Toward a Computational Model of Hemostasis

Hemostasis is the process by which a blood clot forms to prevent bleeding at a site of injury. The formation time, size and structure of a clot depends on the local hemodynamics and the nature of the injury. Our group has previously developed computational models to study intravascular clot formation, a process confined to the interior of a single vessel. Here we present the first stage of an experimentally-validated, computational model of extravascular clot formation (hemostasis) in which blood through a single vessel initially escapes through a hole in the vessel wall and out a separate injury channel. This stage of the model consists of a system of partial differential equations that describe platelet aggregation and hemodynamics, solved via the finite element method. We also present results from the analogous, in vitro, microfluidic model. In both models, formation of a blood clot occludes the injury channel and stops flow from escaping while blood in the main vessel retains its fluidity. We discuss the different biochemical and hemodynamic effects on clot formation using distinct geometries representing intra- and extravascular injuries.

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Karin Leiderman is an Assistant Professor in the Department of Applied Mathematics and Statistics at Colorado School of Mines. Prior to joining the faculty at Mines in 2016, she was an Assistant Professor in the School of Natural Sciences at the University of California Merced from 2012-2016. She was a Visiting Assistant Professor in the Department of Mathematics at Duke University (2010-2012) and received her Ph.D. in Mathematics from the University of Utah in 2010. Dr. Leiderman’s research is aimed at understanding biological systems through the use of mathematics, mathematical modeling, and numerical computation. Dr. Leiderman has interests and expertise in computational modeling of blood clotting and coagulation, biological fluid dynamics, biomechanics, biochemistry, flow through porous materials, and scientific computing.

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