Numerical simulations of blood cell dynamics in microvessels

Adelia Sequeira
Mathematics, Instituto Superior Tecnico
adelia.sequeira@math.ist.utl.pt

Abstract

Whole blood is a concentrated suspension of formed cellular elements that includes red blood cells (erythrocytes) white blood cells (leukocytes) and platelets (thrombocytes). Blood cells are suspended in plasma, an aqueous ionic solution. In the large vessels where shear rates are high enough, it is reasonable to assume that blood has a constant viscosity and a Newtonian behaviour. However in smaller vessels and capillaries or in some diseased conditions, the presence of the cells induces low shear rate and blood exhibits remarkable non-Newtonian properties, like shear-thinning viscosity, thixotropy and viscoelasticity. We refer to [**?**, **?**] as recent review papers on mathematical models of blood rheology.

In this talk we present some numerical simulations to illustrate blood and blood formed cells rheological behavior. Using a mesoscopic lattice Boltzmann flow solver for non-Newtonian shear thinning fluids, we present a three-dimensional numerical study of the dynamics of leukocytes rolling and recruitment by the endothelial wall, based on in vivo experimental measurements in Wistar rat venules [**?**]. Preliminary numerical results obtained for a comprehensive model of platelet activation, blood coagulation and clot formation, that integrates physiologic, rheologic and biochemical factors will also be presented citeBodnar. The corresponding three-dimensional simulations were obtained for a shear-thinning blood model using a finite

volume semi-discretization in space and a simplified explicit Runge-Kutta multistage scheme for time integration.

References

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