Advancing Personalized Medicine with miniaturization of Drug Sensitivity tests for solid tumors using Droplet Microarray technology

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Overview

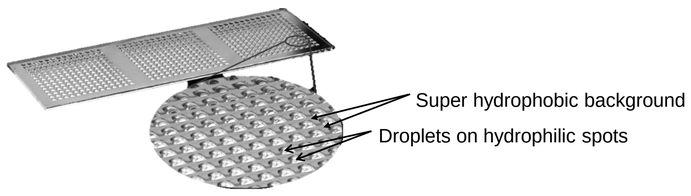
This Study discusses the limitations of current drug sensitivity and resistance tests for personalized cancer treatment and introduces a new approach using Droplet Microarray (DMA) technology. The study demonstrates the potential of DMA to improve drug sensitivity testing by reducing the amount of cells and reagents required for the tests and enabling high-throughput drug screening on various types of cells, including patient-derived cells obtained from surgery and needle biopsy. Results from testing cell lines, spheroids, and patient-derived cells on the DMA slide are presented, highlighting the potential of this technology for personalized cancer treatment in both clinical and research settings.

Introduction

Precision oncology enables physicians to select personalized treatments for patients. One of the approaches is Drug Sensitivity and Resistance Test (DSRT). In these tests, cancer cells derived directly from the biopsy are tested against a range of anticancer drugs with the goal to identify an effective therapy and help physicians to design a personalized treatment for each patient.

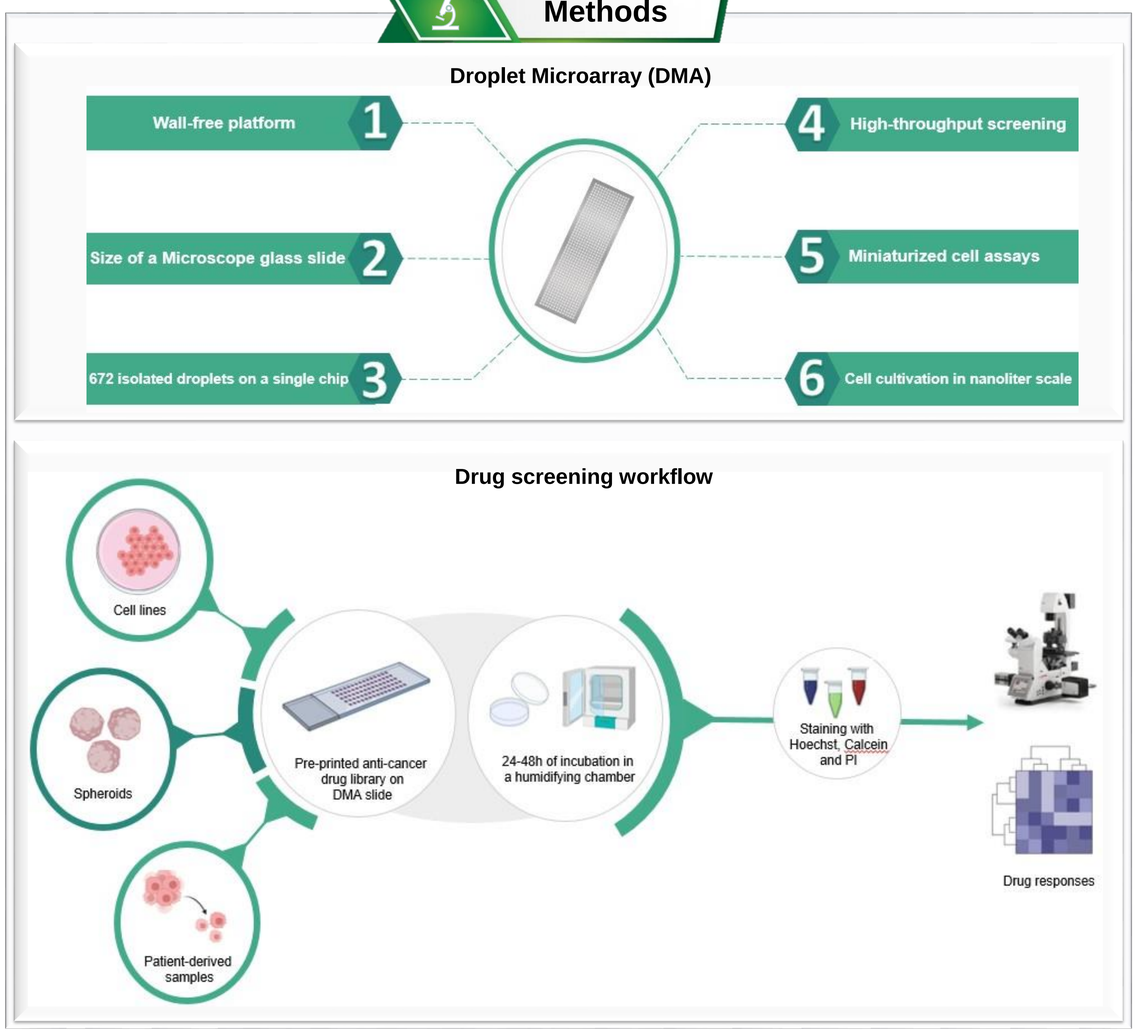
However, these tests are not recommended as a first-in-line prognostic method in clinics due to the quantity of cells derived from biopsy and the cost of reagents and compounds. Miniaturization of the test has the potential to address these limitations.

Droplet Microarray (DMA) is a recently developed platform formed by superhydrophobic–hydrophilic patterning on a microscope glass slide. Superhydrophobic borders enable creation of the arrays of droplets on hydrophilic spots that can be used to cultivate and screen cells in nanoliter droplets and has been demonstrated for various cell types including stem cells, bacteria and primary patient-derived chronic lymphocytic leukemia.



This study aims to explore the potential of using DMA technology to enhance drug sensitivity tests by reducing the required cell number and scaling down the tests to nanoliter size.

Methods



Results

A. Cell lines

1. SCC25, head and neck cancer cell line, 300 cells per spot
2. HaCaT, non-cancerous cell line, 500 cells per spot
3. Droplets of 200 nL
4. 500 cells for creating spheroids
5. Anticancer drug screening with library of 44 drugs including cytotoxic, targeted and epigenetic drugs

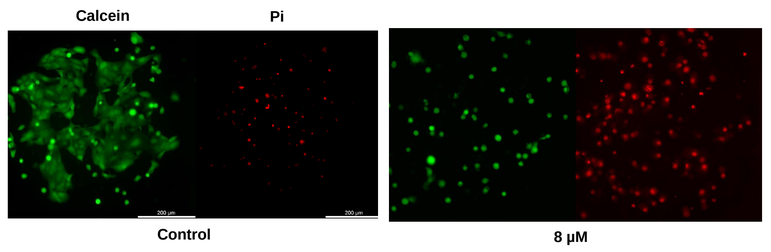


Figure 1. SCC25 Cells treated with a positive control drug, cetuximab, 24h of incubation, stained with Calcein and Pi which shows the alive and dead cells respectively.

B. Cell Spheroids

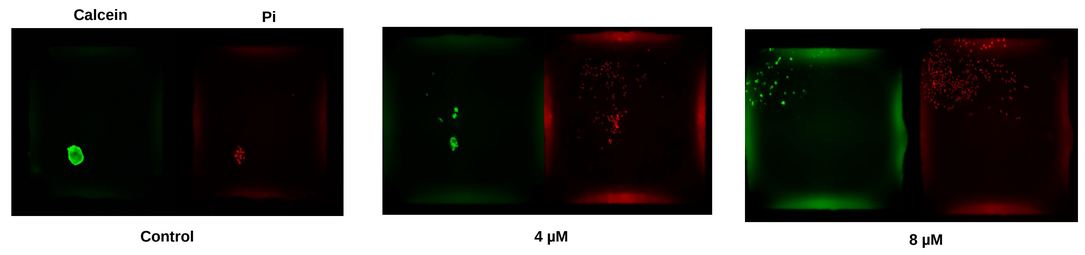


Figure 2. HaCaT cell spheroids treated with different concentrations of cetuximab, 48h of incubation, stained with Calcein and Pi

C. Patient derived cells obtained from surgery

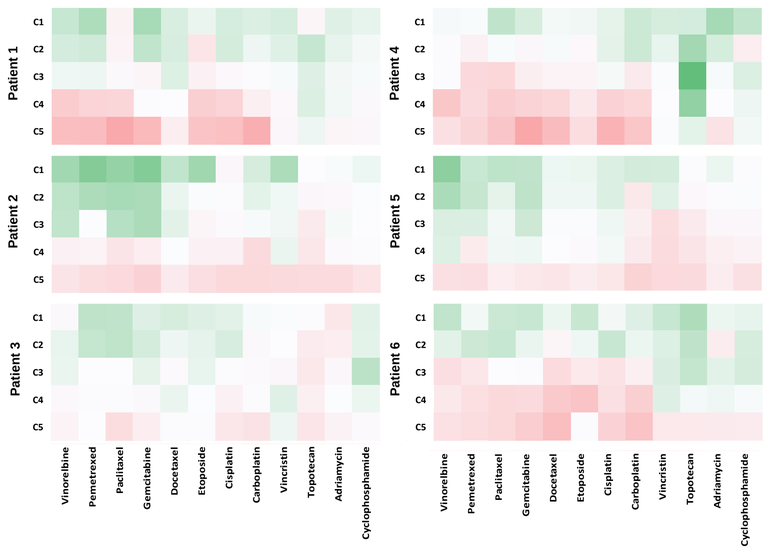


Figure 3. Comparison of effects of anti-cancer compounds on patient-derived cells on DMA slide for 6 different patients. 300 cells were cultured in droplets with 200 nL volume. C1 shows the lowest and C5 shows the highest concentration of the drugs. Cells were incubated with drugs for 24h. The average was taken from five repeats per drug concentration.

D. Patient derived cells obtained from needle biopsy

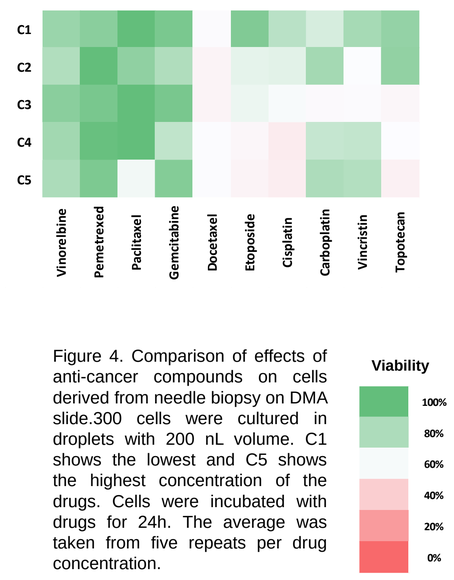


Figure 4. Comparison of effects of anti-cancer compounds on cells derived from needle biopsy on DMA slide.300 cells were cultured in droplets with 200 nL volume. C1 shows the lowest and C5 shows the highest concentration of the drugs. Cells were incubated with drugs for 24h. The average was taken from five repeats per drug concentration.

Conclusion

Our results highlight the potential of DMA technology for improving drug sensitivity tests and personalized cancer treatment, with potential applications in clinics and research settings as it can reduce the amount of cells and reagents required for the tests, enabling high throughput drug screening on patient-derived cells obtained from surgery and needle biopsy.

Acknowledgment

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