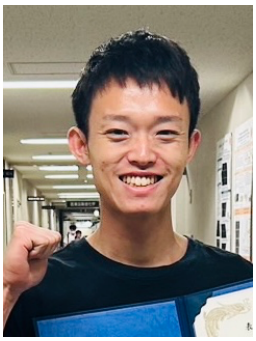
LiMe
Institute for Life and Medical Sciences
Kyoto University

20th nanobiofluids seminar

2025 Nov. 28th, 15:00-16:00
Conference Room (Room 134), 1st Floor, Bldg. No.1
https://www.infront.kyoto-u.ac.jp/en/access/
Zoom link

Membrane Dynamics-Mediated Regulation of Muscle Satellite Cell Functions



Akira Murakami, Ph.D.
Assistant Professor
Department of Integrative Physiology
School of Pharmaceutical Sciences
University of Shizuoka

Abstract
Muscle satellite cells (MuSCs) are muscle-resident stem cells essential for the regeneration of myofibers. During myofiber injury, the activation and differentiation states of MuSCs are dynamically and precisely controlled. I refer to this adaptative capacity as the "***resilience***" of MuSCs and aim to understand its physicochemical basis. In particular, I hypothesize that the cell membrane—the interface between the cell and its surrounding microenvironment—acts as a key regulatory factor. Skeletal muscle is characterized by two notable features: (1) constant exposure to mechanical stress, and (2) being the largest heat-producing organ in the body. By analyzing the relevant physicochemical parameters at the single-cell level, I attempt to uncover the molecular mechanisms underlying MuSC resilience.

I have established *ex vivo* single-cell imaging approaches using fluorescence lifetime microscopy to quantify membrane tension and intracellular temperature in MuSCs. I found that these parameters change in a cell-autonomous manner during activation and differentiation. Importantly, these changes coincided with alterations in membrane lipid composition and in expression of lipid-regulating genes. Furthermore, perturbating these lipid-related factors impaired the proper progression of MuSC activation and differentiation. I am currently trying to demonstrate that the regulation of these physicochemical properties directly governs MuSC fate determination. I would like to discuss how my single-cell biophysical approaches can be integrated with the current wave of omics frameworks to achieve a synergistic understanding of MuSC resilience.

Biography
He received his B.S., M.S., and Ph.D. in Engineering from Kyoto University under the supervision of Prof. Masato Umeda, where he was trained in lipid biochemistry as a JSPS Research Fellow (DC2). He subsequently served as a JSPS Research Fellow (PD) in the Graduate School of Pharmaceutical Sciences at the University of Tokyo, where he received biophysical training under Prof. Takashi Funatsu. During this period, he worked under the mentorship of Dr. Kohki Okabe and engaged in research on the molecular mechanism underlying the formation of intracellular temperature. At the University of Shizuoka, he is working with Prof. Yuji Hara and is now investigating how cell-autonomous regulation of physicochemical parameters contributes to physiological function.

Dr. Murakami has received several awards from academic societies, including the Early Career Award in Biophysics from the Biophysical Society of Japan (2020), as well as awards from the Physiological Society of Japan (2025), the Japanese Conference on the Biochemistry of Lipids (2024), and the Japanese Biochemical Society (2019).

Host: Hirofumi Shintaku, shintaku@infront.kyoto-u.ac.jp