APPLICATION OF ADAPTIVE WAVELET-ANALYSIS FOR THE STUDY OF CUTANEOUS BLOOD FLOW OSCILLATIONS IN PATIENTS WITH DIABETES MELLITUS

Elena Zharkikh*, Mariya Filina, Elena Potapova, Victor Dremin and Andrey Dunaev

Biomedical Photonics Instrumentation Research Group, Orel State University named after I.S. Turgenev, Orel, Russia

*Contact: elena.zharkikh@bmecenter.ru

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The problem of diabetes (DM) has attracted scientists of different specialties, as its prevalence is increasing worldwide and assumes the character of a pandemic. The study of the blood microcirculation system functional state in the lower limbs of patients allows early detection of peripheral blood flow disorders, which can lead, for example, to ulcers on the feet [1]. Additional features in the assessment of the functional state of the microvasculature include the use of a local heating test, since this disease is primarily damaged unmyelinated nociceptive C-fibers, which are activated by heating above 41 °C [2]. The aim of this work was to analyse the changes in the main microhaemodynamic parameters in different modes of heating on the feet of patients with diabetes mellitus.

To achieve this goal the experimental studies were carried out using laser multifunctional complex "LAZMA-ST" (SPE "LAZMA", Russia), that realizes laser Doppler flowmetry (LDF) method with a probing wavelength of 1064 nm. To provide thermal effects the device "LAZMA-TEST", designed for functional heating (5-50°C) and electro-stimulation tests, was used. The study involved 70 patients (53±13 years old) with a diagnosis of diabetes and 47 healthy volunteers with an approximate age of 37.6 ± 13 years. Each study included four stages: basic test for 4 min, cooling to 25 °C – 4 minutes and local thermal tests with temperatures of 35 °C and 42 °C for 4 and 10 min, respectively. The light guide probe was installed on the dorsal surface of the foot on a point located on a plateau between the 1st and 2nd metatarsals.

Each registered LDF-gram was subjected to adaptive wavelet analysis by LDF 3.0.2.384 program. Registration of the blood microcirculation index (Im) was performed. The oscillation amplitude values for the 5 main frequency ranges were determined: endothelial, neurogenic, myogenic, respiratory and cardiac. Indicators of bypass indicator (BI) and nutritive blood flow (Imn) were calculated by well-known methodic [3].

The result of the study revealed that the rate of the perfusion and nutritive blood flow upon heating to 35 and 42 degrees for patients are statistically smaller (4.7 ± 2.5 pf.ed. vs 2.8 ± 2.2 4 pf.ed. for 4 phase of the study), that may indicate disorders in the work of precapillary sphincters. Also reduced growth of perfusion in both heating stages (3 and 4 stages, respectively) in patients (Im3 = 6.74±2.70 PU; Im4 = 11.89±3.71 PU) compared to control group (Im3 = 9.44±3.28 PU; Im4 = 20.12±4.35 PU) indicates insufficient re-regulation of blood-microcirculation system by mechanisms that provide vasodilation.

Thus, based on the results obtained, it can be concluded that the approach in the form of wavelet analysis of the peripheral blood flow oscillations in the feet of patients with diabetes is informative and promising, as it allows to identify disorders of peripheral circulation at an earlier stages.