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Transition to Non-Newtonian behavior of blood suspensions flowing in small tubes BRUCE CASWELL, HUAN LEI, Brown University, DMITRY FEDOSOV, Forschungszentrum Julich, GEORGE KARNIADAKIS, Brown University — Blood flow in tubes is widely considered to be Newtonian down to diameters of about 200 microns. We have employed a multi-scale, Dissipative Particle Dynamics (DPD) model of the red blood cell (RBC) to investigate suspensions driven through small tubes (**diameters 20-150 microns).** The cross-stream stress gradient induces radial migration of the suspended RBCs resulting in the formation of a hematocrit (H) peak at the centerline, and at the wall a cell-free layer (CFL) whose edge is the point of maximum RBC distortion. This suggests that hard-sphere suspension theories will not capture well blood flow in tubes. For the larger tubes the velocity profiles beyond the CFL are essentially parabolic even though the core H is non-uniform. As the diameter decreases: (1) the CFL moves inward and the central H peak grows, but for the smallest (20 microns) the H peak is shifted off-center, (2) the bulk velocity profiles become similar to those of a shear-thinning non-Newtonian fluid. However, accurate modeling of the velocity field of the bulk flow in small tubes as a homogeneous non-Newtonian fluid can only be achieved if model parameters are taken to depend on tube diameter and pressure drop.

George Karniadakis
Brown University

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