BIOENGINEERING Tenure-track Faculty Candidate Seminar

Date: Thursday, February 13, 2020
Time: 12:00 pm - 1:00pm
Location: Exploratory Hall, Room L111
(*Videoconferencing to SciTech, K. Johnson Hall 254)*

Valerie Tutwiler, Ph.D.

Biography: Valerie Tutwiler is a K99/R00 Postdoctoral Research at the University of Pennsylvania Perelman School of Medicine where she studies the structure and mechanics of blood clots. Valerie is passionate about utilizing her PhD in Biomedical Engineering from Drexel University to develop innovative approaches to studying clinically relevant questions. During her PhD research Valerie developed an optical tracking assay to assess the kinetics of blood clot contraction and described the mechanical interplay of active contractile platelets with fibrin and erythrocytes. Her studies revealed that the platelet exhaustion results in a reduced extent of clot contraction in thrombotic conditions such as ischemic stroke and deep vein thrombosis. To further probe the clinical implications of these findings the role of reduced extent of clot contraction in the efficacy of both internal and external fibrinolysis. During her Master's research at the Children's Hospital of Philadelphia Valerie developed a microfluidic assay to examine the role of activated monocytes in the pathogenesis of heparin induced thrombocytopenia. In addition, Valerie is actively involved with developing resources for graduate students and post-docs through her involvement with the American Society of Cell Biology and the University of Pennsylvania Biomedical Postdoctoral Council.

Title: Blood clot structure and mechanics in health and disease

Abstract: Thrombotic conditions such as heart attacks and strokes are leading causes of death and disability worldwide. Clot contraction, which is the volume shrinkage of the blood clot, has been implicated to play a role in hemostasis, wound healing, and the restoration of blood flow past otherwise obstructive thrombi. Despite these clinical implications, clot contraction is the least studied area of the coagulation process, which can be largely attributed to a previous lack of methodology. To address this need we developed a novel optical tracking system that allows for the quantitative assessment of the kinetics of clot contraction. Coupling this technique with mathematical modeling, multi-scale imaging, and mechanical testing provides a holistic picture of the process of blood clot contraction. We determined that clot contraction is influenced by the composition of the blood and functionality the blood cells. We have shown that during the contraction process the red blood cells are compressed into the core of the blood clot forming a tessellated network whereas the platelets and fibrin redistribute to the periphery of the clot. Moreover, patients with thrombotic conditions such as ischemic stroke and venous thromboembolism have an altered extent and rate of clot contraction when compared to healthy individuals. Through the use of tensile testing we probe how the fibrin network is able to resist breakage, or embolization, a deleterious complication of thrombosis. Ultimately, once a clot has performed its physiological role it needs to be resolved through a process known as fibrinolysis. We determined that the extent of clot contraction influences the rate of both physiologic fibrinolysis and clinical lysis. Collectively, these findings provide new information about basic mechanisms of clot contraction and point to its importance with respect to thrombotic conditions. In addition, these findings have the potential to lead to the development of diagnostic assays or therapeutic targets in bleeding and thrombosis.