

Blood flow peculiarities in vessels bifurcation

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Abstract

In this article we study the blood flow in models of branching blood vessels. Blood is a heterogeneous fluid and owing to the complex composition (erythrocytes, platelets, leukocytes, plasma) and the presence of special rheological properties (viscosity, pseudoplasticity, thixotropy), it can be attributed to non-Newtonian fluids. Red blood cells, called erythrocytes, responsible for transporting oxygen to tissues; white blood cells (platelets) for the regulation of the coagulation system activity. All blood components tend to deform and orientate in the stream and gather in clusters, which introduces significant changes in the behavior of blood flow. In the simplest terms, blood can be considered as a suspension of blood cells in physiological solution. The red cells are able to accumulate in the molecular chain and modify its configuration (shape and orientation in the flow). In our study, the blood flow simulation is implemented using rheological viscoelastic FENE-P model. It predicts the properties corresponding to real biological fluid such as the anomaly of viscosity, variable longitudinal viscosity and the finite time of relaxation of stresses. Governing parameters of the flows of such fluids is the Weissenberg number We , which characterizes the ratio of viscous to elastic properties, the Reynolds number Re describing the ratio of inertial to viscous properties, the ability of erythrocytes to change their orientation in the flow, the degree of disentanglement of the chains $L2$ and the coefficient of retardation characterizing the concentration of red blood cells. This article discusses the loss of symmetry of the fluid flow under given values of model parameters.

Keywords

Blood flow, FENE-P rheological model, Finite volume method, The symmetry loss effect of blood flow, The T-junction channel