FIU
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Lecture Series Seminar

Microfabricated Platforms for Stem Cell Research

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This paper describes the development and characterization of microfluidic platforms to study proliferation, differentiation, migration, and apoptosis of neural stem cells (NSCs). NSCs hold tremendous promise for fundamental biological studies and cell-based therapies in human disorders. NSCs are defined as cells that can self-renew yet maintain the ability to generate the three principal cell types of the central nervous system such as neurons, astrocytes, and oligodendrocytes. Despite their promise, cell-based therapies are limited by the inability to precisely control their behavior in culture. Compared to traditional culture tools, microfluidic platforms can provide much greater control over cell microenvironments and optimize proliferation and differentiation conditions of cells exposed to combinatorial mixtures of growth factors. NSCs proliferated and differentiated in a graded and proportional fashion that varied directly with growth factor concentration. Directed embryonic stem (ES) cell differentiation is also a potentially powerful approach for generating a renewable source of cells for regenerative medicine. Typical *in vitro* ES cell differentiation protocols involve the formation of ES cell aggregate intermediates called embryoid bodies (EBs). Recently, we demonstrated the use of poly(ethylene glycol) (PEG) microwells as templates for directing the formation of these aggregates, offering control over parameters such as size, shape, and homogeneity. Despite these promising results, the previously developed technology was limited as it was difficult to reproducibly obtain cultures of homogeneous EBs with high efficiency and retrievability. In this study, we improve the platform by optimizing a number of features: material composition of the microwells, cell seeding procedures, and aggregate retrieval methods. Adopting these modifications, we demonstrate an improved degree of homogeneity of the resulting aggregate populations and establish a robust protocol for eliciting high EB formation efficiencies. Therefore, the development of microfluidic platforms and hydrogel microwell arrays will help in advancing our understanding of brain development and provide a versatile tool with basic and applied studies in stem cell biology.