Extracting Tumor Cells from Blood using Nanotechnology "Espresso Machine"

Scientists from the Institute of Chemistry, Academia Sinica, RIKEN (Japan), the University of California, Los Angeles (UCLA, USA) and Sun Yat-Sen University (China) have developed an improved method for safely extracting and analyzing cancer cells that circulate in patients' blood.

Circulating tumor cells (CTCs) are cancer cells that break away from tumors and travel in the blood, looking for places in the body to start growing new tumors called metastases. Capturing these rare cells allows doctors to detect and analyze a patient's cancer to give insight into personalized treatment design for each patient.

In the Smart Organic Materials Laboratory at Academia Sinica, Hsiao-hua Yu, Associate Research Fellow of the Institute of Chemistry, and Hsian-Rong Tseng from the California NanoSystems Institute at UCLA have developed a way to capture CTCs from blood samples – a liquid biopsy – and then release them from the surface with great cell viability using an invention called the Nano Velcro chip. This allows the scientists to examine the CTCs and analyze their genetic features. The study was published online on December 13, 2014 in the journal ACS Nano.

The Thermoresponsive Nano Velcro CTC purification system, developed by Yu and his colleagues allows them to raise the temperature to adhere the cells, then lower it to release them. This method makes the process for extracting CTCs much more efficient and cost-effective at a time in a patient's life when doctors need as much information as possible and as quickly as possible. Moreover, mutational genetic analysis is successfully demonstrated to monitor the disease evolution of a sample lung cancer patient. This shows the translational value of the device in managing non-small cell lung cancer with underlying mutations.

"Cancer cells are constantly changing with the microenvironment. Therefore it is difficult to manage and track their molecular biological status. With our new system we can control the temperature like an espresso machine for blood to capture then release the target cells," said Yu. "The downstream cellular mutational analysis will reveal information about the cancer status. As a result, the information will lead to a cancer GPS system to detect cancers with underlying mutations, locate their status in the complex cancer-biology map, and subsequently guide medical treatments"

This research was supported by Academia Sinica, the Academia Sinica Research Project on Nanoscience and Technology, RIKEN (Japan), the National Institutes of Health (USA), Sun Yat-Sen University (China) and the National Natural Science Foundation of China.

The full article is entitled “Programming Thermoresponsiveness of NanoVelcro Substrates Enables Effective Purification of Circulating Tumor Cells in Lung Cancer Patients” and is available at the ACS Nano website at:

http://pubs.acs.org/doi/pdf/10.1021/nn5056282

The full list of authors is: Zunfu Ke, Millicent Lin, Jie-Fu Chen, Jin-sil Choi, Yang Zhang, Anna Fong, An-Jou Liang, Shang-Fu Chen, Qingyu Li, Wenfeng Fang, Pingshan Zhang, Mitch A. Garcia, Tom Lee, Min Song, Hsing-An Lin, Haichao Zhao, Shyh-Chyang Luo, Shuang Hou, Hsiao-hua Yu, and Hsian-Rong Tseng