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Erythrocyte hemodynamics in stenotic microvessels: A numerical investigation TONG WANG, Nanjing University of Aeronautics and Astronautics, ZHONGWEN XING, Nanjing University — This paper presents a two-dimensional numerical investigation of deformation and motion of erythrocytes in stenotic microvessels using the immersed boundary-fictitious domain method. The erythrocytes were modeled as biconcave-shaped closed membranes filled with cytoplasm. We studied the biophysical characteristics of human erythrocytes traversing constricted microchannels with the narrowest cross-sectional diameter as small as 3 μm. The effects of essential parameters, namely, stenosis severity, shape of the erythrocytes, and erythrocyte membrane stiffness, were simulated and analyzed in this study. Moreover, simulations were performed to discuss conditions associated with the shape transitions of the cells along with the relative effects of radial position and initial orientation of erythrocytes, membrane stiffness, and plasma environments. The simulation results were compared with existing experiment findings whenever possible, and the physical insights obtained were discussed. The proposed model successfully simulated rheological behaviors of erythrocytes in microscale flow and thus is applicable to a large class of problems involving fluid flow with complex geometry and fluid-cell interactions. Our study would be helpful for further understanding of pathology of malaria and some other blood disorders.

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