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EXPERIMENTAL STUDIES OF THE RELATIONSHIP PARAMETERS OF MICROCIRCULATION AND REDOX RATIO

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ABSTRACT

Introduction
Quantitative spectroscopic analysis methods, such as fluorescence spectroscopy (FS) are a rapidly developing area of medical optical diagnostics. In particular, the study of redox-processes (redox ratio – RR) is important in the assessment of the metabolic activity of tissues. The aim of this work was the experimental search for the relationship between the RR, defined by FS, and nutritive blood flow, defined by the methods of laser Doppler flowmetry (LDF). These parameters characterize the metabolic activity of tissues. When analyzing the relation of nutritive blood flow and redox ratio, we turned to the so-called metabolic theory of blood flow regulation.
Materials and Methods
Experimental studies were carried out in two points on the skin: skin pads (palmar surface) of the right middle finger and on the outside of the right forearm. The perfusion (Im – index of microcirculation) and the fluorescence amplitude of NADH and FAD (at excitation wavelengths of 365 nm and 450 nm respectively) were simultaneously measured at each point by using two devices: the "LAKK-02" (LDF channel) and the "LAKK-M" (FS channel) (SPE "LAZMA" Ltd, Russia) by combining fibers. The study consisted of 4 stages: state of rest, artificial ischemia (occlusion of the forearm), reactive hyperemia and recovery (relaxation). Experimental studies were carried out with the participation of 34 apparently healthy volunteers (34 recordings to the fingertip and 17 recordings to the forearm) of approximately the same age. RR was calculated as the ratio of the normalized amplitudes of NADH to FAD. Nutritive blood flow was calculated on the basis of perfusion.
Results and Discussion
A direct correlation between the forearm measurements of RR and the level of blood flow in the stages of occlusion and hyperemia was noted in most of the volunteers (n = 13). This is

confirmed by theoretical data. On the skin of the fingertip (zone with arteriovenous anastomoses), the correlation values were lower compared with studies on forearm. This may be due to the changes in blood flow being related to thermoregulatory processes in addition to metabolism. In the last stage, the different volunteers were observed to undergo different types of relaxation on the forearm, as with the restoration of metabolic rate (up to occlusion RR = 1.43 ± 0.49 AU; at relaxation RR = 1.42 ± 0.50 AU), and with the maintenance of it at a constant high level (up to occlusion RR = 1.32 ± 0.84 AU; at relaxation RR = 2.10 ± 1.23 AU). This may be due to a variety of adaptive abilities of volunteers.

Conclusion

Preliminary results in the study of a complex approach to diagnosis of the state of biological tissue were obtained. A positive relationship between the nutritive blood flow in the microcirculatory channel and RR of skin tissue is observed. The positive results of these experiments suggest the need to continue further studies, as this will result in the improvement of the methodological and the instrumental base for use of fluorescence spectroscopy technology in medicine.