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Engineering of assembloid culture for an integrated 3D tissue formation

A versatile microfluidic platform enables reproducible assembly and maintenance of 3D assembloids for controlled in vitro complex tissue modeling, disease screening, and drug discovery without the need for external syringe pumps.

Assembloids are 3-dimensional (3D) tissue constructs that can be made from fusion of multiple organoids or organ-specific units and are used to recapitulate complex tissue-tissue interactions in vitro. There is significant potential in using assembloids to model structural and functional integration of multiple tissue types. Conventional methods for forming assembloids rely on passive aggregation strategies such as putting organoids in proximity to allow for fusion. This leads to limited spatial control over the fusion process and difficulty with regulation of the microenvironment. Additionally, passive aggregation strategies suffer from issues with reproducibility and scalability, as well as lacking in control over the soluble biochemical environment. Microfluidic systems are a promising tool that could be combined with assembloid formation as these systems can establish spatially controlled microenvironments through the manipulation of fluid flow and microchannel geometries. However, current microfluidic systems cannot support the formation and maintenance of 3D assembloids with scalability. Researchers at Purdue University have designed a microfluidic platform that addresses the prior concerns and allows for assembly and maintenance of 3D assembloids and control over the soluble microenvironment. The platform's versatile design can also be readily modified into a pump-free configuration, enabling controlled delivery of soluble factors without the need for external syringe pumps, thereby simplifying operation and broadening accessibility for diverse experimental settings. This system can be used for in vitro models to study complex tissue-tissue interactions and bridge the gap between organ-scale studies and larger-scale in vivo models.

Technology Validation:

-Tested system using mouse and human intestinal organoids as proof-of-concept

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Category
Biotechnology & Life Sciences/Cell & Gene Therapy Platforms
Pharmaceuticals/Drug Discovery & Development

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-Showed reproducibility of system and signaling responses were spatially localized confirming controlled compartmentalization within larger construct

Advantages

-Can support formation and maintenance of 3D assembloids

-Reproducible system

-Control over soluble biochemical environment and spatial control of microenvironment

Applications

-Controlled construction of complex tissue models in vitro

-Disease modeling and drug screening in vitro

TRL: 3

Intellectual Property:

Provisional-Patent, 2025-09-24, United States | Provisional-Patent, N/A, United States

Keywords: Assembloids, 3D tissue constructs, organoids, microfluidic platform, tissue-tissue interactions, in vitro models, disease modeling, drug screening, pump-free configuration, spatially controlled microenvironments

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