Application Forum

Automated assays for quantifying cell migration

Christian Renken, Charles Keese, and Ivar Giaever

Applied BioPhysics Inc. (ABP), 185 Jordan Rd. Troy, NY, 12180, USA

Introduction

The ability of cells to migrate is an essential function in maintaining human health. It plays a critical role during embryogenesis, wound healing and immune responses, and mutations in the genes responsible for cell migration play roles in vascular disease and cancer. Cell migration can be observed in vitro using tissue culture. In the most common assay, a cell monolayer is grown to confluence and a cell-free area is then created often by scraping away the cells with a pipette tip or other object. The cells are then observed with microscopy to measure the rate at which the scraped area is repopulated. From these observations, a migration rate is calculated. Since 2004, ABP has provided an automated alternative to this method using ECIS (Electric Cell-substrate Impedance Sensing) to both wound and monitor cell migration. Now ABP has developed an alternate method - the Electric Fence (patent pending). In this method, an electrode is kept cell-free by applying a pulsating electric field as cells are seeded and grow into a confluent layer on the rest of the well surface. When the “fence” is turned off, cells then migrate in, and the population of the electrode is monitored using ECIS. Here we briefly show the use of these methods and the difference between the two.

Methods

BSC-1 cells were seeded at a density of 1×10^5 cells/cm² into ECIS arrays. Impedance was measured using an ECIS ZØ instrument. Wounding pulses of 5 mA were applied for 30 seconds at 40 kHz. The Electric Fence function was pulsed every 5 minutes using 0.6 mA at 20 kHz.

Results

A confluent layer of BSC-1 cells subjected to the wounding pulse results in cell death and the impedance drops immediately. After a short lag period, migration is observed as an increase in impedance, and time at which near full recovery is made is linearly dependent on the electrode diameter (Fig. 1A). In contrast, after the release of the Electric Fence, i.e. removing the electrical pulses, the cells immediately begin to migrate into the cell-free area without a lag period (Fig. 1B).

Figure Caption: ECIS measurements of BSC-1 cells. (A) Cell migration into circular areas with diameters of 250 μ m (black traces), 100 μ m (red traces), and 50 μ m (blue traces), showing lag (blue arrow) and migration (yellow arrow) phases. (B) The Electric Fence function (blue traces) prevents BSC-1 cells from attaching and spreading onto the ECIS electrodes (black traces). Cells are inoculated at time = 0.

Conclusions

ECIS cell migration assays offer the researcher labor-free and highly reproducible means to measure cell migration. The wounding function allows for precise wounding and measurements of migratory rates plus resolution of the initial lag period. The Electric Fence gives the researcher complete control over the surface composition of the electrode as well as decoupling cell migration from the initial lag phase. Since one instrument performs both experiments, results from the two can be directly compared providing further insight into the biology of cell migration.

Sponsored Paper. *BioTechniques* 49:844 (November 2010)
doi 10.2144/000113554

To purchase reprints of this article, contact: carmelitag@fosterprinting.com