CANCER PREVENTION & RESEARCH INSTITUTE OF TEXAS

Award ID:
RP140298

Project Title:
Engineering Microfluidic Devices for Multimodal Mechanical Phenotyping of Tumor Cells in Flow

Award Mechanism:
Individual Investigator

Principal Investigator:
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Entity:
Texas Tech University

Lay Summary:

Everyone knows that honey is thicker than water, but how thick are cancer cells? Supported by a 2009 CPRIT High Impact High Risk Award, we measured the viscosity of cancer cells using a miniaturized cell squeezer device. We unexpectedly found that highly metastatic (HM) cells are viscous, like honey and non-metastatic cells are almost like water. Motivated by these findings, we propose to engineer two novel devices – a microfluidic cell fragmenter (MCF) and a microfluidic cell occluder (MCO). The MCF device breaks cells apart, allowing us to test our hypothesis that HM cells should be difficult to break because of their higher viscosity. The MCO device measures clogging properties of tumor cells. We hypothesize that HM cells clog capillaries easier than non-metastatic cells because of their higher viscosity. We will also check if cells die in the process of fragmentation and occlusion. Finally, we will examine the effect that chemotherapy drugs targeting cytoplasm, membrane and DNA have on the ability of cells to squeeze, fragment and occlude. It is well recognized that tumor cells are transported by blood flow to distant organs causing metastasis. In this journey, tumor cells squeeze through capillaries or occlude or fragment at junctions. Our suite of engineered microfluidic devices closely mimic this physical environment of tumor cells in blood flow. Our results will therefore allow a broad and accurate profiling of metastatic potential. Our proposed work will establish cancer cell viscosity as a new mechanical marker for metastasis, similar to how blood viscosity is a recognized marker for heart diseases. Our technologies can help in rapidly identify malignancy in patient samples such as pleural fluids and fine needle aspirates. Screening for compounds in the in vivo-like environment of our devices will lead to better drugs. Thus, our project will lay the foundation for translating our devices into clinical diagnostics and drug discovery.