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Deformation Properties of Single Red Blood Cell in a Stenosed Microchannel

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Abstract

Red Blood Cells (RBCs) exhibit different types of motions and different deformed shapes, when they move through capillaries. RBCs can travel through capillaries having smaller diameters than RBCs' diameter, due to the capacity of high deformability of the viscoelastic RBC membrane. The motion and the steady state shape of the RBCs depend on many factors, such as the geometrical parameters of the microvessel through which blood flows, the RBC membrane bending stiffness and the flow velocity. In this study, the effect of the RBC's membrane stiffness on the deformation of a single RBC in a stenosed capillary is comprehensively examined. Smoothed Particle Hydrodynamics (SPH) in combination with the two-dimensional spring network membrane model is used to investigate the motion and the deformation property of the RBC. The simulation results demonstrate that the membrane bending stiffness of the RBC has a significant impact on the RBCs' deformability.

Keywords: Red Blood Cell (RBC), Smoothed Particle Hydrodynamics (SPH), Stenosed Capillary, Meshfree Methods, Microcirculation, Numerical Simulations.