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Multiscale Lagrangian Cell-Resolved Simulations of Red Blood Cells GRANT RYDQUIST, MAHDI ESMAILY, Cornell University — The stress and deformation of red blood cells (RBCs) can have a significant impact on their behavior and lifespan. For example, RBCs under large stresses for long periods of time may rupture in a process known as hemolysis. Broadly, simulations of RBCs fall into two categories: macroscale simulations of large vessels that use a constitutive model to represent the effect of the RBCs (and other particles) as a whole on the fluid dynamics in the vessel, and particle-resolved simulations that track the stress and deformation on the individual RBCs. However, due to a large separation in scales, it is infeasible to track the deformation and stresses of individual particles in large blood vessels. The aim of the present work is to overcome this barrier by simulating blood flow in these vessels using a constitutive model, and then calculate the stress and deformation of a limited number of RBCs as they are passively advected through this flow. The velocity and velocity gradient at the location of the particle are used in a boundary element formulation to obtain the hydrodynamic stress on the particles, which is subsequently used to calculate the cell's deformation and stress to predict RBC trauma.

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