



SIR Foundation Summer Medical Student Internship Program

Proposal:

Institution Name: University of California San Francisco

Responsible mentoring physician: Miles B. Conrad, MD, MPH

Length of proposed curriculum: 8 weeks, 40 hours/week.

A. Please provide a brief description of how each of the following curriculum elements will be demonstrated/taught through your program.

1. Concept development – a distillation of a clinical question into elemental components

Hydrodissection is a commonly performed adjunct to percutaneous thermal ablation. Despite this, there is no FDA approved or widely available hydrodissectant available for percutaneous ablation. This project will further develop, refine, and test an alginate-based hydrogel that is injectable, self assembles, insinuates along tissue planes, displaces tissue, absorbs at a predetermined time point, is ultrasound compatible, and acts as a thermal shield from cold and heat. Our gel will be tested in the bench top and in small and large animals this summer. In addition, we will be tasked with creating an easy-to-use applicator (high pressure injector) for the gel.

2. Experimental design and statistics, including proof of concept, steps in validation of new technique: There will be 3 specific aims:

Aim 1: Optimization of the physical properties of the hydrogel and assessment of biocompatibility.

Aim 2: Assessment and optimization of the thermal insulating properties of the hydrogel

Aim 3: Assessment of the ultrasound imaging characteristics of the hydrogel with octafluoropropane microbubbles.

3. Techniques in the basic science lab

In Aim 1 the SIR intern will be an assistant to Dr. Shin on the optimization of the physical properties of the hydrogel and assessment of biocompatibility (e.g., viscosity, injectability and stability) in physiological conditions and preclinical studies for efficient and safe tissue displacement during hydrodissection. We will then assess in vivo mechanical behavior of the hydrogel such as migration and degradation, and biocompatibility using a rat model. After the small animal studies, we will verify the feasibility and efficacy of the hydrogel in conventional CT-guided cryoablation procedure with a swine model.

In Aim 2, the intern will work with the post doc to refine and validate heat transfer properties, thermal conductivity, and heat sink effect of the hydrogel.



In Aim 3, the SIR summer intern will work to optimize the imaging characteristics of the gel and expected tradeoffs between thermal shielding and reduced visibility.

4. Data on thermal shielding, heat sink effect, and image degradation will be analyzed using one-way ANOVA statistical analysis with Tukey's multiple comparison tests and logistic regression.

5. As the proposed research project will potentially be funded by SIR, we will submit anticipated publications to JVIR. I anticipate the intern will be able to participate in at least 2 publications. One will be as a contributor to the ongoing experiments at UCSF and UCB. A second will likely lead to a first author publication on the tradeoff of the thermal properties of the gel and change in density and size of the octafluoropropane microbubbles.

6. I do not anticipate much challenge from our institutional animal research committee either at UCSF or UC Berkeley. The experiments will be carefully executed only after institutional approval with the expectation of oversight of any animal experiments."

Mandatory Elements:

The instructional setting will be at the UC Berkeley Material Science Lab under the direction of Phil Messersmith and the UCSF IR Lab under the direction of Drs. Conrad and Wilson. There will be regular IR lectures, journal club, QA, and case conferences in the UCSF IR fellowship. The intern is encouraged to attend these important didactic conferences. For the proposed project, the intern will contribute by reading about hydrogel material science and using PubMed and other databases to search for publications related to imaging degradation due to gases which cause impedance and the ring down effect. By the end of the summer, we expect to start to compose a manuscript on the tradeoff between image degradation and thermal shielding.

B. Please provide a brief outline of available research topics, one of which the student will select for completion as part of the program.

Research topics:

Causes of peritoneal adhesions

Testing for early signs of adhesions by sampling the peritoneum for fibroblasts and inflammation

Perfluorocarbon microbubbles: degradation and imaging characteristics

Perfluorocarbon micro bubbles as an additive to a hydrogel: Modulating thermal transfer properties

Effect on hydrogel per fluorocarbon micro bubbles and modulating heat sink effect

The tradeoff between image degradation with micro bubbles and heat shielding"