Graduate School of Frontier Biosciences
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セミナーのお知らせ

Mechanical forces influence three-dimensional cell behaviours in the mouse embryo

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2F Seminar room, Biosystems Building

生命機能研究科 生命システム棟 2階セミナー室

A fundamental question in developmental biology is the how organs are shaped. Morphogenesis has long been recognised as an inherently physical process. In recent years, we have been combining data from live light sheet imaging with biophysical approaches and genetics to study solid organ primordia such as the limb buds and branchial arches in the mouse embryo. We showed how physical tissue stress is regulated by developmental pathways to orient cell rearrangements that remodel ectoderm [1,2]. More recently, we tackled the challenge of 3D mesenchymal morphogenesis by generating a magnetic tweezer system to map tissue stiffness [3] and a genetically encoded FRET-based force sensor to measure cortical forces of individual cells in vivo [4]. The emerging data suggest that two modes of cell movement, rearrangements and crawling, both contribute to collective mesenchymal cell movements that shape organ primordia. Our findings show that mesenchymal cell intercalations underlie volumetric convergent extension of the arch in a Wnt5a-dependent fashion. In addition, we define how tissue stiffness affects cell intercalations, and determine the biophysical functions of downstream mediators YAP and PIEZO1 [4]. On the other side, cell rearrangements can be considered to result from liquid-like rigidity phase properties that are determined by cellular geometries and oscillations. There is correlative evidence that cell crawling is oriented by durotaxis, or the movement of cells up a stiffness gradient. In this seminar, I show our current research and discuss our attempts to bridge collective multicellular behaviours to organ shape.

1) Lau, K., Tao, H., et al., Nat Cell Biol. 17(5):569-579, 2015
2) Wen, J., et al., Biophys J.115(12):2243-2450, 2017
3) Zhu, M., Tao, H., et al., bioRxiv 412072, 2018
4) Tao, H., et al., Nat Commun. 10:1703, 2019

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