Researchers use 'nano-Velcro' technology to improve capture of circulating cancer cells

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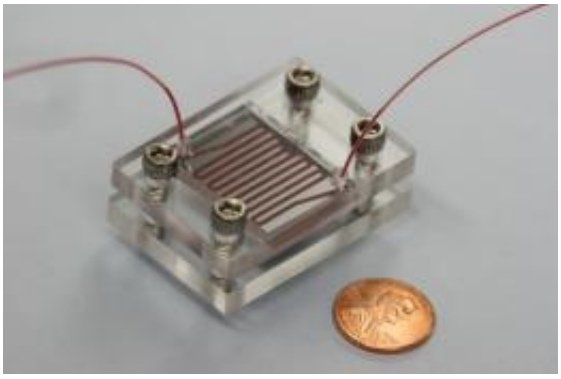


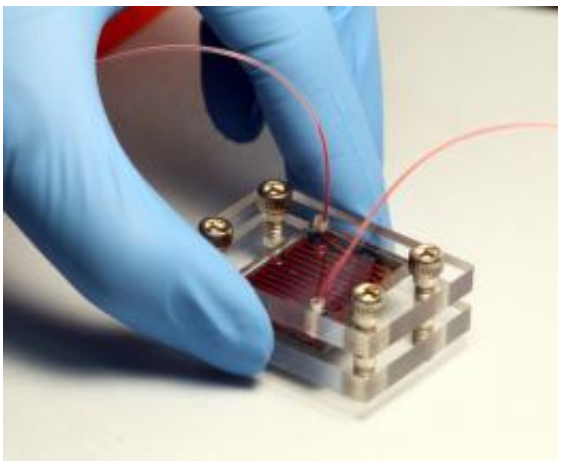
A integrated chip for detecting circulating tumor cells in blood collected from prostate cancer patients. (Image credit: Dr. Libi Zhao and Xiaowen Xu)

(PhysOrg.com) -- Circulating tumor cells, which play a crucial role in cancer metastasis, have been known to science for more than 100 years, and researchers have long endeavored to track and capture them. Now, a UCLA research team has developed an innovative device based on Velcro-like nanoscale technology to efficiently identify and "grab" these circulating tumor cells, or CTCs, in the blood.

Metastasis is the most common cause of cancer-related death in patients with solid tumors and occurs when these marauding tumor cells leave the primary tumor site and travel through the blood stream to set up colonies in other parts of the body.

The current gold standard for determining the disease status of tumors involves the invasive biopsy of tumor samples, but in the early stages of metastasis, it is often difficult to identify a biopsy site. By capturing CTCs in blood samples, doctors can essentially perform a "liquid" biopsy , allowing for early detection and diagnosis, as well as improved monitoring of cancer progression and treatment responses.

In a study published this month and featured on the cover of the journal *Angewandte Chemie,* the UCLA researchers announce the successful demonstration of this "nano-Velcro" technology, which they engineered into a 2.5-by-5–centimeter microfluidic chip. This second-generation CTC-capture technology was shown to be capable of highly efficient enrichment of rare CTCs captured in blood samples collected from prostate cancer patients.



A integrated chip for detecting circulating tumor cells in blood collected from prostate cancer patients. (Image credit: Dr. Libi Zhao and Xiaowen Xu)

The new approach could be even faster and cheaper than existing methods, and it captures a greater number of CTCs, the researchers said.

The prostate cancer patients were recruited with the help of a clinical team led by physicians Dr. Matthew Rettig, of the UCLA Department of Urology, and Dr. Jiaoti Huang, of the UCLA Department of Pathology and Laboratory Medicine.

The new CTC enrichment technology is based on the research team's earlier development of 'fly-paper' technology, outlined in a 2009 paper in Angewandte Chemie. The technology involves a nanopillar-covered silicon chip whose "stickiness" resulted from the interaction between the nanopillars and nanostructures on CTCs known as microvilli, creating an effect much like the top and bottom of Velcro.

The new, second-generation device adds an overlaid microfluidic channel to create a fluid flow path that increases mixing. In addition to the Velcro-like effect from the nanopillars, the mixing produced by the microfluidic channel's architecture causes the CTCs to have greater contact with the nanopillar-covered floor, further enhancing the device's efficiency.

"The device features high flow of the blood samples, which travel at increased (lightning) speed," said senior study author Dr. Hsian-Rong Tseng, an associate professor of molecular and medical pharmacology at the UCLA Crump Institute for Molecular Imaging and the California NanoSystems Institute at UCLA.

"The cells bounce up and down inside the channel and get slammed against the surface and get caught," explained Dr. Clifton Shen, another study author.

The advantages of the new device are significant. The CTC-capture rate is much higher, and the device is easier to handle than its first-generation counterpart. It also features a more user-friendly, semi-automated interface that improves upon the earlier device's purely manual

operation.

"This new CTC technology has the potential to be a powerful new tool for cancer researchers, allowing them to study cancer evolution by comparing CTCs with the primary tumor and the distant metastases that are most often lethal," said Dr. Kumaran Duraiswamy, a graduate of UCLA Anderson School of Management who became involved in the project while in school. "When it reaches the clinic in the future, this CTC-analysis technology could help bring truly personalized cancer treatment and management."

More information: A feature interview with Tseng appears in the March 7 issue of the journal *Nature Medicine*.

The digital object identifier for Tseng's Nature Medicine interview is doi:10.1038/nm0311-266 ; the *Angewandte Chemie* study is doi: 10.1002/ange.2010005853

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