2023 FACULTY RESEARCH DAY

DEPARTMENT OF SURGERY

University of Saskatchewan

Saskatchewan Health Authority

"People with a scientific mindset are analytical, open-minded, flexible and have the capacity to answer questions. They are basically focused on what they do not know, and only exceptionally on what they do know."

- Eraldo Banovac

Dr. Michael Kelly

Professor &
Provincial Head

Department of Surgery

University of
Saskatchewan &
Saskatchewan Health
Authority

Thank you for attending the Department of Surgery Faculty Research Day. I am excited to have been appointed the new Provincial Head of Surgery. The department will continue to build on its prior success. Our priorities will continue to be exemplary surgical care, research, education, and quality improvement. We will prioritize initiatives for departmental Wellness, Equity, Diversity, and Inclusion. I would like to recognize the excellence of all the members of our department including faculty, residents, graduate students, medical students, undergraduate students, and all other staff that help the department succeed on a daily basis.

Our 2023 Faculty Research Day is a testimony to the dedication and commitment of the members in our department to research and our academic mission. This event will give me a chance to thank all the people that work behind the scenes to make our department successful. I would like to thank our Research Director Dr. Daryl Fourney, the Department of Surgery Research Committee and our Research Coordinator, Karen Mosier, for their leadership in the Department's research initiatives.

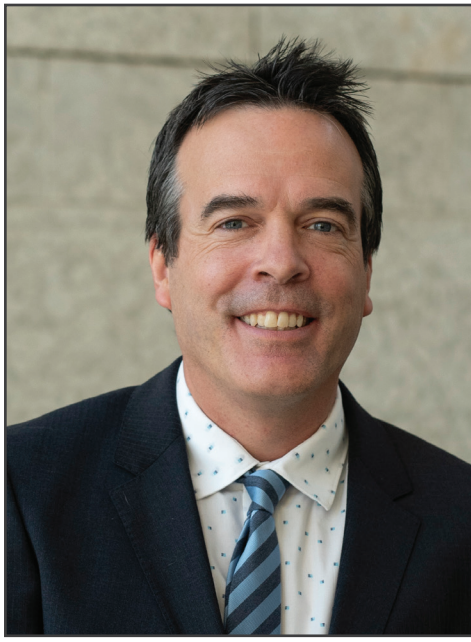
Our guest speaker this year is Dr. Bradley Jacobs, Associate Professor, from the University of Calgary. I would like to thank him for visiting Saskatoon and being our guest.

I am looking forward to an exciting day celebrating research in our department.

Welcome to our 2023 Faculty Research Day! The Research Committee and I are delighted to celebrate our continued progress in research engagement across our diverse faculty. While juggling research endeavors, clinical work, and educational responsibilities is challenging, research is essential for evidence-based data to support quality clinical practice and world-class educational experiences for our trainees.

This is the first major meeting of our Department under our new Provincial Head, Dr. Mike Kelly. Dr. Kelly was passionate about surgical research before entering neurosurgical residency and is living proof that a stellar academic career in surgery can be built right here in Saskatchewan. The Research Committee and I are excited to work with him on our shared commitment to build sustainable surgical research infrastructure across our Province.

Today we have the great privilege of celebrating just a fraction of some of the amazing surgical research in our Department. Please take this opportunity to learn more about research in the Department of Surgery and reach out to your colleagues to collaborate. I wish to thank the presenters, session chairs and judges. I would also like to thank the Department of Surgery Research Committee for adjudicating the abstracts and facilitating such an excellent program. I particularly want to thank our invited guest, Dr. Bradley Jacobs from the University of Calgary. And finally, I would like to thank Karen Mosier, Surgery Research Coordinator, for organizing this exciting event.



Dr. Daryl Fourney

Professor &
Director of Research

Department of Surgery

University of
Saskatchewan &
Saskatchewan Health
Authority

DEPARTMENT OF SURGERY
FACULTY PROMOTIONS & AWARDS

Dr. Trustin Domes

Promotion to Associate Professor

Division of Urology

Award Recipient:
2022 Louis Horlick Spirit of the College of Medicine

Dr. Nathan Ginther

Promotion to Associate Professor

Division of General Surgery

Dr. Lissa Peeling
Division of Neurosurgery

Award Recipient:
2023 Excellence in Teaching Awards from Residents Doctors of Saskatchewan

Dr. Niroshan Sothilingam
Promotion to Associate Professor

Division of General Surgery

Dr. Michael Moser
Division of General Surgery

Award Recipient:
2022 Logan Boulet Humanitarian of the Year

Saskatchewan Transplant Team

Award Recipients:
2022 Logan Boulet Team Award
(Co-Chair: Dr. Gavin Beck)

FACULTY RESEARCH
AWARDS

2022 Award Recipients

Surgery
Faculty Research Day

Platform Presentations:

1st Prize	Dr. Nathan Ginther
2nd Prize	Dr. David Sauder
3rd Prize	Elisabet Jakova (Dr. Francisco Cayabyab)

2021 Award Recipients

Surgery
Faculty Research Day

Platform Presentations:

1st Prize	Elisabet Jakova/Dr. Michael Zaki (Dr. Francisco Cayabyab)
2nd Prize	Dr. Michael Moser
3rd Prize	Dr. Jonathan Norton
Honourable Mention Presentation	Dr. Gary Groot

2019 Award Recipients

Surgery
Faculty Research Day

Platform Presentations:

1st Prize	Dr. Paul Mick
2nd Prize	Dr. Jeremy Reed
3rd Prize	Dr. Michael Zaki
Honourable Mention Presentation	Dr. Jake Pushie

2023

FACULTY RESEARCH DAY
DEPARTMENT OF SURGERY

May 11, 2023

Contents

Introduction

Faculty Research Day
Department of Surgery

08:00 AM - 08:05 AM

WELCOME & OPENING REMARKS

Dr. Daryl Fourney
Professor & Director of Research
Department of Surgery
University of Saskatchewan & Saskatchewan Health Authority

Session I

Faculty Research Day
Department of Surgery

MODERATOR: Dr. Gary Groot

08:05 AM - 09:20 AM

10 Minute Break 9:20 AM - 9:30 AM

Keynote Speaker

Department of Surgery
Faculty Research Day

MODERATOR: Dr. Daryl Fourney

9:30 AM - 10:30 AM

Effective Team Building as a Path to Research Success

Dr. W. Bradley Jacobs

Associate Professor, Division of Neurosurgery
Department of Clinical Neurosciences
University of Calgary

15 Minute Break 10:30 AM - 10:45 AM

Dr. Brad Jacobs obtained an undergraduate degree from Queen's University and completed medical school at the University of Calgary prior to commencing his neurosurgical residency at the University of Toronto. After completing residency training in 2008, he pursued an orthopaedic spinal surgery fellowship at the University of Washington/Harborview Medical Center in Seattle under the mentorship of Drs. Jens Chapman, Carlo Bellabarba and Rick Bransford.

After his spinal surgery fellowship, Brad was recruited to the University of Calgary and Foothills Medical Centre in 2009 as a spinal surgeon member of the Division of Neurosurgery and the Calgary Spine Program. Brad currently holds the academic rank of Associate Professor at the University of Calgary and is also the Chairperson of the Calgary Spine Program. The Calgary Spine Program is a combined orthopaedic/neurosurgical spinal surgery group consisting of 12 spinal surgeons, making it the largest single hospital site spinal surgery group in Canada.

Brad has a large general spinal surgery clinical practice that includes his subspecialty interests in adult spinal deformity and spinal oncology. His research interests are focused on clinical care optimization for adult spinal deformity patients, as well as degenerative cervical myelopathy, for which he is major contributor to the Canadian Spine Outcomes & Research Network (CSORN) national degenerative cervical myelopathy prospective database. Brad is also an ardent spinal surgery educator who has taught residents, fellows, and surgeons on a wide array of spinal surgery topics at national and international venues.

When not in the clinic or the operating room, Brad is an avid road cyclist who follows the edict that one can never own too many bicycles.

Dr. W. Bradley Jacobs

Associate Professor, Department of Clinical Neurosciences

University of Calgary

Lead, Calgary Spine Program

Chairperson, Alberta Spine Foundation

Session II

Faculty Research Day
Department of Surgery

MODERATOR: Dr. Mike Moser

10:45 AM - 12:15 PM

Closing Remarks

Department of Surgery
Faculty Research Day

12:15 PM - 12:30 PM

Dr. Daryl Fourney
Professor & Director of Research
Department of Surgery
University of Saskatchewan & Saskatchewan Health Authority

The 1st, 2nd and 3rd podium presentation winners will be announced later in the day via email.

Acknowledgments

The Departments of Surgery would like to thank the following individuals for serving as judges and moderators for the 2023 Faculty Research Day.

Judges

Dr. Nathan Ginther
Associate Professor, Department of Surgery
Division of General Surgery
College of Medicine, University of Saskatchewan

Dr. Amanda Hall
Assistant Professor, Department of Surgery
Division of General Surgery (Pediatrics)
College of Medicine, University of Saskatchewan

Dr. David Kopriva
Clinical Associate Professor, Department of Surgery
Division of Vascular Surgery
College of Medicine, University of Saskatchewan

Dr. Renee Kennedy
Associate Professor, Department of Surgery
Division of Thoracic Surgery
College of Medicine, University of Saskatchewan

Dr. Bradley Jacobs
Associate Professor, Department of Clinical Neurosciences
Division of Neurosurgery
Cumming School of Medicine, University of Calgary

Moderators

Dr. Gary Groot
Professor, Department of Surgery
Division of General Surgery
College of Medicine, University of Saskatchewan

Dr. Mike Moser
Associate Professor, Department of Surgery
Division of General Surgery
College of Medicine, University of Saskatchewan

2023
Department of Surgery
FACULTY RESEARCH DAY ABSTRACTS

Comparing Language Lateralization in Left and Right Temporal Lobe Epilepsy Using fMRI and Structural Connectivity

Platform Presenter: Dr. Layla Gould

Division of Neurosurgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Dr. Josh Neudorf (Biomedical Physiology & Kinesiology, Simon Fraser University), Shaylyn Kress (Department of Psychology and Health Studies, University of Saskatchewan), Katherine Gibb (Department of Psychology and Health Studies, University of Saskatchewan), Dr. Marla Mickleborough (Department of Psychology and Health Studies, University of Saskatchewan), Dr. Ron Borowsky (Department of Psychology and Health Studies, University of Saskatchewan).

Rationale:
In cases of brain disease such as temporal lobe epilepsy (TLE), damage may lead to functional reorganization and a shift in language dominance to homolog regions in the other hemisphere. If the effects of TLE on language dominance are hemisphere-focused, then brain regions and connections involved in word reading should be less left-lateralized in left temporal lobe epilepsy (lTLE) than right temporal lobe epilepsy (rTLE) or healthy controls, and the opposite effect should be observed in patients with rTLE.

Methods:
A group of 14 patients with lTLE, 8 patients with rTLE, and 14 healthy controls underwent an exception word reading fMRI task. Twenty-five exception words were used as critical stimuli. Tractography was also conducted to visualize white matter tracts.

Results:
fMRI showed that patients with rTLE had more strongly lateralized left hemisphere activation than patients with lTLE and healthy controls in language-related brain regions. Corresponding with this difference, tractography showed differences in connectivity indicative of patients with lTLE having greater tract integrity than patients with rTLE in right hemisphere language-related white matter.

Conclusion:
Based on the hemisphere of the locus of epileptic activity in TLE, we have demonstrated that language processing tends to be more left lateralized for patients with rTLE and less lateralized for patients with lTLE. These findings support some of the theories of function reorganization, which suggest reorganization of function from one hemisphere to the other may occur as a result of the damaging effects of epileptic activity in the temporal lobe.

Funding Sources:
Natural Sciences and Engineering Research Council (NSERC) of Canada, Saskatchewan Health Research Foundation (SHRF).

Associations Between Cognition and Speech Understanding Among Patients Undergoing Cochlear Implant Assessment

Platform Presenter: Dr. Paul Mick

Division of Otolaryngology, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Jiwon Yoon (Department of Community Health and Epidemiology, University of Saskatchewan), Richard Ngo (College of Medicine, University of Saskatchewan), Hyun J. Lim (Department of Community Health and Epidemiology, University of Saskatchewan).

Rationale:

Individuals with severe hearing loss are determined to be cochlear implant candidates if they no longer receive "benefit" from hearing aids. Benefit is typically determined by the ability to recognize recorded words and sentences, presented in a standardized way (i.e., via tests of speech understanding). The FDA and insurance companies use speech understanding criteria (e.g., <60% correct responses) to approve patients for implantation, without considering non-hearing factors such as cognition that might influence speech understanding. We hypothesize that among cochlear implant candidates, executive function and memory are predictive of speech understanding scores, after adjusting for age, sex and peripheral hearing ability (as determined by pure-tone threshold average).

Methods:

Adults (age 18 years and older) presenting for assessment for cochlear implantation in Saskatoon were recruited to the study. Speech understanding was determined for the worse-hearing ear, aided with a hearing aid, using the percent of correct responses for the AzBio sentence-in-quiet test. Measures of executive function were ascertained using the mental alternation test (MAT), animal fluency test (AFT), and Stroop interference test, and the brief visuo-spatial memory test (revised) (BVMT-R) was used to assess memory function. Associations between speech understanding and cognition were assessed using multivariable linear regression, adjusting for age, sex, and pure-tone threshold average. An exploratory analysis was performed to determine if associations differed according for participants with a pure-tone average >=100 dB HL (worse hearing), versus those with a pure-tone average < 100 dB HL (better hearing).

Results:

As of March 31, data were available for 40 patients. Poorer speech understanding was independently associated with lower scores on three of the tests of cognition (MAT, Stroop, and BVMT-R). Exploratory analyses suggested the associations may be stronger among participants with pure-tone threshold averages <100 dB HL versus participants with pure-tone averages >=100 dB HL, but more patients need to be recruited to fully assess effect modification.

Conclusion:

Speech understanding should be interpreted in the context of both hearing and cognition among cochlear implant candidates. Indications for cochlear implantation that are based solely on speech understanding may discriminate against people who compensate for their hearing loss using cognitive strategies, since such individuals are more likely (for a given level of peripheral hearing loss) to have speech understanding scores outside the candidacy range for implantation imposed by regulators and health insurance funding agencies.

Funding Sources:

SHRF Establishment Grant

Addition of Encirclement Procedure to Perineal Proctosigmoidectomy for Rectal Prolapse Reduces Recurrence

Platform Presenter: Dr. Nathan Ginther

Division of General Surgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:

Dilip Gill (General Surgery, University of Saskatchewan), Aiya Amery (General Surgery, University of Saskatchewan).

Rationale:

Rectal prolapse is a benign but debilitating condition that disproportionately affects women (9:1), commonly in their seventh decade of life. There are countless operations and combinations described, however there is no standard approach. Objectives of treatments include correction of the prolapse, minimization of recurrence, and optimization of functional outcomes. Although associated with higher recurrence, perineal approaches are preferred in elderly and high-risk patients. Perineal proctosigmoidectomy (Altemeier's procedure) is a common, effective, and well-tolerated perineal approach, but with a high recurrence risk of up to 58%. Anal encirclement (Thiersch' procedure) is an alternative approach to mechanically restrict the lumen, but its recurrence rates are also up to 50%. We hypothesize that combining these approaches would reduce the recurrence of rectal prolapse.

Methods:

This was a single institution (Royal University Hospital, SK), retrospective analysis from July 2017-October 2022. Patients >18 years of age with a rectal prolapse who underwent an operation with either an Altemeier or Altemeier + Thiersch were included. Rectal prolapse was defined as circumferential, full-thickness protrusion of the rectal wall through the anal verge. Variables were analyzed using Pearson's Chi-squared Test or Man Whitney-U Test as appropriate. Repeated measurement ANOVA was used to compare changes. A p-value of <0.05 was considered significant. All data was analyzed using SPSS v.28 (IBM Corp, Armonk, NY). Recurrence was the primary outcome measured. Secondary outcomes were operative time, length of hospital stay, and complications.

Results:

Twenty-three patients underwent an Altemeier, and twenty-one patients underwent Altemeier + Thiersch. The two groups had similar demographics, including average age, BMI, gender, ASA, and length of prolapse (Table 1). Patients who received the combined procedure had a lower rate (9.5%) of recurrent rectal prolapse, despite a higher proportion of them having had a previous prolapse procedure, than the Altemeier group alone (34.8%). This reduction recurrence was statistically significant, ($p=0.023$). There was no statistical difference in the operating time between the two groups. Hospital stay for patients who underwent the combined procedure was 2.3 days less ($p=0.031$). There were 5 complications in the Altemeier group compared to 2 in the combined group, however this difference was not statistically significant.

Conclusion:

The combination of an Altemeier + Thiersch reduces the risk of rectal prolapse recurrence compared to Altemeier alone. It is safe and is effective in patients with a history of previous failed prolapse procedures.

Funding Sources:

None.

Four Corner Arthrodesis with a Dorsal Locking PEEK Plate - Union Rate and Clinical Outcomes

Platform Presenter: Dr. David Sauder

Division of Orthopedic Surgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Emmitt Hayes (University of Ottawa), David Leswick (Department of Radiology, University of Saskatchewan), Haron Obaid (Department of Radiology, University of Saskatchewan).

Rationale:
Four corner arthrodesis (FCA) is a reliable salvage procedure for advanced wrist arthritis. A Polyetheretherketone (PEEK) radiolucent dorsal locking circular plate has shown favorable clinical and radiological outcomes in early series. We present a retrospective series examining clinical and radiological outcomes among patients receiving FCA.

Methods:
We identified 62 patients between January 1st, 2009 and May 3rd, 2019. Nine met exclusion criteria. Sixteen could not or would not participate. Participants completed two patient reported outcomes. Active range of motion and grip strength were assessed. Radiographs of the operative wrist were obtained at follow up and analyzed by two separate fellowship trained musculoskeletal radiologists.

Results:
We examined 39 wrists (37 patients) at a mean follow up of 55 months. Satisfaction was 81.7/100 (19.0). Pain decreased from 84.4/100 prior to surgery to 35.1/100 after surgery. Mean grip strength was 81% of the nonoperative hand. Mean flexion was 37.2 degrees, mean extension was 28.9 degrees. Eighty-seven percent of wrists achieved union; eight percent of wrists had non-union; union was indeterminate in five percent of cases. There were 16 cases of partial lunate collapse and two cases of complete lunate collapse.

Conclusion:
Our results are consistent with prior literature indicating that this technique is a reliable method of performing FCA. Our union rate is similar to prior studies with the same plate. This rate is comparable to union rates seen in studies examining traditional methods of osteosynthesis in FCA (K-wires, screws, staples).

Funding Sources:
University of Saskatchewan Dean's Project Grant

Delayed C5 Palsy After Surgical Decompression for Cervical Myelopathy: Influence of Approach

Platform Presenter: Dr. Daryl Fourney

Divisioon of Neurosurgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Michael Fehlings (University of Toronto), Alex B Bak (University of Toronto), Ali Moghaddamjou (University of Toronto), Mansour Alvi (University of Toronto), Henry Ahn (University of Toronto), Erin M Massicotte (University of Toronto), Hooman F Farhadi (University of Ohio), Christopher I Shaffrey (University of Virginia), Ahmad Nassr (Mayo Clinic), Praveen Mummaneni (University of California San Francisco), Paul M Arnold (Kansas University), W. Bradley Jacobs (University of Calgary), K. Daniel Riew (Columbia University), Michael Kelly (Washington University in St. Louis), Darrel S Brodke (University of Utah), Alexander R Vaccaro (Thomas Jefferson University), Alan S Hilibrand (Thomas Jefferson University), James S Harrop (Thomas Jefferson University), Jason Wilson (Louisiana State University), S. Tim Yoon (Emory University), Kee D Kim (UC Davis), Carlo Santaguida (McGill University), Branko Kopjar (University of Washington).

Rationale:
Risk factors for delayed C5 palsy after surgical decompression for cervical spondylotic myelopathy (CSM) are unclear. We analyzed a large prospective, multicentre dataset to determine these risk factors, in particular, the influence of surgical technique.

Methods:
Two comparative cohorts were drawn from the CSM-Protect clinical trial based on whether an anterior or posterior approach was used. A multivariate mixed-effects logistic regression method was used to control for variables that were significantly different in between-group comparisons and estimate odds ratios (OR) with 95% confidence intervals (CI).

Results:
There were 283 patients (151 posterior; 132 anterior). The posterior group was older (60.5±9.9 yr vs. 56.4±10.0 yr, p=0.001), with a greater proportion of males (65.6% vs. 47.0%, p=0.002). The incidence of delayed C5 palsy was 7.4% (n = 21) and was significantly higher for the posterior approach (11.26% vs. 3.03%, p=0.008). Combined laminectomy and laminoplasty had the highest incidence of 20.0% (n = 2), followed by laminoplasty (n = 4, 14.3%), and laminectomy with fusion (n = 11, 9.7%). Corpectomy and anterior discectomy / fusion had the same rate of 3.1%. After multivariable logistic regression, the posterior approach was independently associated with 4X greater likelihood of delayed C5 palsy (OR: OR: 4.61 95% CI [1.32–16.12], p=0.017). Complete recovery from C5 palsy was comparable between groups (66.7% anterior; 68.8% posterior).

Conclusion:
The risk of delayed C5 palsy is much greater for posterior versus anterior approaches to treat CSM. This could influence surgical decision-making when there is equipoise in deciding the approach.

Funding Sources:
This study was funded by AO Spine North America.

The Association of Matrix Metalloproteinases 2 and 9 with Acute Kidney Injury Following Cardiopulmonary Bypass-Supported Cardiac Surgery

Platform Presenter: Josie Conacher

Division of Cardiac Surgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Dr. Erick McNair (Department of Pathology and Laboratory Medicine/Department of Surgery, University of Saskatchewan), Dr. Abbas Khani-Hanjani (Department of Surgery, University of Saskatchewan)

Rationale:
Earlier rising biomarkers for the diagnosis of AKI following CPB-supported cardiac surgery are needed. We hypothesize increased activity levels of serum and urine MMP-2 and/ or MMP-9 in patients that develop AKI. Furthermore, MMP-2 and/ or MMP-9 will provide earlier detection, as compared to levels of serum creatinine.

Methods:
Three hundred and forty-six CPB-supported surgeries yielded 54 patients who developed AKI. A matched group design was used to select a sample of 54 non-AKI patients. The primary outcome variables were the measurement of serum and urine activity levels of MMPs-2 and -9 via gelatin zymography. Samples were drawn at the following intervals: pre-CPB; 10-minutes post-CPB; and 4-hours post-CPB. The measurement of serum creatinine was a secondary variable.

Results:
At baseline, there were no significant differences in the activity levels of serum or urine MMP-2 and 9 in non-AKI vs. AKI patients. Between groups, at the 10-minutes and 4-hours post-CPB time points, serum, and urine activity levels of MMPs-2 and -9 of AKI patients were significantly higher as compared to the non-AKI patients. Among AKI patients, there was a significant increase in urine MMP-2 and -9 activity, and serum MMP-2 activity at 10-minutes and 4-hours post-CPB, as compared to pre-CPB.

Conclusion:
Our results show increased serum and urine activity levels of MMP-2 and -9 in patients that developed AKI. This data supports their potential in earlier diagnosis of AKI in CPB-supported patients. This research may lead to therapeutic applications in treatment of AKI in our surgical population.

Funding Sources:
The College of Medicine Graduate Student Awards (CoMGRAD); matching funding provided by the Department of Surgery.

GABA Facilitates Spike Propagation at Branch Points of Sensory Axons in the Spinal Cord

Platform Presenter: Dr. Krista Metz

Division of Neurosurgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Isabel Concha Matos (University of Alberta), Krishnapriya Hari (University of Alberta), Omayma Bseis (University of Alberta), Babak Afsharipour (University of Alberta), Christopher K Thomson (Temple University, Philadelphia), Fancesco Negro (Universita degli Studi di Brescia, Brescia, Italy), Katharina A Quinlan (University of Rhode Island), Shihoa Lin (University of Alberta), Rahul Singla (University of Alberta), Keith K. Fenrich (University of Alberta), Yaging Li (University of Alberta), David J. Bennett (University of Alberta), Monica A. Gorassini (University of Alberta).

Rationale:
For over 60 years it was believed that sensory signals traveling along Ia afferents were reduced in the spinal cord via GABA-A receptor mediated primary afferent depolarization (PAD) at the Ia afferent terminal, termed presynaptic inhibition. However, recent findings have shown a lack of GABA-A receptors and PAD at the Ia afferent terminal, instead revealing clusters of GABA-A receptors at proximal branch points. Activation of these proximal GABA-A receptors reduces branchpoint failure and increases afferent transmission. These novel findings put into question the role of GABA-A receptors on Ia afferents and the mechanisms behind "presynaptic inhibition".

Methods:
Sensory and corticospinal pathways that putatively activate GABA-A receptors, and PAD, were used to condition the H-reflex (Ia – motoneuron pathway) in human participants. Presynaptic effects on the Ia afferent were differentiated from postsynaptic effects on the motoneuron using single motor unit analysis. Our human results were compared to animal studies using direct measures such as intracellular recordings and optogenetic activation of specialized GABA-ergic neurons.

Results:
Conditioning inputs that putatively activate PAD facilitated the H-reflex in a time-course similar to PAD recording in animals, with no direct postsynaptic facilitation of the motoneurons, indicating presynaptic facilitation. When strong enough, the PAD-evoking conditioning input elicited an early reflex response in the test muscle, inhibiting successive activations of the H-reflex, likely via post-activation depression.

Conclusion:
Our human results are consistent with animal studies showing that GABA-A receptor activation (PAD) reduces intermittent failure of action potentials propagating into Ia afferent branches, increasing Ia afferent transmission and reflexes.

Funding Sources:
Natural Sciences and Engineering Research Council of Canada. Grant Number: 05205, Foundation for the National Institutes of Health (FNIH). Grant Number: NS104436.

Enhancing Bowel Adaptation: Using an Intestinal Organoid Model

Platform Presenter: Dr. Nolan Hunka

Division of General Surgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Dr. Amanda Hall (Department of Surgery, University of Saskatchewan)

Rationale:
Human organoids re-create the physiology and architecture of organ systems and allow unique insight to human diseases and development. In clinical practice, breast milk is protective against many neonatal and pediatric diseases, but the cellular intestinal response to breast milk is poorly understood. We hypothesize that breast milk can enhance bowel adaptation by upregulating key nutritional transporters.

Methods:
From stem cell lines, we will establish and verify an intestinal organoid culture system and introduce human breast milk to this model. RT-qPCR, Western blotting, and transporter assays will be used to compare levels of specific genes known to be involved in nutrient absorption and molecular intestinal transport. These levels will be statistically compared with control groups grown in standard culture and passaging conditions.

Our first measurable outcome will be the establishment of a stable intestinal organoid model grown from human stem cell lines. Secondly, we will use qPCR to determine if human breast milk upregulates nutrient transporters. Thirdly, we will examine the resultant proteins and function using Western blot and transporter assays.

Human intestinal organoids are a powerful tool to further scientific understanding of gut development. By demonstrating differences in functional transporter genes, our model provides utility in investigating further clinical applications beyond breast milk. This model will facilitate further investigation of human disease, developmental processes, and markers of bowel adaptation.

Funding Sources:
New Faculty Start-Up Fund, University of Saskatchewan (Amanda Hall), Department of Surgery Resident Research Grant; University of Saskatchewan (Nolan Hunka).

Securing Telemedicine

Platform Presenter: Dr. Jonathan Norton

Division of Neurosurgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Elias Hassani Sangani (Department of Electrical Engineering, University of Saskatchewan), Grant McEwan (Department of Physics, University of Saskatchewan), Artur Sowa (Department of Mathematics, University of Saskatchewan), Francis Bui (Department of Electrical Engineering, University of Saskatchewan).

Rationale:
A single stolen credit card has an estimated value of $10 on the dark web, while a health care record is more than 45 times as valuable in the same market. The COVID-19 pandemic has brought tele-medicine to the forefront. Recent health care security breaches have demonstrated that current cyber security strategies lag behind criminal's approaches. This is especially true in health care. The aim of the project was to develop a method of securely and rapidly encrypting images for secure transmission (tele-medicine).

Methods:
A novel algorithm has been developed that encrypts images, including medical images. The algorithm is based on a new mathematical strategy and is proprietary. An app based on Matlab has been developed. The algorithm has been tested against all current encryption standards.

Results:
The new algorithm encrypts images more rapidly than current strategies, (0.1097s vs 0.186-0.405s). The encryption is more secure, even against novel attack strategies and global entropy (measure of chaos in encrypted image where 8 is the maximum), 7.9993 vs 7.96-7.98. The strength of the key to the encryption is especially powerful, with a key of 2^2304 compared to conventional keys of 2^256 maximum.

Conclusion:
We have developed a potentially powerful new tool that can protect health data and medical images, but which likely has applications beyond tele-medicine. A technology company has been spun-out to further commercialize the technology.

Funding Sources:
Royal University Hospital Foundation, Mathworks, Co.Labs, University of Saskatchewan, Innovate Saskatchewan.

Utility of SVS WIfI (Wound, Ischemia, Foot Infection) Lower Extremity Classification Scoring System in Diabetic Patients with Threatened Limbs: Validation in a Saskatchewan Tertiary Care Centre

Platform Presenter: Jennifer Culig

Division of Vascular Surgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
Dr. Nick Peti (Department of Surgery, University of Saskatchewan), Dr. Kylie Kvinlaug (Department of Surgery, University of Saskatchewan), Dr. Jodi Spelay (Department of Surgery, University of Saskatchewan), Dr. Bruce DuVal (Department of Surgery, University of Saskatchewan).

Rationale:
Diabetes is a chronic disease affecting over 300 million people worldwide and is predicted that by the year 2034 cases will rise to almost 600 million. Its sequelae are devastating, leading to greater than 1 million people per year losing a limb. The Vascular Surgery Division at St Paul's Hospital in Saskatoon has wound patient volumes ranging from 80-100 patients weekly. Full year pre- COVID ambulatory care numbers showed four vascular surgeons seeing 3000 plus scheduled wound patients in ambulatory care alone. There is no standardized classification system utilized in our center and no formal evaluation of the WIfI classification in Saskatchewan has been done.

In 2014 The Society of Vascular Surgery, a national academic society in the United States, developed the threatened limb classification system (WIfi classification) to stratify the risk of amputation and wound healing for patients who present with chronic limb threatening ischemia (CLTI). The WIfI (Wound, Ischemia, Foot Infection) Classification system takes into consideration important factors for a threatened limb: wound, ischemia, and foot infection. The composite score predicts prognosis and can guide further management of limb ischemia.

Methods:
The proposed study is a prospective cohort observational study to be done over 5 years at a single medical institution in Saskatoon SK. A prospectively maintained database of all diabetic patients with a threatened lower extremity undergoing treatment by St Paul's Hospital Vascular Surgery Division Limb preservation service from September 2022 to September 2024 will be completed. Recruitment will be done over a two-year period and will include all outpatients seen in the lower extremity wound clinic and inpatients that have been referred to our service that meet criteria.

WIfI wound, ischemia, infection grades and spectrum scores will be analyzed to find their relationship to primary end points. Society of Vascular surgery performance goals are used as clinical endpoints which are major limb amputation at 1 year and 2 years, 1 year and 2 year amputation free survival and wound healing time.

Funding Sources:
Department of Surgery New Faculty Seed Funding

Imaging Markers of Energy Metabolism in the Post-stroke Mouse Brain

Platform Presenter: Nicole Sylvain

Division of Neurosurgery, Department of Surgery
College of Medicine, University of Saskatchewan

Team Members/Affiliations:
M. Jake Pushie (Department of Surgery, University of Saskatchewan), Huishu Hou (Department of Surgery, University of Saskatchewan), Claire N. DuVal (College of Pharmacy Department of Surgery, University of Saskatchewan), Sally Caine (College of Pharmacy & Nutrition; Department of Biomedical Sciences, Western College of Veterinary Medicine), Mark J. Hackett (Curtin Institute for Functional Molecules and Interfaces/ Curtin Health Innovation Research Institute, Curtin University, Australia), Michael E. Kelly (Department of Surgery, University of Saskatchewan).

Rationale:
Cerebral ischemia results in a lesion comprised of dying cells surrounded by a band of tissue containing cells at risk of dying, called the penumbra. Understanding the status of energy metabolism in the stroke lesion is important for studying interventions, and the detection of energy metabolites presents significant challenges for conventional laboratory techniques. Fourier Transform infrared (FTIR) spectroscopic imaging can be used to map the distribution of different biochemical parameters, such as lipids, proteins, aggregated proteins, glycogen, lactate, pyruvate, ATP/ADP, NADH and glutamate.

Methods:
We employed the photothrombotic stroke model in adult mice to produce a permanent focal stroke lesion. Brain tissue was collected at multiple time points (1h to 4 weeks post-stroke) and imaged using FTIR. Immunohistochemistry was also performed on adjacent tissues to stain for astrocytes and macrophages.

Results:
During the first week poststroke, the lesion shows decreased lipid esters, protein, ATP/ADP, NADH content while showing an increase in glutamate, aggregated protein, lactate and pyruvate. Glycogen can be seen to accumulate in the penumbra starting at 1 day post-stroke until 1 week post-stroke, which correlates with the appearance of astrocytes around the border of the stroke lesion. From 1 week to 4 weeks post-stroke, we observe an increase in lipid esters in the lesion, as well as a decrease in glycogen, lactate and pyruvate, while an increase in ATP/ADP and NADH can be observed.

Conclusion:
We are showing for the first time novel images of multiple energy metabolism biomarkers across a range of post-stroke time points in a mammalian brain. This type of imaging will be important in studying post-stroke interventions.

Funding Sources:
Heart and Stroke, SHRF, USask CoM

Notes

UNIVERSITY OF SASKATCHEWAN
Department of Surgery

Saskatchewan
Health Authority