Evaluating Cell Viability Heterogeneity Based on Information Fusion of Multiple Adhesion Strengths

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Abstract

Cell viability evaluation is significantly meaningful for cellular assays. Some cells with weak viability are easily killed in the detection of anti-cancer drugs, while others with strong viability survive and proliferate, ultimately leading to the treatment failure or the inaccuracy of biological assays. Accurately evaluating cell viability heterogeneity still remains difficult. This paper proposed a multi-physical property information fusion method for evaluating cell viability heterogeneity based on multiple linear regression (MLR) on a single-channel integrated microfluidic chip. In this method, adhesion strengths τN, that are defined as the magnitude of shear stress needed to detach (100-N) % of cell population, were extracted as the independent variables of MLR model by calculating the linear fitting of the impedance-response curves for shear stress (cell detachment assay). Besides, by calculating the non-linear fitting of the drug dose-response curves for cancer cells (IC50 assay), the half-maximal inhibitory concentration (IC50) was extracted as the dependent variables of MLR model. The results show that the mean relative error of our fusion method reduces by 17.87% and 59.66% compared with the single-parameter method and the cell counting method. Moreover, through the theoretical analysis of the drug resistance heterogeneity model, it proved that there is a qualitative relationship between the cell adhesion strength and cell viability heterogeneity, which provides a theoretical basis for our fusion method.

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