# MATHEMATICAL MODELLING OF ARTIFICIAL HEART VALVE PERFORMANCE

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Motivation and Aim: In recent years interest in mathematical modeling of blood flow in vessels and artificial human heart valves significantly increased because of development of new methods of cardiovascular system diseases treatment. An artificial heart valve is an extremely complex system, which must meet a number of requirements, and mathematical modeling can simplify valve development and optimization process. In this paper we propose the mathematical model and its numerical implementation to describe three dimensional blood flow dynamics in artificial heart valve and its numerical implementation.

Methods and Algorithms: The mathematical model, proposed to solve a nonstationary problem of blood flow in valve, allows to take into consideration main features of heart valve performance: the inhomogeneous blood structure, the valve leaflets flexibility and complex geometry. Blood is described as a viscous incompressible inhomogeneous fluid and consists of two components (e.g. plasma and formed elements). The fluid motion can be defined by Navier-Stokes nonstationary system of differential equations with variable density and viscosity. We model a valve leaflet as a flexible impenetrable surface which is deformed under the fluid pressure. The leaflet deformation and interaction with the fluid can be described by the immersed boundary method. The valve leaflets influence on the fluid is described by body forces in the equation of fluid motion.

Results and conclusions: The mathematical model and its numerical implementation were applied to the problem of blood flow inside aortic valve with different forms and admixture distribution to define the dynamics of described biological system, including the flow rate, leafters geometry, stress distribution.

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References: