Microengineered Physiological Systems for Disease Modeling and Nanomedicine Testing

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Abstract

Nanomedicine is the medical application of nanotechnology for healthcare. Advanced treatment of major diseases such as cancer requires controlled targeted delivery of therapeutic and diagnostic nanomaterials (nanomedicines). Despite the progress in the costly development of new nanomedicines, many cannot reach clinical trials. The high failure rate of nanomedicines or drugs highlights the importance of conducting preliminary drug screening with physiologically relevant in vitro model platforms with good predictive power, addressing the current challenge of mammalian in vivo models not amenable to systematic parameter tuning needed for mechanistic studies. To address this challenge, we develop microengineered physiological systems that present cultured cells with controlled mechanical and biochemical cues with physiological relevance. This talk highlights our recent efforts toward the development of microengineered physiological systems for disease modeling and nanomedicine testing. Specifically, I will talk about (i) a microengineered human blood-brain barrier model with 3D glial network for neuroinflammation modeling in Alzheimer’s disease and (ii) a microengineered muscle satellite cell niche model for replicating heterochronic parabiosis on a chip for aging studies. In addition, this talk will briefly introduce our approaches to nanomedicine testing in these microengineered physiological systems. Our ultimate vision is to leverage these technological innovations to enable cost-effective identification of new therapeutic targets for diseases including neurodegenerative diseases, such as Alzheimer’s, and age-related disorders.