FMRI RET 2015-Cell Printing with Smart Hydrogel

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Introduction

Cardiovascular diseases (CVD) have many causes including diet, family history, and lifestyle. CVD have damaging effects on the tissue surrounding the heart. Through cell sheet-based tissue engineering, 3D tissue transplantation can help repair a damaged heart. Here, we attempted to print cells onto a treated slide using a PDMS stamp. Microscopy imaging were used to determine if the cells were confluent in the PDMS channels after printing. Successful printing would allow multiple layers of cells to be fabricated.

Background

- Cardiovascular Diseases cause deaths in 49% of people over 60 years of age. Heart disease equates to 20% of CVD and heart attacks equate to 48% [1].
- Treatments are limited to assistive devices and heart transplants. The healthcare costs range from $273 billion to $818 billion dollars.

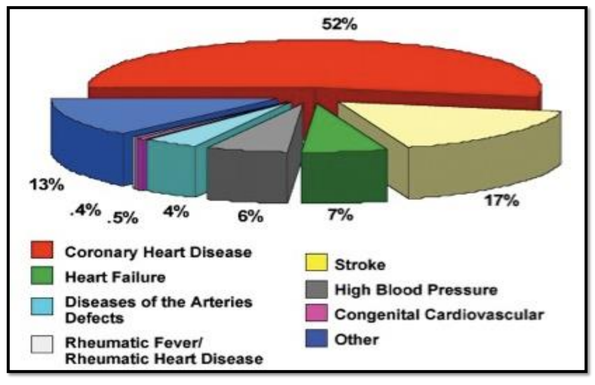


Figure 1: Distribution of Cardiovascular Diseases [1].

Objectives

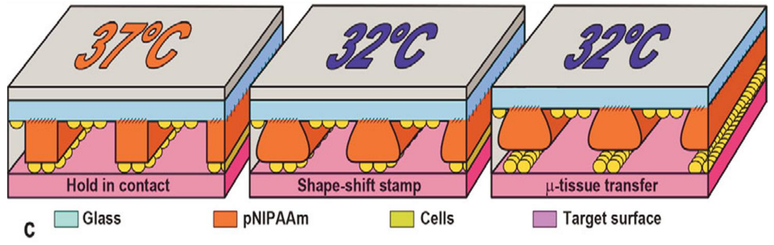
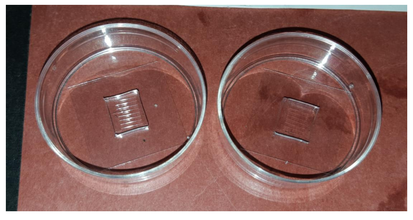


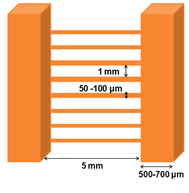
Figure 2: Schematic diagram of micro-contact printing process.

- To demonstrate the feasibility of fabricating and harvesting tissue modules via a strain mediated process [2].
- Print cultured NIH 3T3 fibroblast cells as μ-tissue building blocks with well-defined shape, size, and orientation.

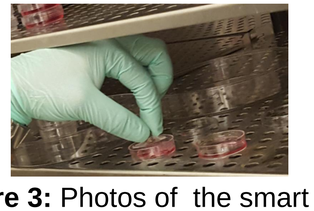
Approach



100 μm width channels of PDMS master mold on treated glass surfaces for fabrication of attached hydrogel stamp.



PDMS mold is then removed from the glass surface leaving behind fabricated smart hydrogel stamp for seeding of cells.



Stamping process to transfer and fabricate first layer of cells onto targeted surface.

Figure 3: Photos of the smart hydrogel and incubation printing process.

Result

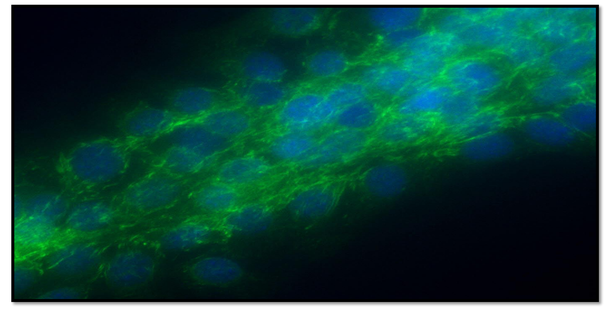


Figure 4: Fluorescence image of printed cells. The blue staining is the nucleus of the cells while the green staining is an alpha 5 integrin localization representing formation of focal adhesion sites.

Conclusions

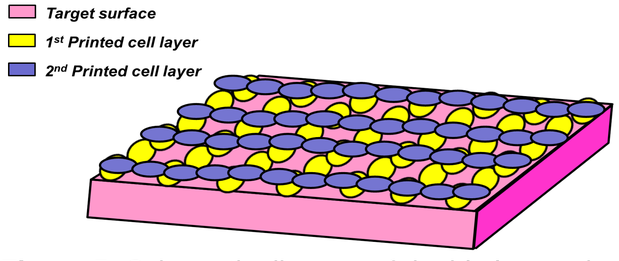


Figure 5: Schematic diagram of double layer micro -tissue transfer from smart hydrogel surfaces.

The future work is to adapt this printing process to other cell types such as cardiomyocytes.

References

1). Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Blaha MJ, et al. Heart disease and stroke statistics--2014 update: a report from the American Heart Association. Circulation 2014;129: e28-e292.

2). Akintewe, O., DuPont, S., Elineni, K., Cross, C., Toomey, R., Gallant, N. Shape-changing Hydrogel Surfaces Trigger Rapid Release of Patterned Tissue Modules. *Acta Biomaterialia 2015;* 11:96-103

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