NUMERICAL STUDY OF THROMBUS FORMATION INFLUENCE ON VASCULARIZED TISSUE NUTRITION

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Thrombus formation processes in the organ blood flow affect on the blood supply of the entire organ in general, for example, the hydrodynamic resistance of the small circulation increases during pulmonary hypertension [1]. Previously, embolization of pulmonary blood flow was studied without taking into account the reactions of clotting and tissue nutrition [2]. Mass transfer has also been studied in microvessel networks that are close to capillary networks [3]. It should be noted that until now one of the most powerful mechanisms of redistribution of blood supply, thrombosis, has not been studied in the context of tissue nutrition issues. The proposed work studies redistribution of tissue nutrition as a result of thrombus formation in branched vascular networks, close to capillary networks.

In the present work, each vessel of the network was divided into segments in which biochemical reactions of blood coagulation occur. The description of biochemical processes is based on system of equations for concentrations of the clotting activator, inhibitor, fibrinogen. Fibrin polymerization was described by the momentum technique, developed earlier [4]. The paper deals with space filling vascular networks with dichotomous topology.

As a result of numerical experiments, it was possible to establish a relationship between the volume of fasting tissue, the network topology, the blood flow velocity and the amount of clotting activator, introduced into the system.

References

1) *Galie N. et al.* Guidelines for the diagnosis and treatment of pulmonary hypertension // Eur heart J. – 2009. – T. 30. – №. 20. – C. 2493-537.
2) *Clark A.R., Burrowes K.S., Tawhai M.H.* The impact of micro-embolism size on haemodynamic changes in the pulmonary micro-circulation // Respiratory physiology & neurobiology. – 2011. – T. 175. – №. 3. – C. 365-374.
3) *Doyeux V. et al.* Upscaling mass transfer in 3D anatomically accurate brain microvascular networks // 13èmes Journéess d'études des Milieux Poreux 2016. – 2016.
4) *Guria G.Th., Herrero M.A., Zlobina K.E.* A mathematical model of blood coagulation induced by activation sources // Discrete and Continuous Dynamical Systems. Series A. 2009; 25(1):175-194.