



**SU2C Circulating Tumor Cell Dream Team:
“Bioengineering and Clinical Applications of Circulating Tumor Chip”**

[This abstract was provided by the scientists when their application was accepted.]

Cancer arises within cells of an organ, such as the breast or pancreas, but it causes the death of our patients by dissemination through the bloodstream, leading to distant metastases in bone, liver, lungs or brain.

Cancer cells spreading from the primary tumor can be found in the blood of patients with cancer, so-called Circulating Tumor Cells or CTCs, but they are extraordinarily rare (estimated at one CTC per billion normal blood cells). As such, their detection presents a major challenge and current technologies are at the limit of resolution. The most commonly used commercial technology has neither the sensitivity nor the reliability to be useful in guiding treatment decisions.

Through a collaboration between bioengineers, molecular biologists and clinicians, we have developed a novel and radically different approach to detect and isolate CTCs, taking advantage of microscopic fluid dynamics to construct a “Chip” with 100 times greater sensitivity than existing technologies. The CTC-Chip contains 78,000 microscopic columns, each of which is coated with a material capable of attaching to CTCs, while allowing normal blood cells to flow through unimpeded.

The CTC-Chip can capture approximately 200 CTCs from a teaspoon of blood taken from cancer patients, making them available for scientific analysis and providing an important new tools for clinical investigation and eventually for clinical care of patients with cancer.

Our goal is to transform the CTC-Chip from the existing manual prototype to a robust technology that will allow detailed studies across multiple different types of cancer.

The CTC-Chip offers unprecedented opportunity for the detection of tumor cells from patients with early stage cancer, the ability to genetically characterize tumor cells without needing an invasive biopsy, and determine responsiveness to the new generation targeted cancer drugs. It also offers the opportunity to study “cancer stem cells” or “metastasis precursors”, thought to be at the origin of cancer spread via the bloodstream, to define their molecular vulnerabilities and help design new therapies to prevent cancer metastasis.

Our finding that CTCs are detectable in the blood before the development of metastatic disease suggests a potentially important new application in early detection and cancer screening.



Scientific Abstract

We propose a bioengineering and molecular biology collaboration between scientists at Massachusetts General Hospital (MGH) and Massachusetts Institute of Technology to enhance the current prototype, push the limits of CTC detection, and define the biological properties of CTCs.

This will enable a clinical collaboration between investigators at MGH, Dana Farber Cancer Institute, Memorial Sloan Kettering Cancer Center, and MD Anderson to apply this technology across different cancers, including cancers of the lung, prostate, breast, colon and pancreas.

Together, scientific and clinical studies using this new technology are likely to have a major impact on the diagnosis and treatment of human cancers.