

NCATS CAN Review Board Virtual Meeting

Update on 3-D bioprinting of human tissues for drug screening

December 9, 2016

3-D Bioprinting of Human Tissues for Drug Screening

Goals

- Establish a multidisciplinary laboratory that uses 3-D bioprinting to generate high throughput screenable assay models of human tissues for drug discovery
- Access by outside investigators to establish human tissue models by differentiation of human iPSCs to the tissue cells of interest

Description of outcome

- Catalog of reproducible, disease relevant, and screenable human tissues using 3-D bioprinting with iPSC cells to be used for efficient drug discovery and development

Potential impact

- 3-D bioprinting of human live tissues derived from human patient stem cells is expected to provide drug efficacy data more predictive of those obtained in whole body responses
- Decrease in clinical trials failure rates, and faster development times than those using the current simplistic *in vitro* and *in vivo* models

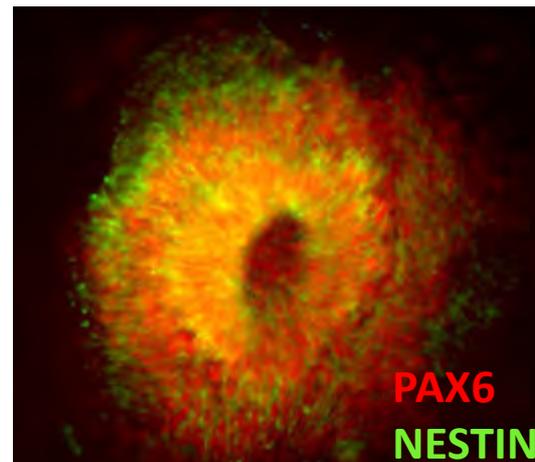
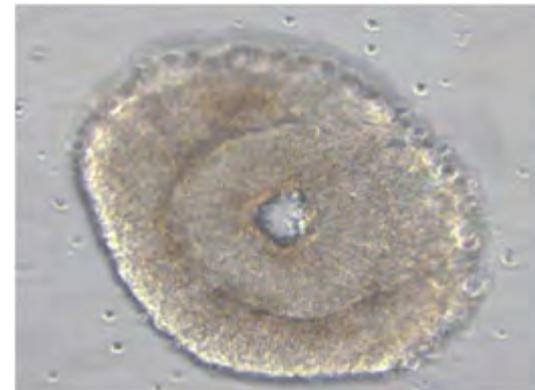


FY16: Establishment of Laboratory

- Major equipment.
 - Leica Two-photon/confocal microscope
 - Molecular Devices HCS
 - RegenHU Bioprinter
 - Laser Microdissection Systems Leica LMD6500
 - Leica VT1200 S Fully automated vibrating blade microtome
 - Leica Aperio VERSA Brightfield, Fluorescence & FISH Digital Pathology Scanner
 - Leica BOND RXm - Fully Automated Advanced Staining system
 - Thermo HistoStar™ Embedding Workstation
 - Thermo Excelsior™ AS Tissue Processor
 - Thermo CryoStar NX50 Cryostat
 - Thermo Gemini AS Automated Slide Stainer
 - Thermo ClearVue™ Coverslipper, ClearVue
- Team.
 - A team of 4 bioprinting scientists and 2 bioengineers in place.

3-D Bioprinting & Engineering of Complex Human Tissues

Robotic manufacturing of multi-cellular layered tissues with *in vivo*-like features

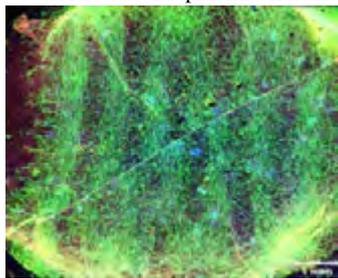


3-D Bioprinting Pilot Projects

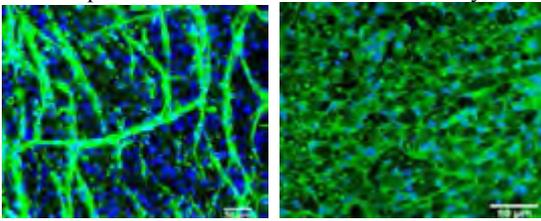
Engineered Blood Retina Barrier with iPSC-RPE and iPSC-endothelial cells



Total Area of Bioprinted choroid



Bioprinted choroid RPE monolayer

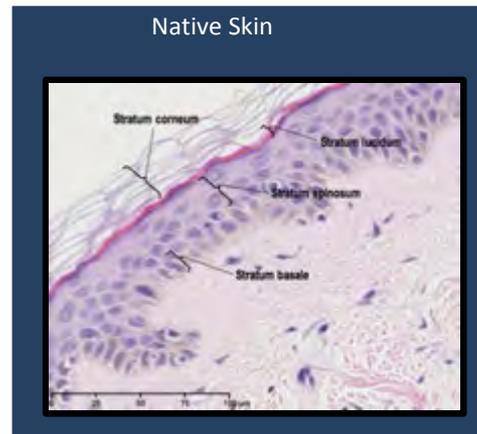
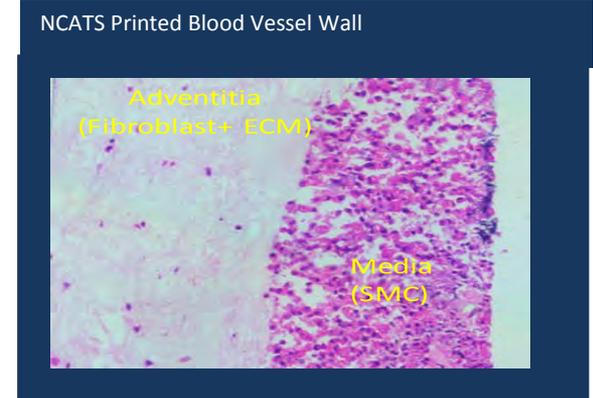
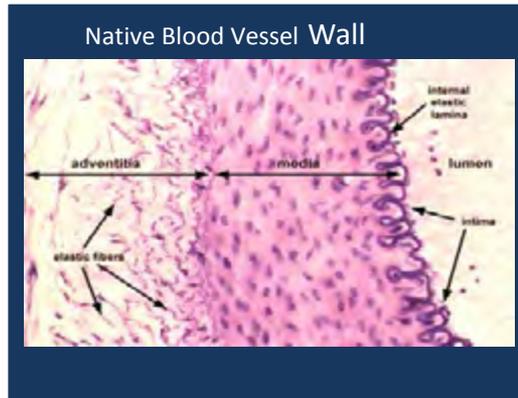


(Green: E-cadherin, Blue: nuclei)

Retina
(Kapil Bharti, National Eye Institute)

Blood vessel wall
(Kan Cao, U of Maryland)

Skin (Angela Christiano, Columbia University)



Summary and Next Steps

- Summary of ongoing research/activities.
 - Bioprinting laboratory space identified.
 - Major equipment acquired and installed.
 - Bioprinting team being built.
 - Ongoing research collaboration with Organovo, Inc.
 - Tissue models of the skin, retina, and blood vessel wall being developed.
- Planned activities during FY17.
 - Continued optimization of skin, retina, and blood vessel wall models.
 - Continued evaluation of bioprinters and associated technologies.
 - Issuance of RFA for access to the bioprinting lab by external collaborators.