Flowing cells in a wavy microchannel for effective size-based cell sorting

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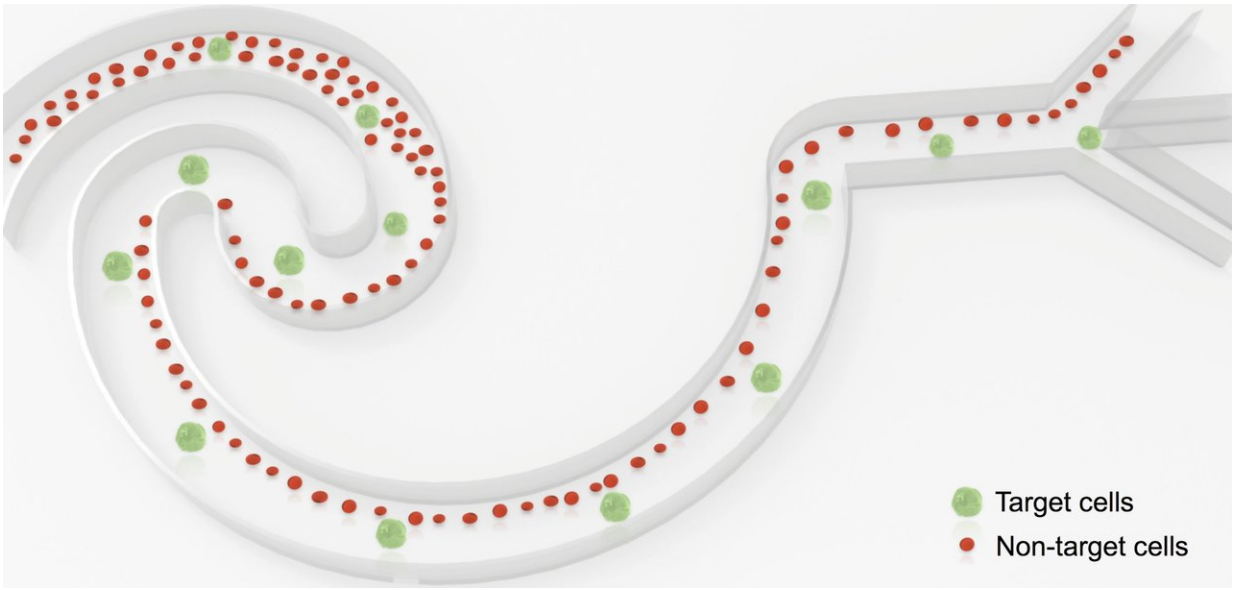

Schematic of size-based inertial cell sorting in a wavy channel unit before the trifurcated output. Differently sized biological cells can achieve distinct focusing behaviors, which thus result in effective size-based separation between target cells and non-target cells. Credit: SUTD

Nearly a half-century ago, scientists noticed that small particles flowing through a long tube can stay at a specific position along the cross-section of a tube. This is known as inertial focusing. Later, along with the development of microfluidic technology in recent decades, inertial focusing, a type of passive microfluidic manipulation technology, has

emerged as one of the most powerful and precise cell manipulation techniques, with immense commercial potential in the bioengineering and pharmaceutical industries.

Assistant Professor Dr. Ye Ai's research team from the Singapore University of Technology and Design (SUTD) recently developed a credit card-sized inertial cell focusing and sorting microfluidic device with a channel measuring 125 μm wide (roughly half of a single fingernail's thickness), providing the potential for rare cell isolation from complex clinical samples.

Currently, cancer is one of the leading causes of human death. One of the major difficulties toward achieving a radical cure in cancer is malignant metastasis, which directly causes overwhelming obstacles in therapeutic management and early diagnosis. The ability to isolate rare circulating tumor cells (CTCs), the seeds for cancer metastasis, enables a much less invasive approach for cancer diagnosis and prognosis. New microfluidic technologies for high-throughput, high-accuracy cell sorting of complex biological samples are desirable to address the challenge in rare cell isolation.

In this research, Dr. Ai's team presented a novel inertial focusing and sorting device with a series of wavy reverse channel structures consisting of semi-circular sections that generate a periodically reversed hydrodynamic flow perpendicular to the main flow direction. The balance between two kinds of hydrodynamic forces resulted in a size-dependent lateral particle movement across the channel, which finally achieved size-based separation of target cells from non-target cells. The principal investigator, SUTD's Dr. Ai said, "Compared to active methods, the passive inertial focusing with the use of hydrodynamic forces exhibit the merits of a simplified setup, high-throughput and low energy consumption. Moreover, the linear array of these repeated wavy channel units also facilitates easy horizontal (2-D) and vertical (3-D)

parallelization of multiple channels, which provides great potential for high-throughput cell sorting in practical biomedical applications." The team has applied the developed sorting technology for high-throughput isolation of cancer cells from whole blood samples.

More information: Yinning Zhou et al, Sheathless inertial cell focusing and sorting with serial reverse wavy channel structures, *Microsystems & Nanoengineering* (2018). DOI: 10.1038/s41378-018-0005-6

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