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A nanosurface fluidic device for physical fingerprints of extracellular vesicles for liquid biopsy in cancer

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Non-invasive liquid biopsies offer hope for point-of-care glimpse into the molecular hallmarks of the disease, including drug resistance and targets. Among different types of liquid biopsy platforms, tumor-derived exosomes (EXs) are unique due to their intercellular tumor communication and serve as carriers of biological information. Exosomes are nanoscale extracellular vesicles (EVs) released from cells into body fluids, carrying cell cargos such as DNA and RNA reflective of their parental cells. They offer a unique opportunity to access biologically important accepts of disease complexity.
In Mahshid Lab, we develop a new nanoplatform for molecular analysis of single EVs. We harnesses a nanopatterned fluidic device that incorporate SERS (surface enhanced Raman spectroscopy) for molecular profiling of cancerous EVs. Using this approach, we were able to distinguish a library of peaks expressed in GBM (Glioblastoma) EVs from two distinct glioblastoma cell lines (U373, U87) and compare them to those of non-cancerous glial EVs (NHA) and artificial homogenous vesicles. In parallel, we develop a nanofluidic device with tunable confinement to trap EVs in a free-energy landscape that modulates vesicle dynamics in a manner dependent on EV size and charge. We show that the surface charge of particles can be measured by analysis of particle diffusion in the landscape. Since extra-cellular vesicles are representative of their parental cells, their surface charge and size can provide information of their parental cells. As proof-of-principle, we perform size and charge profiling of a population of EVs extracted from human glioblastoma astrocytoma (U373) and normal human astrocytoma (NHA) cell lines.

Author: MAHSHID, Sara (McGill University)

Presenter: MAHSHID, Sara (McGill University)

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