World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:11, No:12, 2017

Hybrid Polymer Microfluidic Platform for Studying Endothelial Cell Response to Micro Mechanical Environment

Authors : Mitesh Rathod, Jungho Ahn, Noo Li Jeon, Junghoon Lee

Abstract : Endothelial cells respond to cues from both biochemical as well as micro mechanical environment. Significant effort has been directed to understand the effects of biochemical signaling, however, relatively little is known about regulation of endothelial cell biology by the micro mechanical environment. Numerous studies have been performed to understand how physical forces regulate endothelial cell behavior. In this regard, past studies have majorly focused on exploring how fluid shear stress governs endothelial cell behavior. Parallel plate flow chambers and rectangular microchannels are routinely employed for applying fluid shear force on endothelial cells. However, these studies fall short in mimicking the in vivo like micro environment from topological aspects. Few studies have only used circular microchannels to replicate in vivo like condition. Seldom efforts have been directed to elucidate the combined effect of topology, substrate rigidity and fluid shear stress on endothelial cell response. In this regard, we demonstrate a facile fabrication process to develop a hybrid polydimethylsiloxane microfluidic platform to study endothelial cell biology. On a single chip microchannels with different cross sections i.e., circular, rectangular and square have been fabricated. In addition, our fabrication approach allows variation in the substrate rigidity along the channel length. Two different variants of polydimethylsiloxane, namely Sylgard 184 and Sylgard 527, were utilized to achieve the variation in rigidity. Moreover, our approach also enables in creating Y bifurcation circular microchannels. Our microfluidic platform thus facilitates for conducting studies pertaining to endothelial cell morphology with respect to change in topology, substrate rigidity and fluid flow on a single chip. The hybrid platform was tested by culturing Human Umbilical Vein Endothelial Cells in circular microchannels with varying substrate rigidity, and exposed to fluid shear stress of 12 dynes/cm^2 and static conditions. Results indicate the cell area response to flow induced shear stress was governed by the underlying substrate mechanics.

Keywords : hybrid, microfluidic platform, PDMS, shear flow, substrate rigidity
Conference Title : ICBMEMS 2017 : International Conference on BioMEMS
Conference Location : London, United Kingdom
Conference Dates : December 18-19, 2017