



MASTER'S DEGREE IN BIOMEDICAL RESEARCH

Research Project Proposal

Academic year 2024-2025

Project Nº 23

Title: Biofabrication of human cardiac valves with hiPSC-derived cells and 3D printing

Department/ Laboratory Lab. 101, Program of Biomedical Engineering, Enabling Technologies Division, Cima

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Summary Short summary of the project with a **maximum extension of 250 words**, including the goals and the methodology that will be used

Diseases affecting cardiac valves impact millions of patients worldwide. Current treatment rely on the use of mechanical and decellularized surrogates, whose lifetime is limited, thus requiring patients to undergo regular surgical procedure. Given the advanced age of some individuals, replacement of a defective transplant might not be possible. Including a living (cellular) component, is expected to improve this. In this project, we will obtain the main valve phenotypes, interstitial and endothelial cells (VICs and VECs respectively) through a directed differentiation method. In order to provide an adequate 3D structure to these cells, we will 3D print fibrillary scaffolds, using melt electrowriting (MEW). MEW is an additive manufacturing technology able to deliver high precision with very thin fibres. hiPSC-derived VICs and VECs, after characterisation, will be embedded in a suitable hydrogel, providing a hydrated and 3D environment, and casted over the MEW scaffolds. Constructs will be maintained for 2 weeks, during which cellular survival (Live/dead staining), metabolism (Alamar blue), structure (immunofluorescence) and gene expression (RT-qPCR), will be used to fully characterise the constructs, in comparison with cells plated on conventional 2D substrates. Finally, capacity to undergo mineralisation in response to hyperphosphatemia, will be assayed. All in all, the project will seek to generate the relevant human valvular phenotypes from hiPSCs, and use them as the building blocks for the generation of an engineered valvular tissue.

yes	
no	X

Does the project include the possibility of supervised animal manipulation to complete the training for animal manipulator?