Liquid Biopsy and Expansion of Patient Derived Circulating Tumor Cell Spheroids for Precision Medicine

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We have developed a personalized cancer therapy approach that monitors the patient's individual response to anticancer treatment. It involves testing of anticancer drug efficacy on circulating tumor cells (CTCs) clusters that have been expanded from CTCs obtained from patient blood samples via liquid biopsy. Previous studies attempted to culture these primary cancer cells through long-term maintenance under growth factor supplements into cell lines, but these techniques can take up to more than 6 months as well as low CTC expansion efficiency of less than 20%. We design and develop a simple but unique microfluidics-based culture approach that requires minimal preparation (about 30 min), and does not require prior capture or enrichment of CTCs or use of growth factor supplements. Our approach makes use of co-culture of CTCs with immune cells from the same patient blood sample within specially designed microwells to promote CTC cluster formation of just under two weeks. We also achieve overall cluster formation success rate of over 50%. Drug screening or testing can then be performed by implementing a gradient generator that can expose expanded CTC clusters to a combination of two or more drugs at various dosages or concentrations. Due to its less-invasive nature, regular monitoring of disease progression and drug efficacy can be performed. Arising from the faster readout of our platform as compared with other techniques, our approach can enable clinicians to better and quickly assess or predict a patient's response to various therapeutic strategies, thus enabling personalized or precision therapy.