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Microwave Dielectric Spectroscopy Study of Hemoglobin: Control Stroke-Induced Neurological Damage

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Stroke-induced neurological damages are among the comorbidities of patients with confirmed COVID-19 who develop severe respiratory complications [1, 2]. In our study, we used by the very high-frequency dielectrometry at the operating frequency f = 9.2 GHz [3, 4] that allows *in vitro* studying of the complex dielectric permittivity $\varepsilon = \varepsilon^{/} + i\varepsilon^{//}$ of hemoglobin of the erythrocytes against the background of therapeutic effects. The study used the blood of 10 donors and 20 patients with ischemic (n=10) and hemorrhagic (n=10) stroke. The preliminary diagnosis for each patient was formulated on the basis of the generally accepted European recommendations for the prevention and treatment of stroke [5]. Since the obtained data showed a non-parametric nature of the distribution, the Wilcoxon criterion was used to estimate the significant difference in the results of dielectric permittivity of hemoglobin solution and Fisher's exact method was used for the data analysis with $p < 0.05$. The theory of Debye and Onsager-Kirkwood gives the formulas for the relation between the observed dielectric parameters and magnitudes such as dipole moment, size, and shape of the molecule. It was found that the values of the real part of the complex dielectric constant of the suspension of hemoglobin in patients with ischemic stroke after treatment tend to decrease in comparison with the corresponding indicators in patients before treatment. A significant decrease in the average value of the static dielectric constant of hemoglobin suspensions in patients with hemorrhagic stroke was revealed, as well as a significant increase in the average values of specific electrical conductivity (σ) of all studied of hemoglobin suspensions.

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