NJIT New Jersey Institute of Technology

BME

Department of Biomedical Engineering
Graduate Seminar

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Duke University

Subject: Physicochemical properties of extracellular matrix: Key to function, Clue to mechanism

Abstract:

Reciprocal interactions of cells with their microenvironment are fundamental to multiple cellular processes necessary for tissue development, homeostasis, and regeneration. It is becoming increasingly apparent that while the extracellular environment normally maintains tissue homeostasis, but when negatively perturbed, it may also contribute to disease progression and age-dependent pathologies. In this talk, I will discuss our efforts to delineate the role of the ECM on various cellular responses relevant to tissue regeneration and disease progression. First, I will briefly talk about our efforts to create synthetic analogs of the ECM to direct stem cell commitment in vitro and in vivo and employ such engineered matrices as a platform to understand the molecular mechanism underlying stem cell differentiation (Shih et al., PNAS 111: 990, 2014; 114: 5419 2017; Kang H et al., Biomacromolecules 16: 1050, 2015). I will next talk about our recent efforts in understanding the role of extracellular matrix on cancer metastasis and fibrosis. Our findings show that the cells transition from a proteolytic-independent mode of invasion to a proteolytic-dependent mode upon an increase in the mechanical resistance from the extracellular environment (Aung A et al., Biophys. J 107:2528, 2014). By employing a cutaneous fibrosis model, we unraveled the role of elastic fibers and their components, which lie at the interface of tissue stiffness and inflammation, on fibrosis progression (Nakasaki M et al., Nature Communications 6: 8574, 2015). Surprisingly, interfering with the ECM organization to alter the elastin content and tissue stiffness to levels comparable to normal skin diminished the inflammatory response and abrogated the fibrotic phenotype. I will end by briefly introducing our efforts to develop healthy and disease tissue models in vitro as technological platforms to study basic concepts and screen and small molecules.

Bio:

Shyni Varghese, Ph.D., is a Professor of Biomedical Engineering, Mechanical Engineering & Materials Science, and Orthopedics Surgery at Duke University. She is the inaugural MEDx Investigator at Duke University. Prior to moving to Duke, she was a Professor of Bioengineering at University of California, San Diego. Dr. Varghese's research covers a broad range of topics including stem cells, biomaterials, biologically inspired systems, tissue chips, and regenerative medicine. Her research activities have resulted in over 100 publications and 12 patent disclosures. Examples of ongoing research activities in her laboratory involve developing functional biomaterials such as self-healing hydrogels and bio mineralized matrices; technologies to improve cell-based therapies including stem-cell differentiation, cell transplantation, activating endogenous stem cells, and engineered functional tissue grafts; and organ-on-a-chip technologies. She is currently serving as an Associate Editor of Biomaterials Science (an RSC journal).

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