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Microfluidic Based High Throughput Screening System for Photodynamic Therapy against Cancer Cells

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Abstract : The Photodynamic therapy (PDT) is a treatment that uses a photosensitizer as a drug to damage and kill cancer cells. After injecting the photosensitizer into the bloodstream, the drug is absorbed by cancer cells selectively. Then the area to be treated is exposed to specific wavelengths of light and the photosensitizer produces a form of oxygen that kills nearby cancer cells. PDT is has an advantage to destroy the tumor with minimized side-effects on normal cells. But, PDT is not a completed method for cancer therapy. Because the mechanism of PDT is quite clear yet and the parameters such as intensity of light and dose of photosensitizer are not optimized for different types of cancers. To optimize these parameters, we suggest a novel microfluidic system to automatically control intensity of light exposure with a personal computer (PC). A polydimethylsiloxane (PDMS) microfluidic chip is composed with (1) a cell culture channels layer where cancer cells were trapped to be tested with various dosed photofrin (1μg/ml used for the test) as the photosensitizer and (2) a color dye layer as a neutral density (ND) filter to reduce intensity of light which exposes the cell culture channels filled with cancer cells. Eight different intensity of light (10%, 20%, …, 100%) are generated through various concentrations of blue dye filling the ND filter. As a light source, a light emitting diode (LED) with 635nm wavelength was placed above the developed PDMS microfluidic chip. The total time for light exposure was 30 minutes and HeLa and PC3 cell lines of cancer cells were tested. The cell viability of cells was evaluated with a Live/Dead assay kit (L-3224, Invitrogen, USA). The stronger intensity of light exposed, the lower viability of the cell was observed, and vice versa. Therefore, this system was demonstrated through investigating the PDT against cancer cell to optimize the parameters as critical light intensity and dose of photosensitizer. Our results suggest that the system can be used for optimizing the combinational parameters of light intensity and photosensitizer dose against diverse cancer cell types.

Keywords : photodynamic therapy, photofrin, high throughput screening, hela
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