PROGRAMME DE STAGES D'ÉTÉ
Initiation à la recherche biomédicale
au Centre de recherche du CHU Sainte-Justine
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3D Bioprinting of Cardiac Tissues

Numéro de l'offre de stage : No. 25

Équipe de recherche

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Coordonnées

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Responsable de la supervision du stagiaire

Houman Savoji, PhD
Principal Investigator at CHU Sainte Justine Research Center

Programmes d'études ciblés

Biomedical Engineering, Tissue Engineering, Biomaterials

Description du projet

Chronic cardiovascular diseases such as heart failure is increasing to epidemic levels, affecting 1 in 5 Canadians. The left ventricle has no significant ability to regenerate and the viable tissue remaining after myocardial infarction is often insufficient to maintain adequate cardiac output. Heart transplant is very often not an available or appropriate option. Thus, there is a pressing need for alternative intervention. The long-term goal of this research program is to develop and utilize advanced biofabrication techniques integrated with insights from developmental biology to build engineered 3D *in vitro* models for predictive drug discovery and to create functional tissue-engineered implants for regeneration. Adult cardiomyocytes have a limited ability to proliferate, thus stem cells must be used as their source. The ability to generate cardiovascular lineages from human induced pluripotent stem cells and recent advances in 3D bioprinting, provide an unprecedented opportunity to establish human *in vitro* models of cardiovascular diseases (i.e. heart-on-a-chip models) as well as to develop autologous replacement left ventricle. 3D bioprinting allows precise layer-by-layer positioning of biomaterials (i.e. bioinks) and living cells, with spatial control of the placement of functional components to fabricate 3D functional living cardiac tissues with structural, biological, and mechanical properties that are very similar to those of native tissues. The goals of this research program are to: 1) fabricate and characterize 3D vascularized left ventricle using 3D bioprinting technology; and 2) fabricate and characterize 3D bioprinted heart-on-a-chip platforms. Therefore, we will develop and characterize a 3D bioprinted: 1) sheet-like vascularized artificial left ventricle to accelerate regeneration; 2) ring-like structure as a 3D *in vitro* model for drug discovery and screening applications. The 3D bioprinted artificial vascularized left ventricle (sheet-like structures) will eventually be capable of synchronous contraction in response to electrical stimulation. In a more immediate term, the 3D bioprinted ring-like structures will provide high fidelity models for drug discovery and testing. This model has the potential to test cardiac toxicity with more precision and efficiency, due to the faithfully mimicking the hallmarks of human physiology. Given that cardiac toxicity is a major hurdle to bring novel drugs to market, our *in vitro* model can transform the drug development process. Furthermore, our *in vitro* model is compatible with precision medicine to test drugs in a more personalized environment and shed light to the underlying molecular mechanisms. Overall, it is foreseen that the outcome of this research program will constitute important steps towards providing human functional tissues for regeneration and *in vitro* modelling.

Rôle du stagiaire

The summer trainee will work on an interdisciplinary project involving 3D bioprinting using stem-cell derived human cardiac cells to fabricate functional cardiac tissues. Successful candidate is expected to participate in performing experiments, writing reports, preparing presentations, and publications, etc.

Mots clés

3D Bioprinting, Bioinks, Tissue Engineering, Biomaterials, Cardiovascular Disease, *in vitro* Characterization, Mechanical Characterization, Stem Cells