

Microfluidics Technology for Cancer Diagnosis & Personalized Treatment

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The presence of Circulating Tumor Cells (CTCs) in bloodstream of patients with epithelial cancers is an important intermediate step in cancer metastasis and can provide valuable insights into disease detection, staging and personalized treatment. As compared to obtaining a tissue biopsy which is invasive and painful, “liquid biopsy” for CTCs detection can be easily performed via a routine blood draw. The presence and number of CTCs in peripheral blood has been associated with the severity of the disease and have potential use for early detection, diagnosis, prognosis and treatment monitoring purposes. The isolation of CTCs using microfluidics is attractive as the flow conditions can be accurately manipulated to achieve an efficient separation. Here, we demonstrate several effective separation methods by utilizing the unique differences in size and deformability of cancer cells from that of blood cells. By exploiting the fluid dynamics in specially designed microfluidic channels, CTCs which are generally stiffer and larger can be physically separated from the more deformable blood constituents. Using this label-free approach, we are able to retrieve viable CTCs that are not only suitable for downstream molecular analysis such as genetic or RNA sequencing, but also for expansion and culture. With blood specimens from cancer patients, we confirmed the successful detection, isolation and retrieval of CTCs. Identification of CTCs will not only aid in the determination of malignancy and disease, but also enable personalized treatment by the possible detection of any actionable mutation. Some of these biochips have been commercialized and are undergoing clinical tests in the USA, UK and Asia.