CBIMMS Invited Seminar

"Characterization and Validation of Cell-Based Biosensors"

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ABSTRACT

Cell-based biosensors (CBB's) utilize the physiologic responses of living cells to detect biologically active agents. As detectors, CBB's exploit the naturally evolved sensitivity of cells to a wide range of biochemical stimuli. CBB's are well-suited for applications requiring functional screening of unknown agents such as environmental monitoring or drug discovery. However, there are several issues preventing the widespread use of cell-based systems in these applications. Because these sensors are subject to biological variability, there are concerns regarding the reproducibility of sensor responses. Additionally, because of the broad-based sensitivity of cells, it is difficult to obtain specific information about the type and concentration of a compound. The goal of this work is to address these concerns in the context of a CBB based on monitoring electrical activity in cultured cardiac cells with planar microelectrodes.

Electrical activity was recorded with a custom data acquisition system while the cells were exposed to various toxins and pharmaceuticals. Numerous parameters related to the signal morphologies and timing relationships were extracted and analyzed in order to quantify the effects of the chemical exposure. The sensor responses to a wide range of chemical compounds were characterized. In addition, the major sources of noise affecting the reproducibility of CBB data were characterized and quantified. Despite biological variability, the sensor was able to resolve half-decade differences in concentration. Additionally, discrimination between several different compounds was achieved by simultaneous measurement of multiple output parameters. This work demonstrates both the utility and the limitations of a cell-based biosensor based on the recording of electrical activity in cardiac cell cultures.