

Modeling the Microcirculation and Immune Cell Extravasation

Shayn M. Peirce

Trafficking of immune cells and stem cells via the circulation to injured or inflamed tissues is central in the pathogenesis and resolution of many different diseases. Immune cell trafficking requires the precise regulation of various molecular signals, such as cytokines and cell adhesion molecules, and is modulated by the fluid mechanics of the microcirculation. The molecular mediators that govern immune cell adhesion, rolling, firm adhesion, and extravasation through the microcirculation (i.e. the "Leukocyte Adhesion Cascade") are well defined, and their roles are understood in isolation. However, the complex spatial and temporal dynamics of cell trafficking *in vivo* are less well understood. Achieving a better understanding of this process is important for designing therapies geared toward inhibiting immune cell trafficking (e.g. monocyte recruitment in atherosclerotic plaque formation) or augmenting cell trafficking (e.g. bone marrow-derived stem cell recruitment in peripheral ischemic disease). We employ biomedical engineering approaches, such as computational systems bioengineering and tissue engineering, to understand the complex regulation of cell trafficking *in vivo* and to develop therapeutic approaches for augmenting or inhibiting cell trafficking. A key aspect of our research is the intimate pairing of computational models with *in vivo* experimental work to accelerate and refine the discovery process.