Detection of Circulating Tumor Cells for Early Diagnosis of Cancer on a Microfluidic Platform

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Circulating tumor cells (CTCs) act as an early biomarker representing metastatic cancer, in which cells from a benign tumor release out into the bloodstream. These cells anchor to other organs of the body and begin to use the tissue as a scaffold for growth, leading to rapid progression of cancer. Metastatic cancer is at fault for the rise of breast, prostate, and brain cancer, which have high mortality rates (606, 880 cancer deaths in the U.S).

Current techniques such as surgical and liquid biopsies are invasive and inefficient for early detection of cancer. In this work, we propose the capture and detection of CTCs using an antibody-based microfluidic platform attached to a sensor that uses electrical impedance to sense the presence of cells. The change in capacitance correlates the number of cells captured on the sensor. For this work, we selected the A549 lung cancer cell line. For capturing the cancer cells a microfluidic chamber was coated with antibodies specific to A549 cells which were connected to the sensor that registered the presence of cells by creating an electrical impedance based on how many cells attached to the antibodies.

The goal is to be able to register a small number of cells, around 10-50 cells/mL of sample. The capture of a small number of cells assures early detection of cancer since in the initial stages of cancer progression the number of CTCs would be quite low. If successful, then metastatic cancer can be prevented through medical intervention at a stage where it can be completely removed. This proposed method can verify the presence of a preexisting tumor, allowing for patients to eliminate a cause for a new tumor to emerge.