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A 3D Cell-Based Biosensor for Real-Time and Non-Invasive Monitoring of 3D Cell Viability and Drug Screening

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Abstract : In the past decade, three-dimensional (3D) tumor cell models have attracted increasing interest in the field of drug screening due to their great advantages in simulating more accurately the heterogeneous tumor behavior in vivo. Drug sensitivity testing based on 3D tumor cell models can provide more reliable in vivo efficacy prediction. The gold standard fluorescence staining is hard to achieve the real-time and label-free monitoring of the viability of 3D tumor cell models. In this study, micro-groove impedance sensor (MGIS) was specially developed for dynamic and non-invasive monitoring of 3D cell viability. 3D tumor cells were trapped in the micro-grooves with opposite gold electrodes for the in-situ impedance measurement. The change of live cell number would cause inversely proportional change to the impedance magnitude of the entire cell/matrigel to construct and reflect the proliferation and apoptosis of 3D cells. It was confirmed that 3D cell viability detected by the MGIS platform is highly consistent with the standard live/dead staining. Furthermore, the accuracy of MGIS platform was demonstrated quantitatively using 3D lung cancer model and sophisticated drug sensitivity testing. In addition, the parameters of micro-groove impedance chip processing and measurement experiments were optimized in details. The results demonstrated that the MGIS and 3D cell-based biosensor and would be a promising platform to improve the efficiency and accuracy of cell-based anti-cancer drug screening in vitro.

Keywords : micro-groove impedance sensor, 3D cell-based biosensors, 3D cell viability, micro-electromechanical systems
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