CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

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Project Number

S0420

Project Title

Microfluidic Device for Quantitative Single-Cell Profiling of Human Pluripotent Stem Cells, Year Two

Abstract

Objectives/Goals

Human pluripotent stem cells (hPSCs) hold great potential for treating many fatal diseases. However, many clinical applications are hindered by limited understanding of hPSC behavior and biology. Some challenges include xenogenic contamination caused by animal products that maintain stem cell growth, making transplantations unsafe. Conventional culture systems also do not accurately reflect the 3D in vivo microenvironment. Furthermore, the enormous variation of hPSC lines indicates the need to compare differences between hPSC lines to find the best target cell population for transplantation therapies.

Methods/Materials

To address these issues, a PDMS microfluidic device that reflects a 3D in vivo microenvironment was developed to sustain the growth and development of hPSCs and to profile their characteristics.

Results

In Year 1, feeder-free Matrigel of 20 ug mL-1 resulted in optimum growth confirming the robustness of the microfluidic culture device. Human embryonic and induced pluripotent stem cell lines (H1, HSF6, IPSA1, IPSB2), were cultured under various chemically defined/feeder-free culture media to reduce xenogenic contamination. In Year 2, different stem cell lines were characterized through systematic analysis of multi-parallel detected marker expression in single cells. Pluripotent (OCT4, NANOG, SSEA4, TRA-1-60 and TRA-1-80) and differentiation (SSEA1) marker expression were quantified.

Conclusions/Discussion

By profiling phenotypic responses of stem cells among different hPSCs, ideal stem cell lines for specific therapeutic purposes will be found. This microfluidic device represents an effective tool for maintaining optimum growth in a 3D microenvironment. The precision, high controllability and small reagent consumption of this microfluidic device can provide great opportunities for regenerative medicine.

Summary Statement

This research aims to create a microfluidic device to grow stem cells and quantitatively profile the phenotypes of different stem cell lines in order to better match stem cell lines to a specific therapeutic purpose.

Help Received

Used lab equipment at the University of California, Los Angeles under the supervision and guidance of Dr. Hsian-Rong Tseng and Dr. Ken-ichiro Kamei