

Cross-Talk between Shear Stress and Human Brain Microvascular Endothelial Cells

Sungkwon Kang¹

Advisors: Yong Woo Lee^{2,*}, Pavlos P. Vlachos^{1,2,*}

¹Department of Mechanical Engineering and ²School of Biomedical Engineering and Sciences, Virginia Tech

Blood flow in human circulatory system is as dynamic as its multiple roles that regulate healthy life and exclusively interacts with endothelial cells that cover the inside of blood vessels. The interactions are not only induced by chemical signals flowing in bloodstream but also shear stresses generated on wavy surface of endothelial cells by blood flow. Previous studies have shown that continuous shear stress imposed on the endothelial cells affect the overall morphology, gene expression, and functions of the cells. The study of the interactions between shear stress and the endothelial cells is thus important and it is desirable that more insightful researches to be performed.

Extensive amount of research effort has been focused on what influences the frictional force exerted on endothelial cells. However, it remains unknown whether change in properties of endothelial cells can alter the profile of the blood flow. In the present study, we hypothesized that morphological change in diseased endothelial cells could induce a flow disturbance which would act as physical stimuli to affect neighboring cells as well as change in gene expression of diseased endothelial cells might influence the viscosity of blood by secreting substances. The altered or sickened endothelial cells can cause a tremendous change in blood flow within the scale of capillaries and it is reasonable to anticipate such results.

A micro fluid chamber had been designed to initiate the research. The micro chamber is designed so that a few glass slides with endothelial cells seeded on the top surface can be placed in the chamber to form the bottom of the micro channel. The micro chamber is also designed so that the flow through the micro channel can be recorded by Particle Image Velocimetry (PIV) which will render an actual image of the flow profile. The shear stress exerted on the endothelial cells can then be calculated by looking at the flow profile recorded by PIV. The schematic design of the micro fluid chamber is depicted in Figure 1.

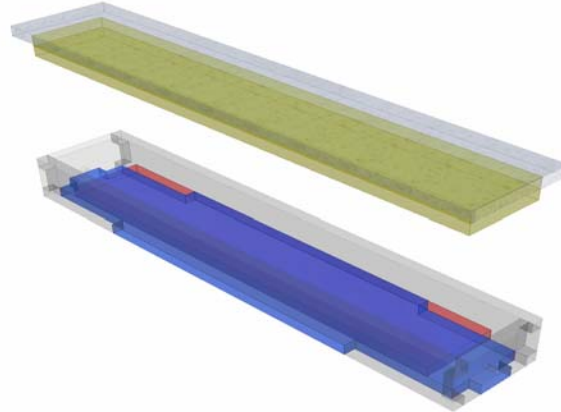


Figure 1 Schematic design of the micro fluid chamber

Observing the influence of the endothelial cells to the fluid flow within the micro channel in certain time interval will enhance the understanding whether the endothelial cells have the ability to manipulate the blood flow. The method to set a constant flow within the micro channel and incubate the whole chamber for a long period of time is yet to be resolved. Also, since the micro fluid chamber is the 2D representation of the blood vessels, the study results should be interpreted in terms of the different shape of the vessel. Subsequently this effort will be followed with 3D blood vessel scaffold and bioreactors.

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