

## **SLIDE 1**

Dear colleagues,

I am glad to participate again in the webinar on the therapeutic effects of light. As can be seen from the rapid growth of research and publications, this topic is very relevant and is of interest to doctors of many specialties.

Thank you for the invitation. I hope that the information provided by me will be interesting and useful.

For more than 35 years, we have been actively studying the mechanisms of the biomodulating effect of low-intensity laser (coherent) light at various levels, from theoretical developments to clinical applications. The main goal and the end result of our research is to develop the most effective laser therapy techniques.

Probably a lot of things in my report will contradict what was said earlier, but I don't see anything wrong with that. It's good when there are different points of view, that's how science works.

Since scientific knowledge in medicine is most often applied one, the truth is proven by the efficiency of the proposed treatment schemes (techniques). Only those ideas are of interest that can improve the effectiveness of treatment.

## **SLIDE 2**

Scientific knowledge, theoretical and experimental developments obtained in Russia are unique. Currently, up to 300,000 laser therapeutic devices are operating in our country in almost every medical institution.

Laser therapy can save billions of euros nationwide. Often, the therapeutic effect is unattainable when using other methods of treatment and rehabilitation.

Unfortunately, the language barrier prevents the rest of the world from receiving information from Russia. This concerns both scientific data and practical experience, first of all, the best methods of laser therapy.

The information blockade is gradually being removed due to sponsors ordering publications on topics of interest to them. In recent years, we have translated into English a dozen articles, published 7 books and two large chapters in compilations.

Last year, the book "Laser Therapy for Pain Syndromes" was published. The book has 840 pages, 2,5 million characters, and more than 4,500 references were used for writing. The book describes in detail the mechanisms of the analgesic effect of low-intensity laser illumination. Effective techniques have been proposed based on their understanding to eliminate 40 pain syndromes, such as: fibromyalgia, joint diseases, phantom pains, neuropathies of various etiologies, headaches and much more.

One of the reasons for pain syndromes of various localization is the inflammatory process and the swelling caused by it. Today we will consider the mechanisms that provide effective treatment using the anti-inflammatory effect of low-intensity laser illumination.

### SLIDE 3

About terminology.

Recently, English specialized literature uses the term *photobiomodulation* (PBM), which implies the use of both laser and incoherent light sources, assuming that their biomodulation effect is identical.

In fact, monochromaticity is of fundamental importance, the narrower (smaller) the width of the spectrum, the better the effect. Therefore, the terms LLLT and PBM are completely different, have different meanings.

Danish physiotherapist Niels Finsen proved this fact more than 120 years ago and was awarded the Nobel Prize in 1903. This information can be found on the website of the Nobel Committee <https://www.nobelprize.org/prizes/medicine/1903/finsen/biographical/> Prize motivation: “in recognition of his contribution to the treatment of diseases, especially lupus vulgaris, with concentrated light radiation, whereby he has opened a new avenue for medical science”.

The term *concentrated light illumination* refers to the use of special optical filters that allow to cut out part of a wide spectrum in the red and blue areas.

### SLIDE 4

The spectral linewidth of a laser is less than 1 nm (nanometers), which is 100 times less than linewidth of the Finsen lamp and 20-30 times less than linewidth of LED. The invention of lasers marked a new surge in phototherapy.

Since the bioeffects from lasers were qualitatively better than the bioeffects from other light sources, the new direction of medicine was called *laser therapy*. So, this is not a tribute to the fashionable word *laser*, as many believe. This name only emphasizes that the best therapeutic effect is achieved precisely because of the narrow spectrum of light generated.

### SLIDE 5

Anyone who thinks that the Nobel Committee was wrong, and I make up stories can easily make sure – just try to cure the simplest disease using a conventional LED lighting lamp.

The picture above shows the difference between the light spot and the LED: on the left, it is round and uniform, and the laser diode has a strip with pronounced unevenness and speckle structure.

Unfortunately, there are many scammers who replace expensive lasers with cheap and useless LEDs, selling them as “laser” devices. Therefore, it is very important to be able to distinguish the truth from the fake.

## **SLIDE 6**

The understanding of the need to ensure **optimal** values for **ALL THE PARAMETERS** in the laser therapy technique was the result of previous reasoning and numerous studies. First of all, the wavelength and mode of operation of the laser are important, since they ensure optimal exposure in the affected area (organ) at the desired depth. In addition, it is necessary to set the **optimal** (not the maximum!) power and exposure (exposure time), this is also the pulse repetition rate for the pulse mode.

## **SLIDE 7**

Once again, it is extremely important to understand that all the parameters listed on this slide must be set, you need to carefully select only the optimal values. This is the usual way to write down an order of a methodology. Our experience of presenting the necessary parameters in tabular form proved to be successful.

## **SLIDE 8**

Unfortunately, very often energy (“dose”) is used as the only characteristic of the technique. This is absolutely unacceptable! The absence of any parameter or the choice of its incorrect value can lead to a lack of result or even to the opposite effect.

For example, if the goal of laser therapy is to eliminate inflammation, with the wrong choice of wavelength, too high power or high frequency, you can get a sharp increase in the inflammatory process with further negative consequences.

## **SLIDE 9**

Mathematical actions, calculating the “dose”, absolutely makes no sense! If the calculated value is formally the same, the result may be exactly the opposite.

## **SLIDE 10**

Here are description and comparison of the different modes. I will not dwell on this topic in detail, since it requires a separate lecture, I just would like to draw your attention to the pulse mode (peak power is 10-100 W; light pulse duration is 100-200 ns), which is the most effective and most widely used in laser therapy.

Continuous and modulated modes are used for laser acupuncture and laser illumination of blood only.

## **SLIDE 11**

This slide demonstrates primary (on the left) and secondary (on the right) mechanisms of biomodulation effect of low-intensity laser illumination.

Consideration of this issue in details requires a lot of time, for this reason I will focus only on the most important points.

1. There is one primary mechanism: the thermodynamic triggering of  $\text{Ca}^{2+}$ - dependent processes inside cells as a result of the short-term release of  $\text{Ca}^{2+}$  ions from intracellular stores.
2. The development of secondary body responses at a higher level of organization and involvement of various regulatory systems, including the central nervous system, in the process.
3. The laser beam (LILI) does not actually cure anything, it is only a tool for regulating and managing physiological processes. By setting the necessary parameters of the technique, you can both increase and suppress various processes.
4. Therefore, it is absolutely no need to illuminate the area of pathology, for example, inflammation, it is often even prohibited. For example, treating mucositis in cancer patients after chemo or radiotherapy, it is not allowed to illuminate the mouth area, most correctly and effectively, to illuminate popliteal fossa. Our long-term experience reveals that a maximum of 2-3 treatments are enough to guarantee almost 100% absence of complications interfering with quality treatment.

#### **SLIDE 12**

I repeat, using Low-Intensity Laser Illumination for different areas of the body, with different wavelengths, varying power, exposure and frequency, various responses can be triggered. The main purpose of a correct technique is to set such parameters in order to elicit a response from the body of the desired strength and orientation.

#### **SLIDE 13**

Here is a demonstration of what happens under the influence of laser illumination of the cell in dynamics. There are a lot of such works, this is one of the first ones. An important common feature for all studies is the time parameters of the  $\text{Ca}^{2+}$  waves, the half-period is equal to 100 seconds, and the second maximum is 300 seconds, no more and no less, exactly these values!

This fact led us to conclusion that the best duration of illumination is from 1.5 to 5 minutes, and illumination of same area for more than 5 minutes is not allowed!

For example, after 10 minutes of laser illumination, the inflammatory process will sharply increase with almost 100% possibility, microcirculation will be disrupted, etc. Of course, the experimental model and the localization of the impact zone also make a difference.

There are also some exceptions. For laser acupuncture, the maximum exposure is 20-40 seconds per point, for intravenous laser illumination of blood, the range is quite wide, from 3 to 20 minutes, and the choice of exposure depends on the wavelength. I'll talk about it later.

#### **SLIDE 14**

This slide shows the main (there are also many others) secondary responses of the body. It is important to understand that it is meaningless to consider any particular system, we have to study an interaction between them, to understand the mechanism of the integral response of the body.

### **SLIDE 15**

Many experts consider the immune system to be the most complicated in the human body. I strongly agree.

The main difference between the immune system and the others is variability caused by adaptation to changes in the external environment and constant improvement.

The most important fact is that the immune system works only in link with the neuroendocrine system, and this whole complex is interconnected through the regulation of metabolic processes.

Laser therapy allows not only to have a positive effect on individual regulatory links, but also to eliminate systemic violations of the interaction of various regulatory systems. This is the most important feature of the method.

### **SLIDE 16**

Inflammation is a protective and adaptive process, the first stage of the immune system activation in response to a damage. Inflammation is classified as acute or chronic. It is also classified by the type of cytokines and T helper cells involved.

Sometimes the inflammatory process can be fixed as a pathological condition, which requires a treatment.

So-called autoimmune diseases take special place. Laser therapy is a unique method of treating such diseases as: autoimmune (Hashimoto's) thyroiditis, bronchial asthma, diabetes mellitus, rheumatoid arthritis, multiple sclerosis and many others.

More than 30 years of work allows us to confidently speak about clinical effectiveness at the level of 90% with a duration of remission up to 3 years.

But I repeat that the object of laser exposure in this case is not only the immune system, but the whole complex together with the endocrine and neurohumoral systems of regulation and maintenance of homeostasis.

And it is also important to understand that immunity cannot be strengthened, it can only be normalized.

### **SLIDE 17**

There are more than 4,000 English-language publications on the topic of "inflammation" in PubMed alone, and more than a million in Google Scholar with an increase of 280 thousand publications in 2023. There is no reason to doubt the effectiveness of laser therapy, however, it is necessary to apply correct techniques with optimal parameters of all the components (wavelength, operating mode, power, frequency, etc.) in order to obtain an adequate result.

## **SLIDE 18-25**

The tables show the results of some studies *in vitro*, *in vivo* and clinical ones, demonstrating the effect of Low-Intensity Laser Illumination (LILI) on the regulation of some immune system components.

Without a doubt, there are much more results. There is no point in commenting on each one, you can get slides from the organizers, I am ready to provide more complete information on request, although this information is quite well-known.

I will draw your attention only to the multidirectional nature of the effect: at the same time, the activity of pro-inflammatory cytokines decreases and the level of anti-inflammatory cytokines increases. In other words, balance is achieved, and the normal regulation of the immune system as a whole is restored.

It is also known that the physiological regulation of the human immune system is fundamentally different from animals, so the results *in vivo*, and, especially *in vitro*, cannot be automatically transferred to the clinic without correction. And for a long time, at least for the last 20 years, we have been well aware of how this problem is being solved.

## **SLIDE 26**

In order to maximize the possibilities of laser therapy we must use a wide range of techniques that differ in localization and technique of their implementation.

Local exposure is carried out on the lesion located close to the surface. Another option is in the projection of internal organs.

These methods differ significantly in parameters. In the second case, only pulsed lasers can be used (pulse power of 20-100 W with a light pulse duration of 100-200 ns), the wavelength has to be 904 nm precisely (infrared spectrum). LILI with such parameters has is effective at a depth of up to 20 cm.

Laser acupuncture strongly replaces the classic version with needles.

The main goal of the paravertebral technique is normalization of peripheral innervation.

In recent years, the transcranial technique of laser illumination has been actively developing.

A special place is taken by different variants of laser blood illumination. These are the most universal methods of laser therapy. Many clinics use only those ones, although this is wrong, it is worth to use the others as well.

The main way to increase the effectiveness of treatment is to combine it with other methods of physiotherapy and in general with other methods of treatment. I will not dwell on these options in detail due to time limit.

## **SLIDE 27**

The basic principles of choosing a laser therapy technique to eliminate inflammation.

1 – to use systemic methods of exposure (laser blood illumination and laser acupuncture) combined with the local methods, on the focus of inflammation

2 – to use either Intravenous Laser Blood Illumination (ILBI), or non-invasive one (NLBI); simultaneous use of both methods is unacceptable

3 – it is necessary to additionally expose the projection of immunocompetent organs (thymus, spleen, etc.) while using Noninvasive Laser Blood Illumination.

4 – for ILBI use a combination of methods: every other day use NLBI with the wavelength of 525 nm (green spectrum) or 635 nm (red spectrum), which allows to improve tissue trophism and metabolism. This technique must be combined with the LUVBI (ultraviolet spectrum (365 nm) laser blood illumination), which has the best impact on immunity.

I repeat, it is forbidden to use both techniques on the same day, only every other day. for example, use ILBI-525 (power 2 mW, exposure 7 min) on Monday and ILBI-365 (2 mW, 7 min) (LUVBI) on Wednesday.

5 – please, use only the minimum power, frequency and exposure

#### **SLIDE 28**

Appropriate equipment is necessary for the most successful realization of laser therapy possibilities.

The modern laser therapy device consists of a basic unit that sets and controls all parameters, laser emitting heads specialized for different techniques, and optical nozzles that ensure the delivery of a LILI with the right wavelength, optimal power and power density to the right place.

#### **SLIDE 29**

The slide presents the correct methods of intravenous laser blood illumination. Please note that they cannot be used on the same day, especially at the same time, only on different days.

At different wavelengths, the same power is used – 2-3 MW, the techniques differ only in exposure. The limit values are indicated, the excess of which can cause exacerbation.

The latter option, using the ultraviolet spectrum (wavelength 365 nm) is designed specifically to normalize the immune system, in particular, to eliminate the pathological inflammatory process.

#### **SLIDE 30**

This is demonstration of intravenous laser blood illumination process. In fact, you can use any available veins.

#### **SLIDE 31**

I repeat, different methods of intravenous laser blood illumination cannot be used on same day. The table shows an example of possible option for combination of different methods on different days.

#### **SLIDE 32-33**

The slide presents the correct methods of non-invasive, percutaneous laser blood illumination. Note that only pulsed red lasers are used (power 40 W, light pulse duration 100 ns), and the advantage is red laser light (wavelength 635 nm).

Pulsed red lasers are our unique project.

Another feature of this technique is the need to influence not only the projection of large blood vessels, but also immunocompetent organs: thymus and spleen.

I would like to draw your attention to the exposure time: when exposed to the projection of blood vessels, the optimal time is 5 minutes, and for the projection of immunocompetent organs the optimal time is no more than 1 minute.

#### **SLIDE 34**

Thank you very much for your attention!

If you have any questions, I would be glad to answer. I also can send the presentation file on request, as well as answer other questions.

There are many open access publications on this website, some of them in English.