THE UNIVERSITY OF BRITISH COLUMBIA

School of Biomedical Engineering

Faculties of Applied Science and Medicine

SBME RESEARCH DAY

OCTOBER 31, 2024

Trainee Talks

TRAINEE TALK #1

Rosalyn Carr

PhD, SBME
Supervisor: Dr. Matthias Görges

Trainee Talk Details:

Location: LSC 1002
Time: 10:10am

Returning Research Results: Exploring Misconceptions, Challenges, and Self-Censorship in Canadian Research Practices

Background: Return of results (RoR) to study participants is a crucial practice in research that involves sharing study outcomes directly with those who provided data. The Canadian research ethics framework strongly encourages this practice, but implementation is lacking. One possible reason for this is misconceptions among the research community, which lead to self-censoring when designing and conducting studies.
Objective: This study aimed to explore the familiarity and prevalence of RoR among researchers and document challenges and misconceptions.
Methods: Thirty researchers, including medical and graduate students, clinicians, research staff, and investigators, participated in focus groups. Participants specialized in fields such as public health, genetics, anesthesia, engineering, and psychology. Transcripts were analyzed using NVivo.
Results: Motivations for RoR were altruism, research environment norms, and participant requests. However, self-censoring was common among researchers from all backgrounds and occurred at various stages of the research process, including conceptualization/ethical approval and after study completion. Reasons included misinterpretation of materials and guidelines, lack of resources, available tools, knowledge of conducting RoR, and concerns about negatively impacting participants.
Conclusion: Developing a standardized tool to facilitate RoR is warranted to address challenges related to RoR.

TRAINEE TALK #2

Katie Chen

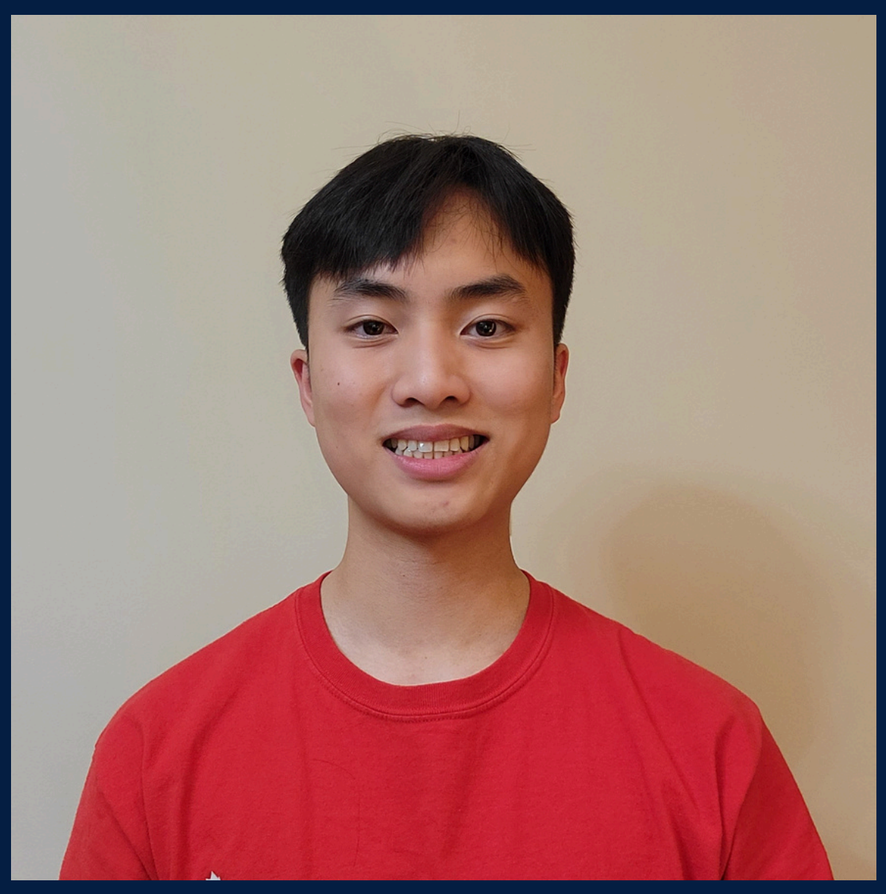
Scientist Immersion in Medicine
Director: Dr. Zachary Laksman

Trainee Talk Details:

Location: LSC 1002
Time: 10:20am

Development and Evaluation of a Synthetic Model for the Simulation and Assessment of Sternum Closure

Median sternotomy is the most common surgical approach to the heart and great vessels. While complications are infrequent, they tend to have high mortality, morbidity and associated costs. Many sternal closure devices have been developed to reduce sternal instability but stainless steel wires remain the most commonly used for sternal approximation due to their proven efficacy, speed, ease of use and low costs. In order to minimize risks of postoperative sternal instability, wire cerclages should be tight enough to prevent movement of sternal halves, but not so tight as to cut through bone or induce fractures in the event of sudden loading. However, gauging appropriate wire tension largely relies on tactile feedback and is therefore challenging to learn through observation and qualitative instruction. Poor performance can result in devastating consequences for the patient, yet alternative means of practice often do not yield comparable skills development due to the differences in tactile feedback. Hence, we propose developing a simulated model that imitates the feel of the sternum and can simultaneously record quantitative pressure profiles throughout the closure process. Pressure sensors will line the inside of sternal halves and pressure maps will be displayed in real time. A pilot study will be conducted to assess closure techniques and the efficacy of this tool in resident training. If proven effective, this tool will enable faster, lower-risk learning and quantitative study of any sternum closure device or technique. Future work might involve cough stimulations, correlation studies of closure technique and adverse outcomes, etc.



TRAINEE TALK #3

Ryan Yeung

Master's, SBME
Supervisor: Dr. Tim Salcudean

Trainee Talk Details:

Location: LSC 1002
Time: 10:30am

Remote Abdominal Tele-Ultrasound Using Mixed Reality – A Clinical Study

Ultrasound is a hand-held, low-cost, non-invasive medical imaging modality which plays a vital role in diagnosing various diseases. Despite this, many rural and remote communities do not have access to ultrasound scans due to the lack of local experts (sonographers) trained to perform them. To address this challenge, we built a mixed reality and haptics-based tele-ultrasound system to enable a sonographer to precisely and remotely guide a novice in carrying out an ultrasound exam. We tested the system in Skidegate on the islands of Haida Gwaii, BC with the sonographers positioned 754 km away at UBC. We performed 11 scans with 10 novices and 2 sonographers. The sonographers were tasked with acquiring 5 target images in the epigastric region. The novices came from various backgrounds and ages, and were inexperienced in mixed reality and not required to have prior ultrasound experience. The novices completed a questionnaire afterwards to assess usability and workload. These results showed all of the novices (n = 10) found the system easy to use and required low mental and physical workload. The acquired images were evaluated by two radiologists not present for the tests. 91.7% of the acquired images were considered usable for interpretation by both radiologists. Overall, we show that human teleoperation is feasible and can achieve high performance for completing remote ultrasound procedures, even at a large distance and with completely novice followers.

TRAINEE TALK #4

Nico Werschler

PhD, SBME
Supervisor: Dr. Josef Penninger

Trainee Talk Details:

Location: LSC 1002
Time: 10:50am

Generation, Characterization, and Functional Assessment of Human Lymphatic Vessel Organoids from Pluripoten Stem Cells

Lymphatic vessels are essential for maintaining fluid homeostasis, modulating immune responses, and mediating lipid absorption. Despite their importance, the study of lymphatic development and function has been hampered by the lack of robust, human-specific models in vitro. Here, we report the generation of human lymphatic vessels from pluripotent stem cells (PSCs), which we term "lymphatic vessel organoids" (LVOs).

Through a stepwise differentiation involving mesodermal induction, vascular specification, and lymphatic maturation, LVOs successfully recapitulate critical features of lymphatic vasculature. These include the expression of hallmark lymphatic endothelial cell markers, distinct lymphatic gene expression profiles, and the formation of three-dimensional tubular networks. Moreover, LVOs exhibit lymphatic anchoring filaments and early-stage valve-like structures, closely resembling the architectural function of native lymphatic vessels. We further demonstrate the utility of LVOs in probing immune cell-lymphatic interactions, modeling arteriovenous malformations, and exploring potential roles in mitigating Alzheimer's disease pathology.

As a novel addition to the expanding field of organoid technology, LVOs provide a valuable platform for advancing the study of lymphatic development, pathophysiology, and therapeutic interventions in a human-specific context.

TRAINEE TALK #5

Hourieh Movasat

PhD, SBME
Supervisor: Dr. Nika Shakiba

Trainee Talk Details:

Location: LSC 1002
Time: 11:00am

Mapping Beta Cell Heterogeneity: Cellular Insights from hPSC-Derived Differentiation

Beta cell death leads to type 1 diabetes (T1D), and while islet transplantation shows promise, donor scarcity remains a significant obstacle. Human pluripotent stem cells (hPSCs) offer an unlimited source for deriving beta cells, but cell loss during differentiation reduces cost-effectiveness. We hypothesize that a subset of hPSCs and their progeny have an enhanced potential to differentiate into beta cells. Using DNA barcoding technology, we track individual hPSC fates during two stages of differentiation: hPSCs to pancreatic progenitors (PPs) and PPs to functional beta cells. Our objectives are to identify high-potential clones, decipher molecular signatures of successful differentiation, and uncover the impact of heterogeneity on differentiation efficiency, yield, and purity. By understanding the fundamental factors contributing to heterogeneity and enhanced differentiation potential, we aim to improve beta cell differentiation efficiencies, addressing a critical need in T1D treatment. This research can potentially advance hPSC-derived beta-cell therapies significantly, offering new hope for T1D patients.

TRAINEE TALK #6

Chengyu Ye

PhD, SBME

Supervisor: Dr. Nozomu Yachie

Trainee Talk Details:

Location: LSC 1002

Time: 11:10am

A rapid retrospective cell clone isolation method

In today's biology, it is challenging to interrogate how a cell's prior molecular state primes its next state, as molecular analysis often requires the destruction of the cell. A recently emerging technological concept, called "retrospective clone isolation," has begun to address this challenge. In this approach, cells are individually labeled with molecular barcodes, such as unique DNA sequences. The barcoded cell population is then divided, with one portion subjected to a defined assay and the other stored. Once a clone exhibits a phenotype of interest, it can be retrieved from the stored population in a barcode-dependent manner, allowing the investigation of the molecular profiles that led to the phenotype. However, current methods rely on CRISPR genome editing, which is limited by response time and cytotoxicity. Here, we propose an RNA-based system, RapidSelect, which uses an RNA deaminase enzyme to overcome the limitations of current methods. In RapidSelect, cells encoding a specific RNA sequence are labeled by a rapid activation of a fluorescent reporter expression. This is achieved through the interaction between a barcode-targeting trigger RNA and a target reporter RNA that encodes an impaired fluorescent gene. The genetic code is repaired by deamination (A→I substitution) at the interacting double-stranded RNA region, restoring fluorescence. We will present our recent progress in the development of this new technology.