JOHNS HOPKINS
BIOMEDICAL ENGINEERING

BME Seminar Series

Valerie Tutwiler, PhD

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Monday, October 3, 2022
1:00 p.m.
Traylor 709

Faculty host: Lakshmi Santhanam

Biomechanics of Blood Clots

Abstract: Diseases of the cardiovascular and circulatory systems are leading causes of death worldwide; we focus on the critical role that blood clotting plays in these diseases. For example, excessive blood clotting can lead to heart attacks and strokes. Fibrin is an extracellular matrix protein and a major component of blood clots that form at the sites of injury to stop bleeding (hemostasis) and of pathological thrombi that form inside vessels and block the blood flow (thrombosis). Fibrin's mechanical properties underlie blood clot behavior in the highly dynamic intra- and extravascular environment. Moreover, there is a rapidly developing field of bioengineering that uses fibrin as a versatile biomaterial with exceptional and tunable mechanical properties. It is critically important that the fibrin gel is mechanically tough and resistant to rupture, as it must be able to prevent bleeding while withstanding forces of blood flow, dynamic pressure of extravascular muscle contractions, pulsations of blood vessel walls, and tensile forces generated by the contracting platelets. Moreover, the fibrin network must be able to resist enzymatic degradation when needed and susceptible to depredation when no longer needed. We take a multidisciplinary approach, combining experiments and mathematical modeling, to examine how the structure of the fibrin network influences the viscoelastic mechanics, fracture mechanics, and enzymatic stability of fibrin blood clots with respect to bleeding following traumatic injury or thrombosis. Mechanical testing is coupled with microstructural studies to characterize clot structure, clot formation, and enzymatic degradation. Gaining a deeper understanding of fibrin structural, mechanical, and enzymatic stability is fundamentally important for the development of novel therapeutics and diagnostics.

Bio: Valerie Tutwiler is an Assistant Professor in the Department of Biomedical Engineering at Rutgers University, where her lab students the structure and mechanics of blood clots. Dr. Tutwiler received her B.S. and M.S. in Biomedical Engineering from Drexel University in 2013. She conducted her M.S. research on developing a microfluidic model of heparin induced thrombocytopenia at the Children's Hospital of Philadelphia. Dr. Tutwiler conducted her Ph.D research between Drexel University and the University of Pennsylvania on the kinetics and mechanics of contracting blood clots. After completing her Ph.D in 2017 she completed her postdoctoral work in Cell and Developmental Biology at the University of Pennsylvania where she studied the structure and mechanics of blood clots as a NIH NHLBI K99/R00 Postdoctoral Fellow. Her work has been funded by the National Institutes of Health, American Heart Association, and American Society of Hematology.