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Volodymyr Pavlov

EVALUATION OF CHANGES IN TISSUE MICROCIRCULATION UNDER LASER AND PHOTON INFLUENCE FOR COMPLEX TREATMENT OF CHRONIC COMPLICATIONS OF DIABETES

Vinnytsia National Technical University

Annotation. *The prospects of using the photoplethysmographic method for assessing tissue microcirculation for studying the processes that occur during laser and photon physiotherapeutic exposure for the complex treatment of chronic complications of diabetes mellitus are shown.*

Keywords:laser and photon physiotherapy devices, tissue microcirculation, biological tissue, diabetes mellitus

Abstract.*The prospects of using the photoplethysmographic method for assessing tissue microcirculation for studying the processes that occur during laser and photon physiotherapeutic exposure for the complex treatment of chronic complications of diabetes mellitus are shown.*

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Introduction

Complications of diabetes mellitus, such as angiopathy and polyneuropathies, are of serious concern to endocrinologists worldwide due to the increase in the number of patients with diabetic neuropathy in recent decades. The therapeutic effect of Barva photon devices is based on the property of visible light to enhance blood and lymph microcirculation, increase the elasticity of blood vessel walls, normalize blood rheological parameters, and normalize the functioning of the immune, endocrine, central and peripheral nervous systems [140-155].

Assessment of peripheral circulatory disorders is effective through the use of photometric research methods, in particular the photoplethysmographic method. Photoplethysmography is based on the illumination of the studied area of the human body with a (monochromatic) beam of light, which after passing through or reflecting from it is recorded by optoelectronic means, amplified and recorded. It has been established that the intensity of radiant energy that has passed through the studied object or reflected from it is a function of the blood content in it [29]. Since the coefficient of absorption of radiant energy by blood is much higher than by tissues, the use of the photoplethysmographic method allows recording only changes in blood content. In this case, light scattering by blood occurs mainly due to reflection from erythrocytes. Also, as in rheography, the dynamics of changes in the optical density of the studied tissues D (t) uniquely characterizes the dynamics of its blood filling. The useful information signal is the increase in optical density AD(t) and is caused by the redistribution of blood with the heart rate relative to some constant level Do.

As a result of experimental studies, it was found that the corresponding response of the body to physiotherapeutic influence occurs at the adaptive level and is periodic in nature, with successively alternating phases of excitation and inhibition. The adaptive response of the body to therapeutic influence by photon radiation affects all systems of the body, both at the cellular and organ-system levels.

Methodology

Almost all models are built according to the same scheme (Fig. 1). First, the object of study and its geometry are selected. Then the optical and physical parameters of all its components are determined. Next, the distribution of radiation in the environment is calculated and, for some models, temperature fields are calculated.

The difference between the models becomes noticeable already at the stage of constructing the geometry. In most cases, the skin is a sequence of flat layers with different optical and thermophysical characteristics. The number of layers can vary from one to seven depending on the tasks.

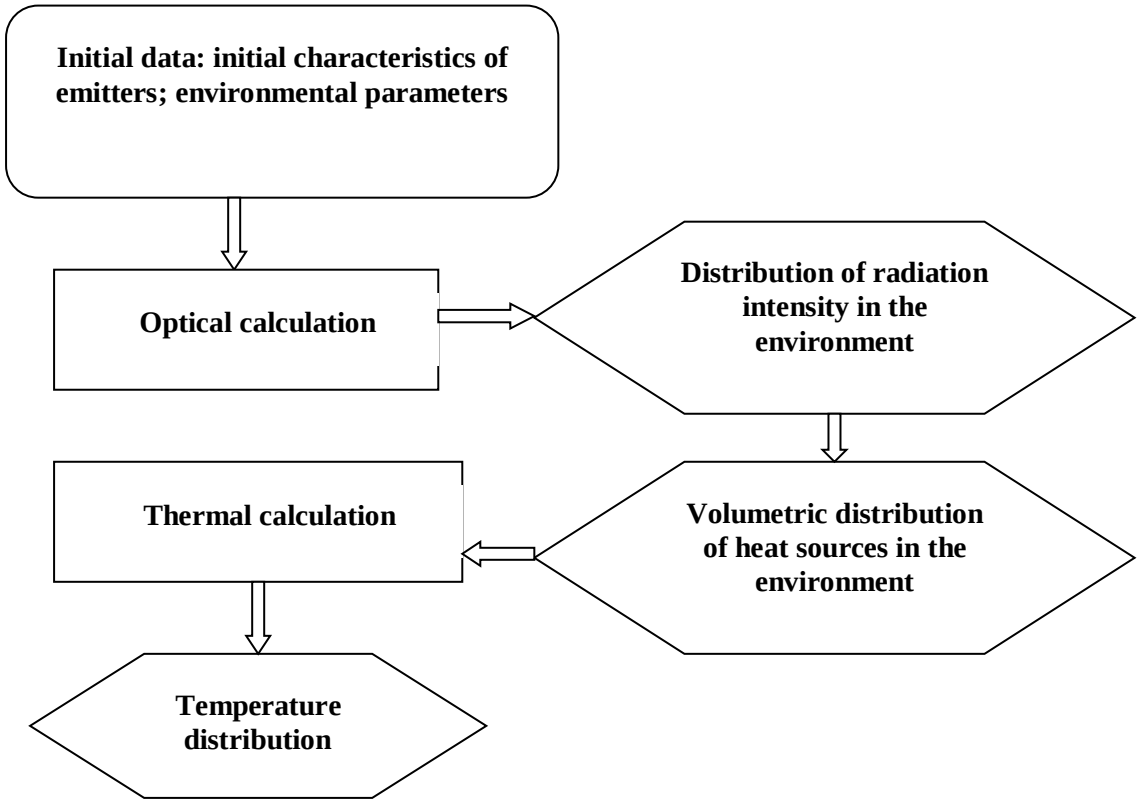
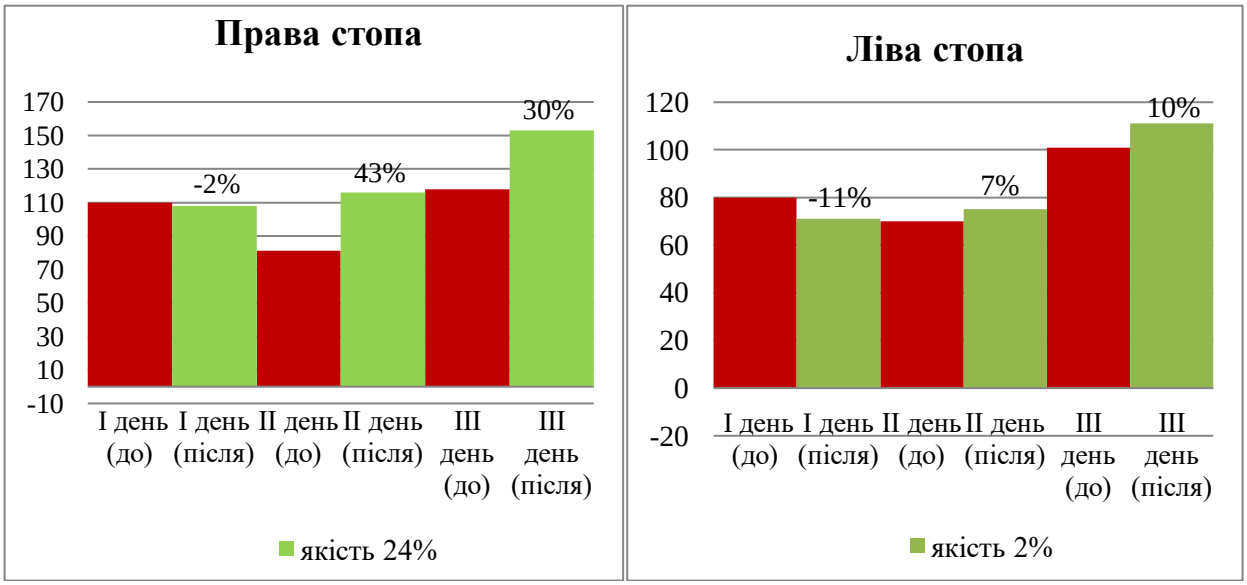


Figure 1 – Model construction scheme

Research results

Physiotherapy was carried out using two-section laser and photon devices. The study involved 20 patients with diabetic angiopathies who were being treated at the endocrine sanatorium "Birch Grove" in Myrhorod. The age of the examined persons was 40-72 years, of which 10 were men and 10 were women. To assess collateral blood circulation in the lower extremities of the patients, laser photoplethysmography (FPG) and infrared thermography methods were used.



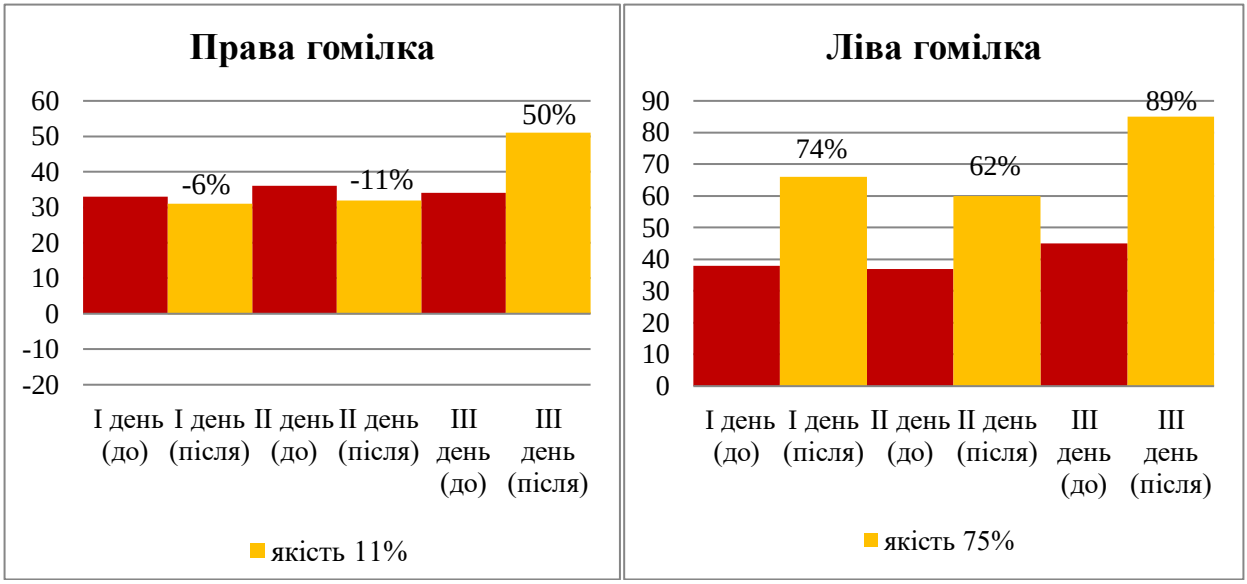


Figure 2 – Assessment of the level of peripheral blood filling when exposed to photon radiation (example 1) (continued)

Example 2. The effect of light therapy on the studied indicators

Initial values of the ENYA% indicator - 57.7% in relation to the age norm. The ENYA% indicator after the first phototherapy session - 64.4% in relation to the age norm. The ENYA% indicator after the second phototherapy session - 71.1% in relation to the age norm.

Indicators of the FPG (Fig. 2): left lower leg - increased blood microcirculation after three sessions by 75%; right lower leg - increased blood microcirculation by 11%; left foot - increased blood microcirculation by 2%; right foot - increased blood microcirculation by 24%.

Conclusion

The prospects of using the photoplethysmographic method for assessing tissue microcirculation for studying the processes that occur during laser and photon physiotherapeutic exposure for the complex treatment of chronic complications of diabetes mellitus are shown.

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Pavlov Volodymyr Serhiyovych– PhDoctor, research associate at the Department of Biomedical Engineering and Optoelectronic Systems, Vinnytsia National Technical University, Vinnytsia, e-mail: machinehead6926@gmail.com

Pavlov Volodymyr– PhDoctor, scientific associate of the Department of Biomedical Engineering and Optical-Electronic Systems, Vinnytsia National Technical University, Vinnytsia, e-mail: machinehead6926@gmail.com