High-Dimensional Single-Cell Cytometry Analysis for Understanding Cancer Stemness

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While cancer starts as a single cell, termed cancer stem cell (CSC), the progeny CSCs are not created equal, but exhibit a spectrum of phenotypes of varying renewal capacities, metastatic potentials, and drug resistances. Understanding this cell-to-cell difference (i.e. heterogeneity) of CSCs holds the key to both scientific and translational cancer research and presents us the opportunity to target and eliminate cancer at its “stem.” Unfortunately, we do not currently have the tools necessary to dissect CSC heterogeneity because CSCs are extremely rare, making their isolation parallel with finding a needle in a haystack. As a result, our current view of CSCs is “pixelated” and “isolated”, keeping us far away from thfe complete understanding of CSCs. In this research, I harvested the power of a recent technological advancement in single-cell detection, namely cytometry by time-of-flight (CyTOF). Using CyTOF, I have successfully collected and then profiled the high-dimensional cytometry data obtained from an antibody panel that allows for simultaneous measurement of 27 markers on a single cell at a rate of 1000 cells per second. For the first time, I was able to directly detect breast cancer CSCs. With further antibody panel expansion and data mining, this study will provide the first comprehensive and high-resolution map of the CSC subpopulations at the proteomic and signaling levels. These results will unlock the answers to central questions regarding cancer stemness, which will change the paradigm of current practices in several aspects of cancer medicine, including early detection, monitoring, therapeutics, and ultimately lead to the development of preventative strategies to suppress or even reverse the initiation of cancer.

Awards Won:

Fourth Award of $500