Dr. Robert Zhong Lecture

“Missing the Forest for the Trees? Upstream Thinking in Surgical Quality”

Dr. David Urbach – Chief of Surgery and Director of Perioperative Services at Women’s College Hospital, and Professor of Surgery & Health Policy, Management & Evaluation at the University of Toronto.
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GROUP INTERACTIVE SESSION

DEBATE: Merits of Surgeon Specific Outcomes and their Impact on Clinical and Teaching Practices
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### PROGRAM AT A GLANCE

**RESEARCH DAY 2015**  
KENNY THEATRE, KING’S COLLEGE  
FRIDAY, JUNE 15, 2018

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| 3:00 – 3:05 PM | AWARDS & CLOSING REMARKS                                  |
| 3:05 – 3:15 PM | COMPLETION OF PARTICIPATION EVALUATION FORMS              |
BIOGRAHY OF DR. ROBERT ZHONG

The Robert Zhong Department of Surgery Research Day was named in honour of Dr. Robert Zhong, a brilliant scientist and colleague who passed away in 2006.

Dr. Robert Z. Zhong was born in Shanghai, China on January 16, 1946. He graduated from Shanghai No 1 Medical University and was then assigned by the government to work as a general surgeon in a community hospital. Dr. Zhong attended a seminar led by Dr. Sun Lee – considered to be the founding father of experimental microsurgery – and whom he would later credit to be one of the most important mentors of his life. Dr. Zhong arrived in Canada first as a research fellow under the supervision of Drs. John Duff and Calvin Stiller in 1984. His persistence and vision led to a full-time appointment in microsurgical animal models that would be applied in human transplantation clinical practice.

Recognizing that molecular biology and transplant immunology were critical to the future of transplantation, Dr. Zhong began his study of these fields in Canada to become one of the world’s leading experts in transplantation and microsurgery. He went on to become a Tier One Canada Research Chair in Transplantation and Experimental Surgery in 2004 and was appointed a full Professor in the Departments of Surgery, Pathology, and Microbiology & Immunology at The University of Western Ontario. Dr. Zhong was a scientist at the Robarts Research Institute; Director of the Microsurgery Laboratory at LHSC; and a scientist at the Lawson Health Research Institute.

Dr. Zhong's influence into the fields of transplantation and microsurgery were profound and far-reaching. He was Past President of the International Society of Experimental Microsurgery; a member of the Canadian Society of Transplantation, American Society of Transplantation; and the American Society of Transplant Surgeons. Dr. Zhong was awarded the Lifetime Achievement Award by the Canadian Society of Transplantation posthumously in 2007.

Dr. Zhong published over 180 peer-reviewed publications and achieved millions of dollars in research grant funding. He supervised more than 70 graduate students and fellows and trained over 70 microsurgeons worldwide during his 21-year career at Western. His superb leadership and vision were recognized as having created an internationally renowned program in experimental transplantation. A brilliant scholar, teacher, and mentor, Dr. Zhong is also remembered as a man of great humility, kindness, and respect.

Dr. Robert Zhen Zhong passed away in London, Ontario on September 8, 2006.

POSTER #1: Kitty Wu  
Characterizing primary fibroblasts in breast capsular contracture formation  
Wu K, Kim S, Yazdani A, Turley E, DeLyzer T  
Division of Plastic and Reconstructive Surgery, Department of Surgery

**Introduction:** Breast capsular contracture is a difficult complication occurring in up to 17% of implant-based reconstructions. The pathological switch that propels a ‘healthy capsule’ towards contracture remains incompletely characterized. The objective of this study is to identify differences in tissue histology and fibroblast subtypes from varying grades of breast capsular contracture.

**Methods:** Twenty-five breast capsular tissue samples from fifteen patients undergoing capsulectomy or implant exchange were collected and grouped according to the Baker classification (Grade 1 to 4). Capsular tissue was processed for histological analysis (H&E, Masson’s Trichrome, picrosirius red staining) to visualize capsular tissue architecture. Capsular tissue was sectioned into 0.5cm² pieces and incubated in DMEM media to allow outgrowth of primary fibroblasts. Fibroblasts were stained for alpha-smooth muscle actin (αSMA) and fibroblast activating protein (FAP) immunofluorescence to identify fibroblast subtypes.

**Results:** Capsular tissue demonstrates densely organized parallel collagen architecture. Primary fibroblast outgrowth occurred by day 6-14. Fibroblasts from all capsule grades were successfully cultured and passaged, except from patients with previous radiation treatment. Analyses showed a trend towards decreased αSMA and FAP expression and an increase in highly flattened senescent-like fibroblasts from higher capsular grades.

**Conclusions:** Decreased αSMA and FAP staining in higher contracture grades may indicate a higher proportion of senescent fibroblasts. These are non-replicative cells that contribute to fibrosis by secreting pro-inflammatory/fibrotic cytokines. The inability to passage fibroblasts from irradiated capsule samples further supports the role of senescent fibroblasts in contracture formation. Understanding this fibroblast type will help to target therapeutic non-surgical options for capsular contracture.
POSTER #2: Vicky Vo

Hydrogen sulfide mitigates the effects of ischemia-reperfusion injury in a donation after cardiac death model of renal transplantation

Vo V1,6, Juriasingani S1,6, Grewal J1,4,6, Lobb I1,4,6, Haig A2, Jiang J6, and Sener A1,3,4,5,6

1Department of Microbiology & Immunology, 2Department of Pathology and 3Department of Surgery, Western University, London, Ontario, Canada; 4Schulich School of Medicine & Dentistry, London, Ontario, Canada; 5Multiorgan Transplant Program and 6Matthew Mailing Centre for Translational Transplant Studies, London Health Sciences Centre, London, Ontario, Canada.

Introduction: Despite increasing use of donation after cardiac death (DCD) kidneys for renal transplantation (RTx), DCD grafts experience prolonged warm ischemia-reperfusion injury (IRI) which is associated with negative graft outcomes. The clinical standard of care for organ preservation is cold storage in University of Wisconsin (UW) solution. We have shown that supplementing UW solution with hydrogen sulfide (H2S) donor molecules can improve graft outcomes in other models of RTx. This study evaluates the effects of NaHS supplementation in DCD organ transplantation.

Hypothesis: UW solution supplemented with NaHS will improve graft outcomes in a murine model of DCD RTx

Methods: In a novel in vivo murine model of DCD RTx warm ischemia was induced via clamping the left kidney for 30min, followed by flushing and 18h cold storage using UW solution (control) or UW+NaHS (150µM, treatment). Blood and urine samples were collected on days 3, 5, 10, 20, and 30, and analyzed. Renal injury was evaluated using histopathology.

Results: UW+NaHS treated transplants showed significantly greater survival over 30 days compared to UW only(p<0.05). The treatment group demonstrated lower protein-to-creatinine ratios as well as lower serum creatinine and urea levels by post-operative day 10 compared to controls(p<0.05), indicating quicker recovery towards normal renal function. Subsequent histopathology supported these findings.

Conclusion: Using a novel in vivo model of DCD RTx, we have demonstrated for the first time that cold storage of donor kidneys in H2S-supplemented UW solution improves survival rates, graft function and renal injury compared to the clinical standard of care.
POSTER #3: Supriya Singh
A Cadaveric, Biomechanical Study Comparing the Subacromial Balloon Spacer to Superior Capsular Reconstruction in the Treatment of Massive, Irreparable Rotator Cuff Tears
Singh, S., Langohr, D., Reeves, J., Athwal, G.S., Johnson, J.
Division of Orthopedic Surgery

Introduction: Massive, irreparable rotator cuff tears are a challenging surgical dilemma. Two techniques have recently been proposed; insertion of a subacromial balloon spacer and superior capsular reconstruction (SCR). The purpose of this biomechanical study was to compare the subacromial balloon to SCR in their ability to restore humeral head position and prevent superior humeral head migration.

Methods: Eight male cadaveric shoulders were tested. The shoulders were mounted on a custom shoulder simulator that permitted muscle loading. Four shoulder conditions were tested: intact, irreparable rotator cuff tear, subacromial balloon spacer and SCR. The primary outcomes were superior humeral head migration and functional shoulder abduction force measured at 0°, 30°, 60° & 90° of abduction.

Results: In comparison to the intact condition, the irreparable rotator cuff tear condition resulted in a significant increase in superior humeral head migration at 0° (p=0.028) and 30° (p=0.017) of abduction. Insertion of the subacromial balloon spacer restored humeral head position, such that it was not significantly different from the intact condition (p=0.177). Similarly, the SCR restored humeral head position, such that it was not significantly different from the intact condition (p=1.000). No significant differences were found between the balloon and the SCR (p=1.000). The functional abduction force was significantly decreased after tear creation (p=0.009). However, the subacromial balloon (p=0.403) and SCR (p=1.000) restored function abduction force to near intact levels.

Conclusion: When biomechanically tested in a shoulder simulator, both the subacromial balloon spacer and SCR restored humeral head position to intact values, with no substantial differences identified between techniques.
POSTER #4: CuiLin Zhu
Over-expression of GDF15 Preventing Renal Ischemia Reperfusion Injury
Division of General Surgery

Introduction: Ischemia reperfusion (I/R) injury still remains one of main causes of early renal dysfunction in kidney transplantation. There are no effective treatments for preventing I/R injury. This study aims to investigate the impact of a new molecule growth differentiation factor 15 (GDF15) in I/R injury in kidney transplantation. We hypothesized that GDF 15 can protect renal function from I/R injury.

Material and method: A murine warm I/R injury model in which left renal artery and vein of mice were clamped and collateral kidney was removed at the beginning of reperfusion. Renal function and histopathological change were measured 24h after reperfusion. Cell apoptosis and gene expression were detected by TUNEL and qRT-PCR, respectively. The effect of GDF15 on renal cell death was assessed using tubular cells in vitro.

Results: Results showed that GDF15 transgenic mice who over-expressed GDF15 had the lowest levels of blood creatinine and BUN, while GDF15 knockout mice had the highest levels of creatinine and BUN. Only one out of six C57Bl/L6 wild type mice survived over 8 days while other mice died within 3 days. All GDF15 knockout mice died next day post I/R. In contrast, four of eight GDF15 mice survived over 8 days and none of GDF15 mice died on next day after clamping. Overexpression of GDF15 attenuated apoptosis in vivo and in vitro and reduced histopathological changes of kidney induced by I/R.

Conclusion: Over-expression of GDF15 protects renal function from I/R injury, highlighting its therapeutic potential in preventing I/R injury in clinic.
POSTER #5: Armin Badre
Role of Anconeus in the Stability of an LCL Deficient Elbow: An In Vitro Biomechanical Study
Badre A, Axford DT, Banayan S, Johnson JA, King GJW
Division of Orthopaedic Surgery

Introduction: The role of anconeus in elbow stability has been a long-standing debate.

Hypothesis: Our hypothesis was that anconeus is a varus and a posterolateral stabilizer of the lateral collateral ligament (LCL) deficient elbow.

Materials and Methods: Seven cadaveric arms were mounted in an elbow motion simulator in the varus position. Kinematic data were recorded during simulated active elbow flexion with the forearm pronated and supinated.

An LCL injured model was created by sectioning of the common extensor origin, and the LCL. The anconeus tendon was sutured in a Krackow fashion and tensioned to 0N, 10N and 20N using a transosseous tunnel placed through the lateral epicondyle.

Results: During active motion, the injured model resulted in a significant increase in varus angulation (5.3°±2.9°, P=.000 pronation; 3.5°±3.4°, P=.001 supination) and external rotation (ER) (8.6°±5.8°, P=.001 pronation; 7.1°±6.1°, P=.003 supination) of the ulnohumeral articulation compared to the intact state (varus angle -2.3°±3.2° pronation; -3.3°±3.2° supination; ER angle 2.4°±5.6° pronation, 1.6°±5.8° supination). Tensioning of the anconeus significantly decreased the varus angulation (-1.2°±4.5°, P=.006 10N pronation; -3.9°±4.0°, P=.000 20N pronation; -4.3°±4.0°, P=.000 10N supination; -5.3°±4.2°, P=.000 20N supination) and ER angle (2.6°±4.5°, P=.008 10N pronation; 0.3°±5.0°, P=.000 20N pronation; 0.1°±5.3°, P=.000 10N supination; -0.8°±5.3°, P=.000 20N supination) of the injured elbow.

Conclusions: In the highly unstable varus elbow orientation, anconeus loading improves the in vitro stability of an LCL deficient elbow during simulated active motion. Strengthening of the anconeus may improve symptomatic instability in patients with varus and posterolateral instability of the elbow.
POSTER #6: Benjamin Fuhrmann

Regulation of NK Cell Cytotoxicity by TEC Expression of Clr Proteins in Kidney Ischemia Reperfusion Injury
Benjamin Fuhrmann, Dameng Lian, Hong Diao, Shengwu Ma, Zhuxu Zhang, Anthony M. Jevnikar
Division of Nephrology, Department of Medicine, Matthew Mailing Centre for Translation Transplant Studies

Introduction: Kidney tubular epithelial cells (TEC) may negatively regulate NK cell activation and cytotoxic capacity by surface expression of a novel class of C-type lectin-related ligand proteins (Clrs) to prevent ischemia reperfusion injury (IRI).

Methods: Expression of Clr-b/f was confirmed in wild type (WT) and Clr-b/f mouse TEC using RT-PCR. TEC were treated in vitro with Clr-f siRNA, and silencing was confirmed by RT-PCR. Cell death was measured in NK-TEC co-cultures by target cell 51Cr release.

Results: Clr-b and f were expressed by WT TEC and upregulated by TNFα+IFNγ in vitro. Clr-b surface expression was increased for >48hr in B6 kidneys following IRI. Elimination of either Clr-b or Clr-f by TEC did not increase NK mediated killing. However, simultaneous silencing of both Clr-b and Clr-f expression resulted in increased NK killing of TEC compared to silenced Clr-b or Clr-f TEC (p<0.01), or WT control TEC (p<0.001).

Conclusion: TEC may increase their expression of Clr-b/f with ischemia and alloimmune renal injury as an endogenous mechanism of protection from NK cells during inflammation. As no current drugs target NK cells effectively, Clr-b and Clr-f fusion proteins that bind to NK cells may represent a novel strategy to protect organs from diverse forms of NK mediated inflammation and cytotoxicity.
POSTER #7: Charles Dion

Revision total knee arthroplasty using a novel 3D printed titanium augments: A biomechanical cadaveric study
Department of Surgery, Division of Orthopaedic Surgery

Introduction: During revision total knee arthroplasty (rTKA), proximal tibial bone loss is frequently encountered and can result in a less-stable bone-implant fixation. A 3D printed titanium alloy (Ti6Al4V) revision augment that conforms to the irregular shape of the proximal tibia was recently developed. The purpose of this study was to evaluate the fixation stability of rTKA with this augment in comparison to conventional cemented rTKA.

Hypothesis: We hypothesized that the novel 3D printed titanium augment would have equal or better fixation stability in comparison to the conventional rTKA.

Materials and Methods: Eleven pairs of thawed fresh-frozen cadaveric tibias (22 tibias) were potted in custom fixtures. Primary total knee arthroplasty (pTKA) surgery was performed on all tibias. Fixation stability testing was conducted using a three-stage eccentric loading protocol. Bone-implant micromotion was measured. The pTKAs were removed and rTKA was performed. The rTKA were loaded. The micromotion between the experimental and control group was compared.

Results: There were no statistically significant differences in compressive or shear displacement between the two types of rTKRs, except during the initial static load on the posterolateral side (p=0.034). A trend of lower compressive μ-motion with the 3D printed augment rTKA was observed.

Conclusions: This study suggests that early fixation of the rTKR with the augment is similar to the conventional fully cemented rTKR and is likely sufficient for promoting bony ingrowth of the augment when in-vivo. Further studies are needed to investigate the long-term in-vivo fixation of the novel 3D printed augment.
POSTER #8: Jennifer Bjazevic
The Effect of Bacterial Infection on Calcium Urolithiasis in a *Drosophila melanogaster* Model
Jennifer Bjazevic¹, Kaitlin Al², Hassan Razvi¹, Jeremy P. Burton¹,²
1. Department of Surgery, Division of Urology 2. Department of Microbiology & Immunology, Schulich School of Medicine & Dentistry, Western University

**Introduction:** Urinary bacteria may contribute to the development of calcium stone disease. Previous studies have directly isolated bacterial from non-struvite stones. In addition, epidemiological studies have demonstrated a correlation between culture proven urinary tract infections and stone disease. Hypothesis: We hypothesized that exposure to bacteria increases the formation of calcium oxalate stones in a *Drosophila melanogaster* fly model.

**Methods:** Flies were administered a non-urease producing strain of *Escherichia coli* (UTI89) and 0.1% sodium oxalate food. Flies were pulverized and cultured on lysogeny broth agar plates on day 1-3 to determine if UTI89 persisted in the flies. Stone burden was assessed with a fecal crystal and Malpighian tubule assays and survival analysis.

**Results:** UTI89 was cultured from the exposed flies for up to three days post-exposure with at least 3x10³ colony forming units/fly. Exposure to UTI89 did not affect survival of flies fed normal food. Preliminary results suggest that exposure to UTI89 altered oxalate crystal production in both fecal pellets and Malpighian tubules.

**Conclusion:** These findings suggest that the presence of a non-urease producing *E. coli* impacts calcium oxalate stone formation, which could have implications in human stone disease. Further investigation is required to confirm these results and to delineate the potential mechanisms by which this may occur.
POSTER #9: Gaung-Ju Zhao
Partial depletion of regulatory T cells prevents secondary *Pseudomonas aeruginosa* infection post sepsis by enhancing host inflammatory response
Guang-Ju Zhao1,2,3, Zhi-Qiang Hu1, Zhong-Qiu Lu1, Tianqing Peng2,3,4
1. Emergency Department, the First Affiliated Hospital of Wenzhou Medical University
2. Lawson Health Research Institute, London Health Sciences Centre 3. Department of Pathology and Laboratory Medicine, Western University 4. Department of Medicine, Western University

**Introduction:** Immune dysfunction contributes to secondary infection and worse outcomes in sepsis. It is well known that regulatory T cells (Tregs) induces immunosuppression. A recent study reported that complete deletion of Tregs failed to rescue septic mice.

**Hypothesis:** Administration of Anti-CD25 mAb reduced the number of Tregs and thus prevented secondary *Pseudomonas aeruginosa* infection post sepsis.

**Materials and Methods:** Sepsis was induced in mice by Cecal Ligation and Puncture (CLP). After 3 and days of CLP, mice received *Pseudomonas aeruginosa* via the trachea as a second hit, respectively. Anti-CD25 mAb was injected 24 hrs before the second hit. The protein levels of IL-17A, IL-1β, IL-6 and IL-10 were measured in tissue lysates. Bacterial load was determined in bronchoalveolar lavage fluids. Histological changes were assessed in lung.

**Results:** Pathological changes and bacterial load in lung and mortality were increased by infection with *Pseudomonas aeruginosa* in septic mice (3 days post CLP) compared with non-septic mice. These effects of existing sepsis on secondary *Pseudomonas aeruginosa* infection were associated with an increased number of Tregs in both lung and spleen. Furthermore, injection with PC61 (anti-CD25) mAb reduced the number of Tregs by 50% in spleen and 60% in lung of septic mice. This partial depletion of Tregs elevated IL-17A, IL-1β and IL-6 production, and decreased IL-10 levels in septic mice with *Pseudomonas aeruginosa* infection, leading to lower bacterial load, attenuation of lung injury and improvement of survival.

**Conclusions:** Tregs may be a potential therapeutic target for limiting secondary infection in sepsis.
POSTER #10: Jiakun Li
Atb-346, a slow-releasing hydrogen sulfide donor, mitigates renal injury following the relief of prolonged urinary obstruction
Li J., Juriasingani S, Liu W., Wallace J, Akbari M, Sener A
Departments of Surgery, Microbiology and Immunology and Pathology, Western University. Department of Physiology and Pharmacology, University of Calgary.

INTRODUCTION: Chronic obstructive nephropathy leads to irreversible renal injury, atrophy, inflammation, and eventually fibrosis. Hydrogen sulfide (H₂S) is an endogenous gasotransmitter with protective properties. In this study, we investigated the effect of ATB-346, which is a slow-releasing H₂S donor and derived from naproxen, on chronic unilateral ureteral obstruction (UUO) and evaluated the underlying mechanism.

HYPOTHESIS: ATB-346 will improve renal function in chronic UUO.

MATERIALS AND METHODS: We used a validated model of rat UUO and re-implantation. Lewis rats were divided into 3 experiment groups. UUO was induced on Day 0 followed by reimplantation and contralateral nephrectomy on Day 15. The treatment group received ATB-346 at 4.5mg/kg (i.p.) daily for 30 days starting on Day 1. A control group of animals received naproxen at 3mg/kg naproxen for the same period and a third group was the sham group which only experienced midline incision with no UUO. On days 3, 7, 10, 17, 21, 24, and 30 urine samples were collected, and urine outputs were recorded. Serum samples were collected on days 3, 10, 17, 24 and 30. Urine osmolality and electrolytes as well as serum creatinine and urea were analyzed to evaluate renal function in each group.

RESULTS: Before and following reimplantation, we observed both treatment and control serum creatinine were persistently higher than sham, as expected. However, we could not see any difference between ATB-346 treatment group and Naproxen. We observed a significantly higher urine output in both treatment and control groups compared to sham animals following ureteric reimplantation (p<0.05). But the difference between treatment group and control was not significant. When we evaluated the urine osmolality, we saw that it was significantly lower (more dilute) in both the ATB-346 and the naproxen groups compared to sham (p<0.05), however, again there was not any difference between the treatment group and control.

CONCLUSIONS: Daily administration of ATB-346 was not more effective in protecting renal function following prolonged UUO and renal recovery in comparison to Naproxen. This can be due to factors such as the administration does of ATB or experimental model. More studies are necessary to find better conditions for more effective use of ATB-346 in urinary diseases.
POSTER #11: Tiago Ribeiro
Assessing Monocyte Infiltration Following Kidney Injury: A Novel Approach to Predicting Graft Function Prior to Transplantation
Tiago Ribeiro, Masoud Akbari, Cindy Page, Sean Gill, Alp Sener
Department of Surgery, Microbiology & Immunology

Background: In the USA alone, there are over 3000 kidneys discarded each year based on subjective criteria, many originating from donors after cardiac death (DCD). There is currently no method to predict which DCD kidneys will have the best functional outcomes. We propose a novel approach to determine the “future” function of kidneys by utilizing a novel positron emission tomography probe, \(^{89}\text{Zr}\)-desferrioxamine-NCS (\(^{89}\text{Zr}\)-DBN), to label monocytes and quantify infiltration/adhesion in potential grafts.

Materials and Methods: We conducted initial in vitro studies to examine the effect of DBN-labelling on monocyte function followed by in vivo studies using carboxy-fluorescein succinimidyl ester (CFSE) labeled monocytes to establish model feasibility.

Results: DBN-labelling of mouse bone marrow-derived monocytes had no effect on monocyte viability, proliferation, polarization, adherence to kidney endothelium, or differentiation into macrophages. We then assessed if adoptively transferred, CFSE-labeled monocytes would isolate themselves into the injured kidney following 30min of unilateral ischemia reperfusion injury (IRI). Fluorescence microscopy revealed that injured kidneys displayed greater monocyte infiltration compared to contralateral healthy kidneys (p<0.05, N=5) which correlated to a significantly higher ATN score (p<0.05).

Conclusions: These data suggest that this model could be utilized to create a predictive tool to evaluate “unsuitable” grafts prior to transplant and sets the stage for our work with \(^{89}\text{Zr}\)-DBN. This novel approach could lead to a greater utilization of previously discarded kidneys, thereby improving patient outcomes while reducing health care costs.
POSTER #12: Simi Juriasingani
Supplementing blood with mitochondria-targeted H$_2$S during subnormothermic machine perfusion improves ex vivo transplant outcomes in DCD grafts
Departments of Surgery, Microbiology and Immunology and Pathology, Western University.

Introduction: While static cold storage (SCS) prior to transplantation is the clinical standard of care, it can exacerbate renal graft injury. Previously, adding hydrogen sulfide (H$_2$S) to cold UW solution has improved renal graft outcomes. However, considering the rising interest in normothermic preservation, we compared SCS in UW with normothermic machine perfusion (NMP) and subnormothermic machine perfusion (SMP) with and without H$_2$S.

Hypothesis: SMP with H$_2$S-supplemented blood leads to improved graft function compared to SCS and NMP.

Methods: We used a mitochondria-targeted H$_2$S donor (AP39) and a clinically relevant ex vivo porcine model of renal transplantation. Warm ischemia was induced in pigs via 30m of renal pedicle clamping. Following nephrectomy, kidneys were flushed with UW and preserved for 4h using SCS in UW or NMP at 37ºC or SMP at 22ºC. One group of kidneys was flushed with UW+200nM AP39 and preserved using SMP+AP39 (200nM) at 22ºC. Non-stressed blood for preservation perfusion was collected prior to clamping and stressed blood (collected after clamping) was used for reperfusion of all the kidneys at 37ºC for 4h. Blood and urine samples were collected hourly and histopathology was used to determine injury.

Results: During preservation, SMP+AP39 kidneys showed significantly higher urine output than SMP and NMP kidneys (p<0.05). During reperfusion, SMP+AP39 kidneys showed significantly greater urine output than SCS kidneys (p<0.05) and significantly lower urine protein compared to SCS kidneys and NMP kidneys (p<0.05).

Conclusions: We demonstrate, for the first time, that SMP with H$_2$S-supplemented blood leads to superior graft function compared to SCS (the clinical standard of care) and NMP at 37ºC (standard for normothermic preservation).
POSTER #13: Mohammed Haddara
The Effect of Wrist Position on Tendon Loads Following Pulley Sectioning and Operative Reconstruction
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Introduction: Post-operative rehabilitation is important for maximizing patient outcomes following surgical pulley reconstruction. The purpose of this study was to identify the optimal wrist position that rehabilitation should be undertaken to decrease the strain on surgically reconstructed pulleys.

Hypothesis: We believe that placing the wrist in a flexed position would reduce strain at the pulley following surgical reconstruction.

Materials and Methods: Fourteen digits comprised of the index, long, and ring fingers were tested from five cadaveric specimens in a novel in-vitro finger motion simulator designed to actively achieve full finger flexion and extension. Servo-motors were used to generate motion through tendons under load or position control while measuring tendon forces. FDP loads were measured sequentially with native intact pulleys, A2 and A4 pulleys sectioned, and with reconstructed A2 and A4 pulleys. Each condition was tested in wrist neutral, and 30° of wrist flexion or extension. The effect of wrist position on FDP loads under each condition were analyzed using multiple one way repeated-measures ANOVA.

Results: With pulleys reconstructed, the wrist position had a significant effect on tendon load (p=0.030). The flexed wrist position resulted in a 31% reduction of FDP load compared to the neutral wrist position (p=0.010). Wrist extension also produced an apparent reduction, though not statistically significant. Conclusion: Placing the wrist in 30° flexion following reconstruction decreased tension in the FDP tendon compared to a neutral wrist. This study suggests that rehabilitation should be carried out with the wrist flexed in order to reduce strain on pulley reconstructions.
POSTER #14: Sanjay Patel
Perioperative Risk Stratification of Liver Transplant Patients using AIMS-65
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Introduction: MELD has been adopted for prioritization of patients awaiting liver transplantation based on predicted wait-list mortality. However, the ability of MELD to accurately predict post-operative outcomes remains elusive. AIMS-65 is a clinical tool that has been validated, and is used to predict mortality following significant gastrointestinal bleed. Attempts have been made to utilize this simple yet effective scoring system in predicting wait-list mortality in end-stage liver disease. We aimed to investigate the utility of AIMS-65 score in predicting perioperative outcomes following liver transplantation.

Methodology: A retrospective review of all patients undergoing transplantation from 2011-2017 was used to evaluated. Patients were stratified as: low (0), intermediate (1-2) or high (3-4) risk. A logistic regression model was used to evaluate AIMS-65 to predict 90-day mortality. Secondary outcomes included ICU readmission, length of stay (LOS) and surgical re-intervention. Finally, performance of AIMS-65 in predicting these outcomes was compared to laboratory-MELD-scores using receiver-operator-curves.

Results: A total of 311 patients underwent transplantation within the study period. Patients were assigned to low (n=84), intermediate (n=164) and high-risk (n=63) strata. Increasing scores were associated with increased risk of 90-day mortality (OR:2.15, 95% CI:1.21–3.80), ICU readmission (OR:1.62, 95% CI:1.02–2.59) and surgical re-intervention (OR: 1.70, 95% CI:1.21–2.39). Median length of stay was significantly different between risk strata (p < 0.0001). ROC analysis using AUC showed similar performance of MELD and AIMS-65.

Conclusion: AIMS-65 shows promise as simple clinical tool predicting perioperative risk following liver transplantation. The risk of 90-day mortality, LOS, ICU-readmission and surgical re-intervention can be stratified by this tool. Endeavors to validate the AIMS-65 in the transplant population should be undertaken to further evaluate its utility and performance.
POSTER #15: Meng Zhang

MicroRNA Modulates T cell Exhaustion in Heart Transplant Rejection via Regulating Inhibitory Receptors
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Introduction: T-cell exhaustion has been recognized as an important mechanism involved in T-cell dysfunction in the chronic infections. Engagement of Inhibitory receptors such as programmed cell death 1 (PD1) by its ligand programmed death ligand 1 (PDL1) inhibits T-cell activation, and leads to T-cell exhaustion. Blocking the interaction between the programmed cell death (PD)-1 protein and its ligand-PD-L1 has been reported to have impressive antitumor responses. The present study was designed to analyze the role of microRNA in regulating T cell exhaustion in heart transplant.

Results: BALB/c mouse Recipient tolerance was introduced by injecting with Rapamycin through subcutaneous injection. Treatment with rapamycin significantly prolonged allograft survival in heart transplant mice (n ≥ 8, p < 0.0001 vs control groups). CD 11c+ Dendritic cells (DCs) were collected through CD 11c microBeads in tolerant mice (100 survival days) and rejected mice (7 survival days) and verified by flow cytometry through incubating with CD11c antibody. Real-time PCR showed that the ligands of Regulating inhibitory receptors (iRs) - PDL1, Galectin 9 and HVEM expression levels in tolerant DCs were significantly higher than rejected DCs. Mouse miRNAs in rejected DCs and tolerant DCs were analyzed by Affymetrix GeneChip 3.0 miRNA Array. MicroRNA Array showed that the rejected DCs over-expressed miR-5119, miR-7033, miR-146a, miR-3535, miR-139, miR-7658 (n = 3, p < 0.01). Real time PCR also showed that the expression levels of miR-5119, miR-146a, miR-3535, miR-139, miR-7658 in the rejected mice were significantly higher than expression in the tolerant mice (n=5, * * p < 0.01). miRNAs binding site analysis demonstrated that miR-5119, miR-146a, miR-3535, miR-139, miR-7658 have binding sites with IR ligands - PDL1, Galectin 9 and HVEM.

Conclusion: T-cell exhaustion was involved in heart transplant tolerant mice. miR-5119, miR-146a, miR-3535, miR-139, miR-7658 contributed the T-cell exhaustion in heart transplant mice through regulating the inhibitory receptor ligands.
POSTER #16: Karen Yang
MicroRNAs modulate T-cell Exhaustion in Heart Transplants in mice via regulating Inhibitory Receptors
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Introduction: T-cell exhaustion has been recognized as an important mechanism involved in T-cell dysfunction in the chronic disease states, including cancer. Engagement of Inhibitory receptors such as programmed cell death 1 (PD1) by monoclonal antibodies has led to impressive antitumor responses by activating T-cells in a cancer milieu. Furthermore, PD-1 exerts its influence via the mTOR pathway and is supported by the PD-L1 ligand action, which can be expressed by cancer cells or by immune cells, like dendritic cells (DCs) However, in the context of graft rejection, T-cell exhaustion is advantageous as it blunts allogenic immune reactivity against donor grafts. Multiple mechanisms, including epigenetic control, are involved in T cell exhaustion, including microRNA (miRNA/miR) action in DCs. miRNAs are a class of small non-coding RNA molecules that can epigenetically inhibit transcription by binding to mRNAs and/or by initiating mRNA degradation. The present study was designed to analyze the role of dendritic cell microRNAs in regulating T cell exhaustion in mTOR-modulated heart transplants.

Results: BALB/c mouse recipient tolerance was introduced by injecting with rapamycin (mTOR modulator) through subcutaneous injection. Treatment with rapamycin significantly prolonged allograft survival in heart transplanted mice (n ≥ 8, p < 0.0001 vs control groups). CD 11c+ dendritic cells (DCs) were collected using CD 11c microbeads in graft-tolerant mice (100 survival days) and graft-rejected mice (7 survival days) and verified by flow cytometry. Real-time PCR showed that the ligands of Inhibitory Receptors (IRs:PDL1, Galectin 9 and HVEM expression levels in graft-tolerant DCs were significantly higher than graft-rejected DCs. miRNAs in graft-rejected DCs and tolerant DCs were analyzed by Affymetrix GeneChip 3.0 miRNA Array. The data showed that the rejected DCs over-expressed miR-5119, miR-7033, miR-146a, miR-3535, miR-139, and miR-7658 (n =3, ** p < 0.01). Real time PCR validation also showed that the expression levels of miR-5119, miR-146a, miR-3535, miR-139 and miR-7658 in the rejected mice were significantly higher than their expression levels in the tolerant mice (n=5, * p < 0.01). miRNAs binding site analysis demonstrates that miR-5119, miR-146a, miR-3535, miR-139 and miR-7658 have binding sites with multiple IR ligands: PDL1, Galectin 9 and HVEM.

Conclusion: T-cell exhaustion was involved in heart transplanted, graft-tolerant mice treated with rapamycin. MiR-5119, miR-146a, miR-3535, miR-139 and miR-7658 contributed to the T-cell exhaustion in heart transplanted mice through regulating the inhibitory receptor ligands in dendritic cells.
POSTER #17: Ingrid Gan

Mitochondrial membrane permeability plays a critical role for endothelial cell necroptosis and cardiac allograft rejection

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Introduction: Transplant injury is invariably associated with programmed cell death resulting in delayed graft function and organ rejection. We were the first to describe receptor-interacting serine/threonine protein kinase 3 (RIPK3) mediated necroptosis in transplant injury, where tissue necrosis and graft rejection were attenuated in RIPK3 null kidney and heart allografts following transplantation. Until now, the effect of mitochondrial dysfunction in the necroptotic pathway remains unclear. Here, our goal was to determine if mitochondrial dysfunction participates in cardiac cell necroptotic death and accelerates graft rejection.

Hypothesis: Mitochondrial dysfunction participates in cardiac cell necroptosis.

Methods: In vitro, we induced necroptosis in murine microvascular endothelial cells (MVECs) with TNF$\alpha$ and caspase-8 inhibitor. Necrotic cell death was measured using Sytox Green nucleic acid staining and quantified with the Essen Bioscience Incucyte Zoom live cell imaging. In vivo, cardiac grafts from wildtype C57BL/6 and mitochondrial permeability transition (MPT) deficient (CypD\textsuperscript{-/-}) mice were heterotopically transplanted into allogeneic BALB/c mice followed by rapamycin treatment.

Results: TNF$\alpha$ triggered cells to undergo RIPK1- and RIPK3-dependent necroptosis under caspase-8 inhibition. Interestingly, inhibition of MPT could also inhibit cell necroptotic death. MPT is largely regulated by Cyclophilin-D (Cyp-D). Cyp-D deficiency or RNA silencing protected MVEC from necroptosis. Furthermore, CypD-deficient cardiac allografts showed prolonged survival in allogeneic BALB/c mice compared to wild type C57BL/6 grafts post transplantation.

Conclusion: Our studies show that MPT may be an important mechanistic mediator of necroptosis in MVECs, and targeting mitochondria-mediated cell death to reduce cardiac graft rejection has therapeutic potential.
**POSTER #18: Kyle Willms**

**Histopathology study of Hydrogen Sulfide (H₂S) enzymes as a tool for prognosis of Renal Cell Carcinoma.**

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**Introduction:** Renal cell carcinoma (RCC) is the most prevalent form of kidney cancer. RCC tumors are pseudohypoxic, angiogenic and glycolytic. H₂S is an endogenously produced gasotransmitter which is produced by the ubiquitously produced enzymes CSE, CBS, and MPST. We have previously reported that inhibiting various combinations of the enzymes responsible for H₂S production can decrease RCC tumor progression, at least in an ex vivo setting. Based upon this, we hypothesized that the various enzymes responsible for H₂S production could be used a predictive tool for RCC tumor stage and progression in the clinical setting.

**Methods:** To evaluate this, we investigated the expression of H₂S enzymes CSE, CBS and MPST in the paraffin-embedded tissue samples obtained from human kidney cancers removed during surgery, using immunohistochemistry (IHC) techniques. Tumor tissues were compared with adjacent healthy control tissue to determine the percentage of diffuse versus discrete expression of H₂S enzymes using image J software and confirmed by a clinical pathologist.

**Results:** Tumor samples demonstrated a significantly higher diffuse expression of CBS than the healthy tissues. However, areas showing discrete expression of CBS were not different between tumor and healthy tissue. The diffuse expression of both CSE and MPST enzymes were lower in tumor samples compared to healthy tissues.

**Conclusion:** The expression patterns of H₂S producing enzymes were correlated with disease occurrence. This switch from the similar expression of all enzymes in healthy tissue to predominantly expression of CBS in the tumor may be a useful tool in better diagnosing of RCC and lead to better treatment and care of patients in the future.
POSTER #19: David Axford
Development of a cantilever-based 3D force measurement system for glenoid reaming simulation
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Introduction: Glenoid reaming during total shoulder arthroplasty requires accuracy and precision during removal of the cartilage layer and subsequent gentle reaming of the subchondral plate. A surgical simulator was developed that reproduces the tactile vibrations that a surgeon feels during reaming. Previously, the simulator could only measure force applied perpendicular to the glenoid and was limited to simulating concentric reaming procedures. However, the capability of simulating eccentric reaming is highly valuable.

Hypothesis: It is proposed that a 3D force measurement system can be developed to measure net force magnitude and angle of approach. The system should have a force magnitude error of less than 2.5 N and an angle measurement error of less than one degree.

Materials and Methods: A cantilever-based force measurement system was designed and calibrated to determine user applied net force magnitude and angle of approach from measured cantilever bending strain. Mean absolute error (MAE) was used to quantify the errors in net force magnitude and orientation between the cantilever-based system and a commercial system over a range of 0 to 125N and -15 to 15 degrees of version and inclination.

Results: Error quantification resulted in net force MAE of 1.12+/-1.16 N, version angle MAE of 0.64+/-0.44 degrees and an inclination angle MAE of 0.51+/-0.49 degrees.

Conclusion: The developed system meets the accuracy objectives for measuring the force vector orientation and magnitude. This functionality will allow the existing reaming simulator to simulate surgical cases requiring eccentric reaming which will aid in the acquisition of complex psychomotor skills.
POSTER #20: Dong Zheng

Selective inhibition of mitochondrial calpain reduces ischemia/reperfusion-induced myocardial injury

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Introduction: Ischemia/reperfusion (I/R) injury contributes to heart failure post myocardial infarction and donor heart malfunction and rejection. Calpain has been implicated in promoting myocardial I/R injury. We investigated whether targeted inhibition of mitochondrial calpain would reduce myocardial I/R injury in vitro and in vivo.

Methods: Transgenic mice with inducible cardiac-specific over-expression of mitochondrial-targeted calpastatin was generated (Tg-mtCAST/tTA). Myocardial ischemia/reperfusion and cardiomyocytes hypoxia/reoxygenation models were constructed. Apoptosis and necroptosis were determined. Mitochondrial reactive oxygen species (ROS) production, ATP synthase activity and the protein levels of ATP5A1, p-RIP3/RIP3 and p-MLKL/MLKL were analyzed in cardiomyocytes.

Results: In cultured cardiomyocytes, H/R increased the protein levels of calpain-1 and ROS generation in mitochondria, induced apoptosis, and promoted necroptosis as evidenced by increased LDH release, decreased cell viability and up-regulation of phosphorylated RIP3 and MLKL proteins. These adverse effects of H/R were attenuated by over-expression of mitochondrial-targeted calpastatin. Mechanistically, the elevation of calpain-1 in mitochondria was associated with a reduction of ATP5A1 protein and ATP synthase activity in H/R-stimulated cardiomyocytes, which was reversed by up-regulation of mitochondrial-targeted calpastatin. Furthermore, over-expression of ATP5A1 or incubation with mitochondria-targeted antioxidant mito-TEMPO prevented apoptosis and necroptosis in H/R-treated cardiomyocytes. In mouse I/R model, Tg-mtCAST/tTA mice exhibited smaller infarct size and less cell death in hearts after I/R as compared to their wild-type littermates.

Conclusions: Selective over-expression of mitochondrial-targeted calpastatin reduces myocardial I/R injury by preventing ATP5A1 activity and ROS generation. Thus, targeted inhibition of mitochondrial-targeted calpain may be a new strategy to limit I/R injury in hearts.
POSTER #21: Corey Smith

Development of Reaction Force Navigation for Surgical Robotics

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Introduction: Total shoulder replacement involves removing bone from the upper arm and the shoulder socket, known as the glenoid, and replacing it with implant components. This is a difficult procedure to perform and can lead to excess bone removal or improper implant placement eventually leading to revision surgery.

Hypothesis: The use of a surgical robot system with reaction-force navigation for glenoid replacement will help improve implant placement accuracy.

Materials and Methods: Flexible components tether a Stewart Platform robot holding a bone burring tool to the patient and reaction loads of the strips allow the robot to “feel” its way around. The system was tested against a fellowship-trained surgeon both performing glenoid replacement on two different shoulder analogs: standard anatomy and posterior glenoid edge wear referred to as a B2 shoulder.

Results: For six standard shoulders the net implant position and orientation errors were 1.47 ± 0.48 mm and 2.57 ± 2.30° for the robot and 1.61 ± 0.29 mm and 5.04 ± 1.92° for the surgeon respectively.

For six B2 shoulders, the net implant position and orientation errors were 2.16 ± 0.36 mm and 2.89 ± 0.88° for the robot and 3.01 ± 0.42 mm and 4.54 ± 1.49° for the surgeon respectively.

Conclusions: The new tracking system was shown to be able to match or outperform the surgeon. The robot proved to be versatile using the same burring tool throughout, while the surgeon required a multitude of tools. Next cadaveric tests will be performed to further validate the system.
POSTER #22: Max Zhang
Evaluating the Protective Effects of Sodium Thiosulfate on Renal Injury
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Introduction: Current methods to combat ischemia-reperfusion injury involves cold storage of organs with a preservation solution prior to transplantation. Addition of hydrogen sulfide (H\textsubscript{2}S) to University of Wisconsin (UW) has been shown to further mitigate graft function and injury. In this study, we investigate the effects of a FDA-approved H\textsubscript{2}S donor (sodium thiosulfate) using an in vitro model of hypothermic preservation and ex vivo DCD model of renal transplantation.

Hypothesis: Adding sodium thiosulfate (STS) to cold UW solution improves renal viability and attenuates tissue necrosis.

Methods: Pig kidney cells (LLC-PK1) cells were treated with UW solution supplemented with 50\textmu M, 150\textmu M, 250\textmu M, 500\textmu M, and 1mM STS. The cells were placed in hypoxia (0.5% O\textsubscript{2}) for 24h at 10\textdegree C followed by reoxygenation (21% O\textsubscript{2}) for 24h at 37\textdegree C. Cells were later stained with Annexin-V and 7-AAD to quantify apoptosis and necrosis using flow cytometry. Pig kidneys were nephrectomised after 1h clamping before being flushed and stored in UW or UW + 150\textmu M STS. Kidneys were perfused with ethidium homodimer after 24h to quantify necrosis.

Results: UW solution supplemented with 150\textmu M and 250\textmu M STS significantly increased (p<0.05) renal cell viability compared to UW solution alone. Pig kidneys treated with STS-supplemented UW showed significantly lower (p<0.05) ethidium homodimer staining.

Conclusion: For the first time, we show that hypothermic preservation (4\textdegree C) with STS-supplemented UW solution significantly increases renal cell viability and leads to reduced tissue injury.
POSTER #23: Mayank Sharma  
Experimental Measurement of the Cutting Forces Generated During a Robot-Driven Glenoid Reaming Procedure  
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1 Department of Biomedical Engineering, 2 Department of Mechanical and Materials Engineering

Introduction: During total shoulder arthroplasty (TSA), due to anatomic variability among patients, surgical experience is required to successfully position the glenoid implant. To provide training-surgeons such experience, a virtual simulator with augmented-feedback is being developed to mimic the TSA procedure. This study pertains to the calibration of a bone-removal model by experimentally collecting forces involved in reaming of bone of different densities.

Hypothesis: Bone regional variability will dictate peak-force, translation speed and stiffness during reaming; quantified data will be used to program the simulator.

Methods: An electric surgical reamer was retrofitted to a Kuka robot. The robot was programmed to apply preset levels of reaming thrust force (36 N) corresponding to an experienced surgeon’s reaming practice. Five synthetic bone specimens of densities replicating different human cancellous bone (0.16 g/cc, 0.24 g/cc and 0.32 g/cc), were reamed to a 5 mm depth. Peak force, reaming speed, and force as a function of displacement (stiffness) were evaluated.

Results: Peak force significantly increased as specimen density increased (p<0.001). Reamer speed decreased significantly as material density increased (p < 0.001). Reaming force as a function of displacement can be related to the medium stiffness. As expected, the perceived stiffness of the reamed material was directly proportional with its density (p<0.001).

Conclusions: The results obtained suggest that greater reaming forces are required in cortical bone when compared to the cancellous bone (former has a higher density than the latter). Future tests will be conducted on human glenoid samples to verify this hypothesis.
POSTER #24: Carlos Garcia-Ochoa

HOSPITAAL: A score to predict blood transfusion in patients undergoing pancreaticoduodenectomy

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General Surgery

Introduction: Blood transfusion is associated with worse outcomes and increased resource utilization after pancreaticoduodenectomy. The aim of this study is to develop a risk score to predict blood transfusion after pancreaticoduodenectomy.

Methods: American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) registry from 2014-2016 was used to develop and validate a prediction model of blood transfusion within 30 days after pancreaticoduodenectomy. We used univariable analysis to determine potential predictors and best subsets logistic regression was used for variable selection, restricting to eight variables. Model discrimination was assessed using c-statistic, and was adjusted using bootstrapping and estimation of Harrell’s optimism. We used a loess-based smoothing algorithm to graphically assess calibration.

Results: From 17,463 patients that received pancreatic surgery, 11,183 patients underwent a pancreaticoduodenectomy, and 2,130 (19%) had a blood transfusion. Fifteen pre-operative variables were associated with risk of transfusion and eight were selected for inclusion in the final model (Hematocrit <38%, Open-pancreatectomy, pre-operative Sepsis, Insulin-dependent diabetes, pre-surgical blood Transfusion, American society of anesthesiologists classification > 3, Albumin <4 g/dl; HOSPITAAL). The eight-variable model had a c-statistic of 0.68 (95% CI, 0.67-0.69) with an optimism of <0.01. The model showed good calibration with concordance between the predicted and observed probabilities.

Conclusion: Blood transfusion is a prominent quality indicator in pancreatic surgery. The HOSPITAAL score shows moderate discrimination in predicting blood transfusion after pancreaticoduodenectomy. This could be used to augment risk-adjustment, standardize performance measurement, and to develop strategies pre-operatively to reduce the risk of blood transfusion.
POSTER #25: Nahid Punjani

The Impact of Common Urologic Complications on the Risk of a Prosthetic Joint Infection

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Introduction: Prosthetic joint infections (PJI) after total hip/knee arthroplasty (THA/TKA) are significant complications. Our objective was to determine if urinary tract infection (UTI) and acute urinary retention (AUR) are significant risk factors for PJI after THA/TKA.

Methods: This is a population-based retrospective cohort study for patients >66 years undergoing an initial THA/TKA between April 2003 and March 2013. Investigated exposures included post-operative UTI within 2 years of THA/TKA and AUR within 30 days of THA/TKA. Primary outcome was PJI requiring hospital admission following THA/TKA.

Results: During the study period, 113,061 patients had arthroplasties (44,495 THA and 68,566 TKA). Median age was 74 (IQR 70-79). Of these, 28,256 (25.0%) had at least 1 UTI, and were more likely to be older, female, have previous antibiotics, cystoscopy or urinary retention, and atrial fibrillation. A total of 2,516 patients (2.2%) had AUR within 30 days of procedure, and were more likely to be older, male, have comorbidities, previous transurethral procedures or cystoscopy, previous urology visits and a general anesthetic during their procedure. A total of 1,262 (1.1%) patients had PJI requiring hospital admission. In multivariate Cox regression analysis, UTI was associated with an increased risk of PJI (HR 1.21, 95%CI 1.14-1.28, p<0.01), however, there was no association between AUR and PJI (HR 0.99, 95%CI 0.60-1.64, p=0.98).

Conclusions: UTI is associated with increased risk of hip or knee PJI, whereas AUR is not a significant risk factor. Timely and appropriate treatment of symptomatic UTIs in this patient population may be important to prevent PJI.
POSTER #26: Mauro Tun-Abraham

Overall complications with the use of preoperative biliary stenting vs. pancreaticoduodenectomy alone in patients with obstructive jaundice and pancreatic adenocarcinoma. An analysis of the ACS-NSQIP Registry.

Liver Transplant, General Surgery

Introduction: The use of preoperative biliary stenting has been associated with a higher complication rate after pancreaticoduodenectomy. Our aim was to compare postoperative complication rates among patients with preoperative biliary stenting vs. surgery alone in patients with adenocarcinoma and obstructive jaundice.

Methods: We used ACS-NSQIP registry from 2014-2016, and compared preoperative biliary stenting to surgery alone in patients with obstructive jaundice and pancreatic adenocarcinoma undergoing pancreaticoduodenectomy. The primary outcome was a postoperative complication in the first 30 days after surgery. We used propensity score matching to ensure balanced baseline characteristics between the two groups. Using a modified Poisson regression model, we estimated the association of preoperative biliary stenting vs. surgery alone with postoperative complication.

Results: From 3,628 patients with pancreaticoduodenectomy and obstructive jaundice, we matched 904 (97%) patients with surgery alone to up to three patients who received preoperative stenting (n=2,318) for a matched cohort of 3,222. A total of 493 (55%) patients with surgery alone experienced a postoperative complication compared to 1,285 (55%) patients with preoperative stenting (risk ratio: 0.99, CI 95%, 0.91-1.05, p=0.65).

Conclusion: Previous studies have shown increased rate of complications with preoperative biliary stenting, however, some of these studies lack an adequate sample size or restrict certain baseline characteristics. Our study showed that preoperative biliary stenting was not associated with an increased risk of overall postoperative complications in patients that had pancreaticoduodenectomy with obstructive jaundice. This favours the increasing indications of preoperative stenting to allow the use of neoadjuvant therapy for pancreatic adenocarcinoma.
POSTER #27: Kathleen Nelligan

Health utility values in breast reconstruction: A systematic review.
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Introduction: Breast reconstruction involves techniques with varying costs and outcomes. Cost-effectiveness analyses (CEA) identify interventions with the greatest quality of life improvement at the lowest cost. Health utility values describe the value of therapeutic interventions, but estimates are variable across the literature.

Hypothesis: Identify utility values relevant to breast reconstruction and use meta-analysis to generate estimates.

Methods: A systematic review was conducted of Medline and EMBASE for all CEAs in breast reconstruction. Results were screened by two independent reviewers and disagreements resolved by consensus. Possible cost-utility analyses and reports of utility metrics were reviewed in full text. Studies that generated utility values were included in the analysis and pooled estimates were generated.

Results: Of 2285 articles screened, 36 were reviewed in full-text stage and 20 articles reporting utilities for 30 health states were included. Instruments used to generate utilities included time-trade-off, visual analog scale (VAS), BREAST-Q and HALex in 5, 10, 2 and 2 studies, respectively. Utility values for successful surgery with implant-based and autologous reconstruction were 0.70 (95%CI 0.63-0.75) and 0.86 (95%CI 0.83-0.88), respectively. Utility values for reconstruction with complications ranged from 0.57 (95%CI 0.48-0.66) for total flap loss to 0.71 (95%CI 0.60-0.82) for mastectomy flap necrosis.

Conclusions: Utility values in breast reconstruction are most commonly generated using VAS. Specific utility values are variable and affected by post-operative outcome. This analysis can serve as a reference for utilities for future breast CEA.
POSTER #28: Shahid Aquil
Transplantation of pediatric en bloc renal allografts from donors weighing less than 10 kg have similar outcomes to donors weighing more than 10 kg.
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Introduction: Few transplant programs use kidneys from donors with body weight (BW) <10 kg or < 8 months old. We hypothesized that pediatric en bloc transplants from donors with BW <10 kg or age < 8 months would provide similar transplant outcomes to larger grafts.

Methods: All pediatric en bloc renal transplants performed at our center between 2001 and 2017 were reviewed (N=28). Data were stratified by smaller (donor BW less than 10 kg) (N=11) or larger donors (BW greater than 10 kg) (N=17). Renal volume was assessed during follow-up by ultrasound.

Results: Demographic characteristics were similar between the two groups of recipients. After mean follow-up of 44 and 124 months, graft and patient outcomes were similar between groups. Serum creatinine at 1, 3, and 5 years was no different between groups. At 1d post-transplant mean total renal volume in the smaller group was 28 ± 9 mm³ vs. 45 ± 12 mm³ (P <0.01). By 3 weeks, it was 53±19mm³ vs.73±19mm³. Complication rates were similar between both groups with one case of venous thrombosis in the smaller group.

Conclusion: Pediatric en bloc renal transplantation from very small donors is a potential source of additional renal allografts. With experience, outcomes were similar to pediatric en bloc allografts that were obtained from larger pediatric donors.
POSTER #29: Jordan Broberg
Effect of patient-specific instrumentation on knee stability following total knee replacement
Broberg JS, Howard JL, Vasarhelyi EM, Yuan X, McCalden RW, Naudie DD, and Teeter MG
Division of Orthopaedic Surgery, Department of Surgery

Introduction: Patient-specific instrumentation (PSI) such as custom surgical guides is a recent development in total knee replacement (TKR). However, no consensus has been reached on the effectiveness of PSI. With the use of radiostereometric analysis (RSA), the current study aims to analyze the stability of the knee throughout flexion when PSI is used to determine whether PSI provides an improvement to TKR.

Hypothesis: Using PSI will provide a more stable knee throughout flexion than conventional instrumentation (CI).

Methods: Patients (n=50) were randomized evenly to either PSI or CI. At the 2-year follow-up, RSA images were acquired during standing knee flexion, ranging in 20° increments from 0° to 120°. Results from the RSA exams were used to attain the contact locations between the femoral and tibial implant components. Stability for each condyle was measured as the root mean square of the incremental anterior-posterior (AP) position change between mid-flexion angles (20° to 100°), and the incidence of condylar separation.

Results: Preliminary results from 36 patients (16 PSI, 20 CI) revealed no difference in the increments of AP position change throughout flexion between PSI and CI for the medial condyle (mean difference=0.82 mm, p=0.06) or lateral condyle (mean difference=0.19 mm, p=0.85). Condylar separation was present in 3 CI patients and no PSI patients.

Conclusions: Early results suggest that PSI provides no substantial advantage for TKR surgery with respect to knee stability. Given its higher cost per case, it offers no benefit for routine primary TKR.
POSTER #30: Maxwell Perelgut  
New Metrics to Determine the Functional Status of Total Hip Arthroplasty Patients  
Perelgut ME, Vasarhelyi EM, Lanting BL, Teeter MG  
Division of Orthopaedic Surgery

**Introduction:** Increasing pressure for rapid recovery care pathways following total hip arthroplasty (THA) is pushing for new ways to measure patient functionality. Instrumented Timed-Up-And-Go (TUG) tests have the potential to provide these measurements. This study aims to compare pre- and post-operative patient reported outcome measures (PROMs) with the TUG test to determine the effectiveness of using these new metrics.

**Hypothesis:** We hypothesize that TUG quantitative metrics will provide important information on patient functionality throughout recovery.

**Materials and Methods:** Patients (n=100) undergoing primary unilateral THA will be recruited pre-operatively. The TUG test, along with a series of PROMs (WOMAC, SF-12, HHS, and UCLA Activity Score) will be administered and reported at each visit (pre-operative, 2-, 4-, 6-weeks, 3-, 6-months, 1-, and 2-years). Patients performing the TUG test will wear four inertial sensors, one above and below each knee, start in a seated position, walk 3 metres, turn around, and return to their seated position.

**Results:** Preliminary results (n=24) illustrate significant Pearson correlations pre-operatively between the HHS Pain Score and TUG total-test time ($r=0.697 \, p<0.001$), TUG sit-to-stand time ($r=0.642 \, p<0.001$), and TUG walking-to-goal time ($r=0.669 \, p<0.001$). HHS Function Score illustrates significant correlations with TUG total-test time ($r=0.773 \, p<0.001$), TUG sit-to-stand time ($r=0.626 \, p=0.001$), and TUG walking-to-goal time ($r=0.707 \, p<0.001$). WOMAC Joint Function Score illustrates significant correlations with TUG total-test time ($r=0.522 \, p=0.009$), TUG sit-to-stand time ($r=0.506 \, p=0.012$), and TUG walking-to-goal time ($r=0.575 \, p=0.003$).

**Conclusions:** Early results suggest that the TUG test provides beneficial measures of patient pre-operation functional status.
POSTER #31: Chris Tarola
Risk Factors for All-Cause Mortality following Post-Cardiotomy VA-ECMO: Analysis of the STS Adult Cardiac Surgery Database

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Introduction and Hypothesis: Given the considerable risk of morbidity and mortality associated with veno-arterial extracorporeal membrane oxygenation (VA-ECMO), we evaluated the corresponding risk factors in the post-cardiotomy VA-ECMO patient population to develop a clinically relevant risk-probability model.

Method: The Society of Thoracic Surgeons Adult Cardiac Surgery Database was queried to identify all adult patients who underwent open cardiac surgery procedures, excluding heart transplantation, requiring post-cardiotomy VA-ECMO between 2014 and 2016. After multivariable adjustment, we isolated variables correlating with survival to hospital discharge and composite morbidity. Using a divide and conquer algorithm, we developed a risk probability model for discharge disposition among survivors.

Results: We identified 1701 patients, 583 (34.3%) female, who required post-cardiotomy VA-ECMO, of which 730 (42.9%) survived to discharge. Mean [SD] age was 61 [13.6] years. After multivariable adjustment, CPB time, MELD score, age, and number of RBC transfusions were significant correlates of mortality. Cross-clamp time, pre-operative balloon pump insertion, and MELD score were significant predictors of morbidity. Recent coronary bypass surgery, higher baseline ejection fraction, and non-emergent case status reduced the likelihood of morbidity. A decision tree was developed demonstrating the discharge disposition and survival probability of a patient given a set of demographic or operative criteria.

Conclusions: The decision to initiate post-cardiotomy VA-ECMO is dependent upon patient and clinical presentation factors. We have identified key patient and procedural characteristics predictive of hospital morbidity and mortality, as well as correlates of patient discharge disposition, in order to assist with the decision to pursue VA-ECMO in the post-cardiotomy setting.
POSTER #32: Shane Smith
Impact of Traumatic Upper Extremity Amputation on the Outcome of Injury Caused by the Antipersonnel Improvised Explosive Device
Shane A. Smith, Mark DaCambra, Vivian C. McAlister
Division of General Surgery

Background: We have previously reported a higher than expected rate of upper extremity amputation (UEA) in victims of the antipersonnel improvised explosive device (AP-IED) compared to a similar cohort injured by antipersonnel mine (APM). The goal of this study is to describe the rate, severity, and impact of upper extremity amputation caused by the AP-IED upon its target.

Hypothesis: Upper extremity amputation is more common with AP-IED’s than APM and is a marker of more severe injury.

Method: A prospective database of 100 consecutive dismounted AP-IED victims with pattern 1 injuries was analysed to compare the cohort with UEA to that without.

Results: UEA [above elbow (8); below elbow (19); through elbow (1); hand (3), digit(s) (15)] was much more prevalent with AP-IED than APM (40% vs 6%; P<0.001). UEA was associated with a higher rate of multiple amputations [39 (98%) versus 32 (53%); p < 0.001], bilateral lower extremity amputation (LEA) [33 (82.5%) vs. 30 (53.3%) p = 0.003] and facial injury [8 (20%) versus 4 (6.4%), p < 0.05]) but not with pelvic disruption 10 (25%), genitoperineal mutilation 19 (48%), eye injury 6 (15%) or skull fracture 6 (15%).The casualty fatality rate was higher in patients with UEA than in those without [12 (30%) vs. 7 (12%); p=0.022].

Conclusion: UEA is more prevalent with AP-IED than APM. Presence of UEA is associated with more severe injury and increased risk of death in AP-IED victims. Upper limb injury has significant consequences for rehabilitation from LEA, which universally accompanies UEA in AP-IED victims. Upper extremity injury should be amenable to prevention by innovative personal protective equipment designed to protect the flexed elbow.
POSTER #33: George Pang
Squamous Cell Carcinoma with Regional Metastasis to Axilla or Groin Lymph Nodes: A Multicenter Analysis of Outcomes
George Pang, Nicole J. Look Hong, Gabrielle Paull, Suzana Kupper, Daniel J. Kagedan, Carolyn Nessim, May Lynn Quan, Frances C. Wright
Department of General Surgery

Background: Cutaneous squamous cell carcinoma (cSCC) of the trunk and extremities with regional metastasis is uncommon but presents a significant clinical challenge. Treatment patterns and outcomes are poorly described. This study examines the clinical outcomes of this patient group in three Canadian centers.

Methods: cSCC patients with axilla/groin lymph node metastasis and underwent curative-intent nodal surgery between 2004 and 2016 were identified at 3 Canadian academic cancer centers. Disease characteristics, treatment pattern and outcomes were described. Overall survival (OS) and disease-free survival (DFS) were calculated using Kaplan-Meier analysis.

Results: Of 41 patients identified, 28 (68%) were male, and median age was 74. Median follow-up was 38 months. Median primary lesion size was 30mm and median time to nodal metastasis was 11.3 months. 29 patients had nodal metastasis to the axilla, 6 (21%) underwent level I-II dissections and 23 (79%) underwent level I-III dissections. 12 patients had groin metastasis, 7 (58%) underwent superficial dissection, and 5 (42%) underwent a combined superficial and deep dissection. 29 (71%) patients received adjuvant nodal radiotherapy; 3 (7%) received neoadjuvant nodal radiotherapy, and 1 (2%) received adjuvant systemic chemotherapy. Following nodal surgery, 9 (22%) patients developed disease recurrence. Crude mortality rate was 37%. Mean OS was 5.6 years (95% CI 4.10 – 7.07) and DFS was 5.0 years (95% CI 1.80 – 8.71). Five-year OS 58%, and five-year DFS 52%.

Conclusion: Contemporary outcomes remain poor for patients with nodal metastases from cSCC, pointing to a need for a continued multi-disciplinary approach and integration of new systemic agents.
POSTER #34: Justin Kwong
The Evolution of Percutaneous Nephrolithotomy: Analysis of a Single Institution Experience Over 25 years
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Introduction: Over the years, there has been an increased use of percutaneous nephrolithotomy (PCNL) in the treatment of nephrolithiasis. Our objective was to characterize the evolution in patient demographics, surgical technique, and PCNL outcomes over a 25-year time period.

Hypothesis: Patient demographics, surgical techniques and PCNL outcomes have significantly evolved over time.

Materials and Methods: We performed a retrospective analysis on a prospectively maintained database, including 2486 patients from 1990 to 2015. Collected data included patient demographics, comorbidities, stone and procedure characteristics, adverse events, and stone-free status at three-month follow-up. Chi squared test was used to evaluate changes in patient characteristics and surgical techniques over time. A multivariate logistic regression was used to identify the effect of time on operative duration, adverse events, stone-free rate and hospital length of stay.

Results: Over time, there was a statistically significant increase in patient age (p=0.009), BMI (p=0.032), comorbidities (p<0.001), and ASA score (p<0.001). Both OR duration (p<0.001) and hospital length of stay (p<0.001) decreased significantly. There was an increase in the operative use of the balloon dilator and ultrasonic lithotripter (p<0.001). Stone-free rate decreased significantly over time (p<0.001), but correlated with an increased use of CT scans for follow-up imaging. There was an increased complication rate with time (p=0.010); however, this was correlated with the increased rate of medical comorbidities. The overall transfusion rate was 1.0%, and did not change over time (p=0.131).

Conclusions: Despite an increasing complex patient population, PCNL remains a safe and effective procedure for the management of large and complex urolithiasis; associated with a high stone-free rate and low risk of complications.
POSTER #35: Harley Williams

Wearable Sensors: Identifying new temporal and joint-specific metrics to improve the characterization of patient functional capacity pre- and post-TKA

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Introduction: Patient-reported outcome measures (PROMs) evaluate total knee arthroplasty (TKA) patient function in an easy, inexpensive way but cannot identify subtle differences between patients. The Timed-Up-and-Go (TUG) test is a reliable performance measure and when paired with wearable sensor technology could allow better characterization of function.

Hypothesis: We hypothesize that an instrumented TUG test will more accurately identify subtle differences between the functional status of TKA patients.

Materials and Methods: Data was collected for n=24 patients pre-operation. Patients have returned to the clinic for 2 week (n=24), 6 week (n=22), and 3 month examinations (n=11). Patients completed the SF-12, WOMAC, KSS, and UCLA Activity Score questionnaires pre-operatively. The TUG test was completed at each visit with sensors placed proximal and distal to their knees.

Results: Total test time (r=0.45, p=0.026), time to goal (r=0.50, p=0.013), turn time (r=0.55, p=0.005), and sit-to-stand time (p=0.42, p=0.042) correlated with the WOMAC Joint Stiffness subscore. Starting (r=0.54, p=0.007; r=0.62, p=0.022) and ending (r=0.46, p=0.023; r=0.56, p=0.047) flexion angle of the operative limb correlated with KSS and WOMAC Functional domains, respectively. Two week TUG performance was predictive of performance at 6 weeks (r=0.91, p=0.021) and 3 months (r=0.82, p=0.023).

Conclusions: Patients with stiffer joints have higher WOMAC Joint Stiffness scores and take longer to perform the TUG. Decreased TUG performance 2 weeks post-operation is likely due to acute pain and swelling. The predictive capability of performance at 2 weeks provides an opportunity for further intervention for patients at risk of poor long-term function.
POSTER #36: Ernst Chan

Revision Surgery for Penile Implants: A Retrospective Review
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Division of Urology, Department of Surgery

Introduction: Penile prosthesis implantation is the standard of care for erectile dysfunction refractory to medical management. Revision surgery for penile prostheses is necessary in up to 40% of cases over 15 years. There is lack of clarity in terms of how risk factors can guide patient selection for prosthesis implantation and if these factors can predict need for revision surgery.

Methods: We performed a retrospective review of all patients who underwent revision surgery for penile prosthesis over a 12-year period (2006 to 2018). All revision surgeries were performed by a single surgeon. Patient characteristics and intraoperative variables that were known risk factors for need for revision surgery were collected and analyzed.

Results: A total of 112 patients met our inclusion criteria. Most patients had revision due to mechanical failure (53.6%). The incidence of infection was 6.3%. Patients with history of CAD (OR 7.46; p=0.04) and immunosuppression (OR 11.32; p=0.02) were more likely to have prosthesis infection. Patients with longer surgeries had higher risk of prosthesis erosion (OR 1.04; p=0.04). Implantation of Coloplast 3-piece penile prosthesis was predictive of need for revision surgery (p<0.001), whereas malleable prosthesis was protective of need for revision surgery (p=0.005).

Conclusion: The incidence of penile prosthesis infection in our sample was lower than previously described rates. This may due to patient selection, perioperative antibiotic regimen, or surgical technique. Patients with CAD or immunosuppression should be counseled on the increased risk of infection. Selection of device type may also influence need for revision surgery.
POSTER #37: Katharine Pacoli

Effect of neuromuscular stimulation on surgical outcomes, physical mobility, and bowel function following kidney and kidney-pancreas transplantation

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Introduction: After transplantation, patients wear thromboembolism deterrent (TED) stockings and intermittent pneumatic compression (IPC) devices to prevent edema and deep vein thrombosis (DVT). Patient compliance with these devices is variable as they are uncomfortable and restraining. The Geko device is a novel, neuromuscular stimulation device designed to reduce the risk of DVT by promoting blood flow in the limbs. Its role in transplantation has not previously been assessed. It was expected that neuromuscular stimulation with the Geko device will lead to improved surgical outcomes, mobility, and bowel function.

Methods: We performed a single-centre study where 140 kidney and kidney-pancreas transplant recipients were randomly assigned to wear TED+IPC device (n=75) or Geko device (n=65), until post-operative Day 6. Surgical outcomes including length of hospital stay, transplant complications, and re-admission rates were monitored. We measured patient weight and calf circumference daily. A pedometer was used to measure patients’ steps post-surgery. Patients completed bowel and mobility questionnaires on post-operative Day 6.

Results: There were no differences in age, sex, or BMI between groups. The increase in leg circumference and weight after transplantation was reduced in Geko patients (p<0.0001, p<0.0001). Geko patients took more steps after surgery (p<0.05) and had reduced difficulty lying in bed and getting to bathroom (p<0.05, p<0.05). There were no differences in complications, re-admission rates, length of hospital stay, appetite, or bowel function.

Conclusion: The use of the Geko device in the post-operative period leads to significant improvements in lower limb edema and physical mobility following transplantation.
POSTER #38: Rachel Liu

Impact of Adjuvant Chemotherapy Completion Rates on Outcomes Following Pancreaticoduodenectomy for Pancreatic Ductal Adenocarcinoma

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Introduction: Prognosis of resectable pancreatic adenocarcinoma improves with the use of adjuvant chemotherapy with 5-year survival rate approaching 21% following a complete course. Despite these promising results, many patients who undergo resection do not complete the planned adjuvant regimen. The benefit from partial treatment is largely unknown. Understanding what factors lead to reduced chemotherapy completion rates and its impact on patient outcomes will help to guide management decisions in this patient population.

Methods: A cohort analysis was performed using a clinical database from a tertiary referral hospital and included patients undergoing pancreatic resection for ductal adenocarcinoma from 2007 to 2016. Patients who completed planned adjuvant chemotherapy were compared to those who did not. Overall survival and disease free survival using a Cox proportional hazards model adjusting for confounding variables was used. A logistic regression analysis was performed to evaluate what factors may influence adjuvant chemotherapy completion rates following resection.

Results: The study cohort included a total of 98 patients with 54 completing chemotherapy and 44 who did not. There were no measurable differences in overall (HR 0.993, p = 0.977) or 1-year survival (HR 0.997 p = 0.992) between these groups. Disease free survival at 1-year was significantly improved with completing chemotherapy (HR 0.225, p=0.001). Chemotherapy completion rates were reduced with increasing age (p=0.003) and improved with the addition of adjuvant radiation (p=0.001). Peri-operative complications, pancreatic fistula, length of stay, and time from resection to first chemotherapy treatment did not have a significant impact on chemotherapy completion rates. Sub-group analysis showed patients who did not complete chemotherapy and received adjuvant radiation had significantly reduced 1-year disease free survival (HR 0.10, p=0.006).

Conclusion: Completion of adjuvant chemotherapy in patients undergoing pancreaticoduodenectomy for ductal adenocarcinoma appears to have a disease-free survival benefit within the first year, but its effect is lost beyond this point. Despite incomplete treatment, overall and 1-year survival did not appear to be adversely affected. These results suggest that complete and partial adjuvant chemotherapy have similar long-term benefits.
POSTER #39: Serena Tejpar

How to build stronger surgeon-patient communication: Exploring the importance of delivery of information
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Introduction: Literature on surgeon-patient communication has highlighted the need to maximize the time surgeons spend with their patients. While surgeons are often excellent at providing details about the surgical approach, little is known about how patients assign value to this encounter. This study explores surgeons’ and patients’ perspectives of what is significant about their conversations. Understanding the surgeon-patient dynamics when planning for complex operations is critical to ensure that priorities for patient care and satisfaction are properly addressed.

Materials and Methods: Semi-structured qualitative interviews were performed with 3 surgeons, 2 patients, and 1 care giver to explore their experiences during surgeon-patient conversations in the context of vascular surgery. Using an inductive approach, patterns in the data were identified through constant comparative analysis.

Results: Both surgeons and patients emphasized the importance of building confidence and trust during their encounters. However, this process was viewed different by the two parties. While surgeons prioritized content, patients focused on the way in which the content was delivered. For instance, surgeons emphasized the importance of discussing the reason behind needing surgery, the preparations, and the recovery process. In contrast, patients valued how empathetic their surgeons were to their emotions and worries when delivering such information.

Conclusion: This study begins to show that it is not necessarily the content but the ways in which surgeons communicate to their patients that impacts patient’s perceptions of successful surgical experience and outcomes. Furthermore, understanding these differences is crucial if we are to make the most out of a surgeon-patient encounter under the current time restrains.
POSTER #40: Esther Lau

Impact of robotic-assistance on mental workload and cognitive performance of surgical trainees performing a complex minimally invasive suturing task

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Introduction: Few studies have investigated the potential impact of robotic-assistance on cognitive ergonomics during advanced minimally invasive surgery. The purpose of this study was to assess the impact of robotic-assistance on mental workload and downstream cognitive performance in surgical trainees.

Hypothesis: Robotic-assistance decreases the mental workload and preserves downstream cognitive performance in surgical trainees performing a complex laparoscopic suturing task.

Materials and Methods: Robot-naïve trainees from general surgery, urology and gynecology, stratified by specialty and level of training, were randomized to either laparoscopic surgery (LS) or robotic-assisted laparoscopic surgery (RALS) and performed a time-limited, complex laparoscopic suturing task. Mental workload was measured using NASA-TLX. Concentration and executive cognitive function were assessed using Psychomotor Vigilance Task (PVT) and Wisconsin Card Sorting Test (WCST), respectively. A p value of 0.05 was considered significant.

Results: Sixteen senior residents (SR; ≥PGY3) and 14 junior residents (JR; PGY1-2) completed the study. There was no difference in mental workload between LS and RALS. Within JR, LS was associated with impaired concentration, which was not observed for RALS. In contrast, amongst SR, RALS was associated with significantly worse performance on WCST.

Conclusions: Robotic-assistance, in this setting, did not provide a technical performance advantage nor impact subjective mental workload. We observed a protective effect on cognitive performance offered by RALS to junior trainees with limited LS experience, yet a detrimental effect on senior trainees with greater LS ability and inadequate pre-study robotic training, suggesting that robotic consoles may be mentally taxing for robotic novices and consideration should be given to formal console training prior to initial clinical exposure.
POSTER #41: Leandra Stringer
Assessing Gender Trends in Acceptance to Urology Residency
Stringer, L., Morris, H., Sener, A., and Stitt, L.
Urology

Introduction: The number of female medical students is increasing and therefore the number of females entering the work force as qualified physicians is also increasing. Despite this trend, there are still surgical specialties that are considered male dominant. Urology specifically has a significant male predominance in both residency and independent practice. This male predominance could have an impact on the physician work force, mentorship opportunities for females pursuing surgery and on medical student attraction to urology as a specialty. Research conducted in the United States has shown that in recent years, although less females enter the field of urology, acceptance rates between the two genders are similar. This study aims to identify if a trend towards gender specific acceptance into urology residency exists within Canada.

Hypothesis: After reviewing CARMS statistics over the past ten years, we suspect that there will be a significant difference in the rates of female versus male success in acceptance to urology. We suspect there will be a trend towards higher rates of male acceptance compared to female.

Methods: Canadian Residency Matching Services (CARMS) data from the previous ten years was analyzed. Logistic regression analyses were used to assess if any significant difference exists between the rates of female and male applicant acceptance into urology. These rates were then compared to the rates of female and male acceptance into surgical residency as a whole.

Results: Within urology applicants, there is no evidence that the success rate over time between males and females differs (p = .47). Likewise, within surgical residency applicants, there is no evidence that the success rate over time differs between male and female applicants (p = .84). In comparing these two rates, there is also no significant difference between rates of acceptance to urology versus surgery in general for female applicants (p = .45).

Conclusion: Overall, our data identifies that there is no significant trend toward male acceptance into urology over female applicants. There is no significant difference related to women acceptance specifically into urology or any difference between rates of females accepted into urology as compared to all other surgical subspecialties combined. Our data is in agreement with American statistics finding similar results.
ABSTRACTS FOR AWARD WINNING RESIDENT/FELLOW RESEARCH PAPERS

PRESENTATION #1: Dr. Oonagh Scallan
DIVISION: VASCULAR SURGERY

Long-term Outcomes Comparing Endovascular and Open Abdominal Aortic Aneurysm Repair in Octogenarians

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Objective: Patients 80 years or older have a significantly lower early mortality with EVAR when compared to open repair for abdominal aortic aneurysms (AAA). The long-term results in this older patient population remain poorly studied. We analyzed the results of both emergent and elective AAA repair in patients 80 years or older who had at least 5 years of follow-up.

Methods: Retrospective review of a prospectively collected vascular surgery database at a university-affiliated medical center was performed to identify all patients who underwent elective repair of an abdominal aortic aneurysm between 2007 and 2012 and were 80 years of age or older at the time of surgery. Open and EVAR groups were compared for outcomes using univariate statistics.

Results: The study cohort comprised of 314 patients 80 years of age or older (mean age, 83.5 +/- 2.9 years) who underwent repair (96 open repair, 218 EVAR). Patients treated with open repair and EVAR had similar comorbidities, except that EVAR patients were more likely to be male, and open repair patients were more likely to have larger aneurysms. When compared to open repair, elective early postoperative mortality was significantly lower for EVAR patients (1% vs 14% P<.001).

Overall mean life expectancy was 5.9 years (5.8 years EVAR, 5.8 years open repair, P=.98). 1-year survival was significantly higher for EVAR (92.9%) compared to open repair (84.1%) (P=.02). While 2-year (83.4% EVAR, 74.6% open repair, P=.07), and 5-year (57.8% EVAR, 60.3%
open repair, P=.98) survival did not differ between EVAR and open repair. The most common causes of long-term mortality were malignant disease and cardiovascular events. Three (1.4%) patients initially treatment by endovascular intervention sustained a mortality related to their aneurysm. Reintervention rates (14% EVAR, 2% open repair; p=.05) were higher in the endovascular treatment group.

Conclusions: EVAR results in an improved 1-year mortality in octogenarians when compared with open repair, although 5-year survival is similar between the two groups. Despite their advanced age, with average life expectancies over 5 years and a 14% reintervention rate, diligent follow-up is required following EVAR in these elderly patients.
**PRESENTATION #2: Dr. Matthew Valdis**

**DIVISION: CARDIAC SURGERY**

**What Happens to the Aortic Root? A Longitudinal Study of Aortic Valve Sparing Root Replacements**

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**Objective:** To evaluate the natural history of aortic root graft geometry, aortic valve competency and patient prognosis following a valve sparing aortic root reconstruction.

**Methods:** Between 2008 and 2017, 70 consecutive patients (mean age 56.4±16.4yrs, 19.7% females) underwent elective or emergent valve sparing aortic root reconstruction. All patients were prospectively evaluated with annual clinical follow-up, echocardiography and CT imaging. Patients were assessed for survival, freedom from reoperation, degree of aortic regurgitation, NYHA status and graft complications over time. All echocardiograms and computed tomograms were read by single echocardiographer and radiologist, respectively. Patients were followed up to 9 years post-operatively (mean 18.3±19.3 months), with 100% follow-up.

**Results:** The largest increase of the aortic annulus observed during the surveillance period was 2.64±5.4% which occurred between the second and third years of follow-up based on CT imaging. Similarly, the aortic sinuses, sinotubular junction and ascending aorta all remained relatively stable based on annual CT imaging. Echocardiographic measurements of these structures showed far more variability in the measurements taken at each annual post-operative visit and with far less precision as compared to the CT measurements taken at the same time. Due to the large variability and greater standard deviations from these measurements, no significant difference was detected between the more precise CT measurements and those from the echocardiogram images. The overall survival rate was 93.4%(66 patients). Freedom from reoperation was 98.4%(69 patients). Throughout the entire duration of follow-up, aortic insufficiency was identified as 0 in 46(65.7%), 1+ in 19(27.1%), 2+ in 4(5.7%), 3+ in 0(0%) and 4+ in 1(1.4%). Mean NYHA status was 1.1±0.3 at most recent follow-up for all patients. CT evidence showed 97.0% (64 patients) freedom from graft complication.
including; endocarditis, thrombosis, embolism, aneurysm, pseudoaneurysm, dehiscence, dissection and kinking.

**Conclusion:** Valve sparing aortic root reconstruction offers a safe and reliable repair of diseased tissue within the aortic root with excellent rates of survival and freedom from reoperation, with improvement and stability of patient symptoms and aortic insufficiency. Furthermore, the annual CT data presented here demonstrates stability of the aortic reconstruction over time and is superior to echocardiographic surveillance for dilation. However, given the stability of the repair annual CT imaging may not be of benefit to the patient or surgeon. This is the first prospective study to compare echocardiographic, CT and clinical data in patients undergoing valve sparing root reconstruction.
PRESENTATION #3: Dr. Patrick Murphy  
DIVISION: GENERAL SURGERY

**Negative pressure wound therapy use to decrease surgical nosocomial events in colorectal resections (NEPTUNE): A randomized controlled trial**

Patrick B Murphy, Sarah Knowles, Sami A Chadi, Kelly N Vogt, Muriel Brackstone, Julie Ann Van Koughnett, Michael C. Ott

**Background:** Surgical site infections (SSI) after open colorectal surgery are a common cause of morbidity and cost. The prophylactic effect of negative pressure wound therapy (NPWT) has not been established. We undertook the following study to evaluate if, amongst patients undergoing elective open colorectal resection, NPWT, as compared to standard post-operative dressings, is associated with a reduction in the rate of SSI.

**Methods:** A single-institution, prospective, randomized, open label, blind endpoint trial (Clinicaltrials.gov NCT02007018) was conducted over a 2-year period. Of 300 randomized patients, 284 (144 NPWT, 140 Standard Dressing) were included in the final analysis. The primary end-point was 30-day SSI, as assessed by wound care experts blinded to treatment arm. Secondary outcomes included length of stay. Statistical analysis was performed on an intent-to-treat basis. A subgroup analysis was planned for patients who received a stoma at the time of initial operation.

**Results:** There was no difference in baseline demographics. The average age was 64 years, 54% of patients were male and the median body mass index was 27. The majority of operations were low anterior or rectal resections (33%) and 15% of included cases were laparoscopic converted to open. The incidence of SSI at 30-days post-operatively was no different between experimental and control groups (32% vs 34% respectively, p=0.68). Length of stay was also no different at a median of 7 days (IQR 5) for both groups. Amongst patients receiving a stoma, there was also no difference in SSI between the experimental and control groups (38% vs 33% respectively, p=0.66)

**Conclusions:** Prophylactic use of NPWT on primarily closed incisions after open colorectal surgery did not impact SSI rates compared to standard gauze dressing. NPWT cannot be recommended for general use in open, or laparoscopic converted, elective colorectal procedures.
PRESENTATION #4: Dr. Leandra Stringer
DIVISION: UROLOGY

Assessing Gender Trends in Acceptance to Urology Residency
Stringer, L., Morris, H., Sener, A., and Stitt, L.
Urology

Introduction: The number of female medical students is increasing and therefore the number of females entering the work force as qualified physicians is also increasing. Despite this trend, there are still surgical specialties that are considered male dominant. Urology specifically has a significant male predominance in both residency and independent practice. This male predominance could have an impact on the physician work force, mentorship opportunities for females pursuing surgery and on medical student attraction to urology as a specialty. Research conducted in the United States has shown that in recent years, although less females enter the field of urology, acceptance rates between the two genders are similar. This study aims to identify if a trend towards gender specific acceptance into urology residency exists within Canada.

Hypothesis: After reviewing CARMS statistics over the past ten years, we suspect that there will be a significant difference in the rates of female versus male success in acceptance to urology. We suspect there will be a trend towards higher rates of male acceptance compared to female.

Methods: Canadian Residency Matching Services (CARMS) data from the previous ten years was analyzed. Logistic regression analyses were used to assess if any significant difference exists between the rates of female and male applicant acceptance into urology. These rates were then compared to the rates of female and male acceptance into surgical residency as a whole.

Results: Within urology applicants, there is no evidence that the success rate over time between males and females differs (p =.47). Likewise, within surgical residency applicants, there is no evidence that the success rate over time differs between male and female applicants (p=.84). In comparing these two rates, there is also no significant difference between rates of acceptance to urology versus surgery in general for female applicants (p=.45).

Conclusion: Overall, our data identifies that there is no significant trend toward male acceptance into urology over female applicants. There is no significant difference related to women acceptance specifically into urology or any difference between rates of females accepted into urology as compared to all other surgical subspecialties combined. Our data is in agreement with American statistics finding similar results.
PRESENTATION #5: Dr. Kitty Wu  
DIVISION: PLASTIC & RECONSTRUCTIVE SURGERY  

Characterizing breast capsular contracture: a translational study of primary fibroblast behaviour  
Kitty Wu, Stephanie Kim, Arjang Yazdani, Tanya DeLyzer, Eva Turley

**Purpose**: Breast capsular contracture is a difficult complication occurring in up to 17% of implant-based breast surgeries. The pathological switch that propels a ‘healthy capsule’ towards contracture is multifactorial and remains incompletely characterized. The objective of this study is to define the fibrotic signature and characterize primary fibroblast behaviour in different grades of breast capsular contracture.

**Methods**: Sixteen breast capsular tissue samples from 11 patients (9 primary augmentation, 7 breast reconstructions with 4 patients receiving radiation) undergoing capsulectomy or capsulotomy were collected and grouped according to the Baker classification (Grade 1 to 4). Capsular tissue was processed for histological analysis (H&E, Masson’s Trichrome) to visualize tissue architecture. Capsular tissue was sectioned into 0.5cm² pieces and incubated in DMEM media with FBS to allow outgrowth of primary fibroblasts. Fibroblasts were stained for alpha-smooth muscle actin (αSMA) and fibroblast activating protein (FAP) immunofluorescence and INK4a to identify fibroblast subtypes.

**Results**: Capsular tissue demonstrates densely organized parallel collagen architecture by Masson’s Trichrome staining and Grade 4 capsules had decreased capsule thickness (p < 0.001). Primary fibroblast outgrowth occurred by day 5-14. Fibroblasts from all capsule grades were successfully cultured and passaged, except from patients with previous radiation treatment. Immunofluorescence identified aSMA+ myofibroblasts within all capsule grades and an increased proportion of SMA+:FAP+ hybrid activated myofibroblasts in higher capsule grades (p <0.01). Two distinct populations of bi-polar and stellate fibroblasts were identified with a higher proportion of bi-polar fibroblasts in higher capsule grades (p = 0.07). Grade 3 capsules show significantly higher staining for senescence marker, INK4a.

**Conclusions**: Higher capsule grade was associated with a higher proportion of hybrid activated myofibroblasts positive for both aSMA and FAP. Higher capsule grades also contain a higher population of INK4a+ senescent fibroblasts. These are non-replicative cells distinct from myofibroblasts, that contribute to fibrosis by secreting pro-inflammatory/fibrotic cytokines. This is the first demonstration of senescent fibroblast populations contributing to breast capsular contracture formation.
PRESENTATION #6: Dr. Supriya Singh
DIVISION: ORTHOPAEDIC SURGERY

A Cadaveric, Biomechanics Study Comparing the Subacromial Balloon Spacer to Superior Capsular Reconstruction in the Treatment of Massive, Irreparable Rotator Cuff Tears
Supriya Singh
George Athwal, James Johnson, Daniel Langohr, and Jacob Reeves

Introduction: Massive, irreparable rotator cuff tears are a challenging surgical dilemma especially in the setting of a younger, active patient without glenohumeral arthritis. Currently, optimal treatment remains controversial, as primary repair is not possible. Multiple treatment options exist including; partial tendon repairs, tendon transfers, interposition grafts, and arthroplasty. Two new techniques include insertion of a subacromial balloon spacer and superior capsular reconstruction (SCR). The purpose of this study is to directly compare the subacromial balloon spacer to SCR in their ability to restore humeral head position and prevent superior humeral head migration.

Methods: Eight right, male, cadaveric shoulders were tested. The shoulders were mounted on a custom shoulder simulator. 10 N loads were applied to the individual rotator cuff muscles and the deltoid muscle was fired at 40 N, and subsequently 80 N. Four shoulder states were tested: intact, massive, irreparable rotator cuff tear, subacromial balloon spacer and SCR. Superior humeral head migration was the primary outcome measured at 0°, 30°, 60° and 90° of static shoulder abduction. Repeated measures analysis of variance was used for statistical analysis.

Results: After creating a massive, irreparable rotator cuff tear, the superior humeral head migration was significant at 0° (p=0.028) and 30° (p=0.017) of abduction. When comparing the intact shoulder to the balloon state, there was no statistical significance detected in the position of the humeral head (p=0.177). Furthermore, no statistically significant differences were found in the humeral head position between the intact and SCR state (p=1.000). Most importantly, when comparing the balloon and SCR, there were no statistically significant differences in humeral head position (p=1.000).

Discussion/Conclusion: Overall after a massive, irreparable rotator cuff tear, the humeral head migrated superiorly, and both the subacromial balloon spacer and the superior capsular reconstruction restored humeral head position to the intact state. This is an important finding in guiding future clinical treatment of massive, irreparable rotator cuff tears.

Level of Evidence: IV

Funding Sources/Disclosures: Ontario Graduate Scholarship, Smith and Nephew, Orthospace
PRESENTATION #7: Dr. Khrystyna Ioanidis

DIVISION: PAEDIATRIC SURGERY

A cost and efficiency analysis of performing myringotomy with tube insertion procedures in the minor procedure room compared to the operating room

K. Ioanidis, J. Davidson, J. Strychowsky, J. Paradis, M. Husein, V. Fantillo

BACKGROUND: Minor pediatric surgeries performed in the minor procedure room (MPR) may be more time efficient and less costly compared to those performed in the operating room (OR).

METHODS: This was a retrospective study on cost and efficiency differences of myringotomy with tube insertions performed in the MPR versus the OR. Charts were reviewed from June 2015 to May 2017. Cost data was based on supply cost and case costing of medical personnel including nurses, surgical aides, and anesthesia assistants.

RESULTS: 294 patients were included in the study. The median age was 2.8 years (range: 0.4-16.7) and there were no differences in gender between locations. 145 patients had surgery in the MPR (49.3%) and 149 had surgery in the OR (50.7%). There was a significant difference in the median length of surgery between locations (OR: 10.0 minutes vs. MPR: 7.0 minutes; p<0.0001). Median hospital stay (1.9 hours vs. 4.2 hours; p<0.0001) and median patient turnover time (6.0 minutes vs. 14.5 minutes; p<.0001) was shorter in the MPR compared to OR. The total overall cost of a myringotomy with tube insertion, including labour and supply cost, was $180.65 in the MPR compared to $407.85 in the OR, a difference of $227.20 per case.

CONCLUSION: Bilateral myringotomy with tube insertions are more time and cost efficient when performed in the MPR. This study supports the need for increased availability of MPR time for appropriate surgeries.
ABSTRACT FOR AWARD WINNING MSc IN SURGERY COLLOQUIUM
PRESENTATION

PRESENTER: Dr. Martina Mudri
DIVISION: GENERAL SURGERY

The effects of tracheal occlusion on Wnt signaling in a rabbit model of congenital diaphragmatic hernia.
Mudri M, Smith SA, Vanderboor C, Davidson J, Regnault TRH, Bütter A

**Purpose:** Tracheal occlusion (TO) reverses the pulmonary hypoplasia associated with congenital diaphragmatic hernia (CDH), but its mechanism of action remains poorly understood. Wnt signaling plays a critical role in lung development but only a handful of studies (including our group) have demonstrated changes in CDH animal lungs. The purpose of our study was a) to confirm that our CDH rabbit model produced pulmonary hypoplasia which was reversed by TO and b) the effects of CDH +/- TO on Wnt signaling.

**Methods:** CDH was created in fetal rabbits at 23 days, TO at 28 days and lung collection at 31 days (Term~32 days). Lung-body weight (LBWR) and mean terminal bronchiole density (MTBD) were determined. mRNA expression was determined in the left lower lobe.

**Results:** Nineteen does produced 222 fetuses: 58 CDH and 17 CDH+TO were created. Fifteen CDH, 15 CDH+TO and 15 controls survived. LBWR was significantly lower in CDH while CDH+TO was similar to controls (p=0.003). MTBD was significantly higher in CDH fetuses and restored to control levels in CDH+TO (p<0.001). House Keeping Genes (HKG) TOP1, SDHA and ACTB were consistently expressed within and between treatment groups. Finally, Wnt 2 mRNA was increased in CDH and CDH+TO (p=0.004, p=0.02). BMP4 and Lgl1 expression was unaffected by CDH+-/TO.

**Conclusion:** CDH+TO reverses pulmonary hypoplasia in the fetal rabbit model of CDH. HKGs demonstrated stable expression amongst all groups, and Wnt2 was altered in CDH rabbits but BMP4 and Lgl1 were unaffected.
DEPARTMENT OF SURGERY NODE PRESENTATIONS:

OVERVIEW OF RESEARCH NODES: Dr. Alp Sener

FUNDAMENTAL SCIENCES & SURGICAL INNOVATION NODE SPEAKER: Dr. Aaron Fenster
Talk Title: Development of Image-Guided Interventional Systems

SURGICAL EDUCATION NODE SPEAKER: Dr. Sayra Cristancho
Talk Title: Untangling Surgical Complexity and its Implications for Surgical Education

PATIENT CENTERED RESEARCH NODE SPEAKER: Dr. Muriel Brackstone
Talk Title: Single Dose Preoperative Breast Radiation (SIGNAL) Trial: Clinical Outcomes and Translational Research Opportunities for Immune Priming/In Situ Vaccination in Breast Cancer

ICES/BIG DATA NODE SPEAKER: Dr. Kelly Vogt
Talk Title: Association between Handover of Anesthesia Care and Adverse Postoperative Outcomes Among Patients Undergoing Major Surgery
THE ROBERT ZHONG LECTURE: Dr. David Urbach

We are very pleased to have David Urbach as our 2018 Dr. Robert Zhong Lecturer.

David Urbach is Chief of Surgery and Director of Perioperative Services at Women’s College Hospital, and Professor of Surgery and Health Policy, Management and Evaluation at The University of Toronto. His clinical practice focuses on minimally invasive surgery, particularly gastrointestinal, hernia, adrenal and obesity surgery. He is a Senior Fellow at the Women’s College Hospital Institute for Health System Solutions and Virtual Care (WIHV), and Senior Scientist at the Institute for Clinical Evaluative Sciences (ICES). His research program focuses on surgery-related health services research, including measurement of the quality and outcomes of surgical care, and methods for the evaluation of surgery and other health technologies.

Previous Robert Zhong Lecturers:

2017  Dr. Clifford Ko, MD, MS, MSHS, FACS, FASCRS, Director National Surgical Quality Improvement Program and Division of Research and Optimal Patient Care, American College of Surgeons

2016  Dr. Marston W. Linehan, MD, Surgeon-in-Chief, National Institutes of Health

2015  Dr. Ivar Mendez MD, PhD, FRCSC, FACS, DSc(hon), FCAHS
2014  Dr. Jonathan Meakins, retired McGill Professor and Chair of McGill’s Department of Surgery, former surgeon-in-Chief of the MUHC and current director of the MUHC Heritage Centre

2013  Dr. Jeremy Nicholson, Head of the Department of Surgery & Cancer at Imperial College in London University, UK.

2012  Dr. Garth Warnock, C.N. Woodward Professor, Head of the Department of Surgery, University of British Columbia, Co-Director, Ike Barber Human Islet Transplant Laboratory and British Columbia Islet Transplant Program

2011  Dr. Amitai Ziv, Deputy Director, Chaim Sheba Medical Center; Director, Israel Center for Medical Simulation, Tel-Hashomer, Israel

2010  Dr. John Monson, Chief of Colorectal Surgery, Vice-chair, Department of Surgery The University of Rochester, Rochester, New York

2009  Dr. Anthony Atala, Deputy Director, Chaim Sheba Medical Center; Director, Israel Center for Medical Simulation, Tel-Hashomer, Israel

2008  Dr. Richard M. Satava, Professor of Surgery, University of Washington

2007  Dr. James Shapiro, Wyeth-Ayerst Canada/CIHR Clinical Research Chair in Transplantation, Director, Clinical Islet Transplant Program, University of Alberta

GROUP INTERACTIVE SESSION

DEBATE: Merits of Surgeon Specific Outcomes and their Impact on Clinical and Teaching Practices

Dr. Michael Chu, Division of Cardiac Surgery & Dr. Patrick Colquhoun, Division of General Surgery

Moderator: Dr. Neil Parry, Division of General Surgery