A Robust Human Stem Cell Based System For Anatomically Correct Neural Tube Morphogenesis

Tech ID: 32445 / UC Case 2021-883-0

BACKGROUND

Morphogenesis is the biological process that causes a cell, tissue or organism to develop its shape. Understanding the morphogenesis of human embryos is a fundamental question in the physics of life with strong medical implications. 3D human stem cell cultures (organoids) capable of recapitulating selected aspects of human organ formation have greatly advanced our understanding of cell fate during organ formation. However, organoids still yield unreproducible and anatomically incorrect tissue shapes and cell fate patterns. Additional systems are used to apply stem cells into scalable, controlled and functional tissues, but these systems limit their shape and do not allow for self-organization as in embryonic development. Thus, new approaches are required in order to study human organ morphogenesis.

DESCRIPTION

Researchers at the University of California, Santa Barbara have addressed the difficulty of studying human organogenesis by creating a reproducible and scalable approach for studying organogenesis in a dish, which is compatible with live imaging. This is achieved by applying surface micro-patterning to precisely control cell fate in 2D stem cell sheets while allowing for self-organization of tissue shape in 3D. In contrast to animal studies, neural and epidermal human tissues are necessary and sufficient for folding morphogenesis in the absence of mesoderm activity. This technology models neural tube defects by interfering with biological signals that regulate tissue mechanics. The potential applications of this invention reach beyond neural tube defects and can add significant benefits to the study of human organ morphogenesis in health and disease.

ADVANTAGES

- Solves the reproducibility challenge of stem-cell cultures by applying surface micro-patterning
- Overcomes limitations of animal studies in human organogenesis
- Does not require support from other systems to complete the integration of stem cells
- Compatible with live imaging and genetic manipulations

APPLICATIONS

- Human stem cell modeling
- Neural disease research

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OTHER INFORMATION

KEYWORDS

morphogenesis, birth defects, neural disease, human stem cell, neural tube defects, organogenesis, cell fate, stem cells

CATEGORIZED AS

- **Biotechnology**
  - Health
- **Materials & Chemicals**
  - Biological
- **Medical**
  - Research Tools
  - Stem Cell
- **Research Tools**
  - Other

RELATED CASES

2021-883-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20240287430	08/29/2024	2021-883

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