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INVESTIGATION OF BLOOD MICROCIRCULATION PARAMETERS IN PATIENTS WITH RHEUMATIC DISEASES BY VIDEOCAPILLAROSCOPY AND LASER DOPPLER FLOWMETRY DURING COLD PRESSOR TEST

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ABSTRACT

Nailfold videocapillaroscopy (VCS) is a safe non-invasive method for studying microcirculation and the analysis of vascular disorders at the microscopic level. The method is based on a high-speed video recording of capillaries in the nail bed. Mathematical processing of the resulting sequence of video frames allows the determination of the rate of capillary blood flow in a single capillary, as well as in different sections of a single capillary. The VCS method allows one to evaluate the morphology of capillaries as well as the actual velocity of capillary blood flow in mm/s. Laser Doppler flowmetry (LDF) is widely used to assess the state of the microcirculation system. The technique is based on the probing of tissue by low-intensity laser radiation, and registration of the back-scattered light. Dynamic parameters of microcirculation can be assessed by analysis of the Doppler shift of coherent light scattered on moving red blood cells. After mathematical processing, the received signal can be expressed as perfusion units, which depend on the blood flow velocity and the concentration of blood cells in the sampling value. Subsequent wavelet analysis of the LDF signal allows for identifying the blood flow oscillations. Many rheumatic diseases are characterized by changes in the perfusion and spectral characteristics of the LDF signal caused by pathological processes in the blood vessels. The aim of this work was to correlate the LDF indications detected in rheumatic diseases with changes in

physiological parameters determined by the VCS method. To assess changes in the parameters of the microcirculation, reserve and adaptive capabilities of the microcirculation system, a cold pressor test (CPT) was used.

The videocapillaroscopy setup consists of a lens optical system, IDS UI-3060CP-C-HQ CCD camera and a LED side illumination. For the data recording and subsequent mathematical processing, specially developed software is used. This experimental setup allows recording at a frame rate of up to 400 fps. To measure the blood perfusion, multifunctional laser non-invasive diagnostic system "LAKK-M" (SPE "LAZMA" Ltd, Russia) has been used. The wavelength of the laser radiation in the LDF measurement channel is 1064 nm. To record the LDF signal, determine the blood perfusion, and wavelet analysis of the signal, the software of SPE "LAZMA" is used.

The experimental protocol includes a single baseline measurement of 5 min before the CPT and three measurements of 5 min after the CPT. Measurements after the CPT were carried out at intervals of 5 min. The cold pressor test was carried out by immersing both hands in a container with cold water of temperature 15 °C for 5 min. A series of experiments was performed on a group of 10 healthy volunteers and 10 patients with rheumatological disorders. The work shows the possibility to apply functional tests for studying the microcirculation system along with the VCS method. A statistically significant difference in blood flow velocity in patients and healthy volunteers has been found.

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