction opposite to the effect on the 11-OCS level. To reveal the correlation between the opioid and 11-OCS levels the estimation of the rank correlation was performed according to tables [2]. A negative correlation was obtained in the first group ($p<0.05$). Thus, transcerebral irradiation in the pulse mode in a dose of 0.08 J leads to interdependent negative correlated changes in the endogenous opioid system and adrenal glucocorticoid activity.

The pituitary is known to be the main source of serum opioid peptides [3]. It may be assumed that transcerebral IR LLI stimulats the production of opioids but their release is soon exhausted, which manifests itself as a decrease of the serum opioid concentration on the 14th day after the end of irradiation.

Thus, transcerebral laser radiation in rabbits causes the activation of the hypothalamic-hypophyseal-adrenal system, which is expressed in an increase of the 11-OCS concentration. It should be deduced that the enhancement of glucocorticoid adrenal activity is the basis for the pronounced immunodepressive effect of IR LLI. Various hormones can effect immunogenetic processes by way of stimulation or suppression of the immune response. The immunomodulative effect may be derived from the combination of the hormonal changes and the stage of immunogenesis. Hormonal effects relating to immune homeostasis regulation should be considered as special manifestations in the broad spectrum of hormone activity, which includes also an effect on metabolism, proliferation, regeneration, protein synthesis etc. Since antibody production is a particular case of protein synthesis governed by the general laws of gene expression regulation, the IR LLI-induced changes of the endocrine state must go hand in hand with the immune response modulation and the rate of metabolic processes. We attempted to produce a direct effect of LLI on the region of the higher autonomic centers and pituitary body in order to modulate the level of endogenous hormones. However, it would be a misinterpretation of the experimental data to conclude that our findings are a result exclusively of changes in the functional activity of the endocrine gland subjected to laser radiation. The entire array of changes induced in the organism by laser radiation should be taken into account. We consider that the immunobiological effects resulting from transcerebral laser irradiation are more diverse than in the case of treatment with hormonal preparations.

The obtained phase changes of serum opioid level is probably dictated by the progressive depletion of the opioid system under laser irradiation. Both immunodepression and the effect on the endogenous opioid system are most pronounced under a pulse mode of irradiation, probably due to the induction of bioresonance effects in the irradiated tissues [4].

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Immunological Screening and Immune Correction in Cardiosurgery of Infants

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The early-onset complications of cardiovascular surgery in congenital heart disease (CHD) can be caused by infection of both endogenous and exogenous origin. The diagnosis of infectious endocarditis as well as of focal infection of other localization is extremely sophisticated in infants with CHD. This is due to the general gravity of the state of a child with CHD, and also to the frequency of latent, nonobvious, and atypical forms occurring against the background of altered immunoreactivity. In a series of reports it was shown that circulatory insufficiency and arterial hypoxemia induce significant derangement in the functional state of the immunocompetent organs and cause the development of secondary immunodeficiency (SID) [1,2,4]. A lowered immunoreactivity associated

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