Online Proceedings

Poster Session 2

MGH 241, Easel 153

1:00 PM to 2:30 PM

Control of Peri-gastrulation Cell Fate Decisions Using *In Vitro* Morphogen Gradients

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Mary Gates Scholar, UW Honors Program
Mentor: Aisha Cora, Bioengineering
Mentor: Mary Regier

Regenerative medicine that utilizes pluripotent stem cells (PSCs) has the potential to transform the treatment of the many debilitating conditions that face modern society. Although research regarding the control and use of PSCs is prevalent, there has been little translation of this research to the clinic. Critically, there remain significant knowledge gaps regarding peri-gastrulation cell fate decisions — the decisions at an early phase in development during which pluripotent stem cells first begin to differentiate toward specific cell fates. Currently, the widely used systems for understanding cell fate decisions rely on differentiating populations of PSCs toward a single target cell lineage in a well plate via uniformly applied morphogen signals. Such uniform stimulation lacks the ability to reproduce the same spatial cell fate decisions as is observed during embryogenesis. We have developed a technology that establishes *in vitro* morphogen gradients to better recapitulate peri-gastrulation cell fate decisions. This research focuses on precision cell colony patterning using CNC milled and stereolithography 3D printed constructs to better characterize the effect of *in vitro* morphogen gradients on single populations of PSCs. This was done by patterning PSC colonies and subsequently forming morphogen gradients of Activin A and BMP-4/CHIR99021 to establish subpopulations of ectodermal, mesodermal, and endodermal lineages. The growth factors Activin A and BMP-4 and CHIR99021 (a small molecule agonist of Wnt signaling) are biochemical factors that influence signaling pathways which control early cell fate decisions. The cells were then fixed and stained for markers of ectoderm (CDX-2), mesoderm (Brachyury), and endoderm (Sox2) to quantify the induced subpopulations. The ability to control cell fate decisions of PSCs is an integral step in developing functional and effective regenerative medicine technologies. Ultimately, this technology has the potential to develop more effective induced differentiation techniques for creating therapeutic, mature cell populations.

Session 2C

Tissue Engineering, Biomaterials, and Regeneration

Session Moderator: Ying Zheng, Bioengineering

MGH 231

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Dynamic Extracellular Matrix Remodeling in a Humanized Mouse Model of Human Liver Regeneration

Jonathan Isaiah (Jon) Mene, Senior, Bioengineering
Mary Gates Scholar
Mentor: Aisha Cora, Bioengineering

The human liver is a unique organ with the ability to regenerate quickly in response to acute injury. During this regeneration process, hepatocytes, i.e. the main cell type of the liver, receive growth factors and other cues and begin to remodel the extracellular matrix (ECM) of the tissue. Liver regeneration has been well characterized in mouse and rat models; however, human liver regeneration remains largely unstudied. In particular, the ECM remodeling process in human liver regeneration is unknown. Here, we use a humanized mouse liver injury model to study changes in the ECM over time during human liver regeneration. To study this, we implanted engineered human liver tissue ”seeds” into the fat pad of FNRG-mice. These mice experience liver damage, and liver regeneration cues flood the bloodstream in response. The seeds become exposed to these cues and expand over time, mimicking human liver regeneration inside a mouse host. To study the ECM over time, we sacrificed the animals every other week and then performed special histology stains to characterize ECM components such as collagen I, IV, and fibronectin. We also immunostained for CK18/CK19, markers for hepatocytes and cholangiocytes respectively. Information on the ECM remodeling process is key to understanding human liver regeneration as a whole. Understanding this process could lead to better informed decisions regarding matrix composition in artificial human liver constructs for regenerative medicine.