Digital molecular fingerprinting of detachable Organ-on-a-chip systems

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OVERVIEW

Digital molecular fingerprinting of detachable organ-on-a-chip systems

- Allows for an improved model of the blood brain barrier organ-on-a-chip
- Applicable to profiling temporal protein secretion of other organ-on-a-chip experiments

BACKGROUND

Organ-on-a-chip platforms are biomedical research tools to evaluate miniaturized versions of human organs on micro-engineered chip devices. These platforms mimic physiologic organ functioning to provide studies of functionality, disease states, and responses to pharmaceutical interventions. Organ-on-a-chip platforms have the potential to offer more cost-effective, ethical, and human-resembling models than animal models for disease study and drug discovery. Temporal profiling of multiple biomarker concentrations in this tissue model adds understanding the onset, progression, and resolution of common disorders. One area of growing interest involves the desire to recreate the semipermeable border which separates blood from the brain and extracellular fluid in the central nervous system. This blood-brain barrier (BBB) functions to protect the brain from harmful substances in the blood, while concurrently supplying the brain with important nutrients. Any shortcomings of the gatekeeping responsibilities of the BBB can lead to serious disorders, so a need exists to optimize methods for studying this interface.

INNOVATION

Inventors have created a means by which to provide digital molecular fingerprinting of detachable organ-on-a-chip systems, including blood brain barrier on a chip (BBB-oC). This innovation integrates digital immunosensors into an organ-on-a-chip platform using a novel "tacking and ultrafast digital fingerprinting" methodology. This approach meets several requirements and addresses several difficulties associated with immunosensing in existing organ-on-a-chip platforms. The new device can replace current ex situ immunoassay pipelines with in situ sensitive digital immunoassay measurements to provide several improvements. The digital immunoassay provides multiplexity, shorter assay times (<30 minutes duration), increased sensitivity, temporal profiling, microenvironment preservation, and ease of use. The method has been capable of profiling longitudinally produced cytokine secretions from BBB-oC endotoxin LPS) exposure. This BBB-oC can therefore better provide a human model of the multifunctional tissue working as an important node to control pathogen entry, drug delivery and neuroinflammation. The technology is also extensively applicable to profiling temporal protein secretion of other microfluidic organ-on-a-chip systems and can provide helpful insights in cytokine level fluctuations in sequentially controlled experiments.