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COMBINED USE OF LASER DOPPLER FLOWMETRY AND VIDEOCAPILLAROSCOPIC METHODS FOR SIMULTANEOUS ASSESSMENT OF RHYTHMIC OSCILLATIONS IN BLOOD MICROCIRCULATION

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ABSTRACT

Laser Doppler Flowmetry (LDF) is widely used method of peripheral blood flow functional state evaluation. The technique is based on the scanning of biological tissue by laser radiation and registration of the back-scattered light from moving RBC. After mathematical processing of the recorded and digitised photocurrent, the index of microcirculation is calculated. This parameter is proportional to blood velocity and concentration in diagnostic volume (1-3 mm3).
Thus, index of microcirculation is modulated by biological rhythms (endothelial, myogenic, breath, heart). A special interest for diagnostics can be the wavelet analysis of these oscillations during functional tests (occlusion, temperature, etc). The significant changes in the registered spectra usually can be associated with microcirculation insufficiency occurring with various rheumatic and endocrine syndromes.
An objective comparison between the integral evaluation of blood flow by LDF and the single-capillary estimation of blood flow velocity can be of the particular interest for many applications of the LDF measurements. The approach is able to eliminate many doubts about the origin of oscillations and rhythms in LDF-signal. The possibility to calculate the blood flow velocity in a single capillary was realised by the video capillaroscopic method. The in-house custom build setup consists of optical subsystem, high-speed IDS UI3060-CP camera and side illumination subsystem. In the system, the registered sequences of frames with a frame rate of 200 fps are processing by the novel dedicated algorithm.
A custom developed laser Doppler measuring channel supplemented by the dedicated software was used for the registration of perfusion. The signal processing model was implemented in the

NI LabVIEW environment to calculate the index of microcirculation. The NI USB 6211 data acquisition board was used to digitise the received signal. Morlet wavelet transformation is used to calculate the spectra of registered signals.
A series of parallel 10-minute experimental records of the microcirculation index and videocapillaroscopic measurements were conducted.
The proposed approach demonstrated the essential correlation between spectra oscillations in the isolated capillary and the integral estimation of the microcirculation index by the laser Doppler flowmetry method. This result demonstrates the deep connection of the LDF signal with objective physical characteristics of the skin blood microflow.

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