IOWA STATE UNIVERSITY
Department of Mechanical Engineering

Restoring Flow and Fixing Wires: Mechanics in Medicine

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Abstract

Cardiovascular diseases affect almost half of all Americans. Observations and applications in solid mechanics, heat transfer, and fluid mechanics can be used to better understand disease etiology and design better treatments, as cardiovascular pathologies regularly manifest in tissue biomechanics. Presented will be two takes on using mechanics in medicine: 1. A pilot study into understanding the mass transport and mechanical properties of coronary arteries as applied to drug-eluting stent therapies, and 2. Clinical applications in the design and use of devices to treat cardiac arrhythmias.

Coronary artery disease is a deadly and costly disease. This year alone 720,000 Americans will have a new coronary event requiring hospitalization. Restoring flow in these patients is critical and one method of doing this is the permanent implantation of a stent. Unfortunately, a response of the body to a stent is the remodeling of the vascular wall and potential restenosis of the treated area. The elution of antiproliferative compounds from the surface of the stent can suppress vascular remodeling. Presented here will be a study into the interactions of the solid mechanical properties, tissue microstructure, and mass transport properties to better understand the interactions of drug-eluting stent therapies with the arterial wall. These pilot studies were performed on porcine coronary arteries investigating how mass transport occurs via the use of a hydrophobic drug surrogate based on arterial location.

The American Heart Association estimates that more than four million Americans have recurrent arrhythmias. Patients presenting with arrhythmias have extreme fatigue, dizziness, and increased incidence of stroke. One method to treat arrhythmias is to identify areas with improper electrical signals and apply radiofrequency energy to selectively heat and ablate these bad electrical pathways. To ensure proper energy delivery in ablation there is a direct correlation between the mechanical response of the myocardium and energy coupling. Presented will be how biomechanics has improved intervention in cardiovascular electrophysiology by: 1. Providing physicians with real-time feedback of therapeutic parameters that have changed the outcomes of therapies, and 2. Providing physicians with the ability to target multiple areas of tissue simultaneously.

Biography

Joe Keyes finished his BS in Mechanical Engineering and his PhD in Biomedical Engineering at the University of Arizona. Between his undergraduate and graduate education he was an opto-mechanical engineer with the WIYN Observatory designing telescope instrumentation. He is currently a Principal R&D Engineer in Advanced Research & Development in Johnson & Johnson Medical Devices focusing primarily on inventing new cardiovascular devices. His research focuses on the intersections of biomechanics, emerging materials, and multiplatform medical devices. He currently has nine first-authored manuscripts and five issued patents.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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