

Assessment of the group variability of the parameters of the microcirculatory-tissue system by using multimodal wearable device

V.E. Parshakova, Yu.I. Loktionova, E.V. Zharkikh, A.V. Dunaev

Research and Development Center of Biomedical Photonics, Orel State University, Orel, Russia

The parameters of the microcirculatory-tissue systems (MTS) of the human body are subject to changes in one person during the day, week and longer periods of time due to the variety of factors affecting blood microcirculation. The use of functional tests makes it possible to improve the diagnosis of the MTS condition by laser Doppler flowmetry (LDF) and fluorescence spectroscopy (FS). The aim of the study was to evaluate the group variability of the parameters of the MTS in healthy volunteers during basal measurements and occlusion tests with the use of the wearable device.

The study involved conditionally healthy volunteers (2 men and 3 women) aged (21 ± 1 year). MTS parameters were recorded using 4 wearable analyzers "LAZMA PF" (LAZMA Ltd.), fixed symmetrically on various parts of the body. One measurement consisted of 2 tests: one in basal conditions, during which the volunteer was lying on a couch, and an occlusion test (OT) with brachial arterial occlusion. When performing the OT, the volunteer was located in a sitting position, his hands were on the table at heart level, the analyzers were located on the middle fingers and on the forearms. The occlusion time was 3 min.

The data obtained demonstrates that the values of the index of microcirculation (I_m) differ in different measurement areas due to the anatomical features of the skin. The values obtained are 24.5 ± 3.2 PU for the middle fingers, 13.8 ± 1.0 PU for the forehead, 10.9 ± 2.1 PU for the big toes, 4.6 ± 1.3 PU for the forearms. The greatest coefficient of variation of I_m in men was observed on the toes $45.9 \pm 3.8\%$ and fingers $33.1 \pm 1.1\%$, in women – on the toes $37.5 \pm 1.7\%$ and on the forehead $33.8 \pm 2.5\%$. The coefficient of variation is greatest in the fingers and toes due to the large number of arteriol-venular anastomoses and thermoregulatory function of blood flow. With the help of the OT, it is possible to determine the capillary blood flow reserve (BFR), a parameter that characterizes the adaptive reserves of the blood microcirculation system. The BFR for men was $179.3 \pm 5.0\%$, for women $138.7 \pm 30.2\%$. The coefficient of variation of BFR in men was $21.8 \pm 11.6\%$, in women $12.5 \pm 8.0\%$.

Thus, in this work, the variability of MTS parameters measured with wearable multimodal devices in a group of healthy volunteers during basal measurements and functional tests was evaluated. As a result of the conducted experimental studies, the values of group variability were obtained in men and women for tissue perfusion with blood, which averaged about 30%. This result indicates the relative homogeneity of the data obtained. The use of functional tests allows to significantly reduce the variability of measured LDF parameters. The values of the coefficient of variation of the BFR measured on wearable devices were mainly 22%, which is comparable to the results obtained on a stationary device (mainly 23%).

This work was supported by the Russian Science Foundation under Project No. 23-25-00522.