

# Wearable laser Doppler flowmetry for the study of blood microcirculation peculiarities in the forehead skin in patients in the remote post-COVID period

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## ABSTRACT

Cognitive disorders are one of the most common manifestations of long COVID syndrome. From 27 to 44% of those who recovered from COVID-19 report impaired concentration, memory loss, and the onset or increased frequency of headaches. It is currently believed that disorders of blood microcirculation and endothelial damage is one of the potential causes of long COVID syndrome [1,2]. Therefore, the aim of the present study was to analyse the features of blood microcirculation in rest and during cognitive test in patients in the remote post-COVID period.

Fifty patients who had previously suffered from COVID-19 participated in the experimental study. According to the results of the questionnaire about the presence and duration of symptoms of long COVID syndrome, the subjects were divided into 3 groups: with mild, moderate and severe course of long COVID syndrome. To measure the parameters of the blood microcirculatory system, the wearable devices "LAZMA PF" (SPE "LAZMA", Moscow) were used, implementing the method of laser Doppler flowmetry for non-invasive diagnostics of the microcirculatory bed [3,4], and the values of the index of blood microcirculation ( $I_m$ , p.u.) and amplitudes of blood flow oscillations in endothelial ( $A_E$ ), neurogenic ( $A_N$ ), myogenic ( $A_M$ ), respiratory ( $A_R$ ) and cardiac ( $A_C$ ) ranges reflecting the regulation of the blood microcirculation system were calculated and analysed. Symmetrical forehead skin areas in the region of supraorbital artery basins were chosen as the measurement area. The study included registration of parameters in the state of physical and psychological rest (baseline test, BT) for 10 min, as well as during and after the cognitive test (CT). The Schulte test was chosen as the cognitive test, which is a psychodiagnostic test to investigate the properties of attention.

The results of the study indicate that patients with a more pronounced course of long COVID syndrome are characterised by a decrease in  $I_m$  values compared to the group with a mild course (30% decrease), as well as a decrease in the amplitudes of all active blood flow oscillations. The implementation of the cognitive test leads to an increase in the perfusion of the forehead skin of patients and an increase in the activity of myogenic oscillations. These changes are most pronounced in groups with moderate and severe course of long COVID syndrome, which may be associated with the development of cognitive disorders in patients. It was noted that in all groups of subjects, CT causes a shift of the peak of the dominant active amplitude of blood flow oscillations to a higher frequency region (during BT the peak of active regulation falls on oscillations with a frequency of 0.11 Hz; during CT – 0.16 Hz), which may indicate the activation of cholinergic parasympathetic regulation. At the recovery stage (after CT) there is an increase in neurogenic regulation of blood flow.

Thus, with the use of wearable laser Doppler flowmetry devices, the peculiarities of forehead skin microcirculation in patients with different severity of the long COVID syndrome were investigated, and the influence of cognitive load on changes in skin perfusion was assessed. The results obtained are of interest for their further application in assessing the effectiveness of therapy and rehabilitation measures.

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## REFERENCES

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