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Nanostructured Substrates for Capturing Circulating Tumor Cells in Whole Blood

HSIAN-RONG TSENG, Department of Molecular & Medical Pharmacology, Crump Institute for Molecular Imaging, David Geffen School of Medicine, UCLA

Over the past decade, circulating tumor cells (CTCs) has become an emerging "biomarker" for detecting early-stage cancer metastasis, predicting patient prognosis, as well as monitoring disease progression and therapeutic outcomes. However, isolation of CTCs has been technically challenging due to the extremely low abundance (a few to hundreds per ml) of CTCs among a high number of hematologic cells (109 per mL) in the blood. Our joint research team at UCLA has developed a new cell capture technology for quantification of CTCs in whole blood samples. Similar to most of the existing approaches, epithelial cell adhesion molecule antibody (anti-EpCAM) was grafted onto the surfaces to distinguish CTCs from the surrounding hematologic cells. The uniqueness of our technology is the use of nanostructured surfaces, which facilitates local topographical interactions between CTCs and substrates at the very first cell/substrate contacting time point. We demonstrated the ability of these nanostructured substrates to capture CTCs in whole blood samples with significantly improved efficiency and selectivity. The successful demonstration of this cell capture technology using brain, breast and prostate cancer cell lines encouraged us to test this approach in clinical setting. We have been able to bond our first validation study with a commercialized technology based on the use of immunomagnetic nanoparticles. A group of clinically well-characterized prostate cancer patients at UCLA hospital have been recruited and tested in parallel by these two technologies.