Blood Brain Barrier Model in a 3D Co-Culture Microfluidic System
Technology #18044

Applications

This invention is a blood-brain barrier model that may be used in drug delivery studies.

Problem Addressed

The Blood-brain barrier (BBB) is a selective and distributed barrier implemented by tight junctions between endothelial cells forming the vascular walls of capillaries in the central nervous system that protects the system from damage. Unfortunately, the BBB also hampers drug delivery. Therefore an accurate, in-vitro BBB model may greatly aid drug delivery studies. Most current models are 2D culture systems that only roughly recapitulate the BBB. This technology uses a single platform for the study of BBB functions and has the potential for high throughput screening of the permeability of drugs and their effect on neuronal growth and function.

Technology

This invention is a microfluidic device that consists of four channels: two for 3D hydrogels and two for culture media (Figure 1A). The two hydrogel channels contain collagen type I and include primary rat astrocytes and neurons, respectively (Figure 1B). The hydrogel solutions are allowed to polymerize in a CO2 incubator. The fluidic channels are incubated coated with collagen to promote cell adhesion before being seeded with human endothelial cells. A number of studies confirm the success of this technology. Immunohistochemistry showed that astrocytes, neurons, and endothelial cells were able to grow, express cellular markers, and display the correct morphological characteristics of each of the three cell types (Figure 1C). The endothelial cells form a monolayer barrier with accurate characteristics of the BBB, such as expression of the junction proteins VE-cadherin and ZO-1 (Figure 1C). Neurite growth was confirmed with immunostaining and confocal imaging IMARIS software, whileand calcium imaging showed synaptic connectivityneural functionality. Lastly, tests demonstrated size-selective permeability of the endothelial monolayer that may be further altered modulated by chemically stimulating the endothelial cells or by adding other cellular components such as pericytes. This technology offers a number of advantages, including potential for high throughput screening, low cost, the interaction of endothelial cells, astrocytes, and neurons, real-time visualization of cellular interactions, precise control over spatiotemporal parameters, and a reduction in the amount of media, cells and chemicals required.

Advantages

- 3D microenvironment that is optimized for multi-cellular co-culture to more effectively model the cellular organization that is crucial for cellular processes in-vivo
- Microfluidic system allows high throughput screening, lower costs, reduced volume of reagents and biological samples, and control of spatiotemporal parameters
- Real time visualization

Contact the Technology Manager: tlo-inquiries@mit.edu
Permeability may be modulated

Categories For This Invention:
- Life Sciences
- Clinical Applications
- Neurology
- Research Tools
- Microfluidics (Research Tools)
- Other (Research Tools)

Intellectual Property:
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- MechanoBiology Laboratory
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