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Leukocyte transport by red blood cells in a microvessel
JONATHAN FREUND, University of Illinois at Urbana-Champaign — A simulation model is used to study the transport of relatively large, spherical, and stiff white blood cells (leukocytes) by the relatively smaller and highly flexible red cell as they flow in the microcirculation. Their interaction dynamics are thought to be an important component of the inflammation response, in which leukocytes bind to the walls of blood vessels. The red cells are modeled in the simulations as highly deformable three-dimensional shells encasing a Newtonian fluid, and the viscous-flow equation is solved via a boundary integral formulation in which the cell shapes discretized by global spectral basis functions. For slow flow rates, it is found that the leukocyte is predominantly adjacent the vessel walls, whereas for faster flow rates this configuration appears to become unstable and the leukocyte traverses the whole vessel in a seemingly random fashion. For the straight round tubes simulated thus far, the stable leukocyte stand-off distance is always beyond the range of the binding molecules that capture it, which suggests that vessel inhomogeneities or interactions with other white cells are needed to create contact and thereby binding with the vessel walls.

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