STATE OF THE ART OF LASER THERAPY IN RUSSIA: A BRIEF OVERVIEW

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Introduction

In addition to being amongst the first successfully to generate laser energy, Russian biologists, and shortly after that, medical specialists, were amongst the first to study the influence of low-intensity or low-energy laser radiation on cells, tissues, organs and bio-systems of mammals and human beings. Up to the time of writing, about 30,000 laser therapy systems are in operation in Russian medical institutions. Interest in low level laser therapy (LLLT) in our country is steadily increasing: every year we organize up to 15 postgraduate resident and visiting courses on laser medicine with a total number of doctors of around 220-240.

LLLT Techniques in Russia

From our reading of the literature, the majority of overseas medical doctors use laser therapy in the form of noncontact or contact applications directly on or over the affected area of the patient's body. In our country, the effectiveness of laser therapy has been remarkably increased due to two novel modalities: laser treatment of the patients blood, and modes of multifocal laser applications.

According to a large number of clinical studies, intravenous laser blood irradiation improves the results of treatment of severe forms of stenocardia and decreases mortality due to myocardial infarction. This technique is applied as a protective measure during general anesthesia and surgical intervention on the lungs, esophagus, stomach, intestine, liver and pancreas. Laser blood treatment results in beneficial changes in patients with hepatitis, liver cirrhosis, mechanical jaundice or peritonitis.

The group of specialists in laser medicine, of which I am one of the leaders, has concentrated on the development of new methods for the use of laser therapy systems, both HeNe and infrared, in the treatment of several diseases of the human viscera: heart constriction; myocardial infarction; bronchitis; pneumonia; bronchial asthma; peptic, gastric and duodenal ulcers; hepatitis; liver cirrhosis; pancreatitis; pyelonephritis; inflammatory disorders of the small organs of the pelvis; the urethra; the testicles and their epididymis, and others.

These methods are based on two modes of application: 1) Laser irradiation onto the projection of an affected organ or an area; and 2) Laser irradiation onto the projection of other organs or systems of the human body which are anatomically allied with the former. For instance: according to our techniques in the treatment of cholecystitis, we irradiate first the projection of the duodenal area on the lateral abdominal wall and on the back in order to relax the outlet of the papilla Vateri to ensure adequate bile evacuation, and then we direct the laser beam onto the projection of the gallbladder in order to decrease the inflammation. This technique is considered as relatively ordinary. Much more often, the plan of treatment includes laser irradiation of the principal nervous tracts (vagal, sympathetic), endocrine glands (adrenal, thyroid, thymus), blood (intravenous or transcutaneous), and skin points associated with reflexotherapy.

Regarding the problems of LLLT, the following aspects should be taken into consideration: namely proved (with hard scientific evidence) and discussed (probable) sequelae. As proved evidence, we were able to record the enhancement of blood microcirculation not only within the irradiated area but in remote organs and systems. This response was experimentally noted as immediate, that is just after laser application, charac-

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terized by enlarged capillary vessels and by the closure of capillary artery-vein shunts; and delayed, characterized by neovascularization. Laser irradiation of endocrine glands resulted in changes of appropriate hormones in blood. Laser treatment of blood leads to the improvement of its rheology, and to an increase in the concentration of more active forms of red and white cells and antibodies. Tissue which had been preirradiated with LLLT was shown to absorb in larger concentrations a variety of alimentary and parenterally used medication.

Multifocal Laser Treatment

Before starting the discussion on the action of laser radiation on biological tissues, we have to present the techniques of soft laser applications routinely accepted in Russian clinics. Thanks to the multifocal laser treatment the curative response increases, sometimes dramatically.

In the *noncontact* technique, the emitter, i.e. the distal end of the light-guide or specialized light-guide tip, is positioned at some distance from the laser target area. It is desirable to adjust the laser parameters to maintain an incident power density of not less than 5 mW/cm². The technique is preferably used for treatment of skin diseases and in stomatology.

In the *contact* technique, the emitter is placed directly onto the skin at the treated area. This and the following techniques are usually used to treat diseases of the inner organs, the spinal column, joints, nerves, in gynecology, obstetrics, and urology. Contact techniques are less dependent on maintaining a certain incident power density, as the laser energy is directed deeper into target tissues than in noncontact techniques, due to the direct interface between the emitter and the tissue. The combination of the contact technique with pressure on the probe is used for laser acupuncture and laser reflexotherapy. It is also useful when deeper-lying articular tissues are the main target. The pressure contact technique provides deeper penetration of the laser radiation.

- In the *intra-cavitary* technique, the distal end of the light-guide or tip is delivered into the thoracic or abdominal cavity either through a hypodermic needle or a suitable drain.
- In the *intra-organ* technique, the distal end of the light-guide or tip is introduced into the cavity of the hollow organs such as the esophagus, stomach, intestines, gallbladder, trachea, bronchi, bile ducts, urethra, urinary bladder and uterus. This way of placing instrument can be *per vias naturalias* or *artificialias*, that is to say, during surgery or through drains.
- In the *intravascular* technique, the distal end of the light-guide or tip is inserted into an artery, vein or lymphatic vessel in order to treat various diseases.
- In the *intra-osteal* technique, the distal end of the light-guide or tip is positioned into the trabecular bone for treatment of bone dysplasia.
- In the *intracutaneous* technique, the distal end of the light-guide or tip is introduced into the dermis for treatment of some skin diseases.
- In the *intra-articular* technique, the distal end of the light-guide or tip is placed into the articular area of the great joints to treat diseases of the joints.
- There are also a variety of techniques to enable placement of the distal end of the light-guide or tip into pathologic cavities, for example directly into cysts or abscesses.
- In the *extra-corporeal* technique, laser irradiation of blood is effected outside of the patients body, in addition to extracorporeal irradiation of blood substitutes, medications, and solutions in order to modify their properties.

Points for Discussion?

During our experience with LLLT and all the above techniques, we have collected some remarks on biological effects of the low-intensity laser irradiation and its interactions with bio-objects: these remarks are to some degree controversial, but with further scientific experimental data, I am sure their viability will be shown.

- Laser low-intensity radiation exerts neither stimulating nor retardative effects on 'normal', i.e., healthy biological tissues.
- Unlike most drugs, LLLT increases biological processes that have been inhibited in some way, and inhibits those that are in a state of overactivation. Furthermore, laser radiation can simulate formation of new normal tissue and at the same time reduce abnormally large growths of tissue, tumor tissues inclusive. All of the above are examples of a balancing or normalizing effect, which is why there is no response from normal tissue to LLLT, as it is already in a state of balance.
- Our recent studies have shown that low incident energy levels of laser radiation change the immunologic state of the body, by for example stimulating production of lymphocytes such as helper and killer T-cells while suppressing production of suppressor T-cells: by enhancing enzyme synthesis and the synthesis of other biologically active substances while at the same time suppressing their overproduction and the production of autoimmune antibodies. In a different way, LLLT can restore depressed immunological

activity and modulate the immunological superactivity.

- Unlike most drugs, laser treatment is not followed by serious complications. In any event the author of this article could not find any data on death or serious morbidity as events during or after laser application.
- In laser acupuncture, to activate acupuncture points along a specific meridian, a very low incident laser energy of up to 1 J is sufficient. On the contrary, much more energy is needed to get a viable response in other tissues in the anatomical approach to LLLT. In other words, the curative mechanisms of laser application can be summarized under two factors: the neuroreflexive mechanisms and the direct mechanisms.

Laser-Tissue Interactions: Hypothetical Theses

Although many advances have been made with good double blind scientific studies, many of the exact mechanisms of interaction between LLLT and biological tissues are still not completely clear and badly needed to be studied. I would like to propose some hypothetical theses that seemingly could explain the curative effect of laser radiation on pathologic states of biotissues.

- First, laser radiation does not exist in nature and is thus artificial, so living cells have no genetic memory of this form of electromagnetic energy and therefore their response sometimes could be unexpected and unpredictable.
- Second, as we know, pathological agents usually attack healthy tissues and organs creating information and pathways of their own and dispersing as to destroy the normal regulatory systems between the attacked tissue and the brain. It is possible that even very low incident doses of laser energy have the capability of boosting the energy levels of the cells in the besieged tissue, thus enabling the re-establishment of normal lines of bioregulatory communication, while at the same time weakening the attacking pathogen and causing its defeat.
- Third, it is well known, cell life cycles are composed of two main phases: the slow or latent phase that does not require much energy, and the rapid or exponential phase that demands more energy for a short time interval. When cells are in an adverse pathologic state there is a deficiency of energy to complete the second phase, so laser energy could possibly provide a much-needed energy supplement. Recent experimental research in Russia have showed that low-intensity laser energy shortens the latent phase. Therefore, laser energy influencing both phases stimulates reproduc-

tion of cells, but in particular in those cells which are in a weakened or diseased state.

LLLT Dosage

Special attention should be drawn to laser energy doses used in clinical situations. In the transcutaneous treatment of diseases of the inner organs we practice the so called 'general dose per session' that usually constitutes some 8 - 6 J. When we treat diseases of the skin and mucous membranes, we use not more than 4 J/cm² per session. In the first case, the laser energy is directed at normal skin in order to penetrate it and reach the inner organ. In the second case the laser energy has to be absorbed superficially and that places a limit on the quantity of energy which can be delivered. And hence, in the first case we usually use infrared laser radiation that has the capability of deep penetration into tissue with corresponding deep absorption of a photophysical nature, and in the second case we use visible red laser radiation which appears to be specifically absorbed by cellular organelles in the superficial layers of the skin and mucosal tissue to initiate the required photochemical reaction. As has been discussed in this journal, although IR and visible red light have different mechanisms, the photomediated cascade of intra- and extracellular events is eventually the same.

LLLT 'at Home'

Finally, several experimental and clinical works have stated that the curative effect of laser light does not principally depend on its coherency, but on its monochromaticity. Although this may hold true for *in vitro* studies, in an *in vivo* situation the coherency is necessary to ensure a sufficiently high photon density and efficient delivery of a clinically useful photon dose at the required depth: at that stage, coherence is not important. Following the publication of these data, in the main, infrared diode laser devices have been manufactured in Russia which are intended for use not only by physicians but also for patients not having a medical education, in the so-called 'home-use' situation. The author would prefer to see all laser therapy carried out by a trained physician or laser therapist. In reality in our country, especially in the rural areas, this may not be possible. In these cases, the patients must at the very least be carefully instructed in the use of the laser systems by their family doctor and must be systematically monitored and controlled by him or her. The trend towards home treatment should be carefully watched, and the training of more clinicians and qualified laser therapists increased, for there is an apparent tendency to increase the laser energy delivered to patients, particularly to

those with chronic diseases and those with diseases of the inner organs. In all cases, this is certainly not the most desirable state of affairs.

Conclusions

We in Russia are proud of our contributions to the state of the art of laser therapy, and we will continually strive to expand the borders of our knowledge. The fields of intra- and extracorporeal LLLT irradiation; multifocal intraluminal, intracavitary and interstitial applications;

and laser photoimmunomodulation of immunoincompetent systems are areas in particular which we seem to be developing ahead of our colleagues worldwide, and I sincerely hope we will be able to share some of these experiments and clinical experiences with the readers of this journal in correctly presented scientific studies in the near future. There is a vast store of LLLT knowledge in Russia, and I hope that through *Laser Therapy* we will be able to tap it to the benefit of our colleagues and, of course, their patients.