McGill Faculty of Engineering

RESEARCH SEMINAR

Barcode Microtechnology for High-throughput, Multiplexed Single Cell Analysis

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Cancer is the leading cause of death in Canada. One of the major challenges in cancer diagnosis is the heterogeneity within a tumor and among patients, which often leads to therapy failure. To date we still do not fully understand the cause of heterogeneity, and are not able to effectively kill aggressive tumors. To address the need for clinical diagnosis and for mechanistic studies, we have developed high-throughput, quantitative and multiplexed barcode technologies for analysis of tissue and blood proteomes. In the first part of this talk, I will introduce the principle of the multiplexed barcode technologies and the integration of barcode microarrays with microchips. Three types of barcode microarrays will be discussed, which have been used for blood proteomic assays, T cell secretome assays and single cell phosphoproteomic assays, respectively. In the second part of my talk, I will focus on the application of a single cell barcode microfluidic chip to understand the influence of cancer cell communications on cellular heterogeneity. The interrogation between pairs of model brain cancer cells shows that the cancer cell communications are distance-dependent. At short separations, cells exert inhibitory influence on each other, whereas they predominantly activate each other at large separations. Protein-specific cell-cell interaction functions are extracted to predict three-cell interactions with a physical model. Our result of cell communications provides an alternative explanation for tumor resistance to targeted epidermal growth factor receptor therapies. The interruption of cell communications may present a new therapeutic approach.

My future work will focus on novel barcode technologies including: (1) integrated microfluidic chips for high-throughput, multiplexed single cell genomic and proteomic analyses to seek biomarkers and study tumor evolution, (2) barcode nanoarray for multiplexed, real-time imaging of live cells to gain insights into dynamics of complex networks.

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