

Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

MGH 241, Easel 162

11:00 AM to 1:00 PM

Perioperative Activity in Thoracic Surgery: Does Adherence to Daily Activity Monitor Use Predict Actual Activity?

Emilee Anne (Emilee) Kauer, Senior, Biology (Molecular, Cellular & Developmental)

Mentor: Stephen Kaplan

Mentor: Richard Thirlby

Mentor: Michal Hubka

Recovery after thoracic surgery can be prolonged and fraught with complications if patients are not active after surgery. Postoperative recovery can strongly be influenced by preoperative baseline activity level and overall fitness. Surgeons have historically relied upon patient report to understand these variables; however, given the ubiquitous nature of activity monitors in today's society, a new opportunity is presented to objectively evaluate perioperative activity. As part of the Perioperative Activity and Outcomes study at Virginia Mason Medical Center, thoracic surgery patients begin wearing a Fitbit prior to surgery and return the device approximately three to five weeks after surgery. However, there are several patient factors that influence the data, such as simply forgetting to wear the device. The objective of this study is to understand whether or not days missed wearing a Fitbit is associated with objective measures of activity. I hypothesize there is a negative correlation between the number of days a patient does not wear their Fitbit and their average daily steps. I will stratify the analysis by preoperative and outpatient postoperative periods, both of which are times where it is incumbent upon the patient to wear the device. In essence, poor compliance with wearing the device may be a surrogate for low activity. The conclusions I draw from this research will contribute to a risk stratification model for improving patient outcomes. By identifying patients at-risk for slow recovery, tailored interventions can be employed to optimize recovery, prevent complications, and improve overall patient outcomes, satisfaction, and quality of life following thoracic surgery.

SESSION 1B

TECHNIQUES FOR IMPROVING QUALITY OF MEDICAL CARE

Session Moderator: Eric Seibel, Mechanical Engineering
MGH 228

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

The Role of Socio-Geographic Factors in Recovery after Thoracic Surgery among Rural and Urban Populations

Aneesha J. (Aneesha) Morris, Junior, Biochemistry

Mentor: Stephen Kaplan

Mentor: Richard Thirlby

Mentor: Michal Hubka

Social determinants of health are non-biologic factors that can strongly influence individual health status, healthcare access, and disease vulnerability. While this subject is well studied, limited data exists on the influence of these social factors on surgery, and more specifically, recovery after surgery. The burden of surgical disease remains taxing globally and disproportionately affects marginalized populations. Due to the limited access to higher level surgical care, patients often travel from eastern Washington and various other rural areas to Virginia Mason Medical Center for cardiothoracic procedures. Through this study I aim to identify social-geographic factors that contribute to this burden, and determine the discrepancies that generate variances in recovery. I hypothesize that among patients undergoing thoracic surgery at Virginia Mason Medical Center, distance from Seattle will be associated with measures of recovery in the postoperative period. I quantify the postoperative recovery of patients by measuring length of stay, postoperative complications, and readmission. Due to the burden of transport, inconvenience, missed work, increased personal costs, and other socioeconomic issues, I expected to see slower recovery, and possibly greater complications among patients coming from further distances. By first characterizing the problem, I then identify unique challenges that arise among various demographics of patients, creating a tailored perioperative education. This optimizes clarity in communication of postoperative planning and potential complications to create an improved set of guidelines, specified towards particular demographics of patients.

SESSION 1S

NEW DIAGNOSTIC TOOLS FOR SEEING AND SENSING DISEASE

*Session Moderator: Benjamin Freedman,
Medicine/Nephrology*

JHN 175

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Detecting Diffuse Liver Disease through Tissue Harmonic Ultrasound Imaging

*Joanna Gloria (Joanna) Sun, Senior, Bioengineering
UW Honors Program*

Mentor: Michalakis Averkiou, Bioengineering

Parenchymal disease of the liver, known as diffuse liver disease, led to 1.4% of the total deaths in the United States in 2013. It causes impaired liver functioning and may lead to portal hypertension, encephalopathy, or hepatocellular carcinoma. Current methods of diagnosing diffuse liver disease are often invasive, subject to heterogeneous variation, and fail to distinguish between intermediate disease stages. Ultrasound imaging has long been used to monitor changes in tissue structure, and it is known that sound attenuation changes with disease progression. Tissue is acoustically nonlinear, meaning that propagating sound waves are distorted due to tissue properties and generate higher order harmonics. Since fatty deposits and fibrosis change with disease progression, we hypothesize that associated attenuation changes may be detected by changes in the nonlinear signal distortion and can be quantified as a marker of disease. We have designed a methodology based in Tissue Harmonic Imaging to use a quantified marker of attenuation to specifically detect diffuse liver disease. This project comprises of (1) a theoretical and experimental investigation of the influence of sound attenuation on harmonic content in tissue, (2) clinical patient data collection and development of MATLAB analysis tools utilizing the disease marker developed in Phase I, and (3) development of new imaging sequences capable of grading diffuse liver disease when coupled with the analysis tools. The non-invasive, easy to use, sensitive, and clinically usable methodology developed in this project has the potential for aiding in diagnosis of diffuse liver disease and enhancing quality of patient care.

In Vitro Characterization of Liver Cancer Cell Viability under Ultrasound and Microbubbles.

Richard Mao Zong, Senior, Bioengineering

Mary Gates Scholar

Mentor: Michalakis Averkiou, Bioengineering

Hepatocellular Carcinoma is the most common form of liver cancer accounting for a quarter of a million deaths annually across the globe. Microbubbles have been shown to be an effective vector for both gene and drug delivery. In combination with ultrasound, the microbubbles can be locally burst to deliver a drug payload via sonoporation – the temporary disturbance of the cell membrane. Ultrasound and microbubbles drug delivery is a strong candidate for the treatment of HCC because the liver that is easily accessible with ultrasound and the organ itself is highly perfused allowing for easy microbubble access. In microbubble gene and drug delivery, ultrasound parameters that induce cell death when used in combination with microbubbles are not well defined. While the literature agrees on general trends that greater exposure times and greater pressure lead to higher cell death, the specific combination of parameters that cause cell death are still disputed. We will design an enclosure such that cells can be cultured and exposed to ultrasound with microbubbles. We hypothesize that at greater exposure times, higher duty cycle, and greater pressures the cell viability will decrease. We hypothesize when multiple parameters are increased in combination, there will be a compounded decrease on cell viability. The rationale behind these hypotheses is that with greater power and force, greater stress and strain will be placed on the cell causing lowered cell viability. The goal of the project is to conclude specific values at which cell viability is compromised. From the study, it was found that while stronger acoustic parameters caused higher cell death, the variable that made the most difference was bubble concentration.

POSTER SESSION 4

Balcony, Easel 99

4:00 PM to 6:00 PM