Early Detection of Atherosclerosis in Coronary Artery Disease using Magnetite Nanoparticles

Overview
Coronary Artery Disease (CAD) is one of the most common causes of death for both men and women in the U.S. Unfortunately, physicians currently lack an effective yet affordable method for detecting the atherosclerotic lesions that are typical in the early stages of CAD. Targeted nanoparticles have been proven to bind to specific regions of interest, such as tumours in cancer patients, thus they potentially could be used to target and highlight atherosclerotic lesions as well. Nanoparticles can be used for multimodal imaging, including IR fluorescence and Photoacoustics, which are much more affordable than the traditional CT or MR imaging.

Objectives
• Identify viable targets for nanoparticles to bind to for each stage of CAD
• Design a bioconjugation scheme for the binding of each target to the nanoparticle
• Develop proof of concept by demonstrating nanoparticle fluorescence in blood

Approach
• Met with project sponsors to discuss customer needs and scope of project
• Researched Coronary Artery Disease to understand disease causes and progression
• Performed a literature review on targeted nanoparticles and how they have been used for targeting atherosclerosis
• Designed a three-pronged approach to detect atherosclerosis by selecting targets for early, middle, and late stages of CAD
• Designed a bioconjugation scheme for each target-nanoparticle pair based on chemistry of the target
• Designed IR-imaging experiment to demonstrate that ICG tagged nanoparticles fluoresce in blood
• Performed IR-imaging experiment with porcine and bovine blood; effectively proved that ICG nanoparticles have significant fluorescence in blood
• Met with graduate student in Dr. Adair's lab to discuss future work on the project after the conclusion of Senior Design

Outcomes
Finally, list the outcomes for this project making sure to clearly convey their implications for the sponsoring company:
• Three unique targets for atherosclerosis in CAD have been identified
• Our experiment demonstrated proof of concept, thus Dr. Adair and his team can feel confident moving forward on this research
• We have laid the groundwork and theory behind using nanoparticles to detect CAD, the next step will be in vivo testing