TITLE: Magnetic cryoprotecting agents for heart bio-banking

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RESEARCH PROJECT DESCRIPTION (brief overview of background, hypothesis, methods, role of medical student, funding and relevant publications -- SHOULD NOT EXCEED ~ 250 WORDS)

Despite advances in surgery and organ preservation technologies, over 2/3 of hearts from multi-organ donors are not used. One critical reason is that time from the donor site to recipient hospital exceeds preservation limits of 3-6 hours. Technologies that enable biobanking of whole hearts could revolutionize heart transplantation by "stopping the clock" on organ degradation while in-depth donor-to-recipient matching takes place and by allowing treatment planning in a way that reduces patient time in intensive care units. My lab is developing novel cryoprotecting agent formulations that enable rapid, uniform rewarming of cryopreserved organs by magnetic rewarming. Biocompatible magnetic nanoparticles used in these formulations distribute throughout the organ's vasculature and uniformly release heat under the action of an externally controlled alternating magnetic field. The role of the medical student in this project will be to assist in surgeries and analyze heart tissues for evidence of nanoparticle perfusion and removal, and damage after cryopreservation. Funding for this project is pending.

TITLE: Spatially focused heat and drug delivery using nanotechnology

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Systemic chemotherapy typically has poor therapeutic ratio and toxic side effects, motivating research into nanoparticles to deliver drugs passively or in response to local stimuli. Despite successes, these approaches still suffer off-target accumulation and toxicity. The use of external stimuli to spatially and temporally control delivery would revolutionize chemotherapy. Achieving therapeutically relevant drug release in tumors while maintaining non-targeted organs below toxicity levels would result in more effective treatments. My lab is developing nanoparticles to enable externally-triggered, spatially-focused drug delivery and heat treatment, through the application of alternating magnetic fields that cause heat dissipation by magnetic nanoparticles. The role of the medical student in this project will be to assist in nanoparticle formulation and characterization, and in vitro and in vivo testing. We aim to demonstrate the potential for spatially-focused combination treatment and evaluate synergy between heat and drug therapy using anti-cancer agents relevant for breast cancer. This project is supported in part by the National Science Foundation and the UF Health Cancer Center.