Vascularized Tissue Engineering

Tech ID: 30220 / UC Case 2018-229-0

BACKGROUND

Tissue engineering and/or regenerative medicine are fields of life science employing both engineering and biological principles to create new tissues and organs and to promote the regeneration of damaged or diseased tissues and organs. Major advances and innovations are being made in the fields of tissue engineering and regenerative medicine and have a huge impact on three-dimensional bioprinting (3D bioprinting) of tissues and organs. 3D bioprinting holds great promise for artificial tissue and organ bioprinting, thereby revolutionizing the field of regenerative medicine.

One of the main roadblocks of 3D bioprinting tissues is the lack of efficient techniques to generated vascularized structures. This is critical for grafting applications as limited supply of nutrients and oxygen resulting in premature death of cells.

TECHNOLOGY DESCRIPTION

Researchers at UC San Diego have an invention that is a methodology which allows for the production of three-dimensional biocompatible matrices penetrated by highly specific lumenal patterns and geometries which can be used for tissue engineering. This can be accomplished with or without cells or primary tissue fragments encapsulated within the matrix, and with or without cells lining the interior of the lumens. The presence of the biocompatible matrix allows for growth and sustenance of encapsulated of cells or excised tissue fragments in an environment that mimics native extracellular matrix conditions, while the lumenal patterns allow for perfusion and sustenance of the system with growth media or biomolecules in a manner that scales with the specific patterns being used.

Specifically, the invention allows for construction of a solid but evacuable free-standing structure thatcan take the form of various 2D or 3D printed geometries including linear channels, sinusoids, grids,and spirals among others. This free-standing structure can subsequently be surrounded by a cell encapsulating solution of biological matrix or matrix-substitute such as Matrigel, gelatin, collagen, fibrin, or a blend of any of the aforementioned. Following enclosure in an aqueous matrix solution, the matrix solution is permitted to gelate to create a cellularized matrix, ultimately with the ability to form a hollow channel. Perfusion of the matrix through the evacuated vascular channels allows for both the design and sustenance of and growth of the cells within thick, tissue constructs for period exceeding 30 days.

APPLICATIONS

The application of the technology is for tissue engineering with broad applications which can generate biologically derived tissue constructs containing vascular channels of complex 3D geometries via 3D printing of poly(vinyl alcohol). For example, in the context of cell culture, it can be used primarily as a matrix component to form porous, cell-laden hydrogels, or to form biocompatible hydrogels via stereolithography. The methodology is both highly simple and easily reproducible, making it accessible in many research settings.

ADVANTAGES

This invention offers of number of superior attributes not available to what is currently available. First, the variety of evacuable geometries (for producing vascular or lumenal patterns) that can be generated by this technique is far greater than the combined total of all the methodologies described, thereby allowing us to generate a much greater variety of structures for 3D culture. Second, the technique is highly democratic, and requires nothing more than a commercial 3D printer along with the raw materials needed for the desired extracellular matrix and cell cultures.

STATE OF DEVELOPMENT

Validated 3D printing approach to generate tissue vasculature with encapsulated cells. we developed an engineered tissue model that contained a vascular channel seeded with primary endothelial cells, and was capable of sustaining both cells and tissue fragments long-term.The inventors demonstrated the viability of creating co-cultures of Caco-2 gut epithelial cells with primary endothelial cells that mimicked in vivo gut-like organization patterns.

INTELLECTUAL PROPERTY INFO

This technology is patent pending and available for licensing and/or research sponsorship.

RELATED MATERIALS

- Hu M, Dailamy A, Lei XY, Parekh U, McDonald D, Kumar A, Mali P. Facile Engineering of Long-Term Culturable Ex Vivo Vascularized Tissues Using Biologically Derived Matrices. Adv Healthc Mater. 2018 Dec;7(23):e1800845. doi: 10.1002/adhm.201800845. Epub 2018 Oct 23. - 12/07/2018

PATENT STATUS

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OTHER INFORMATION

KEYWORDS

3D printing, angiogenesis, tissue engineering, drug-testing, free-standing structures, biological derived matrices, vascularized tissues

CATEGORIZED AS

- **Medical**
  - Research Tools
- **Research Tools**
  - Other
- **Engineering**
  - Other

RELATED CASES

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Patent Pending

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