Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Webinar

Mechanobiology of organ development and homeostasis

Priti Agarwal

Tel Aviv University, Israel

Organ morphology is critical for its function. Biochemical signals along with mechanical cues regulate the development and homeostasis of an organ. Defects in tissue mechanics and force-regulation result in several pathological disorders such as fibrosis, cancer, osteoporosis, progeria etc. Although significant advances have been made in understanding the genetic regulation of development and disease, the role of mechanical forces has remained largely unexplored.

I am using the C. elegans gonad as a model system to understand the physical basis of organ development and homeostasis. In the first part of my talk, I will present a unique tissue-level contractile structure I discovered, which functions as an actomyosin corset in the maintenance of a syncytial architecture in the C. elegans germline. Using laser microsurgery, genetic manipulations and mathematical modelling we map the balance of forces within the gonad and show the effect of altered tension within the actomyosin corset on the structure of the syncytial germline. In the second part, I will provide novel mechanistic insights regarding the development of the typical U-shaped gonadal arms. Each gonadal arm has a single somatic leader cell, known as Distal Tip Cell (DTC), at its tip, and is enwrapped by the basement membrane. Using long-term imaging and tissue-specific knock down approaches, we found that the gonad elongates due to a pushing force generated by confined proliferating germ cells behind the DTC and a concomitant release of pressure in the front due to DTC-induced matrix degradation. Also, stronger cell-matrix adhesion on the dorsal side of the DTC creates a torque which leads to the U-turn of the gonad. Taken together, our study provides a comprehensive understanding of the physical basis of C. elegans gonad development and homeostasis. Given the remarkable conservation of several features of the C. elegans gonad architecture, we speculate that similar physical principles holds true for the organogenesis in other species as well.

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