Biomedical Engineering in Cardiovascular Disease: Heart Attack In Vitro

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Biomedical Engineering Undergraduate School / Major: Jackson State University / Biology

Background/Relevance

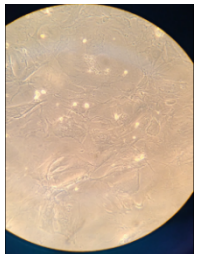
- In vitro studies are performed with microorganisms, cells, or biological molecules outside of their normal context.
- A myocardial infarction (heart attack) occurs when the blood flow to the heart is blocked. This causes the heart to become ischemic (oxygen and nutrient deprived).
- The ultimate goal of most biological research is to gain greater insight into mechanisms of human diseases, or to develop new and improved therapies and/or diagnostics.

Innovation

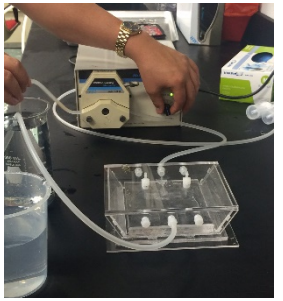
- Create a perfused cardiac cell culture to induce ischemia of cardiomyocytes, and investigate the effects.

Approach

- Primary cardiac cells (Cardiomyocytes) culturing.
- Cell lines (L6 Cells) culturing.
- Create a perfused cardiac cell culture, using a 3D printer, to induce ischemia of cardiomyocytes.



Cardiomyocytes after 3 weeks



Perfused Bioreactor created for experiment

Key Results

- L6 cells were successfully cultured, passaged, and preserved and, thus, equipment and facilities were deemed appropriate for project.
- Cardiomyocytes were successfully harvested from 2-day old rat pups.
- Harvested cardiomyocytes began to beat in culture flask after one month.
- Bioreactor prototype was perfused successfully.

Day	Cardiomyocytes Beat Per Minute		
	Flask 1	Flask 2	Flask 3
1	59 BPM	17 BMP	39 BPM
2	37 BPM	48 BPM	12 BPM
3	50 BPM	32 BPM	9 BPM

Table of cell cultured cardiomyocytes beats per minute

Conclusions

- Cardiomyocytes were successfully harvested, remained viable for an extended period of time, and electric activity occurred (beating).
- Bioreactor prototype is complete and ready for testing in ischemic environment.

Future Work

- Use perfused cell culture to induce ischemia of cardiomyocytes.

Acknowledgements to Dr. Hanna Jensen, Dr. Morten Jensen, Dr. Michelle Kim, Anna Brickell, Genna Nunley, and Jeffrey Curran Henson and Vinicius Sardinha for their support and assistance.

Research Funded by National Science Foundation REU Grant # EEC-1359306 Summer 2016