A Novel Microfluidic Platform for Rare Cell Isolation, Collection, and Retrieval from Whole Blood

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W094d

Abstract

The SelectChip Retrieval was developed to **isolate and collect rare cells from whole blood without pre-enrichment**. This microfluidic platform outputs the target cells into a microcentrifuge tube or well plate with a small fluid volume of less than 100 µL. More than 75% of the target rare cells were recovered.

Background

- Isolating and collecting rare cells for molecular analysis is a technically difficult problem.
- Molecular analysis of rare circulating tumor cells (CTCs) from the peripheral blood of cancer patients offers valuable information for basic research, drug development, and clinical use.
- Significant sample preparation, low recovery of the target cells, low purity of the recovered cells, and large collected fluid volumes make single-cell analysis difficult for rare cell populations.

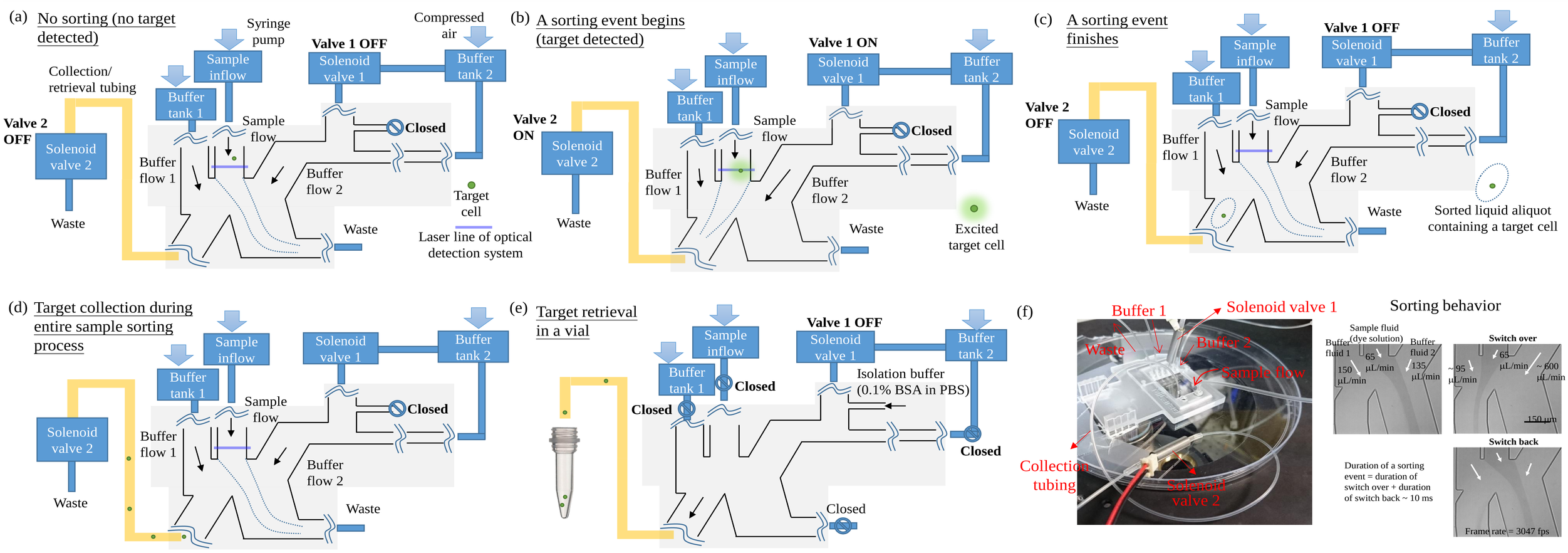
Methods

- Proof of concept testing was done with a sample solution containing fluorescent beads and a high speed camera.
- Analytical validation of the cell isolation and collection was done with 40 cultured cells added to 8-mL of whole blood and run on the MiSelect R instrument.

https://www.micareo.com/

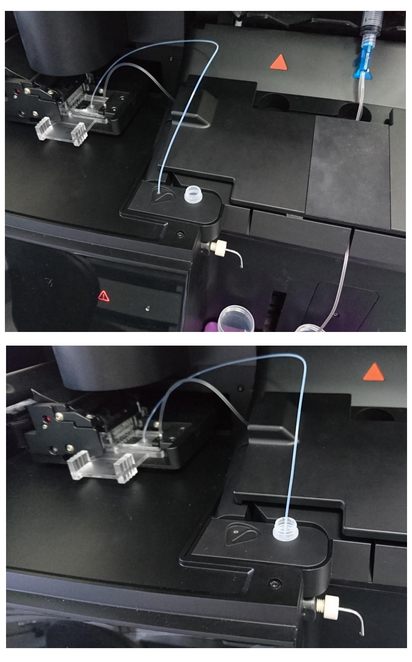
Results

Core Technology

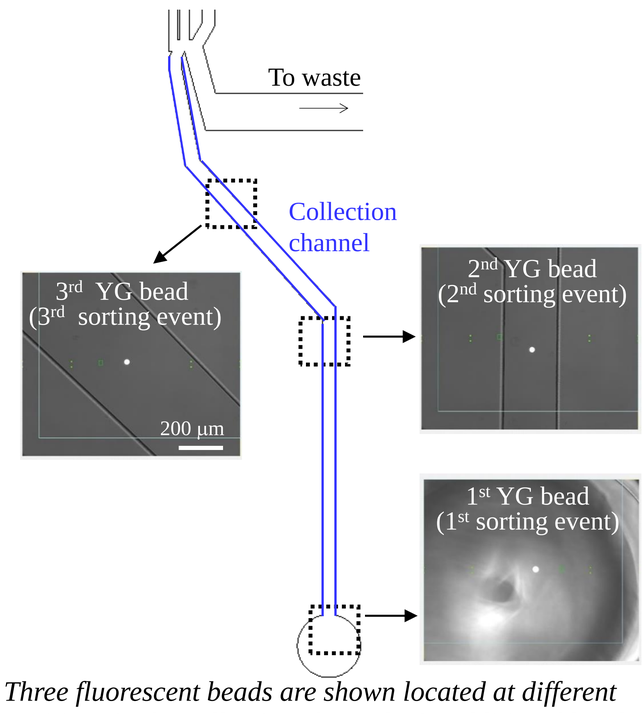


(a) When no target cell is detected, the sample fluid is guided by two buffer fluids to the waste channel. (b) When a target cell is detected, solenoid valves 1 and 2 open simultaneously and sorting begins. (c) After a few milliseconds, the cell has been isolated in the collection channel and the sample flow returns to the waste. (d) Each new target cell is detected, sorted, and moved down the collection channel and tubing. (e) After the entire sample has been processed, the target cells are dispensed into a microcentrifuge tube or well plate for molecular analysis. (f) Images of the chip, fluid tubing connections, and fluid sorting process.

Recovery Test Using a Bead Solution

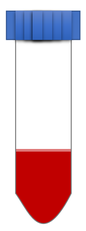


Images of the MiSelect R with the SelectChip Retrieval during the sorting steps (top) and dispensing steps (bottom).



Three fluorescent beads are shown located at different positions in the collection channel. As additional beads are sorted and isolated, these beads will travel further down the collection channel before being dispensed into the microcentrifuge tube or well plate.

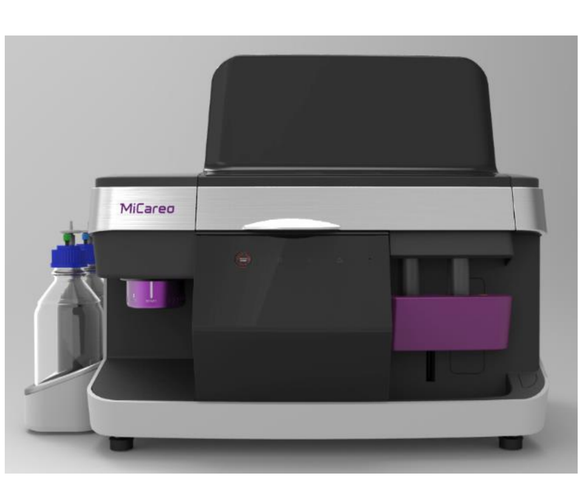
Cell Spike-in Test for VALIDATION



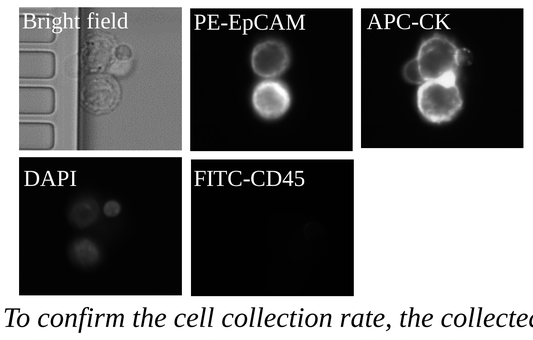
40 cultured Sk-Br-3 cells were added to 8 mL of whole blood and incubated with fluorescently conjugated EpCAM antibody

SelectChip Retrieval Microfluidic Chip (sequential sorting channel inside)

See Poster No. W104e for the concept, design, and additional validation data of the 2S channel



MiSelect R platform for rare cell isolation, collection and analysis.



To confirm the cell collection rate, the collected cells were injected into a microfluidic chip and imaged using fluorescence microscopy.

Retrieval rate of Sk-Br-3 cells.

	# of cell retrieved	Retrieval rate	40 SK-BR-3 cells in 8mL-blood (from healthy donor) for each test
Test 1	30	75.0%	
Test 2	31	77.5%	
Test 3	34	85.0%	
Avg.	31.6	79.2%	

Conclusions

- A microfluidic chip was developed to collect rare cells using an automated process on the MiSelect R instrument.
- Greater than 75% of the input target cells were collected in less than 100 µL of liquid in a microcentrifuge tube.
- The platform will enable single rare cell analysis using PCR and sequencing for precision medicine.