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

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Biomimetic vascular tissue engineering is a health-enabling technology pivotal to new ventures in regenerative medicine, pharmacological studies and bio-nano research.[1] 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).[2]

By design, these 3D micro-vascular 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: ① an SMC/EC bilayer mimicking the small arteriole-like segments, and ② 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.

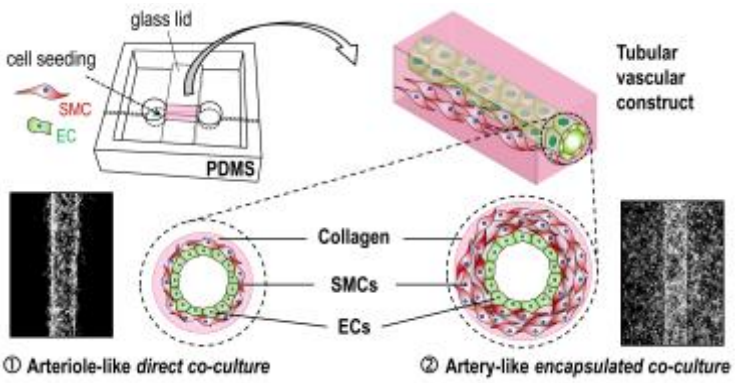

Figure 1: Minimalist design of arteriole- and artery-like 3D tubular constructs comprising a collagen-rich extracellular matrix hosting smooth muscle cells (SMCs) and endothelial cells (ECs).

References: [1]Schimek, K. et al. *Lab Chip* 2013, 13, 3588. *Integrating biological vasculature into a multi-organ-chip microsystem.* [2]Tan, A. et al. *Biomater Sci* 2016, 4, 1503. *Bottom-up fabrication of artery-mimicking tubular co-cultures in collagen-based microchannel scaffolds.*

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Research interests: microengineered 3D tissue models, nanostructured lipid colloids, stimuli-responsive nanoparticles, controlled/localised drug therapy