OPTICAL NONINVASIVE DIAGNOSTICS OF DYNAMIC CHANGES IN THE LEVEL OF BLOOD MICROCIRCULATION AND OXIDATIVE METABOLISM USING TEMPERATURE TESTS

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INTRODUCTION

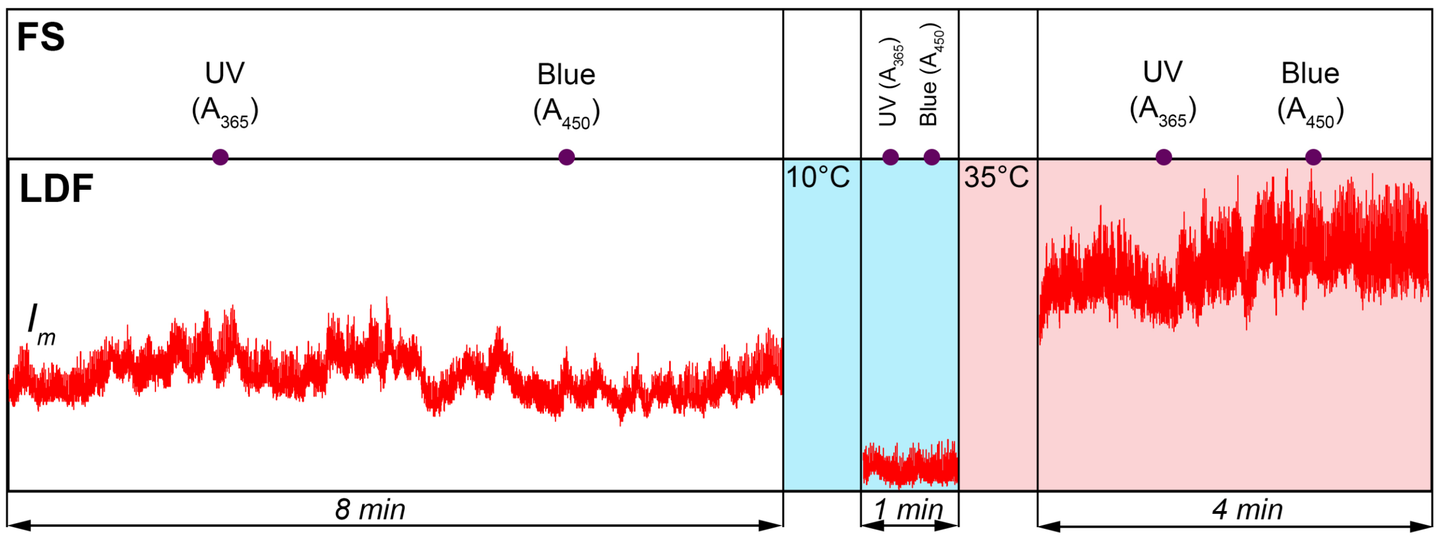
Microcirculation and tissue metabolism is subject to significant structural and functional changes in the development of various pathological processes, for example, in diabetes mellitus (DM). It can be assessed using laser Doppler flowmetry (LDF) and fluorescence spectroscopy (FS).

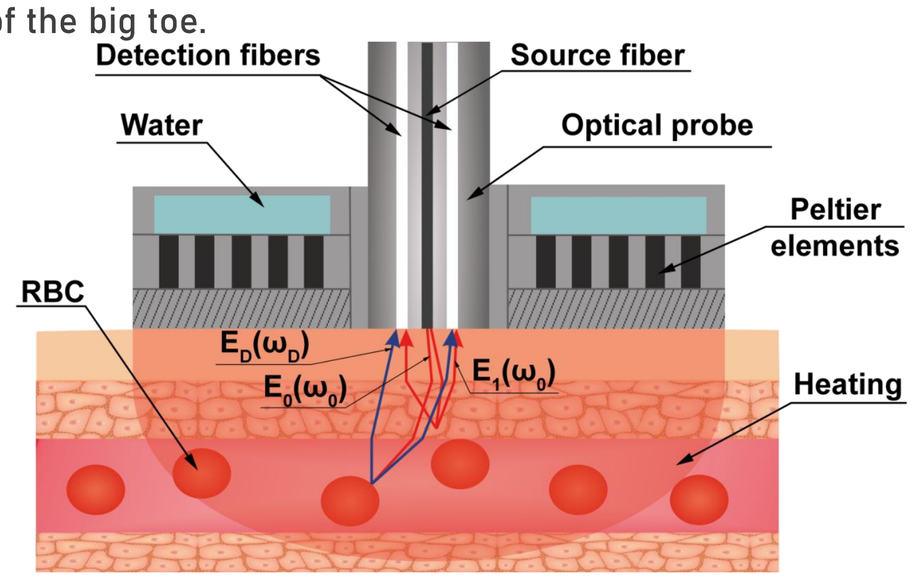
OBJECTIVES

This work aimed at assessing changes in the fluorescence intensity and the blood microcirculation level, evaluated in the skin of patients with DM with the use of local cold and heating tests.

MATERIALS AND METHODS

The study involved healthy volunteers and patients diagnosed with type 2 diabetes. Laser multifunctional complex "LAZMA-ST" (SPE "LAZMA", Russia) was used in the study. The complex includes LDF registration channels with single-mode near-infrared (1064 nm) laser and a fluorescence spectroscopy channel with UV (365 nm) and blue (450 nm) radiation sources. The device "LAZMA-TEST", designed for functional heating, was used to provide thermal effects. Patients rested supine with a probe located on the plantar surface of the big toe.



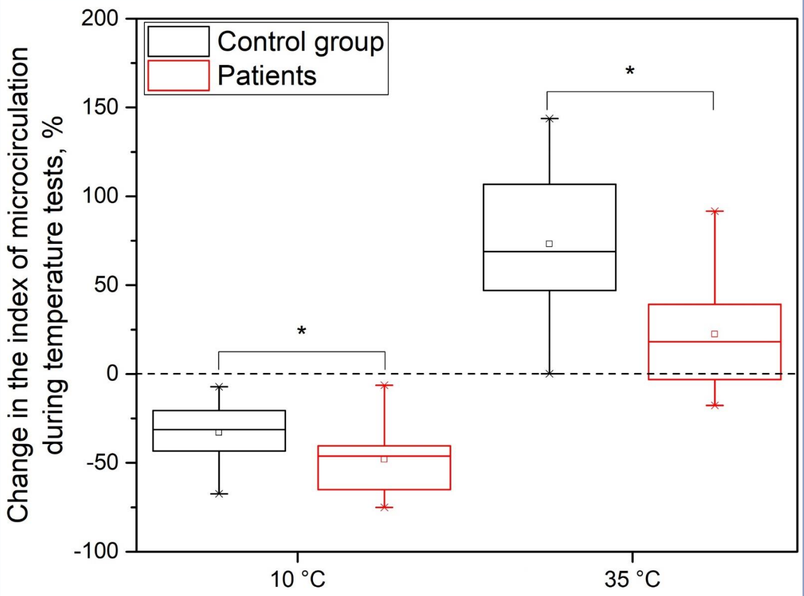


For a comprehensive assessment of the relationship between the microvasculature state and oxidative metabolism in the tissue, the parameter oxidative metabolism index (OMI) was calculated, which depends on the level of nutritive blood flow and the level of skin autofluorescence:

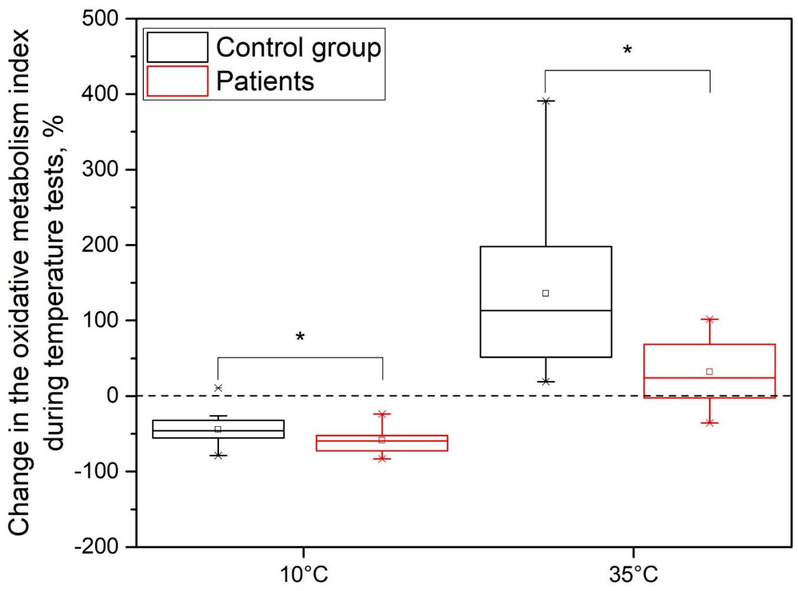
$$OMI = {}^{I_{mn}}/_{(A_{365} + A_{450})}$$

RESULTS

Relative increment of the index of microcirculation



Relative increment of the oxidative metabolism index



* - The significance of the difference between the values was confirmed with p < 0:05 according to the Friedman-Anova test

The increase in perfusion in patients at the third stage of the experimental study was significantly less pronounced. Among patients in 20% of cases there was no restoration of the initial level of the microcirculation index.

The increase in the OMI during heating was significantly more pronounced in the control group compared with patients. Moreover, in the group of patients, there was a lack of growth or a decrease in this indicator in 30% of cases.

CONCLUSIONS

- The study provides preliminary results that need to be further studied with a larger sample size.
- The increase in the microcirculation index and the oxidative metabolism index when using local heating of tissues is significantly less pronounced in patients with DM compared with a healthy controls.
- In patients, cases of the absence of restoration of the initial value of the parameters by the end of the study were noted, which is not observed in a healthy control.
- The proposed research method may have the potential to analyze the state of oxidative metabolism of biological tissues.
- The results can be used to further development of an optical non-invasive diagnosis of diabetes complications.

ACKNOWLEDGEMENTS

This study was funded by the Russian Science Foundation (the research project 18-79-00237). A.D. acknowledges funding from the Academy of Finland (grant No. 326204).

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