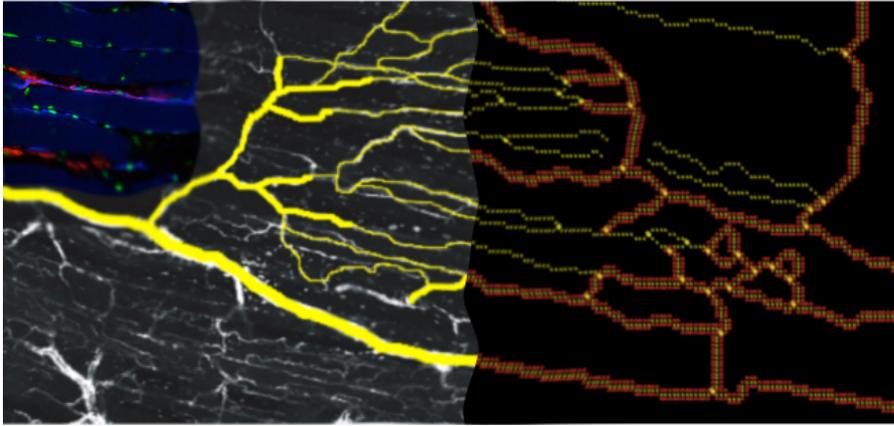


Vascular & Tissue Systems Bioengineering



Every tissue in the body needs a blood supply, and that demand is met by a network of interconnected blood vessels called the microcirculation. The microcirculation is a highly adaptable system of small blood vessels that are a tenth of the diameter of a human hair—you need a microscope to see them—and there are over a million microvessels in a single gram of tissue. Microvascular growth and remodeling are important in nearly every major disease, including diabetes, heart disease, peripheral vascular disease, stroke, neurodegenerative diseases, and cancer. We use novel computational and experimental techniques to study and develop new approaches for growing and regenerating injured and diseased tissues by manipulating the structure and composition of the microvasculature.

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“Inventing and developing new solutions to help patients suffering from cardiovascular disease and diabetes.”



SCHOOL of ENGINEERING
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The Microcirculation in Tissue Engineering and Regenerative Medicine

We are interested in applying our knowledge of the microcirculation in order to grow new tissues and regenerate damaged tissues in the body. Without a blood supply, tissues beyond the small size of one cubic millimeter cannot survive in the body. Therefore, our research aims to address a critical bottleneck for all of tissue engineering and regenerative medicine aspirations: growing new functional and sustainable microvessels that can deliver blood to the tissues that we are trying to heal and/or replace.

Therapeutic Adult Stem Cells in Vascular Disease

We are researching the ability of human adipose-derived cells (hASCs), when injected therapeutically, to contribute to microvascular growth in instances of ischemic disease, wound healing, and retinal disease. By using a combination of multi-cell computer models, in vitro assays, and in vivo experiments, we are determining the cellular and molecular mechanisms that regulate their putative therapeutic contributions toward microvascular growth and support.

Arterial/Venous Polarity in Microvascular Growth

Identifying the cell phenotypes associated with arterial/venous (A/V) determination is critical for understanding how the circulation develops, matures, functions to deliver blood to and from the tissues, and adapts to pathological stimuli. Recently, the discovery of A/V phenotypic markers has provided insight into vascular tree development and microvascular remodeling in the adult. We have identified a proteoglycan that is differentially expressed in arterioles and venules. Using the differential expression of this marker and the expression of other vascular-specific markers, our research aims to understand the signals responsible for conferring an artery or vein phenotype to new and pre-existing vessels and regulating that phenotype as the tissue undergoes pathological stimulation.

Identifying Critical Bottlenecks in Chronic Inflammation

Chronic inflammation is thought to be the underlying cause of many leading diseases, including atherosclerosis, inflammatory bowel disease, and obesity. Understanding the multi-cell interaction, chemokines, and signaling pathways that give rise to this complex process is the focus of much study. Our research group is developing and validating new computational methods for uncovering novel drug targets and opportunities for therapeutic manipulation of these diseases.

RECENT RESEARCH DEVELOPMENTS

- We have identified a new population of cells that can be obtained from liposuction procedures and delivered into the eye to protect against retinal damage caused by diabetes.
- We have recently discovered a new role for immune cells in regulating microvascular remodeling in injured tissue.

RECENT GRANTS

- NIH – Arteriole/Venule Polarity in Adult Microvasculature
- NIH – Adipose Stem Cells for Diabetic Retinopathy
- U.S. Natl. Heart, Lung, & Blood Inst. – Therapeutic Microvascular Pericytes
- Walter H. Coulter Fdn. – Translational Research Partnership in Biomedical Engineering
- The Hartwell Foundation – Pediatric Eye Disease

SEAS Research Information

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