DFD16-2016-020055

Abstract for an Invited Paper
for the DFD16 Meeting of
the American Physical Society

Two problems in multiphase biological flows: Blood flow and particulate transport in microvascular network, and pseudopod-driven motility of amoeboid cells[1]

PROSENJIT BAGCHI, Rutgers University

In this talk, two problems in multiphase biological flows will be discussed. The first is the direct numerical simulation of whole blood and drug particulates in microvascular networks. Blood in microcirculation behaves as a dense suspension of heterogeneous cells. The erythrocytes are extremely deformable, while inactivated platelets and leukocytes are nearly rigid. A significant progress has been made in recent years in modeling blood as a dense cellular suspension. However, many of these studies considered the blood flow in simple geometry, e.g., straight tubes of uniform cross-section. In contrast, the architecture of a microvascular network is very complex with bifurcating, merging and winding vessels, posing a further challenge to numerical modeling. We have developed an immersed-boundary-based method that can consider blood cell flow in physiologically realistic and complex microvascular network. In addition to addressing many physiological issues related to network hemodynamics, this tool can be used to optimize the transport properties of drug particulates for effective organ-specific delivery. Our second problem is pseudopod-driven motility as often observed in metastatic cancer cells and other amoeboid cells. We have developed a multiscale hydrodynamic model to simulate such motility. We study the effect of cell stiffness on motility as the former has been considered as a biomarker for metastatic potential.

[1]Funded by the National Science Foundation