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Viscoelastic Compound-Drop Models for Neutrophil Deformation and Transport in Capillaries JAMES J. FENG, PENGTAO YUE, CHUN-FENG ZHOU, University of British Columbia — It is well known that neutrophils take much longer time to traverse the pulmonary capillary bed than erythrocytes. This results in their accumulation in the lungs and formation of a reservoir readily recruited when needed. In recent years, neutrophil transport in the lungs has been modeled using increasingly realistic representation of the capillary network. However, the cell deformation has mostly been accounted for empirically. Thus, the determination of the transit time is often ambiguous for lack of a direct knowledge of the cell shape during the transit. In this talk, we will describe a detailed numerical simulation of a neutrophil passing through capillaries. Motivated by the intuition that the difference in transit time is due to the white cells' higher rigidity than red cells, we explore how the cell rheology affects its deformation and passage through capillaries. Using a novel phase-field representation, we first test the well-known Newtonian and viscoelastic drop models. Then we examine whether the apparent cell viscoelasticity can be captured by accounting for the existence of a more rigid nucleus. Comparison with measurements will determine which model features are appropriate. Finally we discuss geometric effects relevant to the pulmonary capillary network as well as various microfluidic devices developed for analysis and separation of blood cells.

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