Decoding the Fate of Neural Stem Cells: Insights from Spinal Cord Stem Cells and Gliomas for Enhanced Control and Therapeutic Strategies

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September 24, 2023

While significant progress has been achieved, unraveling the intricate regulatory mechanisms governing the fate of stem and progenitor cells, particularly within in vivo contexts, remains a formidable challenge. Cellular differentiation stands as one of the most meticulously orchestrated biological processes, underpinned by a multifaceted interplay of biochemical factors (e.g., cytokines) and physical cues (e.g., rigidity). These processes are guided by an intricate network of both long-range and local signaling cues, mediated through an extensive array of receptors and molecular switches within the signaling circuitry.

In the context of development and tissue regeneration, stem cells are required to differentiate with spatial and temporal precision, ultimately giving rise to exquisitely organized tissues. Throughout an individual's lifespan, adult stem cells persist within specialized microenvironments known as niches, continuously replenishing tissues with differentiated cells. This journey towards cellular differentiation encompasses both deterministic events and stochastic occurrences, necessitating the integration of artificial intelligence to comprehensively elucidate and predict the trajectories of cell differentiation. Given the inherent complexity of this dynamic interplay, errors in this finely tuned system can lead to cellular dysfunction, ultimately culminating in the development of cancer.

In our laboratory, we are presently dedicated to investigating normal stem cells originating from the spinal cord, as well as tumoral stem cells derived from gliomas, a particularly deadly form of brain cancer. I will present past and recent data showing how Notch and Hippo/YAP pathways participate in the proliferation and fate of these cells.