Evaluation of microhaemodynamics regulation types using wearable laser Doppler flowmetry devices

E. Zharkikh[1], Yu. Loktionova[1], E. Zherebtsov[1,2], I. Kozlov[1], A. Zherebtsova[1], S. Sokolovski[3], V. Sidorov[4], A. Dunaev[1] and E. Rafailov[3]

1 Research and Development Ceneter Of Biomedical Photonics, Orel State University named after I.S. Turgenev, Orel, Russia

2 Optoelectronics and Measurement Techniques, University of Oulu, Oulu, Finland

3 Aston Institute of Photonic Technologies, Aston University, Birmingham, UK

4 SPE “LAZMA” Ltd, Moscow, Russia

Microcirculation is subject to significant structural and functional changes in the development of various pathological processes, for example, in diabetes mellitus (DM). It can be assessed using laser Doppler flowmetry (LDF). This work aimed to assess the violations in the mechanisms of regulating microcirculation that occur in DM using the novel wearable blood perfusion sensor system.

The study involved healthy volunteers and patients diagnosed with type 2 diabetes. A novel wearable distributed multipoint LDF system consisting of four “AMT-LAZMA 1” devices (Aston Medical Technologies Ltd., UK) was used to analyse microcirculatory blood flow. Volunteers rested supine with the analyzers located on the volar surface of big toes and middle fingers. Each study consisted of a 10-minute recording of the LDF signal simultaneously from 4 points and subsequent data processing.

During the study, the following parameters were calculated and analysed: average microcirculation index, nutritive and shunt blood flow, microcirculation oscillations in the endothelial, neurogenic, myogenic, respiratory and cardiac frequency ranges. The results of the study revealed that despite the similar parameters of average perfusion, patients with DM have significantly reduced levels of nutritive blood flow, indicating disorders in the work of precapillary sphincters. Oscillations in the endothelial and myogenic ranges have also been considerably reduced in patients. These differences are more pronounced in the LDF signals recorded in the toes.

Thus, the study has shown that the proposed approach allows one to identify differences in the microhaemodynamics parameters in normal conditions and diabetes. The use of a wireless wearable fibre-free LDF device is a very convenient solution for use in a point-of-care diagnostics.

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