CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

S1704

Project Title

Synthesis of Biodegradable, Monodisperse PEG Microspheres for Controlled Protein Release

Abstract

Objectives/Goals

Polymeric microspheres are small spherical particles that have the potential to be used for coordinated release of therapeutic factors for regenerative medicine. Droplet microfluidics is one method that can be used to fabricate polymeric microspheres as it allows control over size and composition to rapidly synthesize monodisperse microspheres. We hypothesized that by changing the characteristics of microspheres, the microspheres would have different release profiles.

Methods/Materials

To achieve different release characteristics, we regulated the sizes by varying channel size (50µm, 100µm, 150µm, and 200µm) and the polyethylene glycol (PEG) concentration (7.5%, 10%, and 12.5%) of the spheres. Model protein fluorescein isothiocyanate labeled bovine serum albumin (FITC-BSA) and fibroblast growth factor (FGF), an important angiogenic growth factor, were encapsulated in the microspheres. Release from spheres was collected and quantified over a period of 14 days. The bioactivity of FGF was examined through a cell viability assay on adipose-derived stem cells (ADSCs).

Results

No significant trend based on microsphere size was found, but different PEG concentration resulted in distinct release profiles: 7.5% PEG microspheres resulted in maximal protein release and 12.5% in minimal protein release when compared to controls. However, fluorescence microscopy of FITC-BSA-loaded microspheres suggested that the majority of protein remains enclosed. Additionally, 7.5% PEG microspheres encapsulated with FGF led to increased ADSC proliferation on all days, indicating that FGF remains bioactive after release.

Conclusions/Discussion

Further examination of the properties of monodisperse PEG microspheres will allow us to fine tune the fabrication of the spheres to achieve both a controlled-release and high-release system for therapeutic angiogenesis.

Summary Statement

We hypothesized that by independently manipulating the size and PEG composition of microspheres, release from the microspheres can be altered.

Help Received

My mentor, a graduate student at Stanford Medical School, supervisde me throughout my project. He helped me learn the appropriate skills for this project, such as sterile technique and fluorescent imaging, until I was able to perform the experiments and maintain the cells I used in my project on my own. I