Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **4313** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) Characterizing Real-Time Mechanosensory Response of Endothelial Cells to Multi-Directional Wall Shear Stress

Monday 27 May 2024 17:15 (15 minutes)

Introduction: Endothelial cells (ECs) form the innermost lining of blood vessels and can sense and respond, via mechanotransduction, to local changes in wall shear stress (WSS) imposed by blood flow. Blood flow through a vessel can become disturbed when passing through bifurcations or plaque-burdened regions, which disrupts the direction and magnitude of WSS experienced by cells. ECs in these regions show activation of pro-inflammatory phenotypes, manifesting in the development and progression of atherosclerosis. The earliest cell responses to these flow disturbances –particularly the mechanisms by which ECs sense and respond to variations in direction and magnitude of WSS –are not well understood. Excessive increases in reactive oxygen species (ROS) generation within endothelial cells are an early indicator of a disruption of homeostasis and are thought to accelerate the progression of vascular diseases such as atherosclerosis and diabetes. It is hypothesized that ECs will exhibit indications of oxidative stress and damage within minutes of being exposed to WSS disturbances.

Methods: A novel microfluidic device has been designed and fabricated (from polydimethylsiloxane Sylgard-184) for recapitulating the various forms of WSS observed in regions of disturbed flow within the vasculature. It consists of a small channel for fluid to pass over cultured ECs with two opposing jets to create varying levels of bi-directional and multi-directional WSS scrubbing. ECs cultured in this device are grown to confluence and loaded with a ROS dye (5 μM CM-H2DCFDA). Cells are imaged with a confocal inverted microscope (Nikon Ti2-E) while applying disturbed-flow WSS.

Results: Within 30 minutes of being exposed to disturbed flow, ECs exhibited 65% signal increases in ROS, with detectable changes beginning at just 10 minutes. Notably, a differential response was seen for different types of WSS scrubbing, where regions with higher magnitude mean stress and more multidirectional WSS patterns correlated with larger increases in ROS generation.

Conclusion: The results of this experiment will contribute to the understanding of the differential response of endothelial cells to differential forms of WSS. The characterization of EC responses to varying flow patterns is essential in strengthening the link between blood flow dynamics and atherosclerotic development.

Keyword-1

Endothelial Cells

Keyword-2

Fluid Flow

Keyword-3

Cellular Imaging

Author: MOORE, Kevin

Co-authors: Dr HOLDSWORTH, David (Western University); Dr PICKERING, Geoff (Western University); Dr POEPPING, Tamie (Western University)

Presenter: MOORE, Kevin

Session Classification: (DPMB) M3-3 Cell Mechanics | Mécaniques cellulaires (DPMB)

Track Classification: Technical Sessions / Sessions techniques: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)