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RAT MODEL OF MIXED OSTEOBLASTIC-OSTEOLYTIC BONE METASTASIS SUGGESTS PSOAS MUSCLE ATTENUATION AND VOLUME LOSS

[1,5] L. Abraham, [2,4] C. Huang, [3,4] M. Hardisty, [2,3,4] C. Whyne, [1,3,5] M.K. Akens
[1] Department of Medical Biophysics, [2] The Institute of Biomedical Engineering (BME), [3] Department of Surgery, University of Toronto, [4] Sunnybrook Research Institute, [5] Techna Institute, University Health Network, Toronto, ON, Canada

Hypothesis & Purpose: Prostate cancer is highly susceptible to forming mixed osteoblastic-osteolytic skeletal metastases, often presenting with sarcopenia (loss of skeletal mass). This study aims to quantify changes in the psoas muscle secondary to metastatic prostate cancer. Muscle volume and attenuation are hypothesized to be correlated with tumour burden.

Methods: Athymic, 6-week-old male rats (n=4) received an intra-cardiac injection with luciferase-transfected Ace-1 prostate cancer cells (control n=5). Gd-contrast *in vivo* µMR and µCT imaging were performed at days -1, 13, and 20 post-cell-injection. Bioluminescence imaging monitored tumour formation and progression on d14 and d21 post-cell injection. Psoas muscles were manually segmented from fused images to obtain muscle volume and attenuation and normalized to the L2 volume.

Results: Bioluminescence and *ex vivo* µCT images confirmed tumours in the vertebrae of 4 rats. Psoas volumes in tumour-bearing rats increased from d -1 to d13 compared to healthy controls, where an increase in volume was observed at d20. Animals with metastases had significantly smaller increases in normalized muscle volume from d-1 to d20 post-injection (ANOVA single factor, p=0.02), indicating muscle loss. µCT analysis suggests that animals with bone metastases had higher fatty infiltration during disease progression, characterized by a greater negative change in muscle attenuation from d -1 to d13 post-injection (ANOVA single factor, p=0.02); however, these findings need to be confirmed following histological analysis.

Conclusion: Sarcopenia is observed with imaging biomarkers in this preclinical model of bone metastases secondary to prostate cancer and can be used to evaluate disease progression and treatment effects further.

EX VIVO PERFUSION DE- AND RECELLULARIZATION OF RAT HINDLIMBS FOR VASCULAR COMPOSITE ALLOTRANSPLANTATION

Aisha Adil[1,2], Golnaz Karoubi[2], Siba Haykal[1,2,3]
[1]Institute of Medical Science, Temerty Faculty of Medicine, University of Toronto; [2]Latner Thoracic Research Surgical Laboratories, University Health Network, Toronto General Hospital; [3]Division of Plastic and Reconstructive Surgery, Department of Surgery, University of Toronto

Purpose and Hypothesis: This current study will establish a proof-of-concept VCA animal model using the tissue engineering technique of perfusion de- and recellularization in the rat hindlimb. It is hypothesized that sodium dodecyl sulfate (SDS)-based decellularization will remove cellular content while preserving extracellular matrix structure in composite rat hindlimbs. **Methods:** Rat hindlimbs from male Lewis rats were procured and the common femoral artery was cannulated. An *ex vivo* machine perfusion-based closed-system bioreactor was designed to apply detergent perfusion at 1 mL/minute via the cannulated artery using 0.25% SDS concentration. All tissue compartments including the skin, femoral vessels, nerves, muscle, and femur were histologically assessed. For recellularization, 20 x 10^6 human umbilical vein endothelial cells were seeded by arterial perfusion and 20 x 10^6 L6 rat myoblasts by injection. Scaffolds were cultured for 7 days. **Results:** Gross morphology of the rat hindlimb showed systemic white, translucent appearance after 5 days of detergent perfusion, indicative of decellularization. Histologically, tissue architecture was preserved across all five tissue compartments. For recellularization, cells were detected after 7 days in vessels and muscle. **Conclusions:** Perfusion decellularization with 0.25% SDS perfusion retained all respective tissue compartments of the rat hindlimb. This is a lower concentration than typically used, suggesting a less toxic approach. Long-term *ex vivo* recellularization for 7 days shows cell engraftment. Further work with recellularization will involve characterizing the cell types and cell survival. The present study offers a proof-of-concept model for applying this tissue engineering technique for composite tissues and acts as a first step towards regeneration of a bioartificial hindlimb.

A NOVEL MR THERMOMETRY ALGORITHM REDUCED MOTION ARTIFACTS DURING MR-GUIDED HIGH-INTENSITY FOCUSED ULTRASOUND

Arthur Akbulatov, Suzanne M. Wong, Craig A. Macsemchuk, Andrew Headrick, James M. Drake, Adam C. Waspe
Posluns Centre for Image Guided Innovation & Therapeutic Intervention, The Hospital for Sick Children, Toronto, Ontario

Purpose: Magnetic resonance guided high-intensity focused ultrasound (MRgHIFU) is a non-invasive technique used to administer hyperthermia. Involuntary sporadic motions such as muscle twitching and sternutation can introduce large motion artifacts that severely impact the accuracy of MR thermometry. The objective of this work is to improve upon a hybrid principal component analysis (PCA) and projection onto dipole fields (PDF) motion compensation algorithm to minimize thermometry artifacts caused by large unpredictable motions.

Methods: A PCA-PDF algorithm incorporated predicted motion into the PCA atlas using image augmentation techniques. To assess the efficacy of the algorithm, gelatin phantoms were displaced 2.25 cm and were retrospectively processed with varied PCA atlas generation parameters. The temperature standard deviation was calculated in each MR thermometry image to measure artifact severity.

Results: With no motion compensation, the temperature standard deviation was 5.0 °C. The unmodified PCA-PDF algorithm, with no augmentation, yielded a temperature standard deviation of 4.1 °C. The augmented PCA-PDF algorithm with optimized PCA parameters yielded
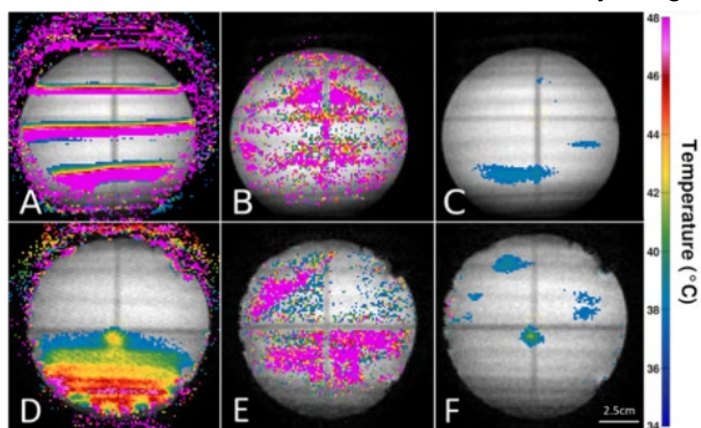
Figure 1: MR thermometry images of phantoms after 2.25 cm displacement. A-C: No heating. D-F: 40.5 °C hyperthermia. A, D: No motion compensation. B, E: Unmodified PCA-PDF. C, F: Augmented PCA-PDF.

the lowest temperature standard deviation of 0.4 ± 0.1 °C over five trials, significantly lower than without motion compensation and the unmodified PCA-PDF approach (p<0.0001) (Figure 1).

Conclusions: Supplementing the PCA-PDF method with an augmented atlas of predicted motion images was able to reduce artifacts created by sporadic motion in MR thermometry.

DEVELOPMENT OF A NOVEL STORAGE PROTOCOL FOR FRESH OSTEOCHONDRAL ALLOGRAFT PRESERVATION

Sarah Aloi[1,2], **Margarete Akens**[1,3], **Marc D. Grynpas**[1,2], **Paul Kuzyk**[1], **Adele Changoor**[1,2]
[1]Temerty Faculty of Medicine, University of Toronto, Toronto, Ontario, [2]Lunenfeld Tanenbaum Research Institute, Toronto, Ontario, [3]Techna Institute, Toronto, Ontario.

Purpose and Hypothesis: This study aims to 1) formulate a novel storage media for storing osteochondral allografts by identifying additives which mimic certain aspects of the native joint environment and extend chondrocyte viability beyond 14 days, and 2) characterize the effects of the proposed formulation on cartilage extracellular matrix characteristics and bone quality. We hypothesize that chondrocyte viability will be extended by storing donor tissues in a supplemented media containing specific components that mimic the native environment of cartilage more effectively than the current standard used by Mount Sinai Allograft Technologies.

Methods: Cell culture medium supplemented with hyaluronic acid and doxycycline will be investigated using a rabbit model. Mature rabbit cartilage will be stored at 4°C in both supplemented and standard (Lactated Ringer's-based) storage media. Analyses will be done on three samples per timepoint (day 0, 7, and 21), per storage condition. Confocal microscopy will be used to analyze chondrocyte cells stained with Calcein AM and Ethidium Homodimer-1 for live/dead quantification, and MitoTracker Deep Red for mitochondrial localization. Effects on the cartilage extracellular matrix and bone quality will be characterized using biochemical assays for collagen and glycosaminoglycan content, biomechanical testing, and histological staining.

Results: Current tissue bank storage protocols maintain the minimum 70% chondrocyte viability required for transplantation for only 14-28 days. It is expected that media supplemented with hyaluronic acid and doxycycline will extend this time when compared to the standard storage, and that mitochondrial localization at the plasma membrane will vary in live versus dead cells in both storage conditions over time.

Conclusion: The addition of hyaluronic acid and doxycycline to may help maintain minimum cell viability for an extended time and increase availability of donor tissue for transplantation.

NEUROMONITORING FOR DETECTING INTRAOPERATIVE SPINAL CORD INJURY DURING SPINAL SURGERY: A SYSTEMATIC REVIEW AND META-ANALYSIS

Mohammed Ali Alvi, AO Spine Guidelines Development Group, Michael G. Fehlings
Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, ON

Purpose and Hypothesis: In an effort to prevent intraoperative neurological injury during spine surgery, the use of intraoperative neurophysiological monitoring (IONM) has increased significantly in recent years. Using IONM, spinal cord function can be evaluated intraoperatively by recording signals from specific nerve roots, motor tracts, and sensory tracts. We performed a systematic review and meta-analysis of diagnostic test accuracy (DTA) studies to evaluate the efficacy of IONM among patients undergoing spine surgery for any indication.

Methods: The current systematic review and meta-analysis was performed using the Preferred Reporting Items for a Systematic Review and Meta-analysis statement for Diagnostic Test Accuracy Studies (PRISMA-DTA) and was registered on PROSPERO.

Results: A total of 163 studies were included. The overall sensitivity, specificity, DOR and AUC for SSEP were found to be 71.4% (54.8-83.7), 97.1% (95.3-98.3), 41.9 (24.1-73.1) and 0.899, respectively; for MEP, these were 90.2% (86.2-93.1), 96% (94.3-97.2), 103.25 (69.98-152.34) and 0.927; for EMG, these were 48.3% (31.4-65.6), 92.9% (84.4-96.9), 11.2 (4.84-25.97) and 0.773; for multimodal, these were found to be 83.5% (81-85.7), 93.8% (90.6-95.9), 60 (35.6-101.3) and 0.895, respectively. Using the QUADAS-2 ROB analysis, of the 52 studies reporting on SSEP, 13 (25%) were found to be high-risk; for MEP, 8 (11.7%) were high-risk; for EMG, 4 (25%) were high-risk and for multimodal, 14 (20.3%) were high-risk.

Conclusion: These results indicate that all neuromonitoring modalities have acceptable diagnostic utility in successfully detecting impending or incident intraoperative neurologic injuries among patients undergoing spine surgery for any condition.

A PILOT STUDY OF CLINICAL RISK PREDICTION OF 90-DAY REINTERVENTION FOLLOWING LOWER EXTREMITY ANGIOPLASTY

Kennedy Ayoo[1], Ben Li[1], Mohammed Al-Omran[1], Elisa Greco[1], Mohammad Qadura[1], Mark Wheatcroft[1], Muhammad Mamdani[2], Charles de Mestral[1,2]

[1] Division of Vascular Surgery, Department of Surgery, University of Toronto, Toronto, Ontario
[2] Li Ka Shing Knowledge Institute of St. Michael's Hospital. Toronto, Ontario

Purpose & Hypothesis: To develop a simple approach to clinical risk prediction of 90-day reintervention following lower extremity angioplasty.

Methods: Data from the St. Michael's Hospital Vascular Quality Improvement Program was used to identify all patients who underwent a lower limb angioplasty +/- stenting from July 1, 2019 -June 30, 2022. Demographic, clinical presentation, and angiographic data were collected from medical records. The cohort was classified by likelihood of 90-day endovascular or surgical reintervention based on clinical presentation and angiographic result, as defined a priori: (i) *Definite,* where part of the established treatment plan, *(ii) Unlikely,* where no limb-threatening ischemia and successful target lesion revascularization without iatrogenic complication, (iii) *Possible*, all others. The frequency and type of reintervention within 90 days were captured and considered across clinical risk prediction groups.

Results: 145 patients were treated with lower limb angioplasty +/- stenting. 33 (22.8%) required reintervention within 90 days: 10 of 10 (100%) in the *definite* group, 20 of 87 (23.3%) in the *possible* group and 3 of 48 (6.2%) in the *unlikely* group. Patients in the *definite* group underwent 8 minor amputations, 1 endovascular and 1 open revascularization. In the *possible* group, reinterventions included 4 major amputations, 8 minor amputations, 5 open and 3 endovascular revascularization and 1 thrombin injection to treat a pseudoaneurysm. No amputations or open revascularizations occurred in the *unlikely* group. There were 2 endovascular reinterventions for contralateral disease and 1 thrombin injection to correct a pseudoaneurysm.

Conclusions: Simple risk stratification based on clinical presentation and angiographic result may provide reliable prediction of 90-day re-intervention risk following lower-extremity angioplasty for high and low risk patients.

VALIDATION OF THE LIFT-OFF SCREW TECHNIQUE IN PATIENTS UNDERGOING CORRECTIVE OSTEOTOMY FOR MALUNITED DISTAL RADIUS FRACTURES

Brent D Bates, Jonathan Persitz, Andrea HW Chan, Ryan A Paul
Division of Orthopaedic Surgery and Division of Plastics & Reconstructive Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: Malunion is a common complication of non-operative management of distal radius fractures (DRF) and can lead to poor functional outcomes. Corrective osteotomy (CO) is an option to improve patient satisfaction. The Lift-Off Screw (LOS) technique described by Roebke et al. uses the equation $L_s = [\tan(T_c) * L_p + C] / [\cos(\theta_s)]$ to plan the sagittal plane deformity correction based on a calculated LOS length. We aim to clinically validate this technique for volar tilt correction (VTC) in patients undergoing CO for dorsally angulated DRF malunions. We hypothesize that the clinical VTC will be within 5 degrees of the calculated VTC, with a strong correlation between LOS length and clinical correction achieved ($r > 0.7$).

Methods: We retrospectively reviewed twenty-three patients with dorsally angulated DRF malunions treated with CO using the LOS technique. We compared the calculated VTC to the clinical VTC achieved, using Student's t-test and Pearson correlation coefficient (alpha = 0.05).

Results: Pre-operative volar tilt ranged from -6° to -50° (mean = -22.9° ± 10.6°), with an average desired correction of 32.5° ± 9.6°. The clinical VTC was 25.7° ± 9.4°. The difference between clinical and calculated correction was -7.0°, with an average post-operative clinical volar tilt of 2.8° ± 5.7°, compared to calculated volar tilt of 9.8° ± 2.4° ($p < 0.001$). There was a strong correlation between LOS screw length and clinical VTC achieved ($r = 0.79$).

Conclusions: This study is the first to describe the LOS technique in a clinical setting of CO for malunited DRF. We demonstrate that this technique under-estimates the clinical correction achieved by 7-degrees, which may be attributed to the effect of soft tissues and bone quality in a clinical setting. This under-correction should be anticipated by clinicians and considered in future implant and cutting guide designs. Further research is needed to explore the implications of under-correction on functional outcomes following use of this technique.

EXAMINING ACCESS TO VASCULAR SURGERY CARE FOR INDIGENOUS PATIENTS IN NORTH WEST ONTARIO

Asha Behdinan (SSTP), Richard Foty, Ben Chan, Mary MacDonald, Ahmed Kayssi
Division of Vascular Surgery, Department of Surgery, University of Toronto, Toronto, ON

Purpose & Hypothesis: Indigenous patients in Ontario face a disproportionately higher rate of lower extremity amputation compared with the general population. The primary purpose of this translational research study is to identify systemic barriers impeding access to vascular surgery care and propose areas for intervention to ultimately improve limb salvage for Indigenous patients requiring vascular intervention in North West Ontario.

Methods: A mixed-methods approach was undertaken for this study. Process mapping was conducted with a quality improvement team at Thunder Bay Regional Health Sciences Centre, in order to engage key stakeholders to model the flow of the system and subsequently identify where gaps in accessing vascular care exist requiring intervention. Semi-structured interviews were then conducted with health care workers identified through a snowball sampling strategy, in order to further explore the barriers to accessing vascular care and possible change ideas.

Results: A high-level process map was developed and analyzed to highlight barriers to care and gaps in knowledge. Key themes that were identified through semi-structured interviews included health systems capacity, physical barriers to accessing care, cultural and societal impact on the patient population, and a lack of sustained provider awareness. Recommendations currently include increased education on peripheral arterial disease, awareness on referral pathways, and research to quantify the magnitude of this problem.

Conclusions: The barriers to accessing vascular surgery care faced by Indigenous patients with tissue loss are complex and multi-faceted. Future work will include the validation of study results, and development and implementation of systemic changes to improve limb preservation outcomes in collaboration with Indigenous patient representatives.

STAGE II/III ESOPHAGEAL CANCER PATIENTS WITH COMPLETE CLINICAL RESPONSE POST NEOADJUVANT CHEMORADIOTHERAPY – A MARKOV DECISION ANALYSIS OF ACTIVE SURVEILLANCE VS SURGERY

Adom Bondzi-Simpson (SSTP)[1] [*]; Tiago Ribeiro (SSTP)[1,2] [*]; Biniam Kidane[3]; Michael Ko[4]; Natalie Coburn[1,2,5]; Girish S Kulkarni[6]; Julie Hallet[1,2,5]
[1]Division of General Surgery; [3]Section of Thoracic Surgery, University of Manitoba; [4]Division of Thoracic Surgery; [6]Division of Urology. *Authors contributed equally

Background: Chemoradiation followed by esophagectomy is the standard of care for locally-advanced esophageal cancer (LAEC) patients. Esophagectomy is a highly morbid procedure, and recent evidence suggests select patients may benefit from omitting or delaying surgery. The purpose of this study is to compare surgery versus active surveillance for patients with LAEC and a complete clinical response (cCR) after neoadjuvant chemoradiotherapy (nCRT). **Methods:** A decision analysis with Markov modelling was used to simulate outcomes. The base case was a 60-year-old male with LAEC with cCR after nCRT. The decision was modelled for a 5-year time horizon. The measured outcomes were life years (LY) and quality-adjusted life years (QALYs). Probabilities and utilities were derived through literature search. Deterministic sensitivity analyses were performed using ranges from literature with consideration for clinical plausibility. **Results:** Upfront surgery was favored over active surveillance for survival with an expected LY of 2.89 versus 2.64. After incorporating utilities, active surveillance was favored with an expected QALY of 1.70 versus 1.56. The model was sensitive to the probability of recurrence on active surveillance (threshold value 0.598), probability of recurrence with node positive disease (0.663), probability of recurrence being local (resectable) (0.318) and disutility of prior esophagectomy (-0.091). The model was not sensitive to perioperative morbidity and mortality. The model demonstrated validity through consultation with content experts and comparative analysis with published literature. **Conclusions:** Active surveillance resulted in an incremental gain of 0.14 QALYs, and an incremental loss of 0.25 LYs. The incremental change is insufficient to make broad clinical or policy directed recommendations, however according to the model both choices appear reasonable decisions and should be considered in the context of patient values and goals.

EXAMINING THE ROLE OF CX3CR1 IN DEGENERATIVE CERVICAL MYELOPATHY

Sydney Brockie, Cindy Zhou, Mandana Movahed, James Hong, Michael G. Fehlings
Krembil Research Institute, Toronto Western Hospital, and the University of Toronto

Degenerative cervical myelopathy (DCM) is the most common form of spinal impairment worldwide and is caused by a series of degenerative changes that compress the spinal cord. DCM can be treated with surgical decompression (DEC), but recovery is impaired by secondary injury, such that 44% of patients who undergo DEC never regain lost function, and 9% experience persistent decline. The fractalkine receptor, CX3CR1, is expressed by monocyte-derived macrophages and CNS-resident microglia, where it mediates communication with neurons expressing its ligand, CX3CL1, and maintains phagocytic, migration, and injury response functions. **Purpose and Hypothesis:** The purpose of this study is to determine the role of fractalkine in degeneration and post-surgical injury**.** We hypothesize that CX3CR1 expression is elevated by DCM and DEC and that inhibiting it may attenuate inflammation and improve functional outcomes. **Methods:** To determine this, I am using a mouse model of C5-6 myelopathy in Cx3cr1-knockout and wildtype mice to produce functional degeneration and neuropathic pain across a 12-week period. **Results:** Immunostaining of spinal tissue from myelopathic wildtype mice indicates upregulation of CX3CR1 throughout DCM and confirms this expression to be mediated by resident microglia. Despite failing to produce major functional benefits, knocking out fractalkine signalling attenuates neuropathic pain across DCM progression. Following DEC, these benefits are reversed, and knockouts experience more pain up to 5 weeks post-surgery, suggesting a critical role for CX3CR1 in mediating secondary injury and chronic pain. I am now using immunostaining to investigate markers of degeneration and secondary injury in the spinal tissue of these animals. This will be used to assess degeneration and surgical recovery in the absence of fractalkine signalling and shed light on potential mechanisms involved. My findings thus far indicate a significant role played by fractalkine signaling in DCM and DEC recovery and posit microglia as a target for therapeutic intervention.

THE USE OF A STANDARDIZED SURGICAL CASE LOG TO DOCUMENT OPERATIVE EXPOSURE TO PROCEDURAL COMPETENCIES IN A SPINE SURGERY FELLOWSHIP CURRICULUM: A UNIVERSITY WIDE INITIATIVE

Ahmed Cherry, Albert Yee, Nadia Jaber, Michael Fehlings

Introduction and Purpose: Currently, there is a paucity of Canadian literature assessing the competencies required and exposure of trainees completing a spine fellowship in Canada. The purpose of the current study is to highlight the surgical exposure of fellows pursuing subspecialty spine training at the University of Toronto.

Methods: Data from 2015-2022 was obtained via case-logs entered into the T-res logbook software by fellows in the University of Toronto Spine fellowship program.

Results: A total of 9275 cases were logged (average of 1325 cases/year). Fifty-one percent of cases were performed at Toronto Western Hospital, with 29% performed at Sunnybrook Health Sciences Center. Diagnoses at the time of surgery was degenerative or inflammatory in 58.3% of cases. (58.3%) and 1047 cases of deformity (11.2%). Of the remaining primary diagnosis identified, 11.2% were deformity, 3.6% infection, 10.2% tumour/malignancy and 9.3% traumatic spine injuries. Seventy-seven cases involved the occiput (0.83%), 2455 cases the cervical spine (26.4%), 2076 the thoracic spine (22.4%), 4265 the lumbar spine (46.0%) and 68 the sacral region (0.73%). The highest number of cases logged by a single trainee was 235 procedures in an academic year, with a mean of 77 cases performed by each fellow annually over the seven year collection period.

Conclusion: The use of a standardized case-log for procedure tracking can be an effective way to document trainee exposure to procedural competencies during fellowship. Documented exposure is increasingly being requested by hospitals during the credentialling process for surgical privileges. Case-logs are one of several accepted methods for capturing training exposure as part of the Royal College of Physicians and Surgeon's accredited Area of Focused Competence (AFC) diploma pathway. Fellowship educators can also leverage case-log data to advance curriculum opportunities that further develops training experience.

3D BIOPRINTED DECELLULARIZED SKIN SUBSTITUTE REINFORCED WITH PCL/PEG/SILVER FOR ENHANCED BURN HEALING

Faraz Chogan[1], Yufei Chen[2], Siba Haykal[1,3], Marc G. Jeschke[1,2,3]
[1]Institute of Medical Science, Temerty Faculty of Medicine, University of Toronto, ON, Canada
[2]Department of Surgery, Faculty of Health Sciences, McMaster University, Hamilton, ON Canada
[3]Division of Plastic and Reconstructive Surgery, Department of Surgery, Faculty of Medicine, University of Toronto, Toronto, ON Canada

About 45,000 burn injuries occur annually in Canada, with 2,000 requiring hospitalizations. Globally, burns result in 2.9 million hospitalizations, making them the fourth most common and one of the deadliest injuries worldwide. Therefore, challenging burn treatment demands innovative solutions. 3D bioprinting is a promising tissue engineering technique for producing readily available skin substitutes to improve burn healing outcomes.

Objectives: The main objective of this study is to develop a 3D bioprinted skin substitute to improve burn wound healing. In this study, a 3D bioprinted skin substitute comprised of decellularized extracellular matrix (dECM) and biodegradable PCL/PEG/Ag Nps was fabricated.

Methods: PCL/PEG and Ag Nanoparticles were mixed, freeze-dried, and pestled to obtain powdery printing materials. Taguchi's design of experiments (DoE) was used to optimize the 3D printing process. For dECM bioprinting, dECM-based skin was developed using validated porcine skin decellularization procedures.

Results: Bioprinting parameters were optimized to produce a 6-layer skin substitute with 56% porosity, and 218µm mean diameter. Histological analyses confirmed the absence of cells in the dECM matrix, and the dECM bioink was designated a thermosensitive hydrogel for 3D bioprinting.

Conclusions: The outcomes of this study demonstrated the promising potential of 3D bioprinting technology to develop skin substitutes for skin tissue engineering applications through the combination of decellularized porcine skin and biodegradable synthetic polymers.

METAL HYPERSENSITIVITY IN FOOT & ANKLE ORTHOPAEDIC SURGERY: A SYSTEMATIC REVIEW

Caroline Cristofaro, Ellie B. Pinsker, Fatima Halai, Jesse Wolfstadt, Gavin Wood, Timothy R. Daniels, Mansur Halai
Division of Orthopaedic Surgery, Department of Surgery University of Toronto

Hypothesis and Purpose: Metal hypersensitivity affects 10-15% of individuals. Orthopaedic implants contain various metals and, therefore, metal hypersensitivity may impact patient outcomes. Our goal is to provide an overview of symptoms, diagnostic methods, treatment, and clinical outcomes through this systematic review on metal hypersensitivity in patients undergoing foot and ankle (F&A) surgery.

Methods: A comprehensive literature search of Ovid MEDLINE and EMBASE was performed from its inception (01-Jan 1966) to 23-Nov 2021. All full-text, English, experimental and observational studies reporting on metal hypersensitivity in the context of foot or ankle surgeries using metallic implants were included. Article screening, critical appraisal, and data extraction was performed by two reviewers with a third reviewer resolving disagreements.

Results: Fifteen studies were identified, reporting on 45 patients (18M:27F). Median age was 58 years and mean follow-up was 20.8 months. In total, 19 patients (42.2%) were diagnosed with metal hypersensitivity to a constituent of their implant, including two (4.4%) patients diagnosed without metal hypersensitivity testing. Of the 19 patients allergic to a constituent of their implant, 14 underwent hardware removal and improved. Twenty-three patients retained their hardware, and two symptomatic patients underwent hardware removal.

Conclusion: Metal hypersensitivity in foot or ankle surgery should be a differential diagnosis in patients who present with hypersensitivity-type symptoms once infection and mechanical failure are ruled out. This review provides a comprehensive algorithm for identifying and treating metal hypersensitivity in foot or ankle patients.

FETAL RABBIT UMBILICUS ABLATION USING HIGH INTENSITY FOCUSED ULTRASOUND: EVALUATION WITH ULTRAFAST ULTRASOUND POWER DOPPLER

Ava Danialy[1,2], Nikan Fakhari[3], Craig Macsemchuk[1,2], Amanda Headrick[2], Suzanne Wong[1,2], Jerome Baranger[3], Karolina Piorkowska[2], Tim Van Mieghem[4], Olivier Villemain[3], James M. Drake[1,2], Adam C. Waspe[2]

[1]Institute of Biomedical Engineering, University of Toronto, [2]Neurosciences and Mental Health, Hospital for Sick Children,[3]Translational Medicine, Hospital for Sick Children, [4]Maternal and Fetal Medicine, Mount Sinai Hospital

Purpose and Hypothesis: Magnetic resonance (MR) guided HIFU can effectively ablate and occlude the umbilical cord vessels in fetal rabbits while preserving viability for untreated fetuses.

Methods: One New Zealand white rabbit was treated at E27 (fetuses were 6-7 centimeters long). Ultrasound was performed to confirm placental blood flow and heart rate. MRI evaluated the size and positioning of the fetuses. MRgHIFU ablated the umbilical cord vessels in three fetuses with a power of 120W for 20s, with 3-7 treatment cells each, depending on their positioning and location. Post-treatment ultrasound evaluated the placental perfusion and viability of targeted fetuses. Necropsy confirmed HIFU lesions.

Results: Thermometry confirmed temperatures above 60 ℃ suggesting ablation was achieved. Post-treatment ultrasound confirmed decrease of the blood volume of placental perfusion in one of the treated fetuses by 90.5% (Figure 1). Necropsy confirmed termination of two of the target fetuses and showed viability of one adjacent untreated size-matched control fetus. Ablation marks were visible on the liver or placenta during necropsy in 100% of cases. Location of the HIFU mark on f1 confirmed excessive movement leading to its survival.

Figure 1B-mode and ultrafast power-Doppler ultrasound, blood volume dropped by 90.5%

No off-target heating in the uterus of the mother was found during necropsy.

Conclusion: MR-guided HIFU therapy can effectively ablate the fetal umbilical artery and vein, on the liver, in rabbit fetuses without harming non-targeted fetuses. This can serve as a model for a treatment procedure for twin-reversed arterial perfusion (TRAP) sequence. Doppler ultrasound can reliably confirm viability of non-targeted fetuses.
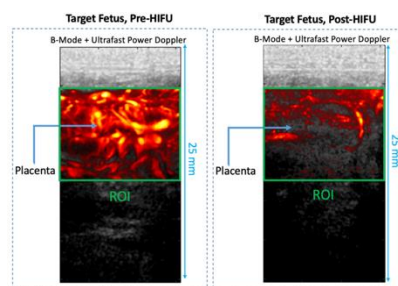
THE ROLE OF GENDER IN PERCEIVED CARDIOVASCULAR RESIDENCY TRAINING: A CANADIAN EXPERIENCE

Shaidah Deghan Manshadi, Sneha Raju, Harsukh Benipal, Nader Chaya, Jean Jacob-Brassard, Thomas Forbes, Elisa Greco

Division of Vascular Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: In medicine, there is an underrepresentation of women and individuals from minority groups. The purpose of the current study was to better understand the impact of gender and visible minority(VM) status on training experiences among residents and fellows training in vascular surgery, cardiac surgery, and cardiology. **Methods:** This prospective survey-based study utilized a previously validated 95-item questionnaire. The survey was emailed to residents and fellows enrolled in all Canadian training programs from November 2021 to January 2023. **Results:** Of the estimated 198 residents invited, a total of 76 (38.4%) completed the survey. Majority of respondents were Canadian Medical Graduates (78.9%), non-immigrant (64.5%), non-minority (56.6%), and from a Caucasian background (50.0%). A Kruskal-Wallis analysis revealed that compared to males, females reported a statistically significant higher lack of gender diversity in their clinical staff (H(2) = 8.348, p = 0.015), with a mean rank score of 41.42 for female and 27.67 for male. A statistically significant proportion of females reported receiving less training opportunities in clinical and OR environments compared to their male colleagues (H(2) = 9.867, p = 0.007), with a mean rank score of 36.27 for female, 24.10 for male. Furthermore, a significantly higher number of females reported being called "doctor" less often ($p<0.001$), and patients were more surprised that they are a cardiovascular specialist ($p<0.001$). Female trainees reported higher incidences of unprofessional comments directed to them by patients ($p<0.24$) and higher unsolicited personal life advice directed at them by colleagues and patients ($p<0.005$). **Conclusions:** We provide the first Canadian perspective on the role of gender, and VM status on cardiovascular specialty training. Notably, we report adverse training experiences for residents who identify as females.

Translational Research

MACROPHAGE ENRICHMENT IN CDH FETAL HYPOPLASTIC LUNGS AND THE IMMUNO-MODULATORY EFFECTS OF AMNIOTIC FLUID STEM CELL EXTRACELLULAR VESICLE THERAPY

Fabian Doktor, Rebeca Figueira, Kasra Khalaj, Matisse Blundell, Lina Antounians, Augusto Zani
Division of General and Thoracic Surgery, Dept. of Surgery, University of Toronto, Toronto, ON

Hypothesis and Purpose: Experimental studies suggested that fetal lungs secondary to congenital diaphragmatic hernia (CDH) have an inflammatory signature that contributes to impaired branching. Herein, we investigated the: 1) inflammatory profile of lungs in a CDH mouse model; 2) anti-inflammatory effects of amniotic fluid stem cell extracellular vesicles (AFSC-EVs).

Methods: CDH was induced in C57BL/6J mice (AUP#64247) by maternal administration of nitrofen/bisdiamine (E8.5). Lungs were harvested on E18.5, grown as lung explants for 72h and treated with AFSC-EVs. AFSC-EVs were isolated by ultracentrifugation, characterized by size (Nanosight), shape (electron microscopy), and canonical markers (Western blot). Lungs were compared for macrophage count (CD68), proinflammatory cytokine/chemokine expression (TNFα and Cxcl1), and airspace density (mean linear intercept [MLI]). RAW264.7 cells were stimulated with lipopolysaccharide, treated with AFSC-EVs or medium, and compared for TNFα expression.

Results: Compared to controls, CDH lungs had increased macrophage density ($p<0.0001$), higher expression of proinflammatory cytokines/chemokines such as TNFα and Cxcl1 ($p=0.0008$; $p=0.01$ respectively) and an increased MLI ($p=0.006$). Treatment with AFSC-EV *ex vivo* decreased the amount of TNFα ($p=0.05$) and Cxcl1 ($p=0.04$) and rescued lung branching by decreasing MLI ($p=0.03$). AFSC-EV administration to RAW264.7 cells confirmed these results with restored TNFα expression ($p=0.006$).

Conclusions: This study provides unprecedented evidence that macrophages play an active role in CDH pulmonary hypoplasia and are a novel treatment target to restore lung development. AFSC-EVs rescue lung branching in part through anti-inflammatory and immuno-modulatory properties.

CORRELATION OF GENETIC MUTATION WITH OUTCOMES IN CHILDREN WITH HEREDITARY SPHEROCYTOSIS UNDERGOING PARTIAL SPLENECTOMY

Tamara Dubljevic, Eveline Lapidus-Krol, Manuel Carcao, Jacob C Langer
Divisions of General Surgery, and Hematology/Oncology, Hospital for Sick Children

Purpose and Hypothesis: Hereditary Spherocytosis (HS) is a common hematological disorder which has been associated with several different genetic mutations coding RBC membrane proteins. Children with severe HS often undergo either partial or complete splenectomy; partial splenectomy has the theoretical advantage of maintaining splenic immune function, but may be associated with splenic regrowth, recurrent hemolysis, and need for completion splenectomy. We hypothesized that surgical and hematological outcomes after partial splenectomy are influenced by a child's genetic mutation.

Methods: After obtaining Research Ethics Board (REB) approval, children with HS who underwent laparoscopic partial splenectomy at the Hospital for Sick Children between 2000 and 2020 were reviewed. The primary outcome was need for completion splenectomy. Secondary outcomes were perioperative complications and initial hematological response to surgery.

Results: Thirty-two children met our inclusion criteria. Of these, 16 had an ANK1 mutation, 10 had an SPTB mutation, and 6 had an SPTA1 mutation. There was a trend toward a greater need for completion splenectomy in children with the SPTA1 mutation (83% vs 30% and 31%, p=0.06 ANOVA), but statistical significance was not reached likely due to small sample size. All other outcomes were similar among groups.

Conclusion: Children with the SPTA1 mutation may have a worse outcome after partial splenectomy for HS. This is the first stage of a multicentre study involving 10 centres in North America and Europe. Once data collection has been completed from all sites, we hope to be able to draw more conclusive results, which could potentially permit better selection of patients for partial vs. complete splenectomy based on the child's genetic mutation.

LONG-TERM OUTCOMES OF FENESTRATED/BRANCHED ENDOVASCULAR ANEURYSM REPAIR IN OCTOGENARIANS

Tiam Feridooni[1], Lauren Gordon[1], Asha Behdinan[1], Naomi Eisenberg[1], Sean Crawford[1], Thomas F. Lindsay[1], Graham Roche-Nagle[1]
[1]University Health Network, Peter Munk Cardiac Centre, Division of Vascular Surgery, University of Toronto, Toronto, Ontario, Canada.

Purpose: We examined the perioperative, postoperative and long-term outcomes of fenestrated/branched endovascular aneurysm repair (F/BEVAR) in octogenarians compared to nonoctogenarians. **Methods**: A retrospective analysis of the Vascular Quality Improvement database from 2012 to 2022 was performed. The patients were stratified into two groups: those aged <80 years and those aged ≥80 years. The preoperative, intraoperative, and postoperative factors were compared between the two groups. Primary outcome of interest included long-term all-cause mortality; secondary outcomes included aortic-specific mortality and aortic-specific reintervention. **Results**: A total of 6007 patients (age <80 years, n = 4860; age ≥80 years, n = 1147) who had undergone F/BEVAR procedures were included. Five-year survival was lower in octogenarians (83% vs. 71%, hazard ratio (HR) 1.70; [95% CI 1.46 – 2.0], $p < 0.0001$). Multivariate Cox proportional hazard analysis demonstrated that age was associated with increased all-cause mortality (HR 1.72, [95% CI 1.39 – 2.12], $p < 0.001$) and aortic-specific mortality (HR 1.92, [95% CI 1.04 – 3.68], $p = 0.038$). Crawford extent II aortic disease was associated with increase in all-cause mortality (HR 1.49; [95% CI 1.01 – 2.19], $p < 0.001$), aortic-specific mortality (HR 5.05; [95% CI 1.35 – 18.9], $p = 0.016$) and aortic-specific reintervention (HR 1.91; [95% CI 1.24 – 2.93], $p = 0.003$). Functional dependence was associated with increased all-cause mortality (HR 2.90; [95% CI 1.87 – 4.51], $p < 0.001$), aortic specific mortality (HR 4.93; [95% CI 1.69 – 14.4], $p = 0.004$). **Conclusions**: Our findings suggest that F/BEVAR in octogenarians is associated with periprocedural outcomes equivalent to those for younger patients but with a higher long-term all-cause mortality. Despite this, when adjusted for other risk factors, age is a moderate risk factor and special consideration should be given to octogenarians with poor functional dependence and Crawford extent II aortic disease.

MEASURING DIFFERENT DESIGN APPROACHES OF CLINICAL CRANIAL IMPLANTS – WHAT SHOULD AUTOMATED METHODS STRIVE TO REPLICATE?

Zachary Fishman[1], James G. Mainprize[2], Glenn Edwards[2], Oleh Antonyshyn[2,3], Michael Hardisty[1,4], Cari M. Whyne[1,4,5]

[1]Orthopaedic Biomechanics Laboratory, Sunnybrook Research Institute; [2]Calavera Surgical Design Inc.; [3]Division of Plastic Surgery, Sunnybrook Health Sciences Centre; [4]Department of Surgery, University of Toronto; [5]Institute of Biomedical Engineering, University of Toronto

Purpose and Hypothesis: New machine learning and statistical shape modelling approaches aim to automate the design process for patient-specific cranial implants, as highlighted by the MICCAI AutoImplant Challenges. To ensure applicability, it is important to determine if the training data used in developing such algorithms represent the geometry of implants designed for clinical use. In this analysis, measuring and comparing cranial implant geometry (thickness, width) can help explain the different approaches used for designing clinical cranial implants.

Methods: Calavera Surgical Design provided a dataset of 206 post-craniotomy skulls and their clinically used implants. The MUG500+ dataset includes 29 craniotomy skulls and implants designed for AutoImplant training. For both implant and skull shapes, the inner and outer cortical surfaces were segmented, and the thickness between them was measured. For the clinical implants, a 'rim' was defined that transitions from the repaired defect to the surrounding skull. For unilateral defect cases, implants were mirrored to the contra-lateral side of the skull and geometry differences were quantified. **Results**: The average thickness of the clinically used implants was 6.0 ± 0.4 mm, which approximates the thickness on the contra-lateral side of the skull (relative difference of -0.3 ± 1.4 mm). The average thickness of the MUG500+ implants was 2.8 ± 1.1 mm, significantly thinner than the intact skull (relative difference of 2.9 ± 1.2 mm). Rim transitions in the clinical implants (average width of 7.4 ± 2.7 mm) were used to create a smooth boundary with the skull. **Conclusions**: This shape analysis quantifies design features of cranial implants that can be used to help guide automated design algorithms to generate implants suitable for clinical use.

AUGMENTED REALITY PLATFORMS FOR SURGICAL INTERVENTION IN LOW- TO MIDDLE- INCOME COUNTRIES: A SCOPING REVIEW

Mikael L. Gouwtama, Kai Iwano, Lai N. Tse, Michael E. Chua, Elena Springall
Division of Urology, Hospital for Sick Children, Toronto, Ontario
Global Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: The purpose of this study is to describe the current reported clinical experience on the application of AR for surgical care in low- to middle-income countries (LMIC). We hypothesized that Innovative augmented reality (AR) technology could address some barriers to timely and quality surgical care in low-resource areas.

Methods: Systematic literature search was performed in May 2022, with an updated search on July 2022 on Medline, EMBASE, Web of Science, and Scopus. Literature was screened and identified as relevant to AR utilization in surgical care among LMICs. Included studies were clustered based on AR platforms and described the reported application in different surgical fields. This scoping review was part of a systematic review registered on PROSPERO CRD42021288630 and conducted according to the PRISMA extension for scoping reviews.

Results: Eight reports were identified describing AR utilization for surgical care/education in LMICs, reported between 2014 to 2021 in Eurasia (n=4), Africa (n=3), and South America (n=3). AR was used in a variety of surgical specialties: plastic (n=2), orthopedics (n=1), general surgery (n=1), neurosurgery (n=1), urologic (n=1), ophthalmology (n=1), and endoscopic (n=1). Among the AR platforms, google glass is the most used (n=3), then Proximine (n=2), SurgTime (n=1), VIPAR (n=1), and AR headset (n=1). Most of reports (n=6) were descriptive qualitative feasibility reports, and 2 reports were prospective observational study.

Conclusion: There are various reports on the clinical utilization of AR in global surgical outreach to underserved communities in LMICs. However, AR developments are required for a seamless experience.

WHAT IS THE EFFECT OF RURALITY ON OUTCOMES FOR PARATHYROIDECTOMY IN A LARGE NORTH AMERICAN JURISDICTION?

Rogeh Habashi [1], Bahar Golbon [1], Jonas Shellenberger [2], Jesse David Pasternak [1]
[1]Endocrine Surgical Oncology, University Health Network, University of Toronto,
[2]ICES, Queen's University

Purpose: While parathyroidectomy outcomes correlate positively with case-volumes, little is known about outcomes across the rurality index (RI). Considering the growing demographic shift away from urban centers post-pandemic, this study investigates parathyroidectomy outcomes across the RI spectrum in Ontario.

Methods: We performed a retrospective study of all patients with classical primary hyperparathyroidism who underwent parathyroidectomy between 04/2016-12/2019 in Ontario. Using univariate analyses, we investigated demographics, surgeon volume and outcomes by RI.

Results: All 5,136 parathyroidectomies were performed in the most urban regions. Surgeons in the most populous region performed 35% (1,816) of operations while those in the most rural region performed only 2% (110).

General surgeons operated more in cities (40% urban vs. 10% rural) although parathyroidectomies were more likely performed by Otolaryngologists, particularly in rural settings (60% urban vs. 78% rural). Urban surgeons had >6-times the yearly volume (37 vs. <6, p<0.0001) and performed more outpatient surgery (34.2% vs. 4.5%, p<0.0001). Similar mean preoperative calcium (11.42mg/dL), cure rate (91.8%) and 30-day morbidity (3%) were seen across RI.

Conclusions: Parathyroidectomy was performed exclusively in larger communities. RI did not influence outcomes. Referral patterns and surgeon practice likely push some patients to larger communities, signaling a possible undertreatment of those in remote regions.

NOVEL CT-GUIDED TRANSBRONCHIAL LUNG PHOTODYNAMIC THERAPY IN RATS

Yoshihisa Hiraishi, Fumi Yokote, Andrew Effat, Takamasa Koga, Hiroyuki Ogawa, Yuki Sata, Shinsuke Kitazawa, Kate Kazlovich, Nicholas Bernards, Gang Zheng, Kazuhiro Yasufuku
Latner Thoracic Research Laboratory, Toronto General Hospital, University Health Network, Toronto, ON, Canada

Hypothesis and Purpose: Photodynamic therapy (PDT) is one of the therapeutic modalities for localized lung cancer and is a minimally invasive treatment using a bronchoscope. Preclinical transbronchial PDT experiment in small animals is considered challenging as it requires ventilatory support, a thin laser fiber, and fiber guidance to precise localizations. The purpose of this proof-of-concept study is to establish a technique for ventilator-assisted CT-guided lung PDT in rats.

Methods: 14–16 week-old male Sprague-Dawley rats received an intravenous porphyrin lipoprotein (PLP, 4mg/kg) or vehicle control 24 hours prior to PDT. Rats were intubated with a 14-gauge angiocatheter, received ventilatory support under isoflurane anesthesia. A micro-CT scan also confirmed the intubation tube position. Rat was then placed left-sided and a thin laser fiber (Thorlabs M135L02, 0.2 mm O.D.) was delivered into the left lung base under CT guidance. Laser ablation was performed at 100 J/cm2 with a 671 nm laser source. One and six days after PLP-PDT, respectively, rats were dissected after evaluation of chest CT, and fluorescence measurements of PLP (Xenogen IVIS Spectrum, Ex/Em: 605/680 nm filtered) and pathology in the explanted lung were examined.

Results: Shadows were visible on the chest CT at one and six days post laser ablation at the site of irradiation. Pathology showed hemorrhage and necrosis consistent with the irradiated area; PLP fluorescence in lung was stronger at one day post laser ablation, but was still visible at day 6. All rats survived postoperatively without evident complications.

Conclusions: We performed rat PLP-PDT with precise fine-diameter fiber delivery under CT guidance. We established a useful model for preclinical testing of human PDT.

AUGMENTED REALITY TECHNOLOGY FOR SURGICAL EDUCATION IN MEDICAL STUDENTS: A SCOPING REVIEW

Kai Iwano, Mikael L Gouwtama , Lai-Nam Tse, Elena Springall, Michael E Chua
Division of Urology, Hospital for Sick Children, Toronto, Canada and Global Surgery, Department of Surgery, University of Toronto, Canada

Purpose/Hypothesis: Augmented reality (AR) technology offers a range of benefits in medical education, including the ability to simulate medical procedures and provide interactive anatomical models. The purpose of this study is to describe the state and application of AR among medical students in the current literature. We hypothesized that the use of augmented reality (AR) technology in medical students has improved surgical learning.

Method: A literature search was performed in May and July 2022 on Medline, Web of Science, EMBASE and Scopus. An additional search was conducted in August 2022 on PubMed. The literature was screened for random-control trials, surveys, and comparative studies relevant to AR in medical students. The included studies were separated according to AR platforms, outcomes, and findings. This scoping review was carried out following the PRISMA extension for scoping reviews. It is part of a systematic review that was registered on PROSPERO under CRD42021288630.

Results: 26 studies were identified between 2013-2022 describing the utilization of AR in medical students. The most prevalent outcome measured was performance/error/proficiency (n=13). The findings in these studies showed increased surgical performance/shorter task time (n=10) and better learning experience/outcome (n=13). Microsoft HoloLens (n=5) was the most used among the AR platforms.

Conclusion: AR technology shows to be promising for medical students regarding surgical performance, knowledge and learning experience. However, further research should be conducted to investigate the feasibility of AR technology in medical student learning.

ACELLULAR EX VIVO LUNG PERFUSION SILENCES PRO-INFLAMMATORY PATHWAYS IN HUMAN LUNG ENDOTHELIAL AND EPITHELIAL CELLS

Jamie E. Jeon[1,2], Lei Huang[1,3], Zhiyuan Zhu[1,4], Aaron Wong[1], Shaf Keshavjee[1,5], Mingyao Liu[1,5]

[1]Latner Thoracic Surgery Research Laboratories, University Health Network; [2]Department of Physiology, University of Toronto; [3]Department of Thoracic Surgery, Huazhong University; [4]Department of Otolaryngology, Nanjing University; [5]Department of Surgery and Institute of Medical Science, University of Toronto

Purpose and Hypothesis: Ex vivo lung perfusion (EVLP) with acellular Steen solution has shown promising clinical outcomes as a platform to evaluate and repair marginal donor lungs, while lung ischemia-reperfusion (IR) injury remains a major post-transplant complication. The purpose of this study was to reveal the molecular responses of human lung cell types to IR and EVLP. We hypothesized that transcriptomic analyses of cell cultures simulating IR and EVLP would help us understand cell-type-specific molecular mechanisms.

Methods: We first incubated human pulmonary microvascular endothelial cells (HPMEC) and human lung epithelial cells (BEAS-2B) in DMEM+10%FBS at 37°C until sub-confluent. Next, the cells underwent 18H of cold ischemia in Perfadex solution at 4°C. Then they were perfused for 4H with either DMEM+10%FBS (IR model) or Steen (EVLP model) at 37°C. RNA samples were collected after 18H of cold ischemia and 4H of reperfusion and EVLP. Total bulk RNA sequencing data were analyzed with R, GSEA, and Cytoscape to identify differentially expressed genes and enriched pathways.

Results: Endothelial and epithelial cells had significant changes in their gene expressions after IR and EVLP simulations. Pathway enrichment analyses revealed significant up-regulation of pro-inflammatory signaling and down-regulation of cell metabolism in the IR models. In contrast, the pathway clusters involved in inflammatory responses were absent in the EVLP models.

Conclusion: Human lung endothelial and epithelial cells were activated by IR, but EVLP with acellular Steen solution kept the cells from inducing inflammatory responses. This finding may help explain how acellular EVLP impacts different cell types that lead to great clinical outcomes.

THRIVING, NOT SURVIVING: POSITIVE EXPERIENCES IN SURGICAL PRACTICE

Stephanie Jiang, Sydney McQueen, Melanie Hammond Mobilio, Aiden McParland, Ranil Sonnadara, Carol-Anne Moulton
Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose: A career in surgery impacts the life of a surgeon in many ways. Current research is dominated by many of the negatives, such as stress and burnout, with little attention paid to the positives. This study explored positive experiences in surgical practice to develop an improved understanding of the nuanced nature of a surgical career and how surgeons thrive.

Methods: This study was a secondary analysis of data gathered from research on the multidimensional experience of flow in surgery. Semi-structured interviews were conducted with 19 staff surgeons. Data unrelated to the experience of flow specifically but that revealed insight to the positive aspects of surgical practice were included, and a thematic analysis approach was used to organize data into descriptive themes.

Results: A descriptive framework was used to highlight key contributors to positive surgical experiences. Three synergistic elements were identified as: 1) Mastery, 2) Meaning, and 3) Matrix. Participants shared that the ability to apply strong technical skills (Mastery) to perform an operation on a patient in need (Meaning), brought a deep sense of purpose to their lives. A positive surgical career further required a supportive team and workplace culture (Matrix). Overall, participants described the positive impacts of their career on a spectrum of the objective (e.g. developing technical mastery) to the existential (e.g. giving meaning to their life), as "every opportunity, every operation [was] an opportunity to give someone their health back." (P16)

Conclusions: Positive experiences in surgical practice are embedded in an intricate network of psychosocial, individual, and institutional factors, which allow for many opportunities for surgeons to find enjoyment in their career and ultimately thrive.

EARLIER TRACHEOSTOMY REDUCES COMPLICATIONS IN COMPLETE CERVICAL SPINAL CORD INJURY IN REAL-WORLD PRACTICE: ANALYSIS OF A MULTI-CENTER COHORT OF 2001 PATIENTS

Vishwathsen Karthikeyan[1], Michael Balas[1], Blessing N.R. Jaja[2], Erin M. Harrington[1], Andrew S. Jack[3], Johann Hofereiter[1], Armaan K. Malhotra[1], Rachael H. Jaffe[4], Yingshi He[1], James P. Byrne[5], Jefferson R. Wilson[1,2,4], Christopher D. Witiw[1,2,4]

[1]Division of Neurosurgery, St. Michael's Hospital, University of Toronto, Toronto, Ontario; [2]Li Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, Ontario; [3]Division of Neurosurgery, University of Alberta, Edmonton, Alberta; [4]Institute of Health Policy Management and Evaluation, University of Toronto, Toronto, Ontario; [5]Department of Surgery, Johns Hopkins Hospital, Baltimore, Maryland, USA

Hypothesis and purpose: This observational cohort study aims to assess whether early tracheostomy is beneficial in patients with acute traumatic cervical spine injury (CSI).

Methods: We collected data from the Trauma Quality Improvement Program database from 2010 to 2018, including adult patients with traumatic CSI that underwent surgery and tracheostomy. Patients were stratified into those receiving early tracheostomy (<= 7 days) and delayed tracheostomy. Propensity score matching was used to assess the association between delayed tracheostomy and the risk of in-hospital adverse events including mortality, major complications, and immobility-related complications. Risk-adjusted variability in tracheostomy timing across trauma centers was also investigated using mixed-effects regression.

Results: In total, 2001 patients met the inclusion criteria of which 654 patients underwent early tracheostomy. After matching, the odds of a major complication were significantly lower for patients that had an early tracheostomy (OR: 0.90; 95% CI: 0.88 to 0.98). Patients were also significantly less likely to experience an immobility-related complication (OR: 0.90; 95% CI: 0.88 to 0.98). Patients in the early group spent 8.2 fewer days in the critical care unit (95% CI: -10.2 to -6.61) and 6.7 fewer days ventilated (95% CI: -9.44 to -5.23). There was significant variability in tracheostomy timeliness between trauma centers with a median odds ratio of 12.2 (95% CI: 9.7 to 13.7) that was not explained by case-mix and hospital-level characteristics.

Conclusion: Early tracheostomy appears to be associated with reduced in-hospital complications, time in the critical care unit and time on mechanical ventilation. Notably, there is substantial unexplained variability in tracheostomy timing between centers.

EFFECT OF TIME-TO-SURGERY (EARLY VS. DELAYED) ON CLOSED DISTAL RADIUS FRACTURE OUTCOMES

Shawn Khan, Jonathan Persitz, Andrea Chan, Ryan Paul
Hand Program, Division of Plastic, Reconstructive and Aesthetic Surgery, Toronto Western Hospital, and Temerty Faculty of Medicine, University of Toronto, Toronto, ON, Canada

Hypothesis & Purpose: It remains unclear whether time-to-surgery for distal radius fractures has an impact on clinical, functional, or radiographic outcomes and health care costs. We hypothesize that early time to surgery (< 2 weeks) is associated with superior outcomes for closed, isolated distal radius fractures in adult patients.

Methods: A comprehensive search of MEDLINE, Embase, and CINAHL was completed for all original case series, observational studies, and randomized controlled trials reporting clinical outcomes of both early and delayed surgically-treated distal radius fractures from database inception to July 01, 2022. A consistent threshold of two weeks was used to define early versus delayed treatment arms.

Results: Nine studies, 16 intervention arms and 1,189 patients (858 early, 331 delayed) were included. Mean age was 58 years (range, 33 – 76). At greater than one year, the frequency-weighted mean DASH score was 4 in the early group (n = 208; range, 1 – 17) and 21 in the delayed group (n = 181; range, 4 - 27). Range of motion, grip strength and radiographic outcomes were comparable. The pooled mean complication rate (7% vs. 5%) and revision rate (3.6% vs. 1%) were very low in both groups.

Conclusion: Delay in time-to-surgery greater than two weeks for distal radius fractures may be associated with inferior patient-reported outcomes. Early surgery was associated with improved long-term DASH scores. Based on the available evidence, range of motion, grip strength and radiographic outcomes are similar. The complication and revision rates were very low in both groups and comparable.

AUTOMATED 3D SPINE ANGLE MEASUREMENTS OF METASTATIC VERTEBRA

Geoff Klein[1,2], Isaac Carreno[3], Joel Finkelstein[2,3,6], Arjun Sahgal[2,4,5], Jay Detsky[2,4,5], Cari Whyne[2,6], Anne L. Martel[1,2], Michael Hardisty[2,6]
[1] Medical Biophysics, University of Toronto; [2] Sunnybrook Research Institute; [3] Orthopaedic Surgery, Sunnybrook Health Science Centre; [4] Radiation Oncology, Sunnybrook Health Science Centre; [5] Radiation Oncology, University of Toronto; [6] Surgery, University of Toronto

Aim: Vertebral metastases can lead to biomechanical instability, pain, and neurological compromise. Stereotactic body radiation therapy (SBRT) delivers high-dose focal treatment to tumours. A significant side effect of SBRT is vertebral compression fracture (VCF), occurring in 10% to 40% following SBRT. Spinal malalignment (scoliotic/kyphotic deformity) has been shown to be related to vertebral fracture risk following SBRT. However, the current evaluation of spinal malalignment can be time-consuming with substantial inter-observer variation. As such, an automated algorithm to evaluate the spinal angle in the coronal and sagittal plane was developed using 3D CT scans and applied to patients with spinal metastases.

Methods: A deep learning end-to-end vertebral instance segmentation model was developed using an open dataset of labelled CT images of the spine (VerSe 2020) to anatomically localize, segment, and classify individual vertebrae in a 3D CT scan. This enabled quantification of the angles was done by averaging the angles measured by two methods: by taking the gradient of a spline fit through the vertebral body centroids; from the dot product between two lines generated by contours from segmentation predictions. This model was applied to SBRT-treated patients at the Odette Cancer Centre. Ground truth angle measurements (114 coronal; 108 sagittal) were performed by an orthopedic spine surgeon receiving fellowship training.

Results: Angle measurement achieved a mean absolute error of 4.6° (95% CI, 3.8°-5.4°) and 5.9° (95% CI, 5.0°-7.2°) in the coronal and sagittal planes, respectively, showing state-of-the-art performance for simultaneous coronal and sagittal angle measurements.

Conclusions: An automated algorithm was developed to measure angles for both scoliotic and kyphotic deformity from 3D CT scans. Future work will focus on combining angle measurements with other imaging features related to fracture risk to improve overall fracture risk predictions.

FIRST-IN-HUMAN CLINICAL TRIAL TO ASSESS KIDNEY TRANSPLANT QUALITY USING PHOTOACOUSTIC IMAGING

Alexander Koven (SSTP)[1,2], Eno Hysi[2], Monica Farcas[1,2], Robert Stewart[1,2], Michael Ordon[1,2], Kenneth Pace[1,2], Xiaolin He[2], Michael Kolios[2], Darren Yuen[2]
[1]Division of Urology, Department of Surgery, University of Toronto, Toronto, Ontario
[2]Li Ka Shing Knowledge Institute, St. Michael's Hospital, Unity Health Toronto

Purpose and Hypothesis: While kidney transplantation has revolutionized the treatment of kidney failure, donor kidneys are in short supply. This leads physicians to accept kidneys from older and sicker donors. Many of these have pre-existing fibrosis and microvascular disease, which can cause damage and kidney function loss after transplantation. Unfortunately, current clinical tools fail to capture these injuries. Our group has developed a novel photoacoustic (PA) imaging technique to simultaneously measure collagen (the main component of fibrosis) and perfusion parameters. In this work, we validate our hypothesis that PA imaging can noninvasively measure fibrosis and perfusion in human kidneys at the time of transplantation.

Methods: A VevoLAZR-X US/PA imaging system (680-930 nm, 15 MHz) was utilized for imaging. A unique spectral unmixing algorithm was implemented to simultaneously quantify collagen and perfusion parameters, such as oxygen saturation (sO2) and total hemoglobin (HbT). Donor kidneys were imaged before transplantation during cold storage to measure PA fibrosis scores and then after transplantation post-perfusion to measure PA perfusion parameters. For the primary outcome, PA fibrosis scores were correlated with fibrosis determined by PSR-stained biopsy sections. Clinical outcomes are also being collected for up to 5 years post-transplant.

Results: 21 patients have been imaged and analyzed to date. Comparison with PSR-stained biopsies confirmed the accuracy of PA to assess fibrosis (r=0.85). Post-perfusion, sO2 and HbT estimates were acquired, with the average sO2 increasing by approximately 20%.

Conclusions: This is the first in-human study applying PA imaging to non-invasively and accurately measure kidney fibrovascular disease burden at the time of transplantation. Next steps will be to correlate imaging scores with clinical outcome data. Once complete, we expect our results will help optimize donor kidney selection and matching to the most appropriate recipients.

NIMBLE – AN ARTIFICIAL INTELLIGENCE-BASED PREDICTION TOOL FOR TUMOUR PROGRESSION IN NON-MUSCLE INVASIVE BLADDER CANCER

Jethro C.C. Kwong (SSTP)[1,2], Kellie Kim[3], Zizo Al-Daqqaq[3], Cynthia Kuk[1], Nathan Perlis[1], Jason Y. Lee[1], Robert J. Hamilton[1], Neil E. Fleshner[1], Antonio Finelli[1], Alexandre R. Zlotta[1], Alistair E.W. Johnson[2,4], Girish S. Kulkarni[1,2]

[1]Division of Urology, Department of Surgery, University of Toronto; [2]Temerty Centre for AI Research and Education in Medicine, University of Toronto; [3]Temerty Faculty of Medicine, University of Toronto; [4]Division of Biostatistics, Dalla Lana School of Public Health

Purpose and Hypothesis: Current nomograms to predict risk of tumour progression in non-muscle invasive bladder cancer (NMIBC) do not reflect current practice and perform poorly on external validation. We hypothesized that artificial intelligence (AI) approaches may improve prediction of tumour progression in contemporary NMIBC patients.

Methods: NIMBLE was trained on patients treated from Jan-2005 to Oct-2014 at the University Health Network (n=564). Predictors included age, sex, history of urothelial cancer, stage, grade, concomitant carcinoma-in-situ, tumour burden and size, and type of intravesical therapy. Internal validation was performed on patients treated from Oct-2014 to Dec-2020 at the same institution (n=142). External validation was performed on a publicly available dataset of patients treated from Oct-2004 to Dec-2013 at Seoul National University, South Korea (n=198). Primary outcome was time-to-progression, defined as relapse of pT2 disease or higher. NIMBLE hyperparameters were tuned to optimize c-index. NIMBLE was compared against the EAU risk groups and a previously published AI model trained on a multi-institutional European cohort (AI-EUR).

Results: Median follow-up was 4.7 years (IQR 2.2-8.3) and 14% of patients developed tumour progression. NIMBLE was well-calibrated and achieved a c-index of 0.81 (95% CI 0.77-0.85) on training, 0.79 (95% CI 0.61-0.93) on internal validation, and 0.78 (95% CI 0.68-0.87) on external validation. In contrast, the EAU risk groups and AI-EUR had a c-index of 0.54-0.77 and 0.60-0.67, respectively.

Conclusion: NIMBLE performed favourably compared to contemporary prediction tools. Ongoing work is being conducted to evaluate the safety and generalizability of NIMBLE in other community and academic institutions.

PARTIAL SCAPHOLUNATE INTEROSSEOUS LIGAMENT INJURIES: A SYSTEMATIC REVIEW OF TREATMENT OPTIONS

Darius Lameire, Hassaan Abdel Khalik, Ryan Paul, Herbert P. von Schroeder, Andrea H.W. Chan
Division of Orthopaedic Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose: This systematic review summarizes the existing evidence on treatment options and outcomes for partial scapholunate interosseous ligament (pSLIL) injuries.

Methods: A systematic electronic search of MEDLINE, EMBASE, CINAHL was carried out from inception through to February 13, 2022. All primary research articles addressing the treatment of pSLIL tears were eligible for inclusion regardless of timing of surgery, surgical technique, or rehabilitation. The PRISMA Checklist guided the reporting and data abstraction.

Results: A total of 14 studies with 342 patients were included for analysis. Treatments were categorized into four groups: electrothermal shrinkage (ES), arthroscopic capsuloplasty (AC), open capsulodesis (OC), no treatment (NT). There were five studies in the ES group (N=69, mean age = 34.3 ± 3.3 years), three studies in the AC group (N=138, mean age = 32.2 ± 3.8 years), five studies in the OC group (N=123, mean age of 30.7 ± 7.8 years), and one study in the NT group (N=12, mean age = 43 years). The average postintervention VAS Pain score for the ES group was 1.4 ± 0.5 (from 5.7 ± 1.8), for the AC group was 3.2 ± 1.3 (from 6.6 ± 0), for the OC group was 2.3 ± 2.1 (from 5.6 ± 1.6), and for the NT group was 3.2 (from 7.6). In the ES group there were 3 complications (11.5%, no major complications), in the AC group there was one major complication (0.9%, complex regional pain syndrome (CRPS)), and in the OC group there were six complications (15.4%, four major complications – CRPS).

Conclusion: All interventional treatment options (ES, AC, and OC) provided significant improvements in patient-reported pain, range of motion, grip strength, and radiographic parameters, with low complication rates. In comparison, no improvement in range of motion or grip strength was noted in the NT group. Therefore, surgical management of pSLIL injuries is an effective and relatively safe treatment option.

RESTORING BIVENTRICULAR INTERACTION IMPROVES LEFT VENTRICULAR FUNCTION FOLLOWING TRICUSPID VALVE SURGERY IN EBSTEIN ANOMALY

Myunghyun M. Lee[1], Leyre Alvarez Rodriguez[2], Ayako Ishikita[2], Rachel M. Wald[2], Osami Honjo[1], David J. Barron[1]
[1]Division of Cardiovascular Surgery, Hospital for Sick Children, University of Toronto
[2]Division of Cardiology, Toronto General Hospital, University of Toronto

Hypothesis and Purpose: To assess biventricular interaction and function in Ebstein anomaly with restored tricuspid valve competence using cardiac magnetic resonance imaging (CMR).

Methods: Consecutive adult and pediatric patients undergoing tricuspid valve surgery (TVS) for Ebstein anomaly from 1976 to 2021 were screened. Exclusion criteria were incomplete CMR, prior TVS, and presence of a bidirectional cavopulmonary shunt. Biventricular dimensions and function were assessed using indexed end-diastolic and end-systolic ventricular volumes, and ejection fraction, respectively. Two-sample t-tests were used for analyses.

Results: A total of 9 adult Ebstein patients underwent both preoperative and postoperative CMR (median age at repair 31.2 years; interquartile range [IQR] 27.6-34.5 years). Surgical techniques were cone reconstruction (n=4) and Danielson repair (n=5). Postoperative CMR was reviewed at a median follow-up of 8.0 years (IQR: 3.3-10.2 years). All had improvement in tricuspid regurgitation. Functional right ventricular end-diastolic volume decreased from 222 mL/m^2 to 148 mL/m^2 (p=0.023). Right ventricular end-systolic volume remained unchanged. Functional right ventricular ejection fraction decreased from 49% to 39% (p=0.045). Left ventricular end-diastolic volume increased from 65 mL/m^2 to 76 mL/m^2 (p=0.043). While left ventricular end-systolic volume remained unchanged, left ventricular ejection fraction increased from 54% to 60% (p=0.045).

Conclusions: Surgical correction of Ebstein anomaly reduces tricuspid regurgitation and right ventricular dimension. Restoration of right ventricular geometry and biventricular interaction may help improve left ventricular diastolic function resulting in higher left ventricular preload and ejection fraction.

BLACK-VS-WHITE RACIAL DISPARITIES IN 30-DAY OUTCOMES FOLLOWING REVISIONAL BARIATRIC SURGERY: AN MBSAQIP DATABASE ANALYSIS

Soomin Lee, Matthew M Hutter, James J Jung
Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: Previous studies demonstrated Black-vs-White disparities in postoperative outcomes following primary bariatric surgery, including higher complication, readmission, and mortality rates[1-5]. With revision bariatric surgery becoming more common, accounting for 17% of American bariatric cases in 2019[6], there is a need to examine racial disparities in revisional surgery outcomes. The purpose of this study is to explore Black-vs-White disparities in postoperative outcomes following revisional bariatric surgery.

Methods: We conducted an observational cohort study of adults who underwent revision Roux-en-Y gastric bypass, sleeve gastrectomy, duodenal switch, or one-anastomosis gastric bypass in the United States and Canada using the 2015-2020 MBSAQIP database. Propensity score was used to 1:1 match Black and White patients across 19 covariates. McNemar's test with Benjamini-Hochberg procedure was used to compare 12 postoperative outcomes modeled in the MBSAQIP semi-annual reports and mortality between matched cohorts.

Results: We identified 10,838 Black and 37,075 White patients who underwent revisional bariatric surgery and 21,314 patients were matched. There were no significant Black-vs-White differences in mortality, morbidity, all-occurrence morbidity, all-cause reoperation, related reoperation, all-cause intervention, related intervention, serious event, and bleeding. Interestingly, Black patients experienced higher rates of postoperative all-cause readmission (p=0.005) and related readmission (p=0.011), but lower rates of surgical site infection (p=0.036).

Conclusions: Overall, postoperative outcomes were similar between Black and White adults who underwent revisional bariatric surgery, which differ from previous findings of racial disparities in primary bariatric surgery. Further elucidating the patient-, procedure-, and system-level differences between primary and revisional bariatric surgery may provide insights into addressing the racial disparities demonstrated after primary bariatric procedures.

DEFINING AIRWAY CLAMPING PRESSURE EFFECTS ON THE PRESERVATION OF DONOR LUNG FUNCTION DURING COLD STATIC STORAGE

Thomás Lima[1], Juan Montagne[1], Jenny Yune[1], Gabriel Siebiger[1], Bruno Pinto[1], Yu Zhang[1,] Vinicius Michaelsen[1], Aizhou Wang[1], Lorenzo Del Sorbo[1], Patrik Rogalla[2], Marcelo Cypel[1]
[1]Latner Thoracic Surgery Laboratories and [2]Joint Department of Medical Imaging, University Health Network, University of Toronto

Hypothesis and Purpose: Lung procurement techniques and protocols play a crucial role in ensuring successful lung transplantation. Yet, they offer no clear definition of airway clamping pressure (AwCP), despite its important role in preventing atelectasis and providing a suitable milieu for continued lung metabolism during preservation. An optimal AwCP could preserve recruitment, avoid overdistention, and result in better and more consistent grafts. **Methods:** Lungs from living pig donors were randomly subjected to one of three AwCP (10 cmH$_2$O, 20 cmH$_2$O or 30 cmH$_2$O). After procurement, lungs were imaged in a 640-slice MDCT (Aquillion One, Canon Medical system and stored at 10℃ for 24h(CIT) before being re-scanned and physiologically assessed on Ex-Vivo Lung Perfusion (EVLP) for 6 hours. Performance was evaluated hourly on EVLP as well as by metabolomic analyses of the perfusate and tissue. Lung volumes and densities were derived from pre and post-CIT scans using Vitrea (Vital Images, Minnetonka, MN). **Results:** All lungs experienced a 30% volume loss by the end of CIT. Both low and high-pressure lungs exhibited heterogeneous physiological performance and increased lung weight gain after EVLP. High-pressure lungs showed high frequencies of parenchymal overinflation, but this was not predictive of poor performance or weight gain. Notably, all lungs exhibited less than 1% of tissue classifiable as poor or not inflated. **Conclusion:** our study shows that even the lowest pressure implemented was sufficient to prevent radiological atelectasis, and a clamping airway pressure of 20cmH2O offers the most consistent and positive results. Future studies will assess whether delivering an active airway pressure to maintain constant volume could further benefit lung preservation.

INDOLEAMINE-2,3-DIOXYGENASE 1 AND 2 ARE EXPRESSED IN HEPATOBLASTOMA CELLS AND DIFFERENTIALLY ASSOCIATED WITH HIGH-RISK DISEASE.

Lisandro Luques[1], Ashby Kissoondoyal[1], Emily De Sousa[1], Paula Quaglietta [1], Reto Marc Baertschiger [1,2]

[1] Genetics and Genome Biology Program, The Hospital for Sick Children (SickKids), Toronto, ON, Canada. [2] Division of Thoracic and General Surgery, The Hospital for Sick Children (SickKids), Toronto, ON, Canada

Introduction and hypothesis: Hepatoblastoma (HB) is the most common pediatric primary liver malignancy. Treatment and prognosis relay on chemotherapy and complete tumor resection. Patients with high-risk disease have dismal prognosis. The molecular mechanisms underlying the aggressiveness of the tumor are unclear. Indoleamine-2,3-dioxygenases (IDO-1, IDO-2) are enzymes that catabolize tryptophan. Its activity was differentially associated with immunoregulation and tumorigenesis. Dysregulated expression of both was reported in different types of cancer, however it was never assessed in HB. We hypothesize that expression of IDO1, IDO2 or both might be related with the aggressiveness of the tumor.

Purposes: This study aims to determine the expression of IDO-1 and IDO-2 in HB cell lines and to determine if the expression is correlated with patient risk classification.

Methods: Expression of IDO-1 and IDO-2 was determined by real-time-RT-qPCR in HepG2 cells and in three patient derived xenograft (PDX).

Results: Both enzymes were expressed in all the lines. Only the expression of IDO-2 was significantly higher in PDX from high-risk patients than in HepG2 and PDX from low-risk disease ($p < 0.05$).

Conclusions: We report that both IDO-1 and IDO-2 are expressed in HB cells. Our results suggest that IDO-2 but not IDO-1 expression might be related with clinical tumor behaviour. Moreover, these findings support the hypothesis that despite having the same activity, IDO-1 and IDO-2 might play different roles in carcinogenesis.

EVALUATION OF THE EFFICACY OF AN ONLINE LEARNING MODULE TO INCREASE WOUND CARE THEORETICAL KNOWLEDGE AMONGST MEDICAL STUDENTS

Gar-Way Ma[a], Leslie Summers deLuca[a], Julien Bernatchez[a], Cesar Cuen Ojeda[a], Anjali Chauhan[a], Daniel Botros[a], Omar Selim[a], Ahmed Kayssi[a]
[a]Division of Vascular Surgery, Sunnybrook Health Sciences Centre, University of Toronto

Objective: We developed and evaluated an online learning module for teaching wound care basics to junior medical learners, which was assessed for its ability to increase theoretical knowledge of wound care, and medical learners' perceptions on the use of an online module to teach wound care practices. *Design:* Between February 2022 to November 2022, participants were enrolled into our unblinded, matched-pair single-arm study. Participants completed a pre- and post-quiz prior to and after completing the online module, respectively. Scores on the pre- and post-quiz were matched by participant and evaluated for improvement. The online module was composed of free text, animated videos with voiceovers, pictorial examples, and tables, as well as unscored knowledge checks, covering the categories of i) normal wound healing physiology, ii) describing wounds/assessment of wounds, iii) choosing dressings for wounds, and iv) addressing and understanding wound aetiologies, including diabetic, arterial, and venous ulcers. *Participants:* Participants were recruited from the undergraduate medicine and physician assistant programs at the University of Toronto. Students were provided with information on how to participate in the study through email and in-person recruitment. Thirty-three participants entered the study, and 23 participants completed the study. *Results:* Across all participants, the pre-quiz to post-quiz score increase averaged 13.29%, representing a statistically significant increase (p=0.0000013). Ten of the 20 questions and all question categories had a statistically significant increase in the post-quiz scores. All respondents found the module very useful (67%) or extremely useful (33%) for learning wound care, and 67% were very satisfied overall with the quality of the module, with the remainder (33%) of respondents somewhat satisfied. *Conclusions:* Online learning modules are effective at increasing wound care knowledge in junior medical learners, with high satisfaction amongst learners.

INTERDISCIPLINARY OPERATING ROOM ERGONOMICS NEEDS AND PRIORITIES: A SURVEY OF OPERATING ROOM STAFF

Alexis Mah, Fahad Alam, Jeremie Larouche, Marie Antonette Dandal, Tara Cohen, Susan Hallbeck, Emmanuel Tetteh, Hamid Norasi, Csilla Kallocsai, Sapna Siriam, James D Helman, Pablo Perez d'Empaire, Julie Hallet
Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: Poor ergonomics lead to musculoskeletal (MSK) injuries for all operating room (OR) staff, with repercussions on patient care, outcomes, and sustainability. Lack of ergonomic awareness and education are crucial risk factors. This study aimed to examine perceived OR ergonomics successes and barriers for the interdisciplinary team.

Methods: We conducted a self-administered web-based survey of OR nurses, surgeons, and anesthesiologists at a single centre (n=238). The questionnaire was developed through item generation and reduction, followed by reliability, validity and clinical sensitivity testing.

Results: The response rate was 53.8% (nurses 45.2%, physicians 59.3%). Respondents perceived that on average 80% of nurses, 70% of surgeons, and 40% of anesthesiologists had MSK injuries, with no difference across professional groups' perceptions. Even though perceived as beneficial by 80-90% of respondents, recommended ergonomics interventions were rarely used (<25% using), except for specialized clothing (33% using), equipment repositioning (59% using), and sitting (37% using). Reported barriers to optimal ergonomics were organizational (time, space, equipment, funding), whereas solutions were individual. Fear of unfavourable perception from others concerned 62%. Individual ergonomic adaptations were perceived as convenience. Routine team discussion, prioritization, and monitoring of ergonomics was reported by <50%.

Conclusions: While most reported barriers to ergonomics are organizational, solutions appeared as individual responsibilities. Team dynamics were not prioritizing or supporting ergonomics. Education tools leveraging the interdisciplinary team are warranted. Interviews and live observations are under way to build educational tools for OR teams.

CRISPR GENOME EDITING FOR A DUAL MODE IMMUNOMODULATION OF DONOR LUNGS FOR TRANSPLANTATION

Kumi Mesaki, Shaf Keshavjee
Latner Thoracic Research Laboratories, Division of Thoracic Surgery, University Health Network, Institute of Medical Science, University of Toronto, Toronto, ON, Canada

Purpose and Hypothesis: Engineering donor lungs to exert early and long-lasting graft immunomodulation holds promise for addressing the unsolved challenges of early graft injury and chronic rejection in lung transplantation. We hypothesized that combining CRISPR-Cas genome editing with adenoviral vector IL-10 gene delivery could achieve the optimal kinetics of IL-10 expression, an anti-inflammatory and immunomodulatory gene, in the donor lung. The purpose of this study was to explore the feasibility of this approach stepwise, in cultured cells, an *in vivo* rat model, and an *ex vivo* perfused human donor lung. **Methods:** We delivered adenoviral vectors, carrying human IL-10 cDNA, Cas nuclease, and single guide RNA, to cell lines and to rat lungs to evaluate the kinetics of IL-10 expression and genome editing. The guide RNA was designed to target the promoter region of the IL-10 gene. To test the feasibility of immunomodulating human donor lungs, we perfused human donor lungs, which were declined for clinical transplantation, using the Toronto *ex vivo* lung perfusion (EVLP) system, treated with the same adenoviral vectors. **Results:** Simultaneous delivery of human IL-10 cDNA and CRISPR-Cas editing enzymes achieved a dual mode of IL-10 expression: an early increase of IL-10 cDNA (to address the innate inflammation of ischemia reperfuion injury) followed by sustained IL-10 expression (to address ongoing acquired immune allo-rejection) through genome editing *in vitro*. The rat study demonstrated that an early increase of IL-10 with significant editing in lung tissue to 28 days after a single vector dose. The human lung EVLP study demonstrated a significant IL-10 increase during 12 hours of perfusion after vector delivery. **Conclusions:** We have achieved a dual mode of IL-10 graft immunomodulation using a genetic engineering approach, proving the concept in both a small animal model and a human lung study. This strategy was designed to be clinically applicable and we plan to move genetically engineered donor lungs to a clinical trial in the future.

BREAST RECONSTRUCTION USE AND IMPACT ON ONCOLOGIC OUTCOMES AMONGST INFLAMMATORY BREAST CANCER PATIENTS - A SYSTEMATIC REVIEW

Ananya Gopika Nair[1], Gary Ko[2], John L. Semple[1,3], David W. Lim[1,2]
[1]Temerty Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada
[2]Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario, Canada
[3]Division of Plastic, Reconstructive & Aesthetic Surgery, Department of Surgery, University of Toronto, Toronto, Ontario Canada

Purpose and Hypothesis: Breast reconstruction is generally discouraged in women with inflammatory breast cancer (IBC) due to concerns of recurrence and poor long-term survival. We aim to determine contemporary trends and predictors of breast reconstruction and its impact on oncologic outcomes among women with IBC.

Methods: A systematic literature review for studies published up to September 15, 2022, was conducted via MEDLINE, Embase, and Cochrane Library. Studies comparing women diagnosed with IBC undergoing a mastectomy with or without breast reconstruction were evaluated.

Results: The initial search yielded 225 studies, of which nine retrospective cohort studies, reporting 2,781 cases of breast reconstruction in 29,058 women with IBC were included. In the past two decades, reconstruction rates have doubled. Younger age, higher income (>$25,000 USD), private insurance, metropolitan residence, and bilateral mastectomy were associated with reconstruction. No significant difference was found in overall survival, breast cancer-specific survival or recurrence rates between the two groups. Breast reconstruction was associated with an increased risk of postoperative complications when compared with no reconstruction but was not associated with delays in starting adjuvant treatment.

Conclusion: Breast reconstruction after a mastectomy may be an acceptable consideration for select IBC patients. Further research is required to identify optimal candidates.

ASSESSING CLINICIANS' BELIEFS AND PERSPECTIVES TO THE IMPLEMENTATION OF A NOVEL AI CLINICAL DECISION SUPPORT TOOL TO THE SURGICAL WARDS AT ST. MICHAEL'S HOSPITAL

Tiffany Ni, Maryam Wagner, Swanee Tobin, Najma Ahmed, Muhammad Mamdani, James Jung

Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and hypothesis: Artificial Intelligence (AI)-powered clinical decision support systems (CDSS) utilize clinical data to help clinicians in decision-making and downstream management. Despite its great promise, adopting such platforms into clinical practice remains slow and fragmented. A critical driver for the uptake of AI-enabled systems is the perspectives of the clinician end-users. The objective of this study is to examine clinicians' perceived beliefs, barriers, and facilitators to implementing AI-enabled CDSS tools. **Methods:** A literature search was conducted, and in total, 353 articles were reviewed to synthesize the current evidence on factors affecting user perception and uptake of AI-enabled tools in healthcare. We developed a survey tool to assess clinicians' perspectives on seven constructs using a Likert scale of 1 (strongly disagree) to 5 (strongly agree). This survey was piloted by a committee of 5 clinicians and methodologists before being sent to clinician participants. **Results:** We synthesized the following seven constructs based the literature search: performance anxiety, communication barriers, privacy concerns, mistrust in AI mechanisms, social biases, unregulated standards, liability issues. In a preliminary analysis of 14 responses, we identified concerns surrounding the performance, with 10/14 respondents believing that AI-CDSS would not be able to adapt to specific and changing medical situations and 8/14 respondents expressed concerns that AI-CDSS may lead to inaccurate predictions or medical decisions. Our results also show concerns related to patient privacy and the use of data for non-clinical purposes and potentiating underlying social biases. **Conclusion:** Our study bears important implications on how AI-CDSS tools can be better used to assist clinicians in their existing workflow, with the ultimate goal of establishing a synergistic partnership at the human-machine interface.

TRANSPLANTATION OF INDUCIBLE OLIGODENDROGENIC NEURAL PROGENITOR CELLS PROMOTES NEUROREGENERATION AFTER CERVICAL SPINAL CORD INJURY

Katarzyna Pieczonka, Kazuya Yokota, Satoshi Nori, Hiroyuki Katoh, Jian Wang, Tomoko Shindo, Shinsuke Shibata, Mohamad Khazaei, Michael G. Fehlings
Department of Surgery, University of Toronto

Background: Neural progenitor cell (NPC) transplantation is an attractive approach to replace the neural cells that have been lost following spinal cord injury (SCI) and to promote beneficial trophic effects. However, following transplantation, NPCs differentiate into a greater proportion of scar-forming astrocytes, at the expense of oligodendrocytes and neurons. **Purpose and Hypothesis:** We aimed to generate inducible oligodendrogenic NPCs (ioNPCs) that are biased to differentiate into oligodendrocytes. We further aimed to assess the cells in vitro and in vivo in cervical SCI. **Methods:** Human ioNPCs were developed by engineering iPSC-NPCs to express Olig2 under the control of the conditional doxycycline-inducible Tet-ON promoter, followed by subsequent doxycycline treatment. To characterise the cells in vitro, RT-qPCR and immunocytochemistry were used. Next, ioNPCs or vehicle were injected into rats that had a cervical SCI, and locomotor recovery was assessed weekly until sacrifice at fifteen weeks post SCI. Finally, ioNPC differentiation, remyelination and tissue preservation were assessed post-mortem using histological methods. **Results:** RT-qPCR revealed that doxycycline-inducible expression of Olig2 in NPCs contributed to an upregulation in several genes involved in oligodendroglial lineage determination. Immunostaining demonstrated that the ioNPCs gave rise to an increased proportion of oligodendrocytes in vitro and in vivo. Additionally, histological analyses demonstrated that ioNPC transplantation contributed to remyelination and improved tissue integrity. Importantly, ioNPC transplantation correlated with significantly better grip strength compared to vehicle (p < 0.05). **Conclusion:** Overall, this work suggests that ioNPC transplantation is a promising strategy for promoting neuroregeneration following cervical SCI.

Translational Research

SUBCOMMISSURAL-ORGAN-DERIVED PEPTIDE AMELIORATING TISSUE REPAIR AND FUNCTIONAL RECOVERY IN A CERVICAL SPINAL CORD INJURY RAT MODEL

Nayaab Punjani[1], Sighild Lemarchant[2], Svetlana Altamentova[1], Jonathon Chio[1], Jian Wang[1], Yann Godfrin[2], Michael G. Fehlings[1]
[1]Genetics and Development, Krembil Research Institute, University Health Network, and University of Toronto; [2]Axoltis Pharma, Lyon, France

Background: Initial physical trauma in spinal cord injury (SCI) is followed by secondary cascades which involve further neural cell death and scar formation. NX210c is a 12 amino acid peptide derived from the sub-commissural organ (SCO)-spondin, a protein proposed to be involved in vertebrate spinal cord regeneration. **Purpose:** To evaluate the efficacy of NX210c to promote repair and functional recovery in a traumatic cervical SCI model. **Hypothesis:** NX210c will enhance neural repair and regeneration at and across the injury site, thus improving neurobehavioural recovery. **Method:** Female adult Wistar rats (250-300g) will receive a clip compression-contusion SCI at the C6/C7 level of the spinal cord to model traumatic SCI in humans. 66 injured rats will be randomized into 4 groups, to receive one daily dose of either NX210c (8mg/kg) or vehicle intraperitonially for 8 weeks, starting 4 hours (h) or 8 h post-SCI. 12 sham rats will receive a laminectomy and vehicle treatment beginning at 4 h post-surgery. **Results:** Early administration of NX210c increased forelimb strength (grip strength) and improved several aspects of locomotion including regularity index and base of support of the forelimbs (CatWalk) [$p < 0.05$]. When delaying first administration to 8h post-injury, NX210c promoted weight gain [$p < 0.05$], accelerated bladder control recovery from 14 to 9 days post-injury, and improved trunk balance (inclined plane) [$p < 0.05$]. Using histology (n=6/group) we demonstrate greater white matter preservation and reduced cavity size at the injury epicenter, along with higher neuronal soma counts caudally, when NX210c treatment is started 8h post-injury compared to vehicle [$p < 0.05$]. **Conclusion:** NX210c improves motor function and bladder control, while also contributing to improved white matter preservation and neuronal counts. We anticipate that this study will provide a strong proof of concept for its use as a treatment for acute SCI patients.

DEFINITION, FREQUENCY, AND RISK FACTORS FOR INTRA-OPERATIVE SPINAL CORD INJURY: A KNOWLEDGE SYNTHESIS

Ayesha I. Quddusi, Michael G. Fehlings

Institute of Medical Sciences, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: The purpose of this two-part knowledge synthesis is to address the gaps in knowledge regarding a definition for intra-operative spinal cord injury (ISCI), reported frequency of ISCI, and the risk factors associated with it.

Methods: A consensus based *a priori* definition of ISCI was formed after experts' consultation. A scoping review was then conducted to review the literature for definitions currently in use for ISCI and ascertain the frequency of ISCI. A systematic review of the literature was conducted to ascertain the risk factors associated with ISCI. **Results:** Most studies used a combination of intra-operative neuromonitoring (IONM) and post-operative neurological examination to determine ISCI. Loss of signal on IONM of 50% or more was considered indicative of ISCI. Frequency of ISCI had a wide range (0-61%). Tumor surgery demonstrated a greater range of frequency of intra-operative deficits (0-61 %) compared to deformity surgery (0-17.8%), while studies with mixed pathologies reported an intermediate range of 0-9.4%. Older age, male sex and abnormal pulmonary function was associated with ISCI. Use of IONM was associated with a decreased risk of ISCI.

Conclusions: The scoping review evidence corroborates the *a priori* definition of ISCI "a new or worsening neurological deficit attributable to spinal cord dysfunction during spine surgery that is diagnosed intra-operatively via neurophysiologic monitoring or immediately post-operatively based on clinical assessment". The wide range of ISCI frequency shows the variability that exists in the literature due to non-uniform definitions and methods of assessment for ISCI currently in practice. Older age, high grade tumor causing compression, severe rigid deformity requiring multiple osteotomies, and structural pathologies causing myelopathy were considered as high risk for ISCI. This knowledge aids in informed clinical decision-making, potentially leading to the development of an evidence-based care pathway to minimize the risk of and mitigate ISCI.

CAN COSTAL COLLAGEN FIBER ORIENTATION EXPLAIN THE TENDANCY OF WARP IN STRUTS PREPARED FOR NASAL RECONSTRUCTION?

Saba Rafieian[1,2], Cari Whyne[1,2,3], Jeffrey Fialkov[2,3,4]
[1]Orthopaedic Biomechanics Laboratory, Sunnybrook Research Institute; [2]Institute of Biomedical Engineering, University of Toronto; [3]Department of Surgery, University of Toronto; [4]Division of Plastic Surgery, Sunnybrook Health Sciences Centre

Purpose and Hypothesis: In post-traumatic nasal reconstruction, costal cartilage is commonly used to re-create the central "L strut" support in the nose. However, the tendency of this tissue to warp when cut leads to a very limited supply of useful intraoperative graft tissue. It has been postulated that warping may be due to microstructural collagen fiber orientation. This research aims to quantify the relationship between collagen fiber orientation and warp by first characterizing the underlying structure of collagen fibers in human costal cartilage.

Methods: Diffusion Tensor Imaging (DTI) is an MRI technique that uses anisotropic diffusion to estimate the organizational structure of a tissue. DTI parameters were optimized to enable reconstruction of the three-dimensional network of collagen fibers in human costal cartilage (long rib and synchondrosis junction) within a 7 Tesla MRI scanner. To reveal the organization of the collagen fibers, specimens were treated with contrast agent and exposed to diffusion gradients for 21 hours. The collagen fiber network was evaluated from these images using tractography.

Result: A fiber orientation map of costal cartilage generated using tractography shows an arc shaped pattern of collagen fibers in the peripheral zones in the sagittal plane, a dominant fiber direction in the craniocaudal orientation in the midzone, and fibers running lengthwise along the rib cartilage. Release of the outer ring of collagen fibers when costal cartilage struts are cut may release tension in the tissue resulting in warp. Histochemical analysis will be conducted to confirm collagen fiber orientation, and evaluate proteoglycan, and glycosaminoglycan distribution.

Conclusion: The elucidation of the relationship between anatomic morphology (fiber orientation) and biomechanical behaviour (warping) in cartilage may allow for optimized utilization of cartilage for nasal reconstruction. Guiding cuts based on structural knowledge could help to reduce operative time and the potential need for re-operation due to postoperative nasal deformity.

WHAT IF THEY CONTINUED THE PREGNANCY? USING PRENATAL ULTRASOUND FINDINGS TO PREDICT POSTNATAL OUTCOMES FOR FETUSES WITH LOWER URINARY TRACT OBSTRUCTION (LUTO) TO IMPROVE COUNSELING AND AID IN DECISION MAKING

Juliane Richter, Shiri Shinar, Lauren Erdman, Hayley Good, Jin K. Kim, Joana Dos Santos, Natasha Brownrigg, Adree Khondker, Priyank Yadav, Michael Chua, Tim Van Mieghem, Mandy Rickard, Armando J. Lorenzo
Division of Urology, The Hospital for Sick Children, Toronto, ON, Canada

Purpose and Hypothesis: LUTO is usually suspected prenatally based on ultrasound features (USF). Given the unknown postnatal trajectory & the potential for significant morbidity & mortality, many families choose termination of pregnancy (TOP), often based on USF alone. We sought to develop a tool that can be used to predict postnatal outcomes based on combinations of USF to aid with prenatal counseling & parental decision making.

Methods: We collected USF and postnatal need for urinary diversion & renal replacement therapy (RRT) of a LUTO database from a high-risk fetal center & tertiary pediatric center. USFs from a gestational age (GA) of 13-26 weeks for TOPs were collected & matched to fetuses who were not terminated to build a random forest model to predict the most likely postnatal outcomes for TOPs had the pregnancy been continued.

Results: USF from 80 TOPs & 83 livebirths with prenatally suspected LUTO were included with a follow-up time of 2081 days. There were 14 prenatal & 20 postnatal deaths. Dialysis was predicted with the highest accuracy [ACC] of 85% (71% sensitivity [SE], 89% specificity [SP]), death the second highest (81% ACC, 56% SE, 91% SP), transplant the third highest (74% ACC, 40% SE, 88% SP), & diversion the least well predicted (72% ACC, 0% SP, 93% SE). For TOPs, had the pregnancies continued, the model predicted no dialysis or diversion & transplantation in only 1 case, however pre-/postnatal death was predicted to occur in 46 of 80 (58%) cases.

Conclusions: Our data suggests that it is possible to predict postnatal renal replacement therapy from USFs in TOPs had the pregnancy been continued. Predictive accuracy will improve with continued follow-up of more patients, enabling more personalized prenatal & allowing for more informed decision making for families.

INVESTIGATING THE ROLE OF STAT3-MEDIATED ASTROGLIOSIS ON FUNCTIONAL RECOVERY AND NEURAL REPAIR AFTER DCM

Sarah Sadat[1,2], Mandana Movahed[1], James Hong[1], Michael G. Fehlings[1-4]
[1]Division of Genetics and Development, Krembil Brain Institute; [2]Institute of Medical Science, University of Toronto; [3]Division of Neurosurgery, Department of Surgery; and [4]Temerty Faculty of Medicine, University of Toronto

Background: Degenerative cervical myelopathy (DCM), is the most common cause of spinal cord dysfunction amongst adults over the age of 55, characterized by chronic, progressive cervical spinal cord degeneration. The gold standard treatment for DCM is decompression surgery (DEC), which can improve patient function and delay disease progression. However, a significant number of patients experience post-operative complications, potentially due to ischemia-reperfusion injury (IRI). Recent studies indicate that STAT3-mediated astrogliosis may be critical in repairing the blood-spinal cord barrier (BSCB) and reducing leukocyte infiltration after spinal cord injury. **Purpose:** This study aims to determine the role of STAT3-mediated astrogliosis in DCM pathogenesis and DEC-induced IRI. Specifically, it seeks to investigate whether the absence of STAT3 signaling in astrocytes affects neuroprotection against DCM and IRI. **Hypothesis:** We predict that animals with a STAT3-cKO will demonstrate worsened recovery due to attenuated astrogliosis, increased BSCB disruption, and reduced axonal regeneration compared to their wildtype counterparts. **Methods:** Catwalk gait analysis will be performed biweekly, and all animals will undergo DEC surgery at 12 weeks post-DCM. Animals will be sacrificed at 24 hours post-DEC, and 1.5cm of tissue centered on the injury epicentre will be extracted for RNA-sequencing or immunohistochemistry. **Results:** We expect that STAT3-cKO animals will show impaired astrogliosis and reduced axonal regeneration, leading to worsened behavioral recovery following DCM and DEC. **Conclusion:** The study will provide key insights into the role of astrogliosis in DCM pathogenesis and IRI after decompression surgery. The findings may identify new therapeutic targets to minimize post-operative IRI-related complications after surgical decompression.

IMPROVING THE ACCURACY AND SAFETY OF MR-GUIDED LASER INTERSTITIAL THERMAL THERAPY OF THE BRAIN WITH ARTIFICIAL INTELLIGENCE PREDICTION MODELS

Saba Sadatamin[1,2], Steven Robbins[3], Richard Tyc[3], Adam Waspe[1,2], Lueder Kahrs[2], James Drake[1,2]
[1]SickKids Hospital, [2] University of Toronto, [3] Monteris Medical

Hypothesis and Purpose: MR-guided laser interstitial thermal therapy (MRgLITT) is a minimally invasive technology, where a laser thermally ablate epileptic foci and tumors under MR thermometry control. However, the heat distribution from the laser, given the many brain heat sinks, is unpredictable, limiting the technology's utility and safety. We have developed an Artificial Intelligence (AI) based preoperative planning tool, to improve the accuracy and safety of the technique.

Methods: We employed U-Net-based AI models, to find a mapping between MRI anatomical planning images and MR thermometry heatmaps generated during previous MRgLITT procedures from a database held by Monteris Medical. We focused on 81 patients who had temporal lobe thermal ablations for epilepsy. The mapping between the two modalities was modeled for 2D images. Four U-Net-based models were trained and validated on the data set using the structural similarity index (SSIM) and mean squared error (MSE).

Results: Four U-Net-based models were developed, and the best SSIM was 0.8870/1.00 and the MSE was 7.5038 °C². The figure below shows the model input MR temporal lobe image (a), the observed (ground truth) thermometry (b), and the AI-based predicted thermometry (c).
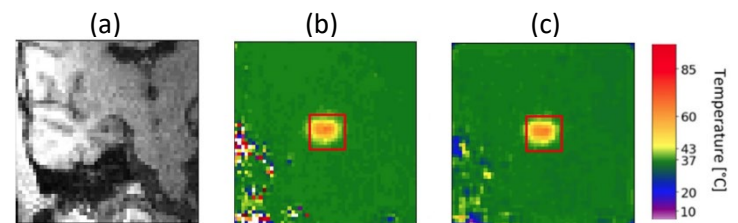
Conclusions: The developed AI-based mapping for MRgLITT procedures can accurately predict the heat propagation distribution for thermometry cases making it a potentially useful planning tool that could improve the accuracy and safety of MRgLITT procedures. The next step will be to test the algorithm on upcoming MRgLITT cases.

IS "RECTOSIGMOID" A DISTINCT PRIMARY SITE OF COLORECTAL CANCER (CRC)?

Paul Savage, David P. Cyr, Sameer Shivji, James Conner, Richard Kirsch, Anand Govindarajan, Satheesh Krishna and Carol J. Swallow

Departments of Surgery, Pathology and Medical Imaging, University of Toronto, Toronto, Ontario, Canada

Purpose and Hypothesis: Given its strong predilection for local and distant recurrence, rectal cancer is managed differently from colon cancer, with respect to pre-treatment staging, neoadjuvant therapy and surgical approach. It is not clear whether primary tumours at the junction between the sigmoid colon and upper rectum ("rectosigmoid") should be treated as colon or rectal cancer. We hypothesized that post-resection pathology findings and patient outcomes for rectosigmoid cancer would resemble those for cancer of the upper rectum. **Methods:** Consecutive patients who underwent resection of colorectal adenocarcinoma at Mount Sinai Hospital from 2011-2016 were identified from a prospective database (N=800). For distal tumours (n=306), pre-treatment CT ± MRI images were reviewed to classify site of primary tumour based on relationship to the sigmoid take-off. Clinico-pathologic features and patient outcomes were compared using Kruskal-Wallis and χ2 tests, and the Kaplan-Meier method. **Results:** Patients were classified as having primary sigmoid (N=147), rectosigmoid (N=89) or upper rectal (N=70) cancer. The proportion who received neoadjuvant therapy was similar for rectosigmoid vs. upper rectal (53% vs. 54%), and less for sigmoid cancer (17%)(p<0.0001). The early re-operation rate was higher following resection of rectosigmoid vs. sigmoid and upper rectal cancer (8% vs. 3% and 0, p=0.02). Positive resection margins were more frequent for rectosigmoid vs. either upper rectal or sigmoid cancer (16% vs. 4% and 5%, respectively p=0.008). At median follow-up of 4.9 yrs (IQR 2.7-6.0), local recurrence in patients with rectosigmoid cancer (13%) approximated that for upper rectal cancer, and was higher than that for sigmoid cancer (HR 7.6, 95%CI 2.2-25.7 rectosigmoid vs. sigmoid, p=0.002). **Conclusions:** Rectosigmoid cancers account for >10% of all CRC and carry a notably high risk of positive resection margins and early reoperation for complications. Local recurrence risk is significant. Management of rectosigmoid cancer should be distinct from that of colon cancer.

MITOCHONDRIAL ISOLATION IN A PORCINE MODEL FOR AUTOLOGOUS MITOCHONDRIAL TRANSPLANTATION IN EX-VIVO LUNG PERFUSION

Gabriel Siebiger[1], Erika Beroncal[2], Aizhou Wang[1], Ana Andreazza[2], Marcelo Cypel[1]
[1]Latner Thoracic Surgery Laboratories, TGHRI, UHN, University of Toronto; [2]Department of Pharmacology & Toxicology, University of Toronto

Hypothesis and Purpose: Autologous mitochondrial transplantation is a promising and innovative therapeutic approach that might allow for improved lung function and amelioration of inflammation in injured lungs allocated for transplantation. Growing literature in the field suggests that preserved, viable mitochondria are required for maximal benefit. Establishing a reliable model for isolating and assessing mitochondrial function, including preserving the donor tissue and evaluating mitochondrial viability in extracorporeal perfusion solutions, is the first step towards moving to trials in large animal models and human lungs. **Methods:** Porcine mitochondria were isolated by automated mechanical dissociation and serial filtration. Liver and skeletal muscle were assessed as potential tissue donors of mitochondria. Following isolation, mitochondrial pellets were assessed through flow cytometry, transmission electron microscopy (TEM), Western blotting, ATP production, and MtDNA content. Different methods of dissociation and filtration were compared, and potential donor tissues were preserved for up to 24h. Finally, isolated mitochondria were suspended in Steen solution (buffered extracellular solution including albumin and dextran 40) to evaluate viability. **Results:** Isolation techniques yielded as much as 99.4% mitochondria with preserved membrane potential, which was maintained at 24h tissue preservation, though ATP concentration and event count was lower. TEM revealed most liver mitochondria retained a condensed state, and preserved mitochondrial count was higher than muscle. ATP production and MtDNA expression in isolated pellets were higher for liver samples. Mitochondria suspended in Steen for 5 minutes preserved viability, which was reduced at 30 minutes. **Conclusions:** Mitochondrial isolation can be achieved successfully in preserved tissue samples, and momentary suspension in Steen solution is feasible for ex vivo applications in lung transplantation.

HEMIARTHROPLASTY FOR UNSTABLE INTERTROCHANTERIC HIP FRACTURES: A MATCHED COHORT STUDY

Jhase Sniderman, Prushoth Vivekananthac, Ajay Shah, Jesse Wolfstadt, Oleg Safir, Alan E Gross, Paul Kuzyk

Division of Orthopaedic Surgery, Department of Surgery, Temerty Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada[1]

Background: Geriatric intertrochanteric fractures remain a significant public health concern due to the considerable disability, morbidity, mortality and healthcare costs associated with these injuries. The underlying poor bone quality and unstable nature of these fractures makes them difficult to treat. The main purpose of this study was to evaluate the outcome of hemiarthroplasty for unstable intertrochanteric hip fractures when compared to the traditional treatment options of open reduction internal fixation (ORIF).

Methods: A retrospective 1:1 matched cohort of 150 patients with intertrochanteric fractures treated with either hemiarthroplasty or ORIF was developed using a local institutional database. Demographic, perioperative and postoperative variables were collected with at least 1 year of patient follow-up. Statistical analysis was performed with use of Student's t-test, chi-square test and ANOVA.

Results: Unstable intertrochanteric fractures treated with ORIF were associated with significantly more blood loss and an increased need for revision surgery. This effect was most pronounced in AO/OTA type 31.A3 fractures, as patients treated with ORIF experienced significantly slower postoperative mobilization, increased blood loss and increased readmission and revision surgery rates. Hemiarthroplasty was associated with an increased risk of greater trochanter escape, which did not appear to effect outcomes in this subset of patients.

Conclusion: Hemiarthroplasty may improve outcomes for patients with unstable intertrochanteric fractures. The benefit of this technique is likely maximized in AO/OTA type 31.A3 fractures. It remains a good option in the hands of experienced surgeons.

PROTOCOL FOR THE DEVELOPMENT OF THE GASTRECTOMY PATHWAY PATIENT EDUCATION TOOL

Gursharan Sohi*, Victoria Delibasic, Shiva Jayaraman, Gordon Tait, Monica Yuen, Leslie Gibson, Leslie Gotlib Conn, Anna Van Osch, Natalie Coburn
Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose & Hypothesis: Gastric cancer (GC) patients frequently report feeling overwhelmed with their prognosis and treatment options following diagnosis. Existing patient information resources regarding GC care are inadequate, despite the understanding that knowledge translation practices are essential contributors to shared decision making and improved outcomes. This project seeks to develop a digital, educational resource for patients undergoing gastrectomy surgery for GC.

Methods: This tool ('the Gastrectomy Pathway') will help to prepare patients for surgery by providing a detailed overview of the gastrectomy procedure as well as pre- and postoperative practices, written in layperson language for accessibility. A dedicated team of medical illustrators will develop accompanying graphics. The content development will be informed by an interdisciplinary team of clinicians as well as patient advocates. A formal impact study will be conducted following Pathway implementation to assess its effectiveness. Outcomes will include scores derived from the Patient Education Materials Assessment Tool and feedback from qualitative interviews with stakeholders.

Results: The primary goal of this project is to increase patient understanding of GC and improve the accessibility of treatment-related resources. The Gastrectomy Pathway will be made freely available on the Internet to allow patients to access high-quality, evidence-based healthcare information using a computer or smartphone.

Conclusions: Existing patient education resources for GC are suboptimal. This ongoing work to design, publish, and evaluate an interactive web-based resource called the Gastrectomy Pathway will help patients and their families better understand their surgery and improve their holistic cancer care.

PREVENTION, DIAGNOSIS, AND MANAGEMENT OF INTRAOPERATIVE SPINAL CORD INJURY IN THE SETTING OF SPINE SURGERY: DEVELOPMENT OF GUIDELINES AND AN EVIDENCE-BASED CARE PATHWAY

Nisaharan Srikandarajah, Nader Hejrati, Mohammed Ali Alvi, Ayesha Quddusi, Ali Moghaddamjou, Brian Kwon, Michael G Fehlings
Division of Neurosurgery and Spine, Department of Surgery, University of Toronto, Toronto, Ontario

Hypothesis and Purpose: Intraoperative spinal cord injury (ISCI) is a challenging complication in spine surgery. Intra-operative neuro monitoring (IONM) has been developed to detect changes in neural function. We report on the first multidisciplinary, international effort through AOSpine and the Praxis Spinal Cord Institute to develop comprehensive guideline and care pathway for the prevention, diagnosis, and management of ISCI.

Methods: This study is a mixed methods approach. Three literature reviews were registered on PROSPERO (CRD 4202229884) and performed according to PRISMA guidelines: 1) Definitions, frequency, and risk factors for ISCI, 2) Meta-analysis of the accuracy of IONM for diagnosis of ISCI, 3) Reported management approaches for ISCI and related events. The results were presented in a consensus session using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) approach with an 80% threshold for inclusion to decide the definition of IONM and recommendation of its use in high-risk cases.

Results: An operational definition and high-risk patient categories cases for ISCI was established. The reported incidence of deficits was documented higher in intramedullary tumour spine surgery (0-61%) with more persistent deficits (26.9%). A random effects model of multimodality IONM has a sensitivity of 0.908 (0.855; 0.943) and specificity of 0.938 (0.906; 0.960). A guideline recommendation of IONM to be employed for high-risk spine cases was made using the GRADE approach. Based on a literature review of management strategies for ISCI a checklist and overall care pathway was developed.

Conclusion: This is the first evidence based comprehensive guideline and care pathway for ISCI using GRADE methodology. This will facilitate a reduction in the incidence of ISCI and improved outcomes from this complication. We welcome the wide implementation and validation of these guidelines and care pathways in prospective, multicentre studies.

3D-PRINTED PATIENT SPECIFIC DRILL GUIDES FOR THE PLACEMENT OF GRAFTS IN AN OVINE OSTEOCHONDRAL ALLOGRAFT TRANSPLANTATION MODEL.

Richard P. Suderman[1], Mark B. Hurtig[2], Sarah L. Aloi[1], Marc D. Grynpas[1,3], Paul R. T. Kuzyk[3], Adele Changoor[1,3]

[1]Lunenfeld Tanenbaum Research Institute, Sinai Health System, Toronto, Ontario. [2]Comparative Orthopaedic Research Laboratory, Department of Clinical Studies, University of Guelph, Guelph, Ontario. [3]Department of Surgery, University of Toronto, Toronto, Ontario.

Purpose and Hypothesis: The purpose of the current study is to design, construct and implement 3D-printed, patient-specific drill guides for use during ovine osteochondral allograft transplantation. The use of 3D-printed drill guides is hypothesized to reduce variability in graft placement and alignment associated with the free-hand drilling technique and overcome challenges associated with inter-species differences when using the ovine model.

Methods: Ovine tibiofemoral joint CT scans were used in combination with custom software [1] to plan graft placement for three sites in the recipient's joint. Guides were designed using 3D modelling software (Materialise Magics v.26). Guides were 3D-printed with an Ultimaker 3 Extended using eSun Polylactic Acid+ material for use during ovine osteochondral allograft transplantation, performed on 14 sheep.

Results: Fourteen sheep underwent bilateral osteochondral allograft transplantation, resulting in 28 operated joints. Feedback on guide use was positive with 70 of 84 grafts visually well-matched with surrounding tissue. Eight of 84 guides were noted to interfere with soft tissue, primarily the patellar tendon, but only half of these (four of 84) were unable to be used due to interference.

Conclusion: The patient specific 3D-printed guides supported perpendicular placement of grafts and matching of joint surface curvature at multiple sites. The use of patient-specific drill guides has usefulness primarily in specialized research settings where multiple grafts are used and proper placement of grafts is a necessity.

References: [1] M. Kunz et al., "Image-Guided Techniques Improve the Short-Term Outcome of Autologous Osteochondral Cartilage Repair Surgeries: An Animal Trial," Cartilage, vol. 4, no. 2, pp. 153–164, 2013.

HIRSCHSPRUNG-ASSOCIATED INFLAMMATORY BOWEL DISEASE (HD-IBD): A MULTICENTER STUDY FROM THE AMERICAN PEDIATRIC SURGICAL ASSOCIATION (APSA) HIRSCHSPRUNG DISEASE INTEREST GROUP

Pattamon Sutthatarn, Eveline Lapidus-Krol, Jacob C. Langer,
for the APSA HD Interest Group
Division of General and Thoracic Surgery, The Hospital for Sick Children

Purpose and Hypothesis: Inflammatory bowel disease (IBD) can rarely develop after surgery for Hirschsprung Disease (HD). The purpose of study was to further characterize HD-IBD, to identify potential risk factors, and to evaluate response to treatment in a large group of patients.

Methods: Retrospective study of patients diagnosed with IBD after pullthrough surgery for HD between 2000-2021 at 17 centres. Clinical presentation and course in this cohort were reviewed and compared to the general population of HD patients from the literature. Effectiveness of medical therapy for IBD was recorded using a Likert scale.

Results: There were 55 patients (78% male). 44% had total colonic disease (compared to 5-10% in the literature). Hirschsprung-associated enterocolitis (HAEC) was reported in 68% (15-50% in the literature). 18% had trisomy 21 (10% in the literature). IBD was diagnosed after age 5 in 63%. IBD presentation consisted of colonic or small bowel inflammation resembling IBD in 69%, unexplained or persistent fistula in 18% and unexplained HAEC >5 years old or unresponsive to standard treatment in 13%. Biological agents were the most effective (80%) medications. A third of patients required a surgical procedure for IBD.

Conclusion: HD-IBD is a rare and poorly understood condition that can occur many years after pull-through surgery. Total colonic HD, HAEC after pull through operation and trisomy 21 may represent risk factors for this condition. Investigation for possible IBD should be considered in children with unexplained fistulae, HAEC beyond age 5, or colonic or small bowel inflammatory disease after pull-through surgery. Biological agents appear to be the most effective treatment, and one third may require surgery for IBD.

MULTIDISCIPLINARY ONCOLOGY EDUCATION AMONG POST-GRADUATE TRAINEES: A SYSTEMATIC REVIEW

Houman Tahmasebi[1], Gary Ko[2], Christine Lam[3], Idil Bilgen[4], Zachary Freeman[5], Emma Reel[6], Marina Englesakis[7], Tulin D. Cil[1,2,6]

[1] Faculty of Medicine, University of Toronto, Ontario; [2] Department. of Surgery, University of Toronto, Ontario; [3] Department of Biology, McMaster University, Hamilton, Ontario; [4] School of Medicine, Koç University, Istanbul; [5] Faculty of Science, Wilfrid Laurier University, Waterloo, Ontario; [6] Sprott Department of Surgery, Princess Margaret Cancer Centre, University Health Network, Toronto, Ontario; [7] Library and Information Services, University Health Network, Toronto, Ontario

Purpose and Hypothesis: The purpose of this study was to conduct a systematic review to assess the state of multidisciplinary oncology education in post-graduate medical training. We hypothesized that training programs are lacking in multidisciplinary oncology education.

Methods: A systematic literature review was performed within MEDLINE, Embase, Cochrane Database of Systematic Reviews, Cochrane CENTRAL, PsycINFO, and ERIC. Original studies reporting the effectiveness of multidisciplinary oncology training among residents and fellows were included. Risk of bias was assessed using the Mixed Methods Appraisal Tool.

Results: Of the 4,959 articles screened, 12 were included. Seven studies analyzed gaps in existing multidisciplinary training of residents and fellows, involving surgical, medical and radiation oncology, geriatrics, and palliative medicine programs. Trainees reported limited teaching and knowledge of oncology outside of their respective fields and endorsed the need for further multidisciplinary oncology training. The remaining five studies assessed the effectiveness of educational interventions in general surgery, radiation oncology, and palliative medicine programs, which included didactic sessions, clinical rotations, and case-based learning. Trainees reported significant improvements in multidisciplinary oncology knowledge and skills following the interventions.

Conclusion: Trainees indicated insufficient multidisciplinary oncology training. Existing educational interventions show promising results in improving trainees' oncology knowledge and skills. There is a need for further research and the development of multidisciplinary oncology curricula for postgraduate medical training programs.

LONG-TERM OUTCOMES FOLLOWING NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS: A POPULATION-BASED ANALYSIS

**Teagan Telesnicki (SSTP), Jordan Nantais, Charles de Mestral,
Anthony De Buck van Overstraeten, David Gomez**
Department of General Surgery, St. Michael's Hospital, Toronto, ON, Canada

Purpose: To describe the real-world treatment failure following non-operative management (NOM) of acute appendicitis (AA).

Methods: We performed a population-based retrospective study of all adult patients presenting to any emergency department (ED) in Ontario between April 2002 and Dec 2019 with a primary diagnostic code for AA. Patients who did not undergo an operative or percutaneous procedure for appendicitis on index presentation comprised the NOM cohort. Patients were followed for the duration of the observation window, with up to 16 years of follow-up. The primary outcome, treatment failure following NOM, was defined by subsequent ED presentation or admission for AA. Time-to-event analysis was performed to describe cumulative incidence of treatment failure, censored for competing risks of all-cause mortality and interval (i.e. scheduled) appendectomy.

Results: Of 176,601 patients identified with an index ED presentation for AA, 21,439 underwent NOM. The NOM cohort included 3,155 patients (14.7%) with complicated appendicitis, as defined by diagnostic codes for abscess or peritonitis. The annual proportion of patients undergoing NOM increased significantly over time (8.5% in 2002 vs.16.2% in 2019, $p<0.001$). The proportion of patients undergoing interval appendectomy was 14.11% at 1 year and 14.91% at 5 years. The cumulative incidence of treatment failure, censored for competing risks of death and interval appendectomy was 5.52% (95% CI: 0.0519-0.0586) at 1 year and 8.62% at 5 years (95%CI: 0.0820-0.0906).

Conclusion: Over the span of over 16 years the proportion of patients undergoing NOM increased significantly. Treatment failure following NOM was lower than previously reported, but the rate of failure continues to increase over time.

AN ADAPTIVE TARGETING ALGORITHM FOR MAGNETIC RESONANCE GUIDED HIGH INTENSITY FOCUSED ULTRASOUND CONTROLLED HYPERTHERMIA
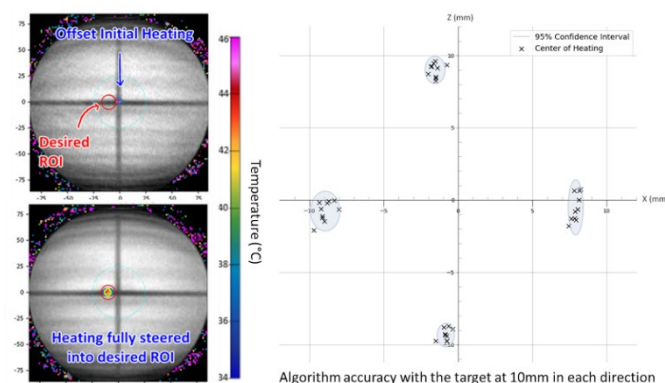
Suzanne Wong[1,2], Phoebe Luo[1], Benjamin Keunen[1], Samuel Pichardo[3], Adam Waspe[1,2], James Drake[1,2]
[1]Hospital for Sick Children, [2]University of Toronto, [3]University of Calgary

Hypothesis and Purpose: An adaptive targeting algorithm was developed to correct mistargeting by using real-time electronic beam steering during magnetic resonance guided high intensity focused ultrasound (MRgHIFU) hyperthermia for cancer therapeutics.

Methods: A temperature tracking algorithm was combined with electronic beam steering for adaptive targeting. The target was purposely offset 10mm from the focus at the origin, with 10 trials in 4 directions within the imaging slice. Hyperthermia was administered to a phantom at 42°C with a Profound Medical Sonalleve V1 HIFU, monitored with a 3T Philips MRI. The HIFU focus location was determined by calculating the center of heating from the MR thermometry.

Results: Over the 40 trials, the average calculated trajectory passed to the HIFU system for electronic beam steering was 9.7mm ± 0.4mm where the target trajectory was 10mm. The accuracy of the adaptive targeting algorithm after the beam steering correction was 0.9mm and the precision was 1.6mm. The adaptive targeting algorithm adaptively corrected the targeting within a performance goal of 2mm, with statistical significance ($p < 0.05$). Within 20 seconds, the mistargeting was fully corrected. **Conclusions:** The adaptive targeting algorithm was implemented successfully and was able to correct the HIFU focus with high accuracy and precision in gelatin phantoms. The results demonstrate the potential of the algorithm to improve MRgHIFU controlled hyperthermia tumour treatments as automated corrections can improve workflow and treatment outcomes.

Algorithm accuracy with the target at 10mm in each direction

GENETIC TESTING FOR BREAST CANCER PATIENTS IN NIGERIA: A SURVEY OF HEALTH CARE PROVIDERS

Funmilola Olanike Wuraola, Anna Dare, Olaide Agodirin, Nneka Sunday-Nweke, Sharif Folorunsho, Olusegun Alatise, Emma Reel, Tulin Cil
Obafemi Awolowo University Ile-Ife Nigeria, University of Ilorin, Alex Ekwueme Federal University Teaching Hospital, General Surgery Division, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: The role of genetics in the management of breast cancer is increasingly important. The National Comprehensive Cancer Centre guidelines outline the subset of patients that will require hereditary breast cancer genetic testing as part of their treatment plan. In low middle income countries like Nigeria, there is limited access to genetic counseling and testing. The aim of this study was to identify the barriers to testing from the health care provider's perspective.

Methods: We surveyed Nigerian breast cancer health care providers via the WhatsApp platform between in June 2022. The survey consisted of demographic information as well as three areas aspects of genetic testing in breast cancer patients: knowledge, training and clinical practice. The results were analyzed using Statistical Package for the Social Sciences (version 24).

Results: One hundred and twenty-one clinicians responded: 54 (44.6%) general surgeons, 4 (3.3%) breast surgical oncologists, 29(23.9%) clinical oncologists, 31(25.6%) oncology nurses and 3 (2.6%) breast radiologists. The knowledge of hereditary breast cancer genetics was high but the implementation is low. Only 32.2% of respondents have ever requested genetic testing and all testing was done through private laboratories. Only 9.9% have received formal genetics training and 13.2% of respondents have a genetic counselor in their hospital. Respondents expressed interest in genetics training with both onsite and online formats.

Conclusions: This survey highlights the need for breast cancer genetic training for Nigerian health care providers. Future genetic testing capacity in Nigeria is a significant barrier that needs to be addressed.

IMPACT OF GEOGRAPHY ON RECEIPT OF MEDICAL ONCOLOGY CONSULTATION AND NEOADJUVANT CHEMOTHERAPY FOR TRIPLE NEGATIVE AND HER2 POSITIVE BREAST CANCER

Elliott K. Yee, Julie Hallet, Nicole J. Look Hong, Lena Nguyen, Natalie Coburn, Frances C. Wright, Sonal Gandhi, Katarzyna J. Jerzak, Andrea Eisen, Amanda Roberts
Division of General Surgery, Sunnybrook Health Sciences Centre, University of Toronto

Hypothesis and Purpose: Consensus guidelines recommend consideration of neoadjuvant chemotherapy (NAC) for patients with early triple negative (TN) and HER2 positive (HER2+) breast cancer, yet most do not receive NAC. We aimed to characterize the impact of geography on receipt of pre-treatment medical oncology consultation and NAC for these patients.

Methods: Using linked administrative healthcare datasets in Ontario, we performed a retrospective population-based analysis of women diagnosed with stage I-III TN or HER2+ breast cancer from 2012-2019. Outcomes were pre-treatment medical oncology consultation and initiation of NAC. We created maps to assess the spatial distribution of outcomes across census divisions. To assess the relationship between distance to the nearest cancer centre and outcomes, we performed a multivariable regression analysis adjusted for sociodemographic and clinical factors, including tumour extent and nodal status.

Results: Among 12,881 patients, there was no statistically significant relationship between distance to the nearest cancer centre (≤5 vs. 5-10, 10-25, and ≥25 km) and receipt of medical oncology consultation or NAC. Mapping demonstrated high interregional outcome variability, ranging across census divisions from 12.2% to 64.3% for medical oncology consultation rate, and 9.3% to 64.3% for NAC rate. 77.7% of patients referred to medical oncology received NAC.

Conclusions: Among patients with TN and HER2+ early breast cancer, rates of medical oncology consultation and NAC were not significantly impacted by distance to cancer centres but varied highly by region. Regional and/or provider practice patterns may underlie discrepancies in referral for NAC. These findings can inform further studies and interventions to improve equitable access to NAC for these patients.

PATIENT AND PHYSICIAN FACTORS IMPACTING TIME TO ANALGESIA IN THE TRAUMA BAY

Betel Yibrehu[1], Mona Khalid[1], Bourke Tillmann[2], Luis Teodoro Da Luz[2], Matthew Guttman[1], Andrea Phillips[2], Corey Freedman[2], Avery Nathens[2], Barbara Haas[2]
[1]Univeristy of Toronto, Toronto, ON
[2]Sunnybrook Health Sciences Centre, Toronto, ON.

Purpose and Hypothesis: The association between a patient's sociodemographic factors and pain management in trauma is not well understood. This study evaluated patient and provider characteristics that may impact the timing of analgesia in the trauma bay. The hypothesis was that marginalized patients experienced delayed analgesia administration.

Methods: We performed a retrospective cohort study of patients > 16 years treated at our level I trauma centre from 2019-2020. We excluded patients with a GCS of 3, those who died in the trauma bay, and patients transferred from another institution. Data were derived from the institutional trauma registry and chart review. The primary outcome was delayed analgesia (analgesia after the 75th percentile of time to any analgesia). Multivariable logistic regression was used to evaluate the effect of sociodemographics on analgesia timing.

Results: We identified 2,497 patients (74.3% male, mean age 44.8 years, median ISS 9), of which 1,957 (77.5%) received analgesia in the trauma bay. The median time to analgesia was 9 min (IQR 7-14). The only sociodemographic factor associated with delayed analgesia was age. Relative to those aged 16-54, patients 55-64 and ≥65 were 1.5 and 2.1-fold (95% CI 1.05-2.03 and 1.58-2.95, respectively) more likely to receive delayed analgesia. Irrespective of age or injury severity, patients injured in falls were more likely to experience delayed analgesia (OR 1.64, 95% CI 1.20 – 2.23). Differences in the treating physician characteristics had minimal impact on timing of analgesia (median odds ratio 1.24).

Conclusions: Increased age and falls significantly increase the odds of experiencing delayed analgesia. With the rising rate of elderly trauma patients, this study highlights the need for evolving strategies in managing acute pain in the elderly.

DEVELOPING AN IMMUNOCLOAKING STRATEGY TO MODIFY DONOR LUNGS FOR TRANSPLANTATION

Jenny Yune[1], Aizhou Wang[1], Haiming Luo[2], Jayachandran Kizhakkedathu[2], Marcelo Cypel[1]
[1]Latner Thoracic Surgery Laboratories, Toronto General Research Institute, University Health Network, University of Toronto; [2]Centre for Blood Research, Life Sciences Institute, The University of British Columbia

Purpose and Hypothesis: Lung transplantation is a life-saving therapy however, it is often challenged by immune-mediated rejection and ischemia-reperfusion injuries (IRI). Siren et al. in 2021 created a created a cell-surface engineering glycocalyx mimic polymer which immune-cloaks the organ's endothelium, reducing immune recognition in murine kidney allotransplant model. We hypothesize that this approach can be optimized to precondition donor lungs during ex-vivo lung perfusion (EVLP) to prevent transplant rejection and improve the success of transplants.

Methods: Immortalized human endothelial cells (EA.hy926 cells) were cultured for 10 days on a 96-well plate and treated with the cell-surface engineering method. Treatment was administered in EVLP solution (STEEN) and incubated at 37°C with the following variables: treatment time (30mins to 4 hours), polymer dose (0.2mM, 0.3mM, 0.4mM, 0.56mM). Cell surface modification was detected through flow cytometry and confocal microscopy.

Results: Cell surface coating of these polymers peaked at 1 hour of treatment and has a tendency of declining over time. 0.2mM of polymer is sufficient to reach the published therapeutic coverage from Siren et al., 2021 condition when treated for 1 hour. When 0.3mM of polymer was used, cell surface coating consistently remained above previous established thresholds.

Conclusion: Initial results shows promise of this cell-surface engineering method's compatibility with lung EVLP milieu. Next steps are to test the immunocloaking abilities in-vitro through a PBMC cytotoxicity assay as well as transition to a rat EVLP model to test the translatability of in-vitro findings.

Translational Research

EXAMINING THE ROLE OF FRACTALKINE ON FUNCTIONAL RECOVERY AFTER DEGENERATIVE CERVICAL MYELOPATHY

Cindy Zhou, Sydney Brockie, Mandana Movahed, James Hong, Michael Fehlings
Genetics and Development, Toronto Western Hospital, Institute of Medical Science, University of Toronto

Background: Degenerative cervical myelopathy (DCM) encompasses several age-related degenerative conditions that cause a compression of the cervical spinal cord. The functional deficits experienced by DCM patients may be caused by a maladaptive elimination of synapses. Recently, the fractalkine receptor (CX3CR1), which is found on microglia, has been shown to be involved in microglial-mediated synaptic elimination. Further, deletion of the receptor results in improved functional outcomes and synapse formation after traumatic spinal cord injury (SCI).

Hypothesis and Purpose: The main objective of this study is to investigate the role of fractalkine (CX3CR1-CX3CL1) signaling on functional outcomes and synaptic elimination following DCM. It was hypothesized that *i)* fractalkine-mediated synaptic engulfment occurs after DCM, and that *ii) Cx3cr1* deletion will attenuate the synaptic loss whilst improving functional recovery.

Methods: DCM was induced in C57BL/6 and $Cx3cr1^{-/-}$ mice by inserting a polyether aromatic material under the C5-C6 lamina. Synaptic elimination and functional recovery were characterized at five timepoints (0, 2, 4, 8, and 12-weeks post-DCM) using synaptic markers and CatWalk Gait analysis.

Results: Our model of DCM significantly reduces total area of the spinal cord and grey/white matter ratio in C57BL/6 animals. In the same animals, a significant loss of Homer-1$^+$ cells was observed in the dorsal horns over 12-weeks of DCM.

Conclusions: Current data suggests that post-synaptic elements of glutamatergic synapses are lost after DCM, but further analyses of $Cx3cr1^{-/-}$ tissue will provide better insight as to how fractalkine contributes.

CREATING A NATIONAL LACTATION POLICY FOR BREASTFEEDING SURGICAL RESIDENTS

Natalia Ziolkowski, Larissa Rogowsky, Julia Innis, Angela Grant Buechner, Jana Dengler
Division of Plastic and Reconstructive Surgery, Sunnybrook Health Sciences Centre, and University of Toronto, Toronto, ON Canada

Purpose and Hypothesis: There are significant barriers to breastfeeding for resident physicians returning to work, but little is known specifically about the lactation experiences of Canadian surgical residents. One barrier is lack of comprehensive lactation policies: our scoping review of North American surgical programs found only one. We sought to survey program directors (PDs) and trainees about their breastfeeding experiences and interest in lactation policy, hypothesizing that there would be significant appetite for, and willingness to instate, such a policy. Our ultimate goal was to create a national lactation policy for surgical residents. **Methods**: This was an REB approved single-site survey-based study designed by a multi-disciplinary team. Two surveys hosted on Google forms were sent, one to surgical PDs and one to trainees. Data was collected and responses analyzed. This informed the creation of a novel lactation policy. **Results**: Ten PDs and 24 surgical trainees responded. Among PDs: 60% were female, 70% had breastfeeding trainees during their tenure, 40% discussed lactation accommodations, and all were willing to instate a lactation policy. Among trainees: 50% thought their maternity leave was too short while 45% met their breastfeeding goals. Fourteen (74%) indicated they stopped lactating due to inability to pump at work; twenty-one (88%) had no plan in place upon their return to facilitate lactation. 96% indicated desire for a lactation policy. Both PDS and trainees felt a policy should cover four stipulations of trainee responsibilities and six regarding lactation scheduling. These included commitment to patient care when scheduling break times (74%), time to leave clinic to pump (97%), and communication with attendings about pumping needs during OR cases (87%).

Conclusions: Trainees reported encountering many barriers and often not meeting their breastfeeding goals. Despite this, program directors and trainees alike supported instating a comprehensive lactation policy. Our proposed policy highlights important ways programs can enable breastfeeding and contribute to a surgical culture that supports new mothers.

REMOTE ISCHEMIC CONDITIONING IN ICU TRAUMATIC BRAIN INJURY PATIENTS: PRELIMINARY RESULTS FROM A PILOT RANDOMIZED CONTROL TRIAL

Zahra Khan [1], Mirjana Jerkic[1], Avinash N. Mukkala[1], Fawad Ashraty[1], Michael Gryciik[1], Sandy Trpcic[1], Menachem Ailenberg[1], Andrew Beckett[1], Shawn G. Rhind [2], Ori D. Rotstein[1]

[1]Department of Surgery, the Keenan Research Centre for Biomedical Science, Unity Health Toronto - St. Michael's Hospital and University of Toronto, Toronto, Ontario, Canada; [2]Defence Research and Development Canada

Introduction: Remote ischemic conditioning (RIC) is a non-invasive intervention shown to lessen ischemia/reperfusion injury. In humans, RIC showed amelioration of neuronal injury specific markers in TBI patients. We hypothesized that RIC would exert beneficial effects in TBI patients by effecting levels of brain injury biomarkers.

Methods: A randomized double-blinded controlled clinical trial is in progress in TBI ICU patients. Plasma biomarkers at 0h (pre-intervention) and 4-6, 24, 48 and 72h (post-intervention) are primary outcome measures. RIC involves 4 cycles of 5-min occlusion at 30mmHg>SBP, followed by 5-min of deflation on an arm (using pneumatic torniquet) within 48h of injury. Preliminary plasma biomarker concentration measures (pg/mL) were conducted on 13/RIC and 15/Sham patients.

Results: After adjusting to baseline, five out of the 13 biomarkers yielded significant differences between Sham and RIC groups at specific timepoints: RIC significantly lowered levels of neural injury marker S100B and repair myokine Irisin at 4-6h, and mitochondrial dysfunction marker lactate at 72h. RIC significantly increased mitochondrial dysfunction marker ccf-mtDNA at 24h, while inflammatory marker HMGB1 was decreased with marginal significance (P ≤ 0.1) at 48h.

Conclusions: We report that RIC demonstrates promising preliminary results in limiting post-injury elevations in several markers observed in TBI patients.

CARDIAC MESENCHYMAL STEM CELL-DERIVED PROTEINS FOR RIGHT VENTRICULAR REGENERATION IN HYPOPLASTIC LEFT HEART SYNDROME

Matteo Ponzoni[1], Azadeh Yeganeh[2], Libo Zhang[2], Ramesh B. Vanama[2], Jennifer Zhang[2], Jason T. Maynes[2,3], John G. Coles[1]
[1]Division of Cardiovascular Surgery, The Hospital for Sick Children, Toronto, Canada
[2]Program in Molecular Medicine, SickKids Research Institute, Toronto, Canada
[3]Department of Anesthesia and Pain Medicine, The Hospital for Sick Children, Toronto, Canada

Purpose and Hypothesis: The systemic right ventricle (RV) in hypoplastic left heart syndrome (HLHS) is exposed to an adverse remodeling process leading to heart failure (HF). We have previously identified a minimal mixture of 4 mesenchymal stem cell (MSC)-derived reparative proteins (BMP-4, CNTF, MIP-3β, and IL-26), whose therapeutic potential relies on the modulation of the inflammatory response after myocardial injury and the inhibition of fibroblasts senescence and fibrosis. We herein hypothesize that these 4 proteins could have a beneficial effect in preventing RV remodeling in a translational model of RV failure induced by pulmonary artery banding (PAB), which mimics the pathophysiology of systemic RV in HLHS.

Methods: Sprague-Dawley 6-8 week-old rats underwent PAB followed by 4-proteins (n=15) or media (n=14) intramyocardial injection 2 weeks later. Controls consisted of sham-operated animals (n=16). Animals underwent weekly echocardiography and, 4 weeks after initial surgery, they were euthanized and the hearts were processed for histological analysis.

Results: Despite similar pre-treatment RV systo-diastolic dysfunction, PAB+4-proteins rats exhibited an improvement of RV fractional shortening (36[9]% vs 25[4]%, $p<0.001$) and TAPSE (2.1[0.2]mm vs 1.7[0.2]mm, $p<0.001$), and a normalization of RV fractional area change (37[6]% vs 28[4]%, $p<0.001$) and RV myocardial performance index (0.64[0.1] vs 0.83[0.1], $p<0.001$) compared to PAB+media rats. From preliminary histological analysis, untreated PAB rats displayed an increased burden of RV fibrosis (2.6% vs 0.4% of total RV area, $p=0.025$) and RV fibroblasts senescence (4% vs 0.1% of total RV area, $p=0.021$) compared to shams.

Conclusions: Our early results show that MSC-derived proteins can revert RV remodeling in response to pathologically increased afterload, possibly acting on underlying fibrotic pathways.

PREDICTING MAJOR ADVERSE CARDIOVASCULAR EVENTS FOLLOWING CAROTID ENDARTERECTOMY USING MACHINE LEARNING

Ben Li (SSTP), Derek Beaton, Hani Tamim, Mohamad A Hussain, Jamal J Hoballah, Douglas S Lee, Duminda N Wijeysundera, Charles de Mestral, Muhammad Mamdani, Mohammed Al-Omran

Division of Vascular Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: Carotid endarterectomy (CEA) carries significant perioperative risks; however, outcome prediction tools remain limited. We used machine learning (ML) to develop automated algorithms that predict 30-day outcomes following CEA.

Methods: The National Surgical Quality Improvement Program (NSQIP) targeted database was used to identify patients who underwent CEA between 2011-2021. Input features included 36 pre-operative demographic and clinical variables. The primary outcome was 30-day major adverse cardiovascular event (composite of stroke, myocardial infarction, or death). Our data were split into training (70%) and test (30%) sets. Using 10-fold cross-validation, we trained 6 ML models using pre-operative features. The primary model evaluation metric was area under the receiver operating characteristic curve (AUROC). Model robustness was evaluated with calibration plot and Brier score.

Results: Overall, 38,853 patients underwent CEA during the study period. Thirty-day MACE occurred in 1,683 (4.3%) patients. Our best performing prediction model was XGBoost, achieving an AUROC (95% CI) of 0.91 (0.90-0.92). The calibration plot showed good agreement between predicted and observed event probabilities with a Brier score of 0.02.

Conclusions: Our ML models accurately predict 30-day outcomes following CEA using pre-operative data. They have potential for important utility in guiding risk mitigation strategies for patients being considered for CEA to improve outcomes.

Translational Research

THE ROLE OF CASPASE-1 IN TRIPLE NEGATIVE BREAST CANCER, THE IMMUNE TUMOR MICROENVIRONMENT, AND RESPONSE TO ANTI-PD1 IMMUNOTHERAPY

Wanda Marini (SSTP)[1,2,5], Weiyue Zheng[2], Kiichi Murakami[2], Pamela Ohashi[2,3,6], Carol J. Swallow[1,4,5], Michael Reedijk [1,2,6]

[1]Division of General Surgery, University of Toronto, Toronto, Ontario, Canada [2]Princess Margaret Cancer Centre, University Health Network, Toronto, Ontario, Canada, [3]Department of Immunology, University of Toronto, Toronto, Ontario, Canada, [4]Mount Sinai Hospital, Toronto, Ontario, Canada, [5]Institute of Medical Science, University of Toronto, Toronto, Ontario, Canada, [6]Department of Medical Biophysics, University of Toronto, Toronto, Ontario, Canada

Hypothesis and Purpose: Triple negative breast cancer (TNBC) is an aggressive breast cancer subtype with poor prognosis and no known targeted therapies. TNBC is known to have high expression of the inflammatory cytokine IL1β, which promotes the recruitment of pro-tumoral tumor-associated macrophages (TAMs) to the tumor microenvironment (TME) [1]. In addition, TNBCs are rich in tumor infiltrating lymphocytes (TILs), which theoretically creates a favorable condition for immunotherapy. However, immunotherapy has shown disappointing results in recent clinical trials [2-4]. Here we report that TNBCs have elevated caspase-1, a key requirement for IL1β cleavage and maturation, and this helps shape the immune TME. As well, by inhibiting TAM recruitment through caspase-1 inhibition, response to immunotherapy can be improved.

Methods and Results: Using publicly available gene expression data, caspase-1 had an inverse correlation with estrogen receptor (ER) expression and was associated with the TNBC subtype. This relationship was confirmed *in vitro* using both human ER positive and TNBC cell lines. Using mouse allografts, caspase-1 knockout (KO) or pharmacological inhibition resulted in significant decrease in tumor growth and TAM infiltration. Finally, caspase-1 inhibition reversed resistance to anti-PD1 immunotherapy in mouse allografts, resulting in significant deceleration of tumor growth when used in combination. **Conclusions:** The lack of ER in TNBC promotes caspase-1 expression, allowing IL1β maturation, macrophage recruitment and tumor progression. Genetic or pharmacologic inhibition of caspase-1 inhibits TAM recruitment and reverses resistance to immunotherapy in TNBC. Our data provides new insights into the biology of TNBC and identifies a novel therapy to combat this disease.

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EVALUATING THE ABILITY OF 10°C TO IMPROVE UTILIZATION OF DONOR LUNGS FROM UNCONTROLLED DONATION AFTER CARDIAC DEATH IN A PORCINE MODEL

Juan Montagne[1], Thomás Lima[1], Jenny Yune[1], Gabriel Siebiger[1], Bruno Pinto[1], Yu Zhang[1], Vinicius Michaelsen[1], Aizhou Wang[1], Marcelo Cypel[1]
[1]Latner Thoracic Surgery Laboratories, University Health Network, University of Toronto

Hypothesis and Purpose: Lungs coming from uncontrolled donation after cardiac death (uDCD) represents an underutilized donor pool. However, limited experience using uDCD lungs shows low usage (15%) due to concerns over lung quality. Recent report demonstrates intentional storage of acid injured donor lungs at 10°C restores lung quality. We hypothesize intentional storage of uDCD lungs at 10°C for an extended period will restore warm-ischemia injured allograft and lead to increased utilization. **Methods:** Using a porcine model, cardiac arrest was induced and after 2.5 hours of warm ischemic time (WIT) from asystole and lungs were flushed in standard fashion. After procurement, lungs were randomly allocated to the following intervention groups (n=5/group) for the different cold ischemic time (CIT): 1) 12 hours at 10 C°, 2) 12 hours at 4 C. The allograph function was physiologically assessed on Ex-Vivo Lung Perfusion (EVLP) for 6 hours. Lung function was evaluated hourly on EVLP. Metabolomic and cytokines of the perfusate and tissue will be analyzed. **Results:** 10°C group showed significantly better lung function as reflected by better lung physiology during EVLP: higher delta P/F (P < 0.0001, 10°C vs 4°C; 334±30 mmHg vs 211±45 mmHg at the end of EVLP), lower peak airway pressure (P = 0.004), higher dynamic compliance (P=0.0005), lower plateau pressure (P = 0.042), and higher static compliance (P=0.002). The 10°C group also tended to develop less edema (lung weight gain after EVLP: 17±5% vs 64±23%, P = 0.06). **Conclusion:** we demonstrate 10°C as a potentially superior lung preservation temperature in comparison to the current standard of 4°C by evaluation within a large animal model of uDCD. Based on clinical experience, 100% of lungs within the treatment group would've been accepted for transplant after EVLP. More studies are underway to strengthen the robustness of our findings.

EFFECT OF SMOKING ON PROSTATE CANCER SURVIVORS' FUNCTION AND QUALITY OF LIFE: AN ANALYSIS OF THE CEASAR STUDY

David-Dan Nguyen[1], Daniel A. Barocas[2], Li-Ching Huang[2], Zhiguo Zhao[2], Karen E. Hoffman[4], Tatsuki Koyama[3], David F. Penson[2], Christopher J.D. Wallis[1]

[1]Division of Urology, University of Toronto, Toronto, ON, Canada; [2]Department of Urology, Vanderbilt University Medical Center, Nashville, TN, USA; [4]Department of Radiation Oncology, The University of Texas MD Anderson Center, Houston, TX, USA

Hypothesis and Purpose: There is limited evidence of the effect of smoking on cancer survivors' quality of life (QOL) and function. As the natural history of localized prostate cancer (PCa) is protracted, there is a need to identify modifiable factors that can influence survivorship, such as tobacco smoking. **Methods:** We used 5-year data from the CEASAR (Comparative Effectiveness Analysis of Surgery and Radiation) study, a prospective, population-based, observational study of men diagnosed with localized PCa in 2011-2012. We excluded patients that didn't complete the smoking, baseline, and at least one post-baseline question. Survivors were categorized as never, former, and current smokers. Multivariable regression models adjusting for baseline QOL and function, treatment type, and patient and disease characteristics assessed the association of smoking history with 5-year scores on the EPIC-26 and SF-36 questionnaires. **Results:** We included 2185 men of which 109 (5%) were current smokers, 925 (42%) former smokers, and 1151 (53%) never smokers. In unadjusted analyses, current smokers had worse scores on all domains of EPIC-26 and SF-36 compared to never smokers (p<0.05). In adjusted analyses, there was no association between smoking with EPIC-26 (p>0.05). On the SF-36, in adjusted analyses, compared to never smokers, current smokers had worse physical function (-7.53, 95%CI -11.16 to -3.89, p<0.01), emotional well-being (-5.03, 95%CI -7.78 to -2.27, p<0.01), and energy and fatigue (-4.51, 95%CI -7.73 to -1.28, p<0.01). These findings were robust to more lenient definitions of smoking. **Conclusion:** PCa survivors that smoke experience worse PCa-specific functional outcomes and physical functioning compared to never smokers. After adjustments, smoking was associated with worse physical functioning. Tobacco smoking cessation in PCa survivors can enhance QOL and function and should be integrated into survivorship care.

PATIENT DERIVED XENOGRAFT ENGRAFTMENT OF LUNG ADENOCARCINOMA IS ASSOCIATED WITH PREOPERATIVE RADIOLOGICAL FINDINGS

Hiroyuki Ogawa[1,2], Takamasa Koga[1,2], Nicholas Bernards[1], Alexander Gregor[1], Yuki Sata[1], Shinsuke Kitazawa[1], Yoshihisa Hiraishi[1], Tsukasa Ishiwata[1], Masato Aragaki[1], Fumi Yokote[1], Andrew Effat[1], Kate Kazlovich[1], Quan Li[2], Katrina Hueniken[2], Ming Li[2], Nhu-An Pham[2], Ming-Sound Tsao[2], Kazuhiro Yasufuku[1]
[1]Latner Thoracic Research Laboratory, Toronto General Hospital, University Health Network, Toronto, ON, Canada
[2]Princess Margaret Cancer Center, University Health Network, Toronto, Ontario, Canada

Hypothesis and Purpose: Patient derived xenografts (PDXs) are useful for preclinical drug efficacy studies as they preserve many molecular and histological features of patient tumors. We investigated the relationship between PDX engraftment and radiological, pathological and gene mutation status in lung adenocarcinomas.

Methods: The pulmonary nodules were classified into two categories such as solid tumor and tumor with GGO according to the presence of GGO in preoperative CT image. The data on radiological, pathological were obtained from patient clinical records. Gene mutation status were derived from whole exome sequencing data.

Results:.A total of 254 resected primary lung adenocarcinomas were reviewed. Engraftment was successful in 58 cases (22.8%). Among them, stable engraftment, which could be passaged serially at least 3 times was observed in 43 cases (16.9%). There were 190 (74.8%) solid tumors and 64 (25.2%) tumors with GGO. Stable engraftment rates from solid and tumor with GGO were 22.1% (42 /190 cases) and 1.6% (1 /64 cases), respectively. Solid adenocarcinoma subtype, poorly differentiation, and TP53 gene mutation status were also strongly associated with PDXs stable engraftment.

Conclusions: Radiological, pathological, and gene mutation status were strongly associated with PDX stable engraftment. It may be cost-effective to avoid tumor with GGO nodules for establishing PDXs in lung adenocarcinomas due to the low engraftment rate.

INTRAOPERATIVE IMAGING TO DETECT OCCULT PENETRATION OF SCREWS AFTER VOLAR PLATING OF DISTAL RADIUS FRACTURES: A CADAVERIC STUDY

Jonathan Persitz, Andrea Chan, Ryan Paul
Hand Program, Division of Plastic Reconstructive and Aesthetic Surgery, Toronto Western Hospital, University of Toronto, Toronto, Ontario, Canada

Hypothesis and Purpose: The purpose of this cadaveric study is to compare two conventional fluoroscopic imaging views (Carpal Shoot-Through [CST] and Dorsal Horizon [DH] views) with ultrasound to establish the best intra-operative imaging modality for surgeons to use to identify penetration of screws through the dorsal cortex and / or into the distal radioulnar joint.

Methods: Twelve human cadaveric upper limb specimens were instrumented with distal radius variable angle locking plates and four distal locking screws from a volar approach. There were 6 surgeons divided into 3 groups of different clinical experience performing the evaluations. Sensitivity and specificity of detecting screw penetration along with the surgeon's confidence in each modality were established.

Results: CST view was the most sensitive in identifying the presence of dorsal screw penetration (100%) and absence of dorsal screw penetration (78%). Ultrasound evaluation had the lowest sensitivity and specificity (28%, 56% respectively). The fellowship trained upper extremity surgeons had the highest sensitivity and specificity rate of 78% and 78% respectively. Surgeon's confidence in evaluating for screw penetration was highest with the CST view.

Conclusion: CST view was found to be the best intra-operative imaging modality to "rule in" and "rule out" screw penetration through the dorsal cortex during volar plating of distal radius fractures. DH view was most reliable in detecting DRUJ screw penetration. Ultrasound evaluation had the lowest sensitivity and specificity in all categories, demonstrating that this not a reliable modality for surgeons without specific training in point-of-care ultrasonography.

THE TORONTO MANAGEMENT OF INITIALLY UNRESECTABLE LIVER METASTASES FROM COLORECTAL CANCER IN A LIVING DONOR LIVER TRANSPLANT PROGRAM

Luckshi Rajendran, Marco Claasen, Tommy Ivanics, Ian McGilvray, Mark Cattral, Anand Ghanekar, Nazia Selzner, Carol-Anne Moulton, Trevor Reichman, Chaya Shwaartz, Ur Metser, Ron Burkes, Erin Winter, Steven Gallinger, Gonzalo Sapisochin
Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose: The purpose of our study is to describe our interim experience with living donor liver transplantation (LDLT) at a large transplant and hepatobiliary centre in North America.

Methods: Adults with unresectable bilobar, liver-only CRLM, receiving systemic chemotherapy were recruited. Relevant data on demographics, referral, and clinical characteristics were extracted from study inception in October 2016 to February 2023. Patients were divided into three groups: transplanted, resected, and control (excluded and referred back for systemic chemotherapy). Overall survival (OS) and recurrence-free survival (RFS) were compared.

Results: 91/106 referred patients underwent assessment and screening, of which 7 were transplanted, 24 were resected, 50 were excluded (control), and 10 are pending ongoing workup (Figure 1). No differences in pre-assessment baseline characteristics existed. Median time from assessment to transplantation was 15.3 months. The control population had significantly worse post-assessment OS than the transplanted population (p=0.002) and resected population (p<0.001). There was no statistically significant difference in post-operative OS (1-year 100% vs. 93.8% [95%CI 82.6-100], 3-year 100% vs. 43.3% [95%CI 22.6-83.0], p=0.17), but significantly better RFS (1-year 85.7% [95%CI 63.3-100] vs. 10.9% [95%CI 31.3-38.3], 3-year 68.6% [95%CI 40.3-100] vs. 10.9% [95%CI 31.3-38.3], p=0.011) in the transplanted vs. resected populations.

Conclusion: Most patients with unresectable liver metastases from colorectal cancer referred to LDLT are deemed ineligible for study inclusion. However, patients deemed eligible experience excellent oncologic outcomes. LDLT is a viable treatment option in this highly selected population. Future results after trial completion can inform the long-term trial outcomes.

PREDICTING COLD SENSITIVITY SEVERITY FOLLOWING TREATMENT FOR CARPAL TUNNEL SYNDROME USING DEEP LEARNING

Moaath M Saggaf (SSTP), Dimitri J Anastakis
Division of Plastic, Reconstructive and Aesthetic Surgery, Department of Surgery, University of Toronto

Purpose and Hypothesis: The aim of the study was to design a decision aid predicting personalized patient-reported outcomes following treatment for carpal tunnel syndrome (CTS) using artificial intelligence (AI). We hypothesized that the AI model could predict cold sensitivity severity improvement with excellent performance, measured by the area under the curve from a receiver operating characteristic curve greater than 0.8.

Methods: We built a deep-learning neural network from a recent prospective comparative study. We measured cold sensitivity using the validated cold intolerance symptom severity (CISS) questionnaire. Patients were classified based on improvement above or below the minimal clinically important difference (MCID). The data were randomly divided into a 60% training subset, a 20% tuning subset and a 20% testing subset. We held out a testing dataset for internally validating the model that was not used during the training or the tuning procedure. The outcome was defined as an improvement in CISS beyond the MCID. We used the Bayesian approximation method to account for uncertainty and interpret the model.

Results: There were 85 patients who completed the study: surgery (n=49); splinting (n=36). The mean follow-up period was 10 months. Following the internal validation, the model accurately predicted the outcomes in (17/18) 94.4% of the cases. The area under the curve for the model was 94%, indicating excellent performance. Surgery (OR=5.56, 95% CI: 5.37 to 5.75) and high abductor pollicis brevis Medical Research Council grade (OR=2.36, 95% CI: 2.29 to 2.43) predicted improvement following CTS treatment.

Conclusion: AI models can predict personalized patient-reported outcomes in CTS with excellent performance and can be considered a precision decision aid for CTS patients.

ACCELERATED TRANSCRANIAL ULTRASOUND NEUROMODULATION IN PARKINSON'S DISEASE: A PILOT STUDY

Nardin Samuel (SSTP), Mandy Yi Rong Ding, Can Sarica, Ghazaleh Darmani, Irene Harmsen, Talyta Cortez Grippe, Xingyu Chen, Ke Zeng, Andrew Yang, Robert Chen, Andres Lozano[1,2]
Toronto Western Hospital, Division of Neurosurgery, University of Toronto, Toronto, Ontario

Introduction: Low intensity transcranial focused ultrasound (TUS) is a novel method for neuromodulation. We investigated the effects of accelerated theta-burst TUS (a-tbTUS) to bilateral M1 on neurophysiologic and clinical MDS-UPDRS-III outcomes in Parkinson's disease (PD) patients. **Methods:** Patients were randomized to receive active or sham a-tbTUS for the first visit, and the alternate condition in the second visit, at least 10 days after. a-tbTUS was administered in 3 consecutive sonications at 30-minute intervals. An accelerated protocol was employed with the goal to enhance the additive effect of stimulation. Patients were OFF medication for each study visit. Transcranial magnetic stimulation (TMS)-elicited motor evoked potentials (MEPs) were used to assess motor cortical excitability before and after TUS. Clinical outcomes after a-tbTUS administration were assessed using MDS-UPDRS-III. **Results:** A total of 20 visits were conducted in 10 PD patients. TMS-elicited MEP amplitudes significantly increased following active but not sham sonication compared to baseline ($p = 0.0057$). MEP amplitudes were also higher following a-tbTUS compared to sham sonication ($p = 0.0064$). There were no statistically significant changes in MDS-UPDRS-III scores with active or sham tbTUS.
Conclusion: a-tbTUS increases motor cortex excitability and is a feasible non-invasive neuromodulation strategy in PD. Future studies should be aimed at determining optimal administration parameters and the durability of neurophysiologic and clinical outcomes in PD patients.

EARLY SURGERY COMPARED TO NON-OPERATIVE MANAGEMENT FOR MILD DEGENERATIVE CERVICAL MYELOPATHY: A COST-UTILITY ANALYSIS

Husain Shakil (SSTP), Armaan K Malhotra, Michael G. Fehlings, Jefferson R. Wilson, Christopher D Witiw
Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ontario, Canada

Hypothesis and Purpose: We sought to perform a cost-utility analysis to examine whether early surgery is a cost-effective treatment strategy for mild degenerative cervical myelopathy (DCM) from the healthcare payer perspective.

Methods: Data was extracted from the Cervical Spondylotic Myelopathy AO Spine International and North America trials. Clinical assessment measures were obtained using the Modified Japanese Orthopaedic Association scale and health-related quality of life measures were obtained using the Short Form-6D utility score at baseline (pre-operative), and 12 months post-surgery. Cost measures were derived from micro-costing estimates for a subset of AO-Spine North America patients undergoing DCM surgery at Toronto Western Hospital and inflated to 2021 values using the Bank of Canada consumer price index protocol. We employed a Markov state transition model with Monte Carlo microsimulation using a lifetime horizon to obtain an incremental cost utility ratio associated with early surgery for mild myelopathy.

Results: Surgery for mild DCM was associated with a lifetime increase of 1.26 quality-adjusted life years (QALY) compared to observation. The cost incurred to the healthcare payer over a lifetime was $14,678.39 CAD, resulting in a lifetime incremental cost-utility ratio of $11,649.52 CAD/QALY. With reference to the 2021 World Health Organization definition of "very cost-effective" ($74,000 CAD), probabilistic sensitivity analysis demonstrated that 100% of cases were cost-effective.

Conclusions: Our analysis suggests surgery compared to initial observation for mild DCM is cost-effective from the Canadian healthcare payer perspective and associated with lifetime gains in health-related quality of life.

COST-UTILITY ANALYSIS OF GENDER AFFIRMING TOP SURGERY: IMPACTS FROM THE PUBLIC HEALTH SYSTEM PAYER PERSPECTIVE

Chantal R. Valiquette (SSTP)[1, 2], Jessica Morgan[2], Sarah Rae[2], Peter Coyte[2], Brian Chan[2], Rebecca Hancock-Howard[2], Kathleen Armstrong[1], Mitchell Brown[1]
[1]Division of Plastic, Reconstructive, and Aesthetic Surgery, Department of Surgery, University of Toronto, Toronto, Ontario
[2.]Health Services Research, Institute of Health Policy, Management, and Evaluation, Faculty of Medicine, University of Toronto, Toronto, Ontario

Purpose: Gender Affirming Surgery (GAS) has significant positive clinical impacts on the mental and physical health of transgender and gender diverse (TGD) individuals desiring surgery. Associated cost and utility impacts have yet to be appraised in Canada.

Hypothesis: Provision of top surgery (i.e., chest reconstructive mastectomy or augmentation) for TGD adults desiring GAS in Ontario is cost-effective.

Methods: A Markov model was used to conduct a cost-utility analysis examining incremental cost per quality adjusted life year (QALY), a standardized measure of patient intervention impact, gained through the provision of gender affirming top surgery compared to no surgery. Both arms included sub-groups with and without hormone therapy. Given provincial funding differences, the analysis used the Ontario public payer perspective with costs reported in 2022 Canadian dollars. Costs, QALYs, and probability states were derived from health authority reports and the literature.

Results: Top surgery was cost-effective compared to no surgery over a 10-year time horizon when considering the impacts of mental health, suicidal ideation, and smoking, using a typical willingness to pay threshold of $50,000/QALY. The 10-year incremental cost effectiveness ratio was $-81, 183.56 per QALY gained. Probabilistic sensitivity analysis results were robust, finding top surgery cost effective in 97.5% of simulations.

Conclusions: Economic evaluation findings suggest top surgery is cost-effective when compared to no top surgery for adult TGD individuals in Ontario. The model may serve as a base case for national evaluation of GAS in future research.

CANADIAN COACHING PROGRAM LEADS TO SUCCESSFUL TRANSITION FROM OPEN TO LAPAROSCOPIC HPB SURGERY

Alice Zhu[1], Shiva Jayaraman[1,2,3]
Division of General Surgery, Department of Surgery, University of Toronto, Toronto, Ontario

Purpose and Hypothesis: The adoption of minimally invasive surgery (MIS) in HPB is slow compared to other surgical fields. We aim to explore surgeons' perspective of coaching in surgery, barriers to the uptake of laparoscopy in HPB surgery, and the role of an interactive coaching program in the uptake of laparoscopic HPB surgery across Canada. We hypothesize that peer-coaching will have a positive effect in the transition to laparoscopic surgery in the field of HPB.

Methods: Between 2012-2019, practicing HPB surgeons at 11 HPB Centres across Canada participated in a hands-on, practical coaching program designed for introducing and enhancing MIS HPB surgery. The coaching consisted of 1) didactic lectures/discussions 2) institutional visit to the Coach's centre 3) Skills-lab training and 4) Institutional visit to participating centres for real-time coaching. Exit interviews were conducted with one lead surgeon from each centre.

Results: Coaching was identified as a powerful tool in surgery, particularly in light of ongoing, rapid developments. Barriers identified for the uptake of laparoscopic HPB included inadequate experience and training. Surgeons reported that coaching played a significant role in the uptake of laparoscopic HPB procedures at their institution, helping them in their transition towards MIS. Coaching increased the proportion of pancreas and liver resections done laparoscopically at their institution by 57% and 17%, respectively.

Conclusion: An interactive, hands-on surgical coaching program creates an opportunity for professional development and may help with the uptake of laparoscopy in HPB. Expanding coaching initiatives in this context is key in the broader effort to successfully integrate new techniques in surgery.

SELECTIVELY TARGETING THE EPIGENOME IN EMBRYONAL RHABDOMYOSARCOMA

Anna Mandel[1,2], Yael Babichev[2], Claire Wunker[1,2], Abha A. Gupta[3], Elizabeth Demicco[2], Richard Marcellus[4], Rebecca Gladdy[1,2]
[1]Institute of Medical Science, University of Toronto; [2]Mount Sinai Hospital; [3]PCMRT; [4]OICR

Objective: Vincristine, the backbone of standard of care chemotherapy in embryonal rhabdomyosarcoma (ERMS), has high systemic toxicity and resistance is common in metastatic patients. Regulatory aberrations of the epigenetic reader bromodomain and extra-terminal domain (BET) family proteins have been shown to promote malignancy in RMS. Our goal is to explore epigenetic mechanisms in ERMS and test BET inhibitors (BETi) in primary and metastatic in vivo models.

Methods: BETi compounds (n=3) were obtained from the Ontario Institute of Cancer Research (OICR). ATPlite cell viability assay was used to confirm the sensitivity of a panel of human ERMS cell lines (n=3) to the inhibitors. Caspase-3 activation apoptosis assay was performed by flow cytometry and endogenous target expression was assessed using immunoblotting. Metastatic models were created using surgical methods.

Results: All three human ERMS cell lines were highly sensitivity (EC50 < 1uM) to BETi. Endogenous target expression assay showed significant overexpression of BRD4 in RD and RMS-YM compared to myoblast control. Treatment with EC50 concentrations of the BETi compounds induced apoptosis in ERMS cells, with the highest level of apoptosis observed in the MYC-amplified RD cell line. Xenografts from the sensitive cell lines were successfully established, and metastasis mirroring human disease was consistently observed in mice injected with the RD cell line.

Conclusion: BETi may exploit an epigenetic weakness in ERMS, perhaps related to MYC amplification. Future studies will include transcriptome assays to gauge molecular dependencies, and preclinical drug studies.

WHO RECOVERS INDEPENDENCE OF BOWEL AND BLADDER FUNCTION AFTER COMPLETE ASIA A ACUTE TRAUMATIC SPINAL CORD INJURY?: A LONGITUDINAL ANALYSIS OF PROSPECTIVE, MULTICENTER DATA IN 319 PATIENTS

Alex Beomju Bak[1], James S. Harrop[2], Bizhan Aarabi[3], Ali Moghaddamjou (SSTP)[1], Michael G. Fehlings[1]
[1]University of Toronto, Toronto, Canada; [2]Thomas Jefferson University, Philadelphia, USA; [3]University of Maryland, Baltimore, USA

Purpose and Hypothesis: Neurogenic bladder and bowel management are among the top long-term recovery priorities after traumatic spinal cord injury (SCI). Hence, it is important to identify recovery trajectories and associated factors for managing expectations and counselling.

Methods: Patients who underwent decompressive surgery for complete (ASIA grade A, ≤72hr of injury) acute SCI from two prospective, multicenter datasets (NACTN and STASCIS trials) were analyzed. Latent class trajectory modelling (LCTM) of bladder and bowel management Functional Independence Measure (FIM) scores from 1 (requiring total assistance) to 7 (complete independence) was performed on scores at acute care discharge and 3mo, 6mo, and 1yr follow up. Baseline predictors of LCTM trajectories were estimated using multivariate logistic regression. A final prediction model was assessed using R-squared and AUROC. **Results:** Of 319 patients with complete, predominantly cervical SCI (82.6% cervical, 53% thoracic, 0.6% lumbar), 24.8% followed a trajectory of recovery of their bowel sphincter function, while 75.2% did not recover by 1 year. For bladder sphincter function, 27.9% improved, while 72.1% did not recover. On multivariate regression, upper extremity motor score (UEMS) was the only significant predictor of both bowel (OR: 1.07, 95% CI [1.02–1.13], p=0.011) and bladder function (OR: 1.07, 95% CI [1.01–1.13], p=0.015). Cervical level of injury was not a significant predictor. A single-item prediction model with UEMS had an R-squared of 0.1333 and 0.183 and AUROC of 0.739 and 0.783 for predicting bowel and bladder function recovery, respectively.

Conclusion: Approximately three-quarters of patients with complete acute SCI follow a trajectory of minimal recovery of their bladder and bowel independence by 1yr follow up. The UEMS assessed ≤72 hours of injury is strongly predictive of bladder and bowel independence.