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Editorial Note for the Special Issue in Honor of Professor Shu Chien's 80th Birthday

Professor Shu Chien is a renowned frontier and educator in physiology as well as biomedical engineering nationally and internationally. His vision and effort have revived both fields and led the establishment of NIBIB at NIH. After his outstanding work in biorheology more than two decades ago, Professor Chien started to integrate biomedical engineering with cardiovascular physiology and molecular cell biology. In particular, Professor Chien and his colleagues elucidated the molecular mechanisms by which cells in the vessel wall respond to mechanical stimuli, including fluid shear stress and mechanical stretch. Professor Chien further pioneered the research on the visualization of mechanobiology with high spatiotemporal resolutions. All these work have significantly advanced our in-depth and systematic understanding of vascular biology and bioengineering. To date, Professor Chien continues to lead and contribute to the emerging field of "mechanobiology". Because of Professor Chien's scientific achievements, he has been recently awarded with National Medal of Science, the highest honor bestowed by the United States government on scientists and engineers. Professor Chien is also one of the few scientists who are elected to serve as the members of all three U.S. national institutes: the National Academy of Sciences, National Academy of Engineering and the Institute of Medicine.

In honor of Professor Shu Chien's 80th birthday, we have organized this special issue entitled "Mechanobiology: Attribute to Shu Chien's Scientific Achievement", focusing on mechanobiology and bioengineering in Cellular and Molecular Bioengineering. Bioengineering pioneers, Professors Robert Nerem and Larry McIntire led the issue with two prefaces on their counts of Professor Chien's achievements and contributions.

To shed lights on the fundamental mechanism in mechanobiology, Weinbaum and his colleagues provide an in-depth overview on the biomechanical aspects by which fluid flows can trigger biochemical and molecular activities in cells. Shyy *et al.* present a current understanding of how adenosine monophosphate-activated protein kinase (AMPK), a master regulator of energy metabolism, is involved in maintaining endothelial homeostasis under shear stress. Kaunas *et al.* overview the roles of shear stress as a mechanical factor in synergizing with biochemical factors to stimulate pro-angiogenic signaling in endothelial cells and promote sprout formation in post-capillary venules. Zhou and Chiu *et al.* further summarize the roles of epigenetic factors, including histone deacetylases and microRNAs, in the regulation of endothelial cell gene expression and function in response to shear stress. Liao and Wang *et al.* review the biomechanical properties of biomaterials for bone tissue engineering, and how cells can interact with biomaterials and respond to these biomechanical environmental cues. Hou and Lim *et al.* present an overview of current status on the study of the cellular and molecular biomechanics utilizing the microfluidic approaches. These articles should provide a broad and comprehensive overview of the research activities and progresses in the field of mechanobiology.

Several recent studies elucidating the molecular mechanism underlying mechanobiology are also reported in this special issue. Alonso-Latorre and Lasheras *et al.* utilize principal component analysis to dissect the mechanics of chemotaxis of amoeboid cells into a specific set of dominant components of traction forces and suggest a crucial role of non-muscle myosin in regulating the cell-substrate interactions and motility of amoeboid cells. Fuentes and Butler *et al.* develop a nanoelectrode coated with extracellular matrix (ECM) proteins to approach bovine aortic endothelial cells at the apical surface and observe nascent focal adhesion assembly. This work demonstrates the capability of precisely-timed induction and 3-D mechanical manipulation of focal adhesions. Hsu and Li *et al.* study the shear stress effect on smooth muscle cells (SMCs) with neural crest markers and suggest that PI-3 kinase mediates the shear-induced SMC proliferation and its associated gene expressions. Green and Sung *et al.* demonstrate the importance of a membrane-bound Erythrocyte tropomodulin (E-Tmod) in regulating the actin network organization and mechanobiology of erythrocytes.

General signaling transduction and bioengineering research have also been presented. Fero and Li *et al.* report the differential signaling molecules involved in the Epherin-A1-induced cell migration and cell-substrate interactions of mouse fibroblast cells. Khanna and Dong *et al.* apply computational methods to reveal that VCAM-1 binding increases PAK activation rates and decrease PAK off rate to cause the augmentation of p38 and VE-cadherin phosphorylation levels in endothelial cells. Xiang and Zhu *et al.* further develop a new genetically-encoded Förster resonance energy transfer (FRET)-based biosensor for studying the dynamics of SYK activities in living cells at subcellular levels and quantify the real-time activation of SYK in K562 cells upon IgG Fc engagement of Fcγ receptor IIA and in mouse embryonic fibroblasts upon stimulation by the platelet derived growth factor. Pot and Schmid-Schonbein *et al.* report the proteolytic cleavage of Glycocalyx in spontaneously hypertensive rat (SHR) red blood cells (RBCs). Liu *et al.* present evidence that the IL-6-stimulated leukocytes release MMP-2 to mediate the mobilization of hepatic cells in myocardial ischemia.

Last, but not the least, it is crucial to translate the findings in basic research quickly and efficiently into clinical science and have broader impact to the society. Feng summarizes and emphasizes the significant contribution of Professor Shu Chien in promoting chemotherapeutic engineering as an emerging and prospective multidisciplinary area, especially chemical engineering principles to solve the problems in chemotherapy of cancer and other fatal diseases such as cardiovascular disease and AIDS. Deng and Hornberger design a pressure inflating cuff and hypothermia cuff to provide more controllable ischemia and hypothermia and reveal that hypothermic intervention may reach the maximum protective effects in the deep hypothermia range near 17 °C for skeletal muscles.

In all, authors contributing papers in this special issue, whereas presenting their efforts on individual topics, synergize their views on how a great leader can promote a field. The editors also want to express their great gratitude to the chief editors, Profs. Edward Guo and David Odde, the supporting team from the *CMB* journal, as well as all the reviewers for their tremendous dedication and support.

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