Yuji Yamazaki

Michael Levine lab, Princeton University

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Optimization of the gene regulatory elements in the coordinated cell shape changes

Abstract

The coordinated cell shape changes and movements are required for morphogenesis in the multicellular organism. The coordination of these cells indicates that cells know where they are located within the body and how they should behave. Since transcriptional regulatory elements are well-known to handle the spatiotemporal patterns of the genes, I suggest that these elements intrinsically direct the cells' coordination. Nonetheless, the precision of spatiotemporal information at the single-cell level and whether there is any significant correlation between the timing of transcription and cell shape changes is still not well understood.

To elucidate the regulatory changes necessary to undergo morphogenesis, I will utilize *Drosophila* gastrulation due to its simplicity and the potential to visualize the kinetics of the zygotic transcripts. I've applied the live imaging of myosin-GFP to capture myosin contraction patterns, and utilized the MS2-GFP live imaging system for the study of nascent transcription during the mesoderm invagination. Using these live-imaging techniques, I analyzed single-cell morphogenetic cues arising from the promoters and enhancers of the zygotic genes regulating cell shape changes.

From these experiments, I noted that the level of Snail transcripts affects the apical constriction pattern in the ventral furrow formation, and defined the multiple bars of the cellular processes potentially imposed during the invagination. This suggested that the coordinated invagination could be ensured with the substantial amount of Snail transcripts. By analyzing the correlation between transcription and cell behavior, I've found a peculiar temporal dynamic pattern on the cellular effector genes "pre-shadowing" the cell movements, which could be important for the reliability of morphogenesis. Together, these results suggest a significant optimization of gene regulatory elements for the coordinated manner of morphogenesis.

Contact:
Sakan Yoo, Physiological Genetics, sakan.yoo@riken.jp, Tel: 078-306-3150 (ext: 3150)