Biomimetic Microengineered Vessels Coupled with Advanced Analytics for Bio-Nano Research

Angel Tan*, Ben J. Boyd

381 Royal Parade, Parkville, Victoria 3052, Australia
Monash Institute of Pharmaceutical Sciences (MIPS)
ARC Centre of Excellence in Convergent Bio-Nano Science & Technology (CBNS)
Monash University

Biomimetic vascular tissue engineering is a health-enabling technology pivotal to new ventures in regenerative medicine, pharmacological studies and bio-nano research. The current work highlights a simple and versatile needle-based fabrication technique to achieve controlled 3D microvasculature models to emulate the basic morphology and healthy microenvironment of human vascular tissues (Fig. 1).

By design, these 3D microvascular constructs are hosted within a PDMS-embedded collagen-rich extracellular matrix (as the tunica externa); smooth muscle cells (SMCs, forming the tunica media) and endothelial cells (ECs, constituting the tunica interna) are co-cultured stepwise to generate: an SMC/EC bilayer mimicking the small arteriole-like segments, and a lateral SMC multilayer/luminal EC monolayer resembling the morphology of a larger artery. Optical and confocal fluorescence microscopy images promisingly illustrated progressive cell elongation, sprouting and maturation behaviours in a 3D direction. Both arteriole- and artery-like models underwent a relatively high glucose metabolic rate during the initial proliferation phase before reaching a temporary quiescent, mature state. These 3D constructs potentially coupled with advanced analytics (e.g. small angle X-ray scattering) will create a new platform to facilitate detailed studies into the interactions between nanomaterials, blood circulating particles and tissue cells under a biomimetic microenvironment.

References:

Biographic Details
Angel Tan
Research Fellow
Monash University, Australia
E-mail: angel.tan@monash.edu
Research interests: microengineered 3D tissue models, nanostructured lipid colloids, stimuli-responsive nanoparticles, controlled/localised drug therapy