

Investigation of blood microcirculation parameters in patients with rheumatic diseases by videocapillaroscopy and laser Doppler flowmetry during cold pressor test

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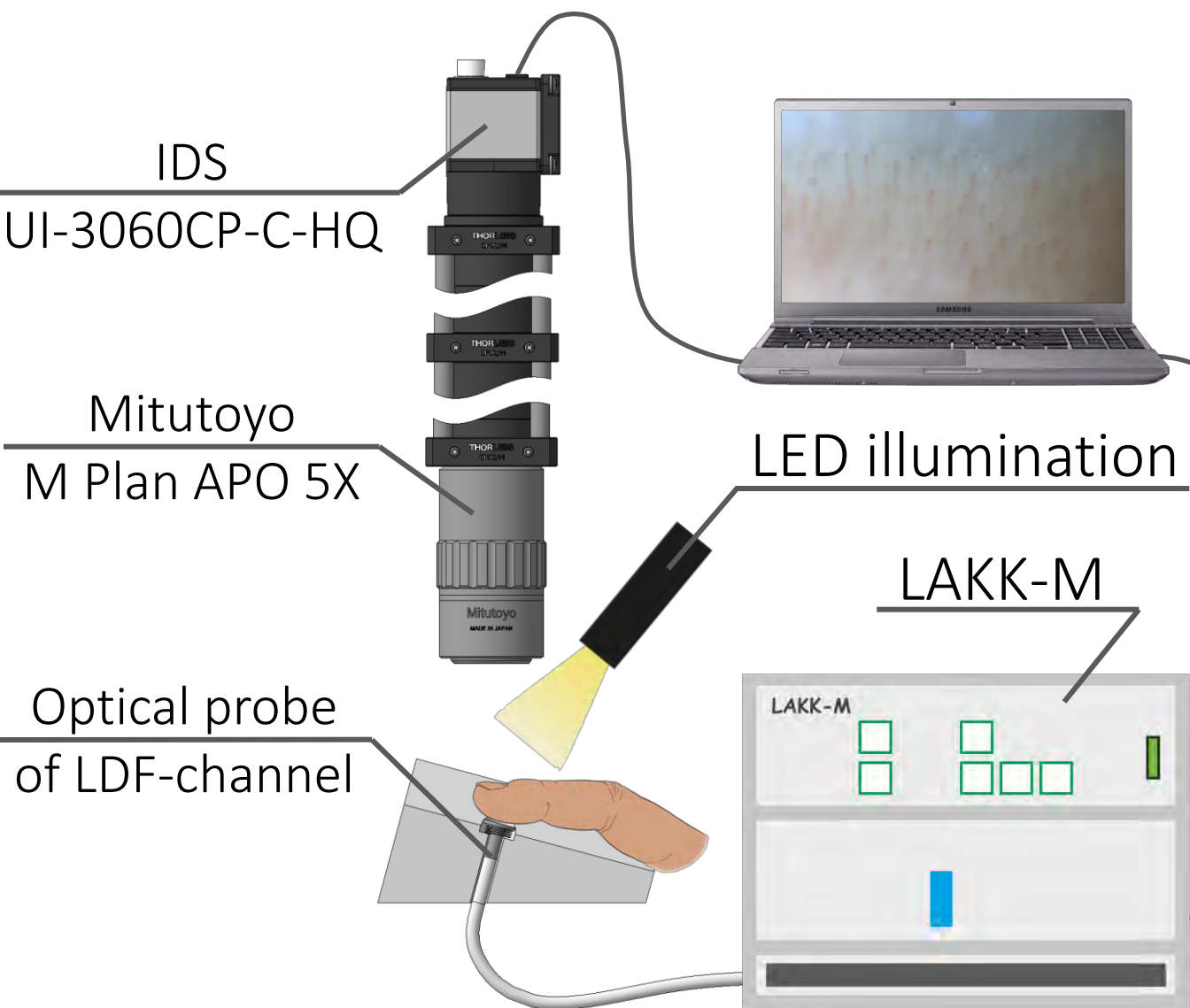
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Introduction

Microcirculatory disorders are the unifying link of the pathogenesis of all rheumatic diseases. Microcirculatory disorders are manifested in the regulatory mechanisms failure, the blood microcirculation disorder and architectural disorganization of vessels. The combined use of videocapillaroscopy (VCS) and laser Doppler flowmetry (LDF) methods to assess these disorders is perspective. These diagnostic methods allow to obtain information from different diagnostic volume and areas of research.

Experimental setup



For the data recording and subsequent mathematical processing, specially developed software was employed. For determination of the velocity of capillary blood flow the resulting images was processed using a specially developed algorithm performs stabilization and compensation procedures.

The aim of research

The aim of this work was to correlate the LDF indications detected in rheumatic diseases with changes in physiological parameters (such as capillary morphology and velocity of capillary blood flow) determined by the VCS.

Experimental study

To assess changes in the parameters of the microcirculation, reserve and adaptive capabilities of the microcirculation system a cold pressor test (CPT) was used. CPT was carried out by immersing both hands in a container with cold water of temperature 15 °C for 5 min.

Stage	Basic test 1	CPT	Basic test 2	Rest period	Basic test 3
Stage duration, min	5	5	5	15	5
Study duration, min	35				

Studies were conducted on the fourth finger of the right hand, which had the highest skin transparency.

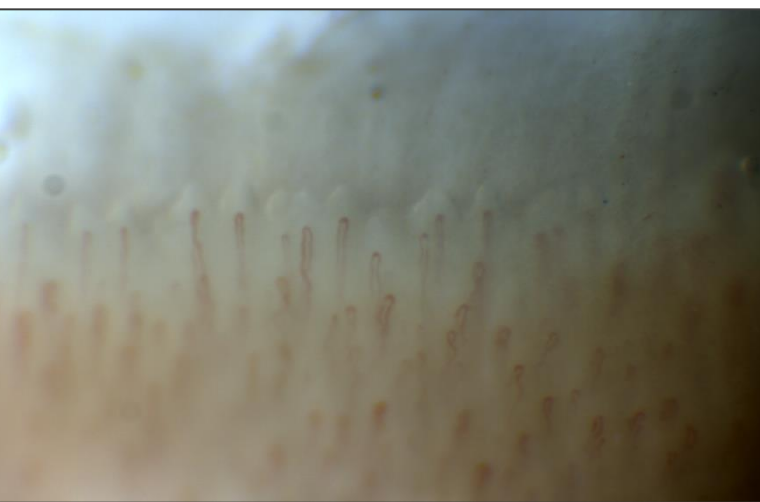
Measured and calculated parameters:

- I_m – the index of blood microcirculation (perfusion), PU;
- V – the velocity of capillary blood flow, mm/s;
- BI – the bypass index, AU:

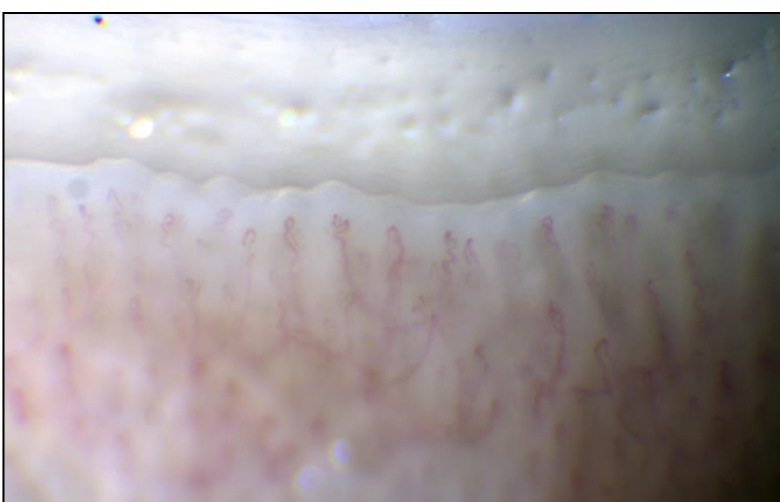
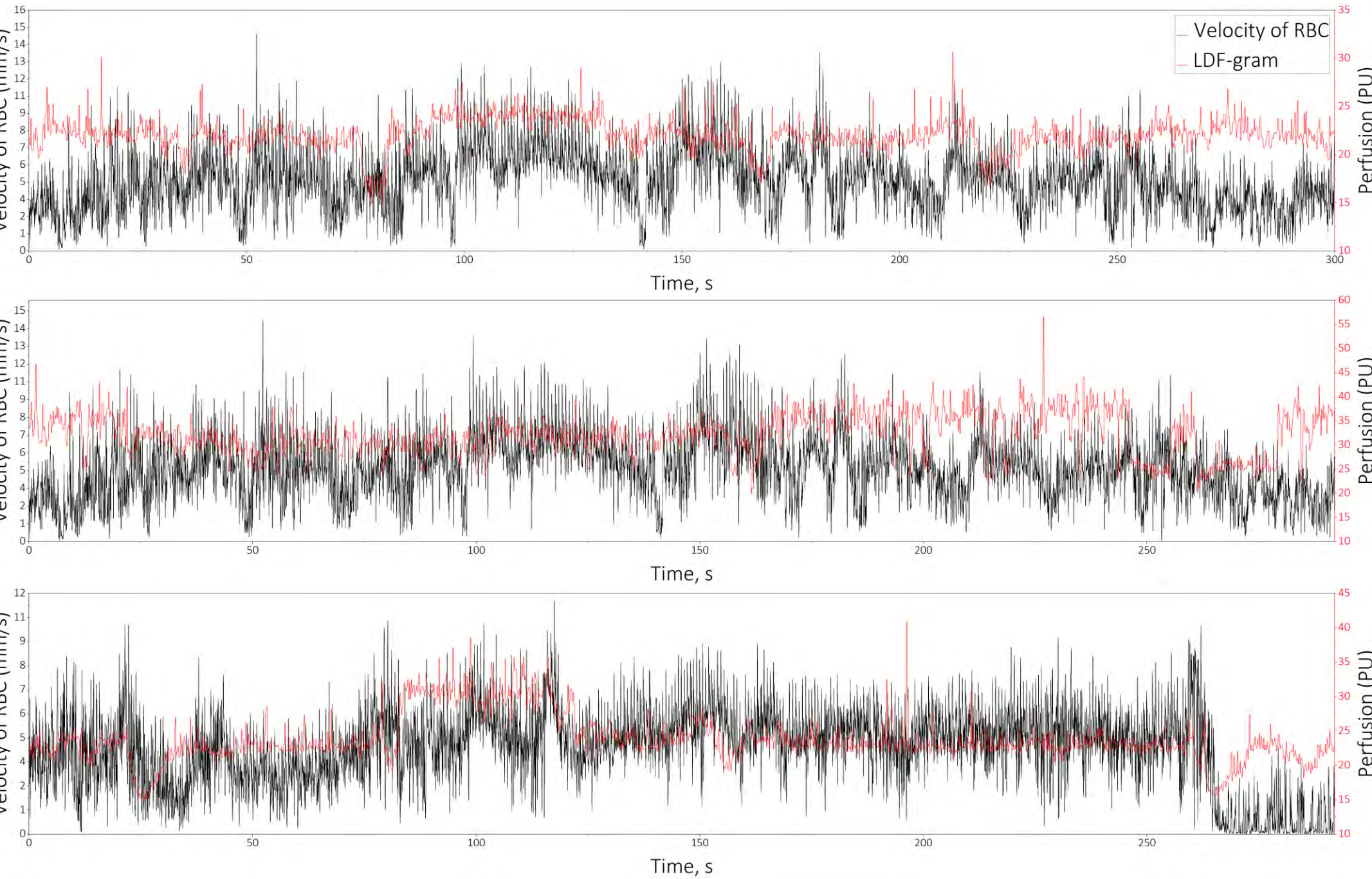
$BI = BI_1 + BI_2$,
 $BI_1 = 1 + A_n/A_m$, $BI_2 = A_{pass}/A_m$,
 A_n , A_m – the oscillation amplitudes of blood flow in neurogenic and myogenic range;

A_{pass} – the maximum oscillation amplitude of blood flow in cardiac or respiratory range.
 BI_2 is taken into account in the calculation of bypass index if $BI_2 \geq 1$.
 I_{mnutr} – the proportion of nutritive blood flow in the general microcirculation, PU:
 $I_{mnutr} = I_m/BI$.

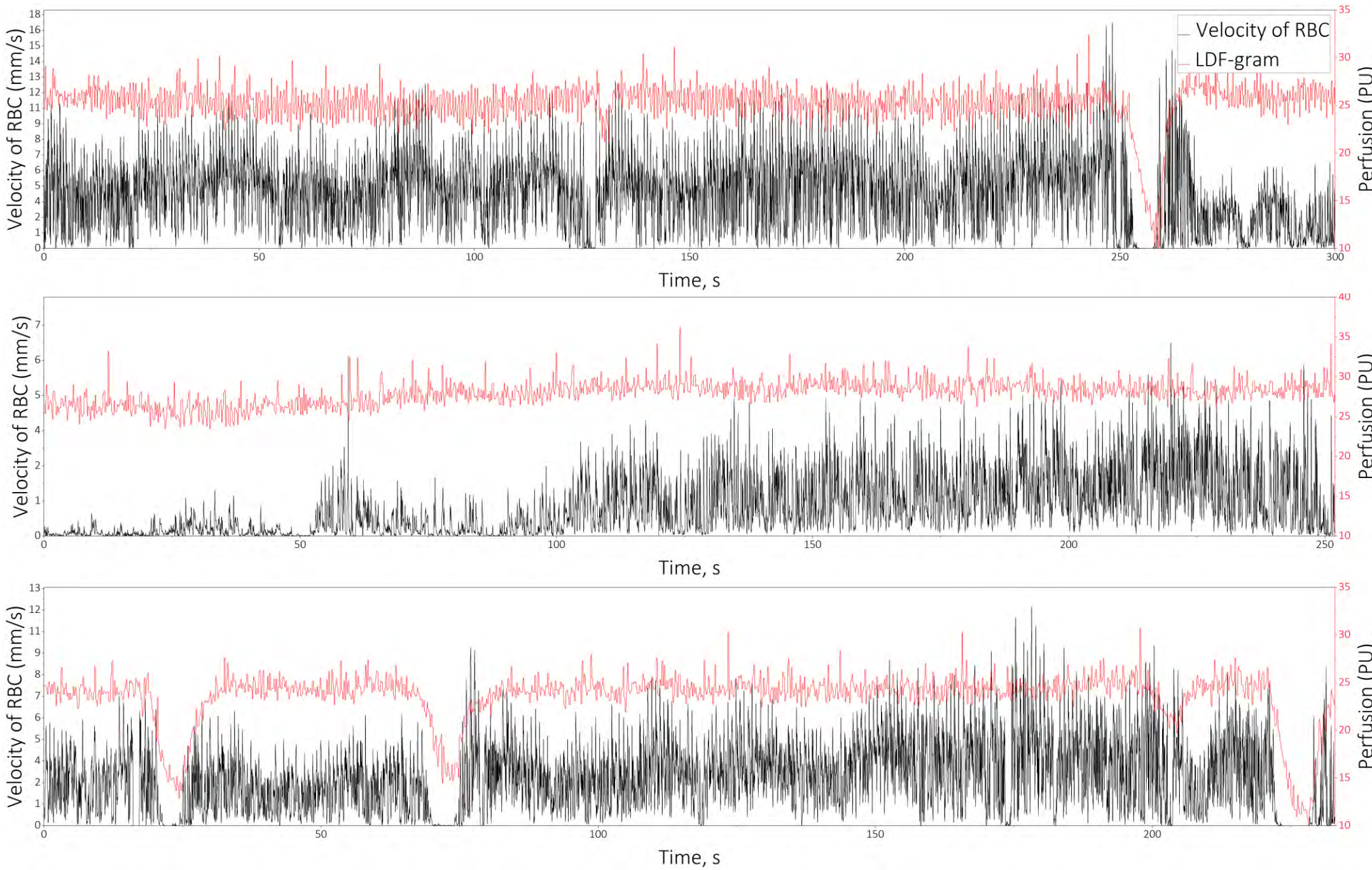
Results and Discussion



Basic test	Parameter			
	I_m , PU	BI , AU	I_{mnutr} , PU	V , mm/s
BT1	22,0	1,3	16,7	4,8
BT2	32,1	2,4	13,0	4,8
BT3	23,8	1,8	13,1	4,2



Basic test	Parameter			
	I_m , PU	BI , AU	I_{mnutr} , PU	V , mm/s
BT1	25,0	3,8	6,5	4,2
BT2	27,1	2,3	11,4	0,8
BT3	23,3	2,0	11,6	2,2



Conclusion

Obtained differences in the measurement and calculated parameters using VCS and LDF in the healthy volunteer and the patient with rheumatic disease allows to conclude about prospects of combined use of these methods for the early detection of microvascular disorders. To increase the informative of diagnostics and to identify diagnostic criteria, the spectral analysis of the VCS signals and comparison with results of spectral analysis of the LDF signals seems promising.

Acknowledgements

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