KEYNOTE SPEAKER

Dr Mohit Bhandari
Canada Research Chair
Musculoskeletal Trauma & Surgical Research
Professor, Department of Surgery
McMaster University

Surgery Research Day
2014

Recognizing accomplishments in Research and Innovation in the Department of Surgery, University of Manitoba

January 15, 2014

7:45a.m. Department of Surgery Grand Rounds
Visiting Speaker
Theatre C—Bannatyne Campus

9:00—5:00 Research Day Program
Canad Inns—Destination Health Sciences Centre
Annual Department of Surgery
Research Day 2014

Sponsored by:
Department of Surgery GFT Surgeons
The Wayne Beecroft Western Surgical Lectureship Fund

This event is an Accredited Group Learning Activity (Section 1) as defined by the Maintenance of Certification Program of The Royal College of Physicians and Surgeons of Canada and approved by the University of Manitoba for a maximum of 4.5 credits.

Participants should only claim credit for the actual number of hours attended.
A University of Toronto graduate in Medicine, Dr. Bhandari completed both his Orthopaedic and Master’s of Clinical Epidemiology and Biostatistics training at McMaster University. To broaden his clinical trauma exposure, he trained with world experts in Los Angeles, California and Minneapolis, Minnesota. Currently, he serves as a Professor and Division Head of Orthopaedic Surgery and has recently been appointed to the Associate Chair of Research in the Department of Surgery at McMaster University.

He has received international recognition for his research efforts including a nationally recognized Canada Research Chair in Musculoskeletal Trauma. Dr. Bhandari has also received the Edouard J. Samson Award for a Canadian Orthopaedic surgeon with the greatest impact on research in the last 5 years, the Founder’s Medal for Research, and Randomized trial Mentoring Award from the Canadian Institutes of Health Research. Recent awards include the Royal College of Physicians and Surgeons of Canada Medal in Research, Kappa Delta/OREF Clinical Research Award, Top Achievements in Health Research Award (CMAJ/CIHR), the Canadian Orthopaedic Association Award of Merit and the Royal College of Physicians and Surgeons Mentor of the Year Award (Ontario).

Over the past 5 years, Dr. Bhandari has published hundreds of peer-reviewed papers across top medical and Orthopaedic journals including New England Journal of Medicine, JAMA, BMJ, CMAJ, and the Journal of Bone and Joint Surgery-American. He was recently listed among the top 10 cited orthopaedic surgeons over the past 20 years. He currently holds funding from the National Institutes of Health and Canadian Institutes of Health Research, and US Departments of Defence for large multicenter trials of tibial fracture management. He has received over 25 million dollars in research funding in recent years.
Judges

**Dr Mohit Bhandari**
Professor  
Department of Surgery, McMaster University

**Dr Chad Ball**  
Clinical Assistant Professor  
Department of Surgery, University of Calgary

**Dr Ramin Kholdebarin**  
General Surgery Resident  
Department of Surgery, University of Manitoba

The Royal College’s Maintenance of Certification program requires that all accredited activities be evaluated. Your input is invaluable to help us know today’s event met your expectations and where there is room to improve and enrich the Department of Surgery’s Annual Research Day for surgeons, residents, medical students and staff.

To help you with this process, today’s sessions will be evaluated electronically. Upon registration you will receive a card containing the link to the evaluation form. An email reminder will be sent to all participants after Research Day 2014 to complete the evaluation.

We appreciate your support and thank you for your time and collaboration.

Research Day 2014 Planning Committee

Dr Sadeesh Srinathan, Co-Chair  
Dr Ted Tufescu, Co-Chair  
Dr Richard Keijzer, Thorlakson Chair in Surgical Research  
Dr Christopher White, Resident Representative  
Mary Brychka, Administrator
Research Day 2014 Objectives

At the end of the Department of Surgery Annual Research Day, participants will be able to:

- Discuss the findings from surgical research conducted in the Department of Surgery at the University of Manitoba with colleagues and translate knowledge into clinical practice, patient care and academic teaching.
- Understand the professional activities of surgeons in advancing international medicine programs and research collaborations.
- Understand the advances in therapeutic approaches to trauma and translate knowledge into clinical practice, patient care and academic teaching.

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Disclosure

Before each presentation, speakers will disclose on their first slide any significant relationships that may be a perceived or apparent conflict of interest into the subject of the proposed CME/CPD activity.
Program Details - Morning

7:45  Department of Surgery Grand Rounds
Dr Chad Ball, University of Calgary
Penetrating Torso Trauma: Non-Therapeutic is Not Good Enough Anymore
Theatre C – Bannatyne Campus—University of Manitoba

9:00  Opening Remarks - Dr Sadeesh Srinathan
Ambassador Room A (second floor)
Canad Inns – Destination Health Sciences Centre

Plenary Session  Moderator: Dr Tom McGregor

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<td>Donor whole blood facilitates superior preservation of myocardial function during ex vivo heart perfusion</td>
<td>Christopher White Cardiac Surgery</td>
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<td>9:26</td>
<td>Long-term outcome of repair of full-thickness rotator cuff tears: From 9 to 19 years ago</td>
<td>Peter MacDonald Orthopedic Surgery</td>
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<td>9:37</td>
<td>Renal nephrometry score and predictors of complications in partial nephrectomies</td>
<td>Deepak Pruthi Urology</td>
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<td>9:48</td>
<td>Determining the natural history of cystic pancreatic neoplasms in the Manito-ban cohort</td>
<td>Jonathon Broughton General Surgery</td>
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<td>Does ultrasound predict intraoperative findings at cholecystectomy? An institutional review</td>
<td>Shannon Stogryn General Surgery</td>
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<td>10:10</td>
<td>The incidence of medically refractory TN: A 10-year prospective population based study</td>
<td>Christopher Walmsley Neurosurgery</td>
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<td>10:21</td>
<td>Fetal tracheal occlusion for severe pulmonary hypoplasia in congenital dia-phragmatic hernia: A systematic review and meta-analysis of survival</td>
<td>Jamila Almaary Pediatric Surgery</td>
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Plenary Session  Moderator: Dr Melanie Morris

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<td>10:47</td>
<td>Relative changes in the biomechanical properties of living rabbit brain tested under controlled physiologic conditions with indentation</td>
<td>Colin Kazina Neurosurgery</td>
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<td>10:58</td>
<td>Evaluation of in vivo wear measurement in total knee replacements using model-based radiostereometric analysis</td>
<td>Trevor Gascoyne Orthopedic Surgery</td>
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<td>11:09</td>
<td>The impact of frailty on post-operative delirium in cardiac surgery patients</td>
<td>Patrick Jung Cardiac Surgery</td>
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<td>The age factor in survival of a population cohort of well differentiated thyroid cancer</td>
<td>Alok Pathak Surgical Oncology</td>
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<td>Gamma knife stereotactic radiosurgery for treatment of large vestibular schwannomas</td>
<td>Mark Bigder Neurosurgery</td>
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<td>Validation of a proposed objective assessment protocol for ultrasound image acquisition</td>
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<td>Three-dimensional molecular characterization and isolation of circulating tumor cells in metastatic prostate cancer patients</td>
<td>Tadeusz Krodzak Urology</td>
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<td>12:04</td>
<td>Modular total knee replacements and the influence of insert thickness on polyethylene wear</td>
<td>Sean O’Brien Orthopedic Surgery</td>
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<td>12:15</td>
<td>Lunch</td>
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<td>12:45</td>
<td>Awards Ceremony</td>
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Presented by Dr Jack McPherson, Head & Dr Richard Keijzer, Thorlakson Chair in Surgical Research
2013 Resident Research Awards
2013 Department of Surgery Grant Competition Awards
## Program Details - Afternoon

### Keynote Speaker

Dr Mohit Bhandari  
*Thinking INSIDE the Box*

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<td><strong>Brief Session</strong></td>
<td><em>Moderator: Dr Colin Kazina</em></td>
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<td>2:00</td>
<td>Do fundamentals of laparoscopic surgery (FLS) and LapVR evaluation metrics predict intraoperative performance?</td>
<td>Sara Steigerwald, General Surgery</td>
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<td>2:05</td>
<td>The effect of a lubricant composition on polyethylene wear</td>
<td>Leah Guenther, Orthopedic Surgery</td>
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<td>2:10</td>
<td>Characterizing physician staffing models in the care of the postoperative cardiac surgical patient</td>
<td>Minahal Asif, Cardiac Surgery</td>
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<td>2:15</td>
<td>Incidence, distribution, predictors and outcomes of node positive patients at radical prostatectomy: Manitoba Prostate Center experience</td>
<td>Kamaljot Kaler, Urology</td>
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<td>2:20</td>
<td>Lumbar spinal stenosis and pre-surgical assessment: The impact of walking induced strain on a performance-based outcome measure</td>
<td>Michael Johnson, Orthopedic Surgery</td>
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<td>2:25</td>
<td>Point of care ultrasound utilization among trauma providers across Canada: cross-sectional study</td>
<td>Essa Aleassa, General Surgery</td>
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<td>2:30</td>
<td>Microvascular decompression for hemifacial spasm: Analysis of surgical failures and repeat surgery</td>
<td>Mark Bigder, Neurosurgery</td>
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<td>2:35</td>
<td>Superficial MCL injury: evaluation of medial joint laxity and the effect of a novel double row repair</td>
<td>Jeff Leiter, Orthopedic Surgery</td>
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<td>2:40</td>
<td>What is the evidence in evidence-based thoracic surgery? A study looking at the type and quality of thoracic surgery literature</td>
<td>Elizabeth Berg, General Surgery</td>
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<td>Current perspectives of urology involvement in renal transplantation: A survey of Canadian senior residents</td>
<td>Jennifer Bjazevic, Urology</td>
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<td>Non-cranial neurosurgical intraoperative magnetic resonance imaging – applications to complex cervical lesions</td>
<td>Behzad Sabit, Neurosurgery</td>
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<td>2:55</td>
<td>An analysis of Manitoba Prostate Center active surveillance patients: Treated versus untreated</td>
<td>Kamaljot Kaler, Urology</td>
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<td>3:00</td>
<td><strong>Coffee Break (15 minutes)</strong></td>
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<td><strong>Plenary Session</strong></td>
<td><em>Moderator: Dr Jason Old</em></td>
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<td>3:10</td>
<td>Computational assessment of aortic aneurysm rupture</td>
<td>April Boyd, Vascular Surgery</td>
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<td>The relationship between injury to surgery time and the incidence of secondary joint injury in an ACL-injured population</td>
<td>Meaghan Rollins, Orthopedic Surgery</td>
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<td>3:37</td>
<td>HMG-COA reductase inhibitors do not attenuate the inflammatory response associated with glutaraldehyde-fixed bioprosthetic heart valve conduits</td>
<td>Kanwal Kumar, Cardiac Surgery</td>
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<td>Protective roles of stem cell factor high mobility group A2 (HMGA2) against temozolomide in glioblastoma</td>
<td>Suchitra Natarajan, Human Anatomy</td>
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<td>A porcine knee model is valid for use in the evaluation of arthroscopic skills in a residency program</td>
<td>Kyle Martin, Orthopedic Surgery</td>
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<td>4:10</td>
<td>Microvascular decompression surgery for hemifacial spasm: A 10-year prospective population based analysis</td>
<td>Alexandra Prior, Neurosurgery</td>
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<td><strong>Research Day Presentation Awards</strong></td>
<td>Presented Dr Richard Keijzer, Thorlakson Chair in Surgical Research</td>
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<td>Come and celebrate with the winners of today’s top presentations</td>
<td><em>Come and celebrate with the winners of today’s top presentations</em></td>
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Donor Whole Blood Facilitates Superior Preservation of Myocardial Function During Ex Vivo Heart Perfusion

Christopher White, Paul Mundt, Yun Li, Devin Hasanally, Bo Ziang, Rakesh C. Arora, Trevor W. Lee, Amir Ravandi, Ganghong Tian, Larry Hryshko, Darren H. Freed
(Section of Cardiac Surgery)

Introduction
Discarded hearts from brain-dead and DCD donors represent unutilized organs for transplantation; however, demonstration of adequate function prior to transplant is necessary. Ex vivo heart perfusion (EVHP) facilitates such functional assessment. We sought to determine what type of oxygen carrier provides superior preservation of myocardial function during EVHP.

Methods
27 pig hearts were procured and underwent EVHP for 6 hours. Hearts were allocated to 4 groups according to the composition of the perfusate solution. Donor red blood cell concentrate (RBC, N=6), donor whole blood (RBC+Plasma, N=6), an acellular hemoglobin based oxygen carrier (HBOC, N=8), or HBOC plus donor plasma (HBOC+Plasma, N=7) were added to STEEN solution to achieve a hemoglobin concentration of 40 g/L. Myocardial function was assessed in working mode using pressure-volume loop analysis. Oxidative stress was assessed through quantification of oxidized phosphatidylcholine (OxPC) compounds using mass spectrometry. Myocardial energetics was assessed using magnetic resonance spectroscopy.

Results
A hemoglobin concentration of 40 g/L preserved myocardial energetics. Systolic function was comparable between treatment groups. Diastolic function was assessed using the end-diastolic pressure-volume relationship (EDPVR) and was superior in RBC+Plasma hearts at 1, 3, and 5-hours of EVHP (Figure 1). Donor plasma reduced the generation of OxPC compounds (Figure 2) and the development of myocardial edema in HBOC perfused hearts (HBOC+Plasma 9.8±1.7 vs. HBOC 16.3±1.9 grams/hr, p=0.03) but not in RBC perfused hearts (RBC+Plasma 6.6±0.9 vs. RBC 6.6±1.2 grams/hr, p=0.98).

Conclusion
During EVHP a hemoglobin concentration of 40 g/L preserves myocardial energetics. Donor plasma minimizes oxidative stress and the development of myocardial edema, and a donor whole blood-based solution (RBC+Plasma) provides superior preservation of diastolic function.

Figure 1
Figure 2
Long-Term Outcome of Repair of Full-Thickness Rotator Cuff Tears: From 9 to 19 Years Ago
Jeff Leiter, Jeff Wheeler, Sheila McRae, Peter B. MacDonald
(Section of Orthopedic Surgery)

Introduction
The purpose of this study was to determine the long-term functional and quality of life outcomes in patients that had a rotator cuff repair by a single surgeon longer than 9 years ago.

Methods
In this retrospective case series, an attempt was made to contact all patients that underwent rotator cuff repair by the principal investigator between 1991 and 2003. Patients that agreed to participate completed a demographic questionnaire, the Western Ontario Rotator Cuff index (WORC), and the American Shoulder and Elbow score (ASES). They also underwent a clinical assessment that included range of motion, manual muscle testing, impingement signs, and a 13-point shoulder ultrasound examination.

Results
Of 301 patients identified, 81 (27%) had no current contact information and 42 (14%) were deceased. Of the 178 patients for whom current contact information was available, 65 (22%) consented to the study, 4 (1%) declined, and attempts to contact the remaining 109 patients are ongoing. The mean (SD) age of participants at present was 68.2 (8.9). The mean (SD) age at the time of initial rotator cuff repair was 55.7 (8.8) years and initial surgery took place on average 12.5 (3.5) years before. Mean (SD) WORC and ASES scores were 69.3% (22.7) and 72.0% (21.6), respectively. Mean active range of motion of the repaired shoulder was the following: forward flexion 165.3 (23.6); abduction 156.5 (28.8); external rotation 49.1 (19.4); external rotation in abduction 71.8 (24.9); internal rotation in abduction 55.8 (17.6). Six participants had positive Neer sign and seven had positive Hawkin’s sign for impingement.

Conclusion
Patients 9 to 19 years post rotator cuff surgery had less quality of life and function relative to a comparative population two years post surgery, but still substantially better than a comparative population awaiting surgery.
Renal Nephrometry Score and Predictors of Complications in Partial Nephrectomies

Deepak Pruthi, Darrel E. Drachenberg, Thomas B. McGregor
(Section of Urology)

Introduction
Feasibility of partial nephrectomy for small renal masses extends beyond clinical tumor size and includes anatomical complexity of the tumor. We analyze patient characteristics and anatomic tumor factors to determine variables associated with surgical complications after partial nephrectomy.

Methods
Retrospective review of all patients who underwent partial nephrectomy at our institution between January 1, 2012 and Aug 31, 2013. Follow-up extended to 8 week post-operative outpatient clinic visit. The R.E.N.A.L. Nephrometry score (maximum radius for tumor size, exophytic/endophytic tumor, nearness of tumor to collecting system/sinus, anterior/posterior descriptor, tumor location relative to polar line) was applied to each pre-operative scan. Standardized grading systems and statistical analysis were applied.

Results
Of the 83 patients who underwent partial nephrectomy 72 had a laparoscopic approach. Seventeen (20%) patients had complications and seven were Clavien-Dindo grade 3 to 4. Two patients had laparoscopic partial nephrectomies converted intra-operatively to radical nephrectomies; two other laparoscopic partial nephrectomies were converted to open partial nephrectomies. Forty-three (52%) of operated patients were either obese, morbidly obese, or super obese. Fifteen (18%) of patients had pathologic oncocytomas or angio-myelipomas. In univariate analysis Charlson comorbidity score (~>6 p=0.0027), diabetes (42% p=0.0195), age (>70 p=0.02034), and total R.E.N.A.L. Nephrometry score (10-12, 67%, p=0.0254) were associated with complications. Nephrometry score also correlated with warm ischemic time (WIT) in laparoscopic cases (low 26 min [SD +/- 11.71], intermediate 31 min [SD +/- 7], high 34 min [SD +/- 14]).

Conclusion
Categorizing renal masses according to the R.E.N.A.L. Nephrometry score may help us council patients towards expected WITs, complication rates, and predicted renal function outcomes. This is increasingly important as the majority of our patients are either obese, elderly, or have significant comorbidities; all of which have been shown to be associated with increased complication rates.
Determining the Natural History of Cystic Pancreatic Neoplasms in the Manitoba Cohort

Jonathon Broughton¹, Andrew McKay¹, Jeremy Lipschitz¹, Michael Cantor², Dana Moffatt², Ahmed Abdoh³
(¹Section of General Surgery, ²Department of Internal Medicine, Department of Surgery)

Introduction
Low-risk pancreatic cystic neoplasms (PCN), as defined by the Sendai Criteria, harbor a low malignancy potential. It is thought that observation of small (<3 cm) lesions, in the absence of worrisome features such as mural nodules, solid component or main pancreatic duct (PD) dilatation, is a safe treatment option. The purpose of this study was to describe the natural history of these cysts among Manitobans, in order to assess the safety of non-surgical management.

Methods
A prospective historical cohort study model was used, with billing data and clinical records from 2000-2012, to include all adult patients (age 18+) diagnosed with PCN at the University of Manitoba. Initial treatment plan (surgery or observation) was used to distinguish high and low risk lesions. Predictors of initial surgical treatment, delayed surgery in the observation group and the clinical/radiological predictors of malignancy were assessed. IBM SPSS Statistics (Armonk, NY: IBM Corp) was used for statistical analysis. The primary outcome measure was the rate of malignancy, defined by presence of carcinoma-in-situ or invasive carcinoma.

Results
497 patients were included. 43 (8.7%) had initial surgery, with 13 (30.2%) cases of malignancy. Malignancy was associated with jaundice (p<0.001), PD dilatation (>6 mm, p=0.025; >10 mm, p=0.016) and non-incidental finding (p=0.001).
450 (90.5%) low-risk cysts were observed for a median of 17.3 months (range: 0.00-142.3). 29 (6.4%) cases of delayed surgery occurred, with malignancy found in 4 (13.8%). In cases of malignancy, median time-to-delayed surgery was 16.99 months (95% CI: 0.00-63.71 months). The incidence of malignancy in the low risk lesions was <1%.

Conclusion
This study supports the safety of long-term observation of low-risk pancreatic cysts and the use of the Sendai criteria for risk stratification of cysts. The duration and intervals of follow-up have not yet been safely established.
Does Ultrasound Predict Intraoperative Findings at Cholecystectomy?
An Institutional Review
Shannon Stogryn, Jennifer Metcalfe, Ashley Vergis, Krista Hardy
(Section of General Surgery)

Introduction
Ultrasound (US) is the mainstay of biliary tract imaging, but there are few recent studies that test its ability to diagnose acute cholecystitis (AC). Our objective was to determine how well an US diagnosis of AC correlates with intraoperative diagnosis. We hypothesize that US under calls the frequency and severity of AC leading to unexpected findings in the operating room.

Methods
This retrospective review included all patients admitted to the acute care surgical service of a tertiary hospital in 2011 with suspected biliary pathology who underwent a diagnostic US and subsequent cholecystectomy. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of US were determined using intraoperative diagnosis as the gold standard. Further analysis identified which US indicators were most predictive of an intraoperative diagnosis of AC. A logistic regression model was used to analyze the effect of age, gender, BMI, and diabetes on US reliability.

Results
Of the 288 patients receiving an US for biliary symptoms, 152 were diagnosed with AC and 143 (94%) subsequently underwent emergency surgery (median time to OR = 23.03 hours). Regarding the ability of US to predict intraoperative findings, relatively high sensitivity (73.22%), specificity (85.48%) and PPV (93.71%) were found. NPV (51.96%) was quite low. For the 102 patients with other biliary pathology who underwent cholecystectomy, 49 had intraoperative findings suggestive of AC (false negative rate of 48.04%). The US indicators most predictive of AC were cholelithiasis, thick-walled gallbladder, and a positive sonographic Murphy’s. Logistic regression showed that selected patient demographics had no significant effect on the accuracy of US diagnosis (BMI: p = 0.2403, age: p = 0.4149, gender: p = 0.6702, diabetes: p = 0.9407).

Conclusion
US is highly sensitive and specific for diagnosing AC. The poor NPV confirms our hypothesis that US can undercall AC.
Introduction
Trigeminal Neuralgia (TN) is regarded as one of the most painful conditions afflicting humans. It is a relatively rare disease with an estimated incidence of 4/100,000/year. While TN progresses in severity over time, it is not known what proportion of sufferers go on to develop pain refractory to standard medical therapy and then require neurosurgical interventions.

Methods
A prospective database was established at our centre that provides the exclusive neurosurgical services for a relatively constant provincial population of 1.26 million people. Baseline demographics and disease characteristics were recorded for all patients undergoing their first TN surgery between 2001-2010, and any subsequent surgeries for recurrent TN pain up to 2013. Incidence of first surgical intervention for TN was calculated as well as rate of failure, defined as patients undergoing subsequent surgery for recurrent TN pain.

Results
During the 10 year enrollment period, 177 patients underwent their first surgery for TN that had become refractory to standard medical therapy, a rate of 1.4/100,000/year. The duration of TN prior to first surgery was 1-31 years (7.2 +/- 6.9). After a minimum follow-up of 3 to 13 years, the first surgery had failed in 54 patients (30%) with significant difference between microvascular decompression (MVD) at 14% versus GammaKnife rhizotomy (GKR) or percutaneous needle rhizotomy (PR) at 50% and 67%, respectively (p<0.05). Average time of failure after the first surgery 0-10 years (2 +/- 2), was not significantly different between types of surgery.

Conclusion
Over one-third of TN sufferers will develop pain refractory to medical therapy and require surgical treatment. MVD as first surgery for TN was associated with the lowest failure rate (14%) while approximately half of those undergoing rhizotomy procedures required additional surgery within 2 years.
Fetal Tracheal Occlusion for Severe Pulmonary Hypoplasia in Congenital Diaphragmatic Hernia: A Systematic Review and Meta-Analysis of Survival

Jamil Almaary1, Kris Milbrandt, Richard Keijzer, Jan A. Deprest2
(1 Section of Pediatric Surgery, 2 Department of Obstetrics & Gynaecology, UZ Leuven, Leuven, Belgium)

Introduction
To evaluate the effects of fetal tracheal occlusion on survival in fetuses with severe congenital diaphragmatic hernia.

Despite recent advances in neonatal intensive care, CDH still has a high mortality and morbidity. Fetal tracheal occlusion stimulates lung growth and improves gas exchange in animal models of CDH, but the effects in humans are still under investigation.

Methods
We searched Pubmed, Cochrane, Embase and Scopus databases for human studies on tracheal occlusion and congenital diaphragmatic hernia. Survival was the primary outcome and oxygen need at 30 days or pulmonary vasodilator use upon discharge were secondary outcomes. The PRISMA statement guided the meta-analysis.

Results
We included 10 studies describing 769 patients (322 control, 385 tracheal occlusion and the remaining were pregnancy terminations). Group 1 included patients that underwent an open laparotomy for tracheal occlusion, while group 2 had percutaneous fetoscopy. Survival improved in the tracheal occlusion group 2 (WMD 0.86, 95% CI 0.06 - 1.66; P = 0.04). Tracheal occlusion did not reduce the need for pulmonary vasodilators upon discharge (WMD -0.37, P=0.12) nor did it decrease the need for oxygen supply (WMD -0.08, P=0.8).

Conclusion
Fetal tracheal occlusion improves survival in cases of congenital diaphragmatic hernia with severe pulmonary hypoplasia compared to the standard perinatal treatment strategy.
Introduction
Mechanical testing of living brain with control or measurement of all potential sources of variability is difficult and not often or consistently performed. The primary objective of the current work is to compare mechanical properties of the living rabbit brain across relatively high and low groupings of arterial blood partial pressure of carbon dioxide (pCO2) and mean arterial pressure (MAP), with control or measurement of all deformation, anatomical, and other physiological variables. It is hypothesized that there are significant differences in relative viscoelastic properties of the living rabbit brain under different combinations of pCO2 and blood pressure.

Methods
Stress-relaxation brain indentations were performed on seven consecutive anesthetized living rabbits, with control or measurement of all possible variables. Five indentations were performed on each animal, with 15 minute periods of rest between each indentation, with pCO2 and MAP controlled for.

Results
The data were fitted to a viscoelastic model. The relative stress-relaxation coefficients and material properties were determined, and compared using statistical analysis. Peak stresses encountered with relative step-loading ranged from approximately 2-4 kPa, corresponding “instantaneous” elastic moduli approximated 4-8 kPa, and short and long Time of Relaxation ranged from 0.03 – 1.72 s and 9.92 – 32.55 s respectively. Comparison of stress-relaxation coefficients and material properties reveals statistically significant differences in the stress coefficients and their respective elastic moduli across different combinations of pCO2 and MAP, and between the last indentation group and previous indentations.

Conclusion
Mechanical properties of step-loaded living rabbit brain are relatively dependent on pCO2 and MAP, and repetitive deformations. This may be important for further understanding of the brain in different physiological states and accurate mechanical characterization.
Evaluation of In Vivo wear Measurement in Total Knee Replacements Using Model-Based Radiostereometric Analysis

Trevor Gascoyne, Martin Petrak, Jan-M. Brandt, Eric Bohm, Thomas Turgeon
(Section of Orthopedic Surgery—Concordia Joint Replacement Group, Orthopedic Innovation Centre)

Introduction
Polyethylene (PE) is the most common bearing material in total knee replacements (TKR). Improvements to the bearing material are commonly directed at reducing wear and increasing longevity. However, there is currently no old-standard for measuring short-term TKR wear in vivo. Model-based radiostereometric analysis (MBRSA) is a high-accuracy radiographic system which can potentially measure PE wear, but further optimization and validation is required. This study evaluates the ability of MBRSA to estimate short-term in vivo TKR wear by comparison to explanted PE bearings.

Methods
Ten patients were recruited for this study, each requiring revision surgery of their TKR. Five different MBRSA exams were obtained for each patient. Following surgery, the explanted PE bearings were retrieved and the physical wear was estimated through 3-D comparison to new, matching PE bearings. Using data from MBRSA, the virtual wear was estimated and compared to the physical wear measured on the retrieved bearings.

Results
The mean rate of physical wear was 100 mm³/yr (95% CI: 41 mm³/yr), which was generally underestimated by MBRSA (virtual wear) as 70 mm³/yr (95% CI: 30 mm³/yr). Weight-bearing exams improved wear estimation over non-weight bearing exams as less condyle lift-off was encountered. Combining wear data from both standing and flexed-knee MBRSA exams also improved wear estimation.

Conclusion
Short-term wear measurement of TKRs appears feasible with MBRSA as 70% of the physical wear was correctly estimated. Weight bearing exams and flexion of the knee provided the greatest amount of wear information and prevented detrimental condyle lift-off. There are several limitations to this research; atypical wear patterns with revision patients, varied TKR characteristics, and manufacturing tolerances of the PE bearings. Despite these limitations, MBRSA shows potential for use in short-term, in vivo assessment of novel bearing materials.
Introduction
Frailty is a geriatric syndrome of decreased physiologic reserves, which leaves individuals in a state of increased vulnerability. Post-operative delirium is an acute disorder of attention and cognition that is associated with important negative outcomes. The link between frailty and post-operative delirium has not been elucidated in the cardiac surgery population. Thus, the objectives of this study were: i) to determine if frailty in cardiac surgery patients is associated with an increased occurrence of post-operative delirium, and ii) to identify which elements within the definition of frailty are most predictive of delirium.

Methods
A prospective cohort study was conducted at St. Boniface Hospital. Patients over age 18 and undergoing elective CABG and/or valve procedures were eligible to participate. Excluded were patients in whom post-operative delirium could not be reliably assessed. 133 patients consented to participate and completed all study requirements. The primary exposure variable was frailty, as defined by the Modified Fried criteria. The primary outcome variable was post-operative delirium, as assessed by the Confusion Assessment Method (CAM) and the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). Linear regression modeling was performed.

Results
Seventy-two patients (54.1%) met the definition of frailty. Twenty-four of the 133 (18.0%) experienced post-operative delirium. Frail patients had a greater than five-fold increased risk of post-operative delirium (OR 5.05, 95% CI 1.58-16.13, P-value 0.0015). Within the Modified Fried criteria, weight loss and weak grip strength were the two components most predictive of post-operative delirium.

Conclusion
Frailty in cardiac surgery patients was seen to increase the risk of post-operative delirium by five-fold. Weight loss and weak grip strength were the elements of frailty most predictive of delirium. External validation of our findings is required.
The Age Factor in Survival of a Population Cohort of Well Differentiated Thyroid Cancer

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Introduction
Well differentiated thyroid carcinoma (WDTC) represents a group of thyroid cancers with excellent prognosis. Age, a well recognized risk-factor for WDTC, has been consistently included in various prognostic scoring systems. An age threshold of 45 years is currently used by the AJCC-TNM staging system for risk-stratification of patients.

Methods
The present study analyzes the relationship between the patients’ age at diagnosis and thyroid cancer specific survival in a population based thyroid cancer cohort of 2115 consecutive patients with WDTC, diagnosed during 1970-2010, and evaluates the appropriateness of currently used age threshold. Oncological outcomes of patients in terms of disease specific (DSS) and disease free survival (DFS) was calculated by the Kaplan Meir method, while multivariable analysis was done by Cox proportional hazard model and proportional hazards regression for sub-distribution of competing risks to assess the independent influence of various prognostic factors.

Results
The mean age of the patients was 47.3 years, 76.6% were female and 83.3% had papillary carcinoma. The median follow-up of the cohort was 122.4 months. The DSS and DFS were 95.4% & 92.8% at 10 years and 90.1% & 87.6% at 20 years. Multivariable analyses confirmed the patient’s age to be an independent risk factor adversely impacting the DSS but not the DFS. Distant metastasis, incomplete surgical resection, T3/T4 stages, Hürthle cell histology, and male gender were other independent prognostic determinants. The DSS was not independently influenced by the age until the age of 55 years.

Conclusion
An age threshold of 55 years is better than that of 45 years for risk stratification.
Introduction
The treatment of small to medium sized vestibular schwannomas (VS) with Gamma Knife (GK) Stereotactic Radiosurgery is a well-documented treatment alternative to surgical resection, with prospective non-randomized trials demonstrating facial nerve and hearing preservation rates favoring GK over microsurgery. Larger VS pose a difficult clinical challenge, with many authors favoring surgical resection due to concerns around radiation dosing and side effects. The aim of this study is to review our institutional experience with Gamma Knife (GK) stereotactic radiosurgery in treating large vestibular schwannomas (VS) of 3 to 4 cm diameter.

Methods
We conducted a retrospective cohort review of all patients treated with GK for VS at our institution between November 2003 and March 2012. Data on age, sex, VS volume, location and maximal diameter, House-Brackmann (HB) facial nerve scores pre and post-GK, Gardner-Robertson (GR) hearing score pre and post-GK, GK treatment parameters, VS response time, complications and clinical outcome was recorded.

Results
A total of 28 patients during the defined time period were identified. Three patients were lost to follow-up. Mean follow-up was 34.5 months. Tumor control occurred in 92%, and was maintained in 85.7% at two years. Facial nerve or hearing preservation occurred in all treated compared to pre-GK status, as per HB and GR grading. Transient complications occurred in 80%. Temporary vestibular dysfunction occurred in seven patients (28%). One patient (4%) had the permanent complication of worsening pre-GK hemifacial spasm. Four patients (16%) developed hydrocephalus post-GK.

Conclusion
GK stereotactic radiosurgery as a primary treatment modality for large VS, can provide acceptable tumor control rates with good facial nerve and hearing preservation, and low complication rates.
Validation of a Proposed Objective Assessment Protocol for Ultrasound Image Acquisition
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Introduction
The objective assessment of technical skills is well-described, but no formal protocol for the assessment of ultrasound imaging has been validated. We proposed the development of an assessment protocol for ultrasound image acquisition during the Focused Assessment with Sonography for Trauma (FAST) exam.

Methods
Using a modified Delphi technique we developed scoring assessments of image acquisition including task checklists (dynamic and static images), a global rating scale, and hand-motion analysis. Two cohorts of twelve participants each were recruited representing novices and experts, and each cohort was asked to perform a FAST exam on a live human volunteer. Performances were scored by two certified FAST sonographers according to the developed protocols.

Results
Expert participants scored substantially higher than novices on all three scored assessments including the static image scoring system (mean score 11.58 versus 6.63, p<0.0001), the dynamic image scoring system (mean 17.21 versus 11.08, p=0.0005), and on the global rating scale (mean 29.79 versus 18.42, p<0.0001). Inter-rater agreement was substantial for all scoring checklists, with Shrout-Fleiss coefficients of 0.7951 on the dynamic images checklist, 0.7610 on the static images checklist, and 0.6066 on the global rating scale.
Hand motion analysis demonstrated that experts had shorter left-hand lengths of travel (18.52 m versus 28.01 m, p=0.0346), right-hand lengths of travel (14.25 m versus 32.09 m, p=0.0026), and fewer total movements to complete the examination compared to the novice cohort (263.0 movements versus 452.4, p=0.0216).

Conclusion
Our data demonstrates that our proposed scoring system for the assessment of ultrasound image acquisition skill has criterion validity in assessing expertise. We are able to confidently and consistently discriminate between a novice and expert calibre performance and this tool will be useful for assessing trainees’ skills.
Three-Dimensional Molecular Characterization and Isolation of Circulating Tumor Cells in Metastatic Prostate Cancer Patients

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Introduction
Circulating tumor cells (CTCs) are emerging as a promising liquid bio-marker in prostate cancer screening and in monitoring of disease progression. In order to utilize CTCs clinically, an efficient and reliable method of CTC isolation must be developed. Upon isolation, analysis of the three-dimensional (3D) nuclear organization of telomeres can be used to profile prostate cancer patients. The relative aggressiveness of a tumor can be correlated to the degree of CIN seen within a given cell. 3D telomeric analysis of isolated CTCs determines the level of chromosomal instability (CIN) of the CTCs. We show that metastatic prostate cancer patients display CTCs and telomeric profiles that correlate to high-risk prostate cancer phenotypes.

Methods
CTCs from ten consecutive patients presenting to the Manitoba Prostate Center with metastatic prostate cancer were isolated using the ScreenCell filtration technique. Cytokeration 8, 18, 19 immunostaining and 3D quantitative fluorescence in situ hybridization was performed on the isolated CTCs followed by 3D image acquisition using a Zeiss Axiolmager Z2 microscope. Quantitative image analysis with Teloview and Teloscan were then performed to obtain 3D telomere profiles and to identify the number of CTCs.

Results
Preliminary data shows that CTCs are present and can be isolated in metastatic prostate cancer. Furthermore, these CTCs have similar telomere profiles when comparing the following statistical parameters: percentage of cells with aggregates, average number of telomeres per cell, average number of aggregates per cell and average nuclear volume.

Conclusion
This proof of principle study shows for the first time that CTCs in metastatic prostate cancer patients can be isolated and characterized by 3D nuclear telomere profiling using ScreenCell filters as well as presenting similar telomeric profiles. These findings show that CTCs may have the potential to become a biomarker for tumor stage and progression.
Modular Total knee Replacements and the influence of Insert Thickness on Polyethylene Wear
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Introduction
Total knee replacement implant retrieval studies have previously demonstrated that insert thickness may affect the wear and damage of tibial inserts at both the articular and backside interfaces. Although insert thickness may be primarily selected for the balancing of soft tissue, the surgeon can maintain some control over the required thickness through careful bone resection and tibial augmentation. The objective of the present study was to investigate the effects of insert thickness on contact pressure, sliding distances and wear using a computational methodology.

Methods
The CAD model for the PFC-Sigma (DePuy-Synthes, Warsaw, IN) was utilized, with insert thicknesses ranging from 5-25mm, with both polyethylene (PE) and crosslinked PE materials. Finite element simulations were conducted under the displacement and loading conditions of ISO 14243-3; 2009. The well established wear model of Turell et al. was implemented as the computational wear model.

Results
Increasing insert thickness from 5-25mm was found to marginally decrease both articular peak contact pressure (≈4%) and articular wear (≈5%). Meanwhile for the backside surface, increasing insert thickness was found to marginally decrease peak contact pressure (≈4%), profoundly increase both peak cumulative sliding distances (≈101%) and backside wear (≈38%). The interference fit (press-fit) of the locking mechanism was also found to have a substantial effect on the wear rate.

Conclusion
PE wear was demonstrated to be marginally affected by insert thickness. However, the magnitude of changes to overall wear rate remained small for the range of insert thicknesses and materials which were considered. Yet, reduced insert thickness may cause excessive articular wear for inserts of inferior material properties, such as oxidized PE, as a result of the increased stresses. Additionally, thicker inserts could lead to increased backside sliding distances after prolonged periods in vivo.
Introduction
Considerable resources have been invested in both low (video trainers) and high fidelity (virtual reality simulators) for surgical training and assessment. The purpose of this study was to establish: 1) construct validity for the Fundamentals of Laparoscopic (FLS) program, LapVR, and GOALS in our center, and 2) to determine predictive validity of FLS and the LapVR virtual reality simulator using a human cholecystectomy model.

Methods
26 participants (PGY 1-5) were divided into a senior group (n=10) and a novice group (n=16). All participants performed 4 tasks from the Fundamentals of Laparoscopic Surgery (FLS) program, 5 tasks on the virtual simulator, and a laparoscopic cholecystectomy. Performance was evaluated using standardized FLS metrics, automatic computer evaluations, and the previously validated GOALS global rating scale.

Results
Both construct and predictive validity was strongly demonstrated for the FLS tasks. For the LapVR virtual reality simulator, construct and predictive validity were indeterminately demonstrated.

Conclusion
Construct and predictive validity were more thoroughly demonstrated for the FLS tasks and video trainer than for the LapVR virtual reality simulator. In resource limited surgical training programs, the higher cost LapVR remains experimental. Efforts should instead be focused on utilizing the well-validated, lower cost FLS and video trainer for assessment of laparoscopic skills.
The Effect of a Lubricant Composition on Polyethylene Wear

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Introduction
The composition of wear testing lubricants used to mimic synovial fluid is known to significantly affect in vitro polyethylene (PE) wear; however, some wear testing standards are promoting the use of lubricants that are not clinically relevant. Using clinical data obtained in previous studies, the objective of the present study was to investigate the effect of a more clinically relevant lubricant on PE wear using a pin-on-disc (POD) apparatus.

Methods
A POD apparatus was used to conduct tests on mildly crosslinked PE pins against CoCr alloy discs. Each test was divided into 4 lubricant subtests where each subtest used a different lubricant to evaluate its effect on wear in a stepwise fashion. Non-iron supplemented alpha calf serum (ACS) was diluted to a protein concentration of 34 g/L using either deionized water (DW) or phosphate buffered saline solution (PBS). Some of the lubricants contained hyaluronic acid (HA), which was added at a concentration of 1.5 g/L or 3 g/L. After each subtest, the weight loss of each pin was assessed. Mann-Whitney U was used to statistically analyze data.

Results
The DW lubricant produced the highest wear rates (3.12±0.49 mg/Mc), while the HA lubricants produced the lowest wear rates (0.248±0.11 mg/Mc). Interestingly, the wear rates generated using 3g/L HA were not found to be significantly different from wear rates generated using 1.5g/L HA (p ≥ 0.906), which suggests that increasing the HA concentration in the lubricant has little effect on PE wear in POD testing.

Conclusion
The effect of a more clinically relevant lubricant on wear may not be apparent in POD tests; however, the authors do not discourage the use of a more clinically relevant lubricant in these types of wear tests, since other factors, such as protein composition, have been found to significantly influence wear rates and surface damage.
Characterizing Physician Staffing Models in the Care of the Postoperative Cardiac Surgery Patient

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Introduction
Subsequent to intensive care unit (ICU) admission, physician staffing is an important aspect of patient outcomes. Current intensive care unit physician staffing (IPS) models for the postoperative cardiac surgery patients have not been previously investigated. We therefore undertook a national survey on IPS models in Canadian Cardiac Surgical Care Units to determine the level of variability that exists in the care of the postoperative patients following cardiac surgical procedures.

Methods
A survey of the 31 Canadian cardiovascular ICUs (CVICU) was undertaken to determine IPS models of care during daytime and “after-hours” in each respective unit. Data were collected regarding surgical case volume, base specialties of consultants and style of IPS management as either “open”, closed or semi-opened. For ICUs with in-house overnight physicians, we documented the minimum and maximum level experience of the bedside healthcare provider.

Results
Responses were received from 27 CVICUs surveyed (~87%). Of these units, 3 (11.1%) had an “open”, 18 (66.7%) had a “closed”, and 6 (22.2%) had a “semi-open” unit IPS strategy. The base specialties of CVICU physicians varied, with anesthesia being the most common. After-hours coverage provided by an MD in the vast majority of CVICUs (86%). In 3 (12.5%) units, a Physician Assistant provided overnight coverage and only 1 unit did not require any in-house coverage. In the CVICUs with MD coverage, in-house coverage was a junior resident (PGY 1-3) in 6 (25.0%), a senior resident (PGY 3 - 6+) in 8 (33.3%), an attending consultant (non-critical care medicine certified) in 3 (12.5%). In 2 units (8.3%) overnight coverage was provided by a critical care certified consultant.

Conclusion
In-house overnight physician staffing in Canadian CVICUs varies widely. The impact of different overnight staffing and experience requires further evaluation with respect to patient outcomes.
Incidence, Distribution, Predictors and Outcomes of Node Positive Patients At Radical Prostatectomy: Manitoba Prostate Center Experience
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Introduction
Pelvic lymph node dissection at the time of radical retropubic prostatectomy (RRP) varies among surgeons and institutions. Differences focus on candidacy for node dissection and the limit of dissection (limited versus extended). We analyzed our local experience of lymph node dissection and metastases at time of surgery.

Methods
Data from the Manitoba Prostate Center was collected on consecutive patients undergoing RRP from January 2003 to June 2013 by two urologists with subspecialty training in oncology. Information extracted includes age, PSA, biochemical recurrence characteristics, biopsy and pathological results. A univariate and multivariate analysis was conducted using SAS software.

Results
420 consecutive patients comprised the data set and of whom 411 underwent a RRP and 9 aborted prostatectomies. Patients’ average age was 60 with a mean preoperative PSA of 11. Overall lymph node metastases rate is 16.1 percent. Of these N1 patients, average number of positive nodes was 2.3. Average nodes removed for all patients were 13.4. Positive nodes on the right and left were found 53 percent and 47 percent of the time respectively. When looking at zones of positive pelvic lymph node metastasis, 54 percent are hypogastric, 13 percent obturator, and 33 external iliac. With an average of 37 months follow-up 2 patients with N1 disease died and only 1 from prostate cancer. 79 percent had biochemical recurrence. Median time to treatment for biochemical recurrence was 4.5 months (0 to 33 months) with a median PSA of 0.28. Multivariate analysis of predictors is pending.

Conclusion
This contemporary series of pelvic lymph node dissection with RRP represents high lymph node metastases (16%) relative to literature. Performing a limited pelvic lymph node dissection would under stage 54 percent of our patients. Despite high biochemical recurrence only one patient died of prostate cancer.
Introduction
Activities of daily living create strain in degenerative lumbar spinal stenosis (LSS) patients. Using a recently established performance-based outcome measure, we explored strain in LSS patients pre-surgery using a walking task. We predicted that strain induction would enhance pre-surgical assessment using an objective performance-based outcome measure.

Method
LSS patients (N=16) and healthy controls (N=16) performed 2 blocks of great-toe pointing movements to a series of projected squares. Following block-one participants completed a 12-minute progressive exercise treadmill test (PETT). Pointing movements were analyzed using 3D motion analysis. Behavioural and kinematic measures evaluated performance. The Health Research Ethics Board approved all procedures.

Results
Both groups’ reaction times (RT) lengthened as task difficulty increased. An interaction revealed LSS patients were more adversely impacted $F(3,372)=4.207; p=.006$. The PETT facilitated RT for both groups, $F(1,124)=5.105; p=0.026$. Control participants were less variable in time to peak velocity post-strain, a benefit not shared by LSS patients, $t(31)=2.149; p=0.040$.

Behavioural and kinematic variables replicated previous findings. LSS patients did not experience equal benefits of treadmill walking as controls. Both movement preparation and limb movement initiation variability were impacted in an LSS population post-strain.

Conclusion
A lower extremity movement task captured differences under strain between healthy and LSS populations. To enhance pre-surgical assessment performance-based outcome measurement, future LSS clinical intervention studies may consider strain induction.
Point of Care Ultrasound Utilization Among Trauma Providers Across Canada: Cross-Sectional Study

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Introduction
Point of care (POC) ultrasound is revolutionizing care of critically ill patients. However, training in POC ultrasound is extremely variable with no clearly accepted or standardized credentialing process and very limited literature. Having a good understanding of the training background and opinions of current users is a crucial first step in designing an optimal training module. We aim in this study to delineate the training experience and utilization of POC ultrasound among trauma providers across Canada.

Methods
Cross sectional study via a secured e-questionnaire was designed and sent to members of the Trauma Association of Canada. The questionnaire included sections about the demographics, first exposure and utilization pattern of ultrasound, opinion on current ultrasound training courses and proposed optimum course design. Descriptive statistics was used to analyze the data.

Results
52 physicians completed the questionnaire (38% response rate, n=137). Among them 26 were emergency physicians, with the remainder being surgeons with 36 (70.6%) working at a level I trauma center. All trauma providers had access to an ultrasound machine. 43 (86%) used the ultrasound machine for purposes beyond FAST. 16 (32%) were at an attending level when first exposed to POC ultrasound. 37 (74%) received formal ultrasound training through a variety of courses. Only 20 (40%) underwent a credentialing process but 82% (41) felt that alterations to current credentialing processes should at least be considered. 45 (94%) believe that residency programs must include ultrasound training.

Conclusion
POC ultrasound utilizers among trauma providers come from different specialties. Many of them were first exposed to POC ultrasound after their residency training. There is no consensus on the modality of POC ultrasound training yet most of them agree that more emphasis needs to be placed on early introduction of a structured training during the residency training.
Microvascular Decompression for Hemifacial Spasm: Analysis of Surgical Failures and Repeat Surgery
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Introduction
Hemifacial spasm (HFS) is a condition of debilitating, involuntary contractions of facial muscles with an estimated prevalence of 11/100,000. The potentially curative microvascular decompression surgery (MVD) aims to alleviate compression upon the facial nerve root entry zone (fREZ) by mobilizing culprit vessels and maintaining them off the nerve with implant material. Surgery is undertaken in less than 10% of sufferers across North America, such that few centres have a concentrated volume of MVD experience. We examined the operative findings and outcomes of repeat surgery after failed MVD for HFS.

Methods
A database of over 700 MVDs performed by the senior author was reviewed to identify patients undergoing repeat surgery for HFS where the original surgery was performed elsewhere. Intraoperative findings were obtained from operative reports and diagrams. Outcomes were determined from hospital records and telephone questionnaires.

Results
Twelve HFS patients were identified and all were found to have persisting vascular compression on the fREZ not identified or alleviated at initial surgery. In 3 cases the prior implant material was found in the region of the fREZ but not alleviating the culprit vascular compression. In 9 cases there was no evidence of exploration or implant material at the fREZ but rather more distally on the cisternal portion of the nerve. Repeat surgery was successful in decompressing the fREZ in all 12 cases and postoperatively all improved. At a mean follow up of 64 months (3-180), 10 patients reported complete resolution of spasms, 1 reported >75% and another >50% spasm reduction. No patients had major permanent complications, although 6 had mild or worsening of pre-existing partial facial weakness or hearing loss.

Conclusion
Failure of MVD to cure HFS is related to inadequate identification and alleviation of vascular compression upon the affected fREZ. Repeat surgery was successful at a high-volume centre.
Superficial MCL Injury: Evaluation of Medial Joint Laxity and the Effect of a Novel Double Row Repair

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Introduction
The purpose of this research was to determine if a novel double row repair of the distal insertion of the sMCL restores medial joint opening to baseline. We also explore agreement among experienced knee surgeons when evaluating medial joint laxity.

Methods
Eight fresh-frozen non-paired human cadaveric knee specimens (mid-femur to toes) were used. An isolated tear of the distal insertion of the sMCL was performed to replicate injury (incision was surgically released off tibia). The double row repair was performed using a “suture-bridge” technique by passing suture limbs of the suture anchors into the knotless anchors and deploying them into the tibia. Anterior-posterior fluoroscopy images were taken in 0 and 20 degrees flexion, with and without a clinician applied valgus stress, with the ligament intact, cut and repaired. Metal calipers were used to calibrate images to 1cm. Valgus stress was applied by the same surgeon. Three knee surgeons with over 10yrs experience performed an exam with no stress and valgus stress applied in 0 and 20 degrees flexion without fluoroscopy and quantified joint opening. This was converted to a Grading scale, where Gr.I=1-3mm of joint opening; Gr.II=4-5mm; Gr.III=>5mm. Surgeons performed an exam with the sMCL intact, cut and repaired. Descriptive statistics were performed to report quantification of joint opening. Fluoroscopic measurements were evaluated with repeated measures MANOVA to explore effects of ligament status, stress and degrees of flexion on joint opening.

Results
A significant difference in joint opening measured with fluoroscopy was observed between ligamentous states (p=0.008). Mean surgeon-based and fluoroscopy-based measurements in 20 degrees flexion were similar across all ligament states.

Conclusion
With respect to the double-row repair, significant differences were detected between an intact and cut ligamentous state; this difference was eliminated once the sMCL was repaired.
What is the Evidence in Evidence-Based Thoracic Surgery?
A Study Looking at the Type and Quality of Thoracic Surgery Literature

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Introduction
The information that informs an evidence based general thoracic surgical practice comes from three main sources: direct interaction with one’s trainers and colleagues, a synthesized body of literature such as text books, or published primary studies, “the literature”. This project is designed to reliably identify and define the type and quality of thoracic surgery literature.

Methods
The scope of general thoracic surgery practice was defined according to the Royal College of Physicians and Surgeons of Canada. A literature search was done from Jan 1, 2008 to Dec 31, 2011; 38 journals including those published on CTSNET and other high profile medical journals were selected. Excluded were pediatric thoracic surgery, chemotherapy trials when surgery was not an option, case reports, consensus studies, and gastric cancer if not extending to the esophagus. Data extraction was completed by two independent reviewers and adjudicated by a third. Studies were categorized into intervention, diagnosis, prognosis, or prevalence (epidemiology) according to a pre-written set of instructions that each reviewer was given. A raw agreement of 90% was the target for all data-entry fields.

Results
2971 articles were selected for title and abstract review. 1208 articles were excluded. Of the remaining 1763, 140 articles were randomly selected for full text review. The types of studies were 54% intervention, 8% diagnosis, 18% prognosis, and 4% prevalence. 44% of articles originated in the USA, with Canada contributing only 6%. Type of disease was most commonly malignant (70%), with 57% of those being lung malignancy.

Conclusion
Currently the primary evidence guiding a general thoracic surgeon’s practice are mainly intervention studies published on malignant diseases. The next step for this project will be to focus on intervention studies and determine the quality of their evidence.
Current Perspectives of Urology Involvement in Renal Transplantation:
A Survey of Canadian Senior Residents

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Introduction
The role of urology in renal transplantation has become highly variable with the growth of surgeons specialized in multi-organ transplant. We determined the involvement of urology faculty and residents in renal transplantation, and perceptions of the role of urology in transplantation across Canada.

Methods
An anonymous questionnaire was administered to all thirty-one final-year Canadian urology residents at the Queen’s Urology Examination Skills Training program (QUEST). The survey utilized a validated five-point Likert scale and was devised to assess resident exposure to renal transplantation. Descriptive statistics and Pearson’s chi-squared test were used in analysis.

Results
All residents completed the survey. Urologists were involved in performing renal transplant surgery at most training centers across Canada (77.4%). The majority of residents believed that urology should remain highly involved with transplant (77.4%), and that it should be a mandatory component of residency training (64.5%). There was a positive correlation between the involvement of urology in renal transplantation at a resident’s training centre, and the opinion that urology should continue to play an important role in this field (r=0.51, p=0.003). However, barely half of the residents (51.6%) felt they had sufficient exposure to transplant surgery. Only 41.9% would feel comfortable performing transplant surgery after residency, and these residents were involved in an average of 30 transplant surgeries and 16 laparoscopic donor nephrectomies. A minority of residents had plans for fellowship training (9.7%) or future careers (12.9%) involving renal transplant.

Conclusion
Renal transplantation remains a limited component of the majority of residency training programs in Canada. However, the number of residents intending to pursue fellowship training or a future career that involves transplant remains limited. Consequently, a strong exposure to renal transplant during urology residency training is vital to ensuring urology remains highly involved in renal transplantation.
Non-Cranial Neurosurgical Intraoperative Magnetic Resonance Imaging - 
Applications to Complex Cervical Lesions
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Introduction
This report focuses on the clinical evaluation of intraoperative magnetic resonance scanning in non-cranial neurosurgery. Intraoperative MR imaging has a well defined scope in cranial surgery, the extension to the sub-axial spine is both uncommon and challenging. This preliminary report demonstrates the surgical utility of both pre-and intra-operative MR imaging in relation to the planning and execution of complex cervical spine surgery.

Methods
This case series summarizes the initial experience with MR guided complex cervical surgery. The patient population includes spinal oncology (intra and extra medullary tumours), and multi-level cervical cord compression with myelopathy. All patients were treated in the IMRIS 3.0 Tesla MR Surgical Suite situated in the Kleysen Institute of Advanced Medicine of the Health Sciences Center, Winnipeg. All patients were treated under general anesthesia and with full neuro-electrophysiologic monitoring. Post-surgical outcomes were evaluated with routine clinical neurological examination.

Results
The strikingly high image quality of spinal MR utilizing the standard head MRI coil whilst under anesthesia will be demonstrated and its utility in selecting the optimal approach versus the usual pre-op MR study will be demonstrated. Scanning protocol selection versus total scan time and total surgical time for re-operative intervention are delineated. Case examples of clinically under-appreciated MR-identified residual compression resulting in additional resection/decompression are presented.

Conclusion
Optimal MRI strategies to minimize total surgical time expenditure and maximize MR image value are described for a small cohort of mixed etiology complex cervical spine surgical patients undergoing treatment in novel surgical environment.
An Analysis of Manitoba Prostate Centre Active Surveillance Patients: Treated vs Untreated
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Introduction
PSA screening has resulted in a significant increase in the diagnosis of low risk prostate adenocarcinoma. Treating these cancers would cause significant morbidity with radical treatment. Active surveillance (AS) is an alternative to radical treatment for these cancers and to monitor them with the intent to treat radically once the cancer progresses.

Methods
In this retrospective study with institutional board ethics, patients treated at the Manitoba Prostate Cancer with an active diagnosis of Prostate Adenocarcinoma with Gleason ≤ 3+4, ≤t2b, and PSA <20 (two exceptions) were analyzed for changes in PSA, PSA doubling time, PSA density, Prostate volume changes, triggers for biopsy, triggers for treatment, types of treatment, changes in Gleason grading, pathological changes such as cores involved, percent minimum and maximum, and linear distance. Further biopsy intervals were assessed, follow-up time, and surgical pathology if available. SAS software was used for univariate analysis.

Results
Manitoba Prostate Center has 290 patients on Active Surveillance; 115 of whom received treatment. Of the treated patients the median age was 65 with an average follow up of 5.3 years, and average of 1.97 biopsies each. Median interval to first biopsy was 12.7 months, and 15.4 between all biopsies. Seventy one percent of patients had Gleason 3+3 when started on active surveillance. Majority of patients had biopsies triggered by PSA and majority of treatment started because of upgrading on biopsy. Univariate analysis pending.

Conclusion
The Manitoba Prostate Center rates of treatment of AS patients is higher than most published literature. This could be a reflection of longer follow-up. Further the data collected represents a significant cohort of patients relative to available literature.
Computational Assessment of Aortic Aneurysm Rupture

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Introduction
Aortic size is the primary factor used to predict abdominal aortic aneurysm (AAA) rupture potential; however, this fails to account for AAA that rupture at smaller sizes, or reach extreme sizes without rupture. Currently there is no truly reliable way to evaluate the susceptibility of a particular AAA to rupture. We hypothesize that the site of maximal pressure and wall shear stress (WSS) within individual AAA will lead to biomechanical wall failure and will predict the site of aortic rupture.

Methods
We used computational fluid dynamics (CFD) software (ANSYS CFX) to solve the governing equations for mass and momentum for CTA-derived 3D images of ruptured AAA (RAAA). Predicted intra-aortic pressure and WSS profiles were obtained.

Results
The average AAA size at rupture was 8.3 +/- 1.52 cm. Three of the five RAAA ruptures at or near the site of maximal diameter. The maximal predicted intra-aortic pressure was 14.25 +/- 6.29 Pa and generally was localized on the anterior aortic wall. In most cases the site of actual rupture was the lateral wall of the AAA where the pressure was not significantly different from that at the site of maximal pressure (12.12 +/- 6.27 Pa, p.0.05, ns). In these RAAA the highest predicted WSS was on the anterior aortic wall and measured 0.184 +/- 0.02 Pa. At the actual site of rupture, WSS was significantly lower at 0.044 +/- 0.0006 Pa (p<0.0001).

Conclusion
In all cases the rupture occurred in a low WSS region at a site of flow recirculation. This study was the first to model blood flow in the geometry of actual RAAA. In all cases rupture occurred in flow recirculation zones, where low WSS predominated. This work will provide the basis for future research on a more precise prediction of rupture risk.
The Relationship Between Injury to Surgery Time and the Incidence of Secondary Joint Injury in an ACL-Injured Population
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Introduction
The effect of surgical wait time on the incidence of secondary joint injury with an ACL injury is unknown. The purpose of this study is to determine if there is a difference in secondary pathology between patients that have early ACL reconstruction compared to patients that are scheduled according to the normal wait list.

Methods
This is a prospective randomized clinical trial. Sixty-seven patients undergoing arthroscopic ACL reconstruction with hamstrings graft were recruited. Patients were randomized to an EARLY group (surgery within 12 weeks) or a LATE group (normal waiting list). Outcome measures consisted of MRI scans, and quality of life and functional index questionnaires. Analysis of variance (p<0.05) was used to detect differences in overall subjective scoring. Mann-Whitney U testing was performed to determine whether there was difference (p<0.05) between groups in secondary pathology.

Results
A total of 41 participants completed the study. The EARLY group consisted of 12 females and 9 males with a mean (SD) age of 28.1 (7.3) years. Seventeen females and 6 males made up the LATE group with a mean age of 26.8 (7.4) years. Time to surgery in the EARLY group was 60.8 (14.6) days compared to 222.2 (105.3) days in the LATE group (p<.001). There were no differences in subjective questionnaires at the time of injury. Tegner activity levels decreased significantly in both groups following injury (p<.001). NO differences were evident in total number of secondary pathologies between the EARLY and LATE group (p<.752).

Conclusion
The hypothesis that secondary joint pathology would be more evident in the LATE group was rejected. However, pre-operative MRI findings in the LATE group suggest more secondary pathologies were present that were not evident via arthroscopy. This may indicate that further delays in operative time would result in a greater incidence of secondary pathology observed during surgery.
HMG-COA Reductase Inhibitors Do Not Attenuate the Inflammatory Response Associated with Glutaraldehyde-fixed Bioprosthetic Heart Valve Conduits
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Introduction
Evidence suggests that there is an immunological response towards bioprosthetic heart valves. Information on the impact of statins and their anti-inflammatory properties on bioprosthetic valve failure remains limited and difficult to study. We sought to examine the efficacy of statin therapy in rodent model of bioprosthetic valve implantation.

Methods
Fresh or glutaraldehyde-fixed aortic valve root conduits from Lewis rats or Hartley guinea pigs were implanted intravascularly into the infrarenal aorta of Lewis rats. Animals were assigned to 1 of 4 groups (n = 10 / group). The syngeneic control group consisted of a fresh rat valve conduit implanted into a rat (Group 1). The xenogeneic control group consisted of glutaraldehyde-fixed guinea pig valve conduit implanted into a rat (Group 2). Groups 3 and 4 consisted of xenogeneic groups treated with either daily steroids (methylprednisolone [0.5mg/kg]) or rosuvastatin (20mg/kg). At the study end point (28 days post implantation), valve conduits were excised for histological and immunological analyses.

Results
Electron microscopy confirmed that our rodent model conduit undergoes similar changes that occur with bioprosthetic valves for humans. Steroid treatment attenuated the inflammatory response seen within the xenogeneic glutaraldehydefixed valve conduits. This finding was confirmed by H&E analysis (median inflammatory score 0 versus ++ as reviewed by two blinded pathologists), immunohistochemistry (median CD68 infiltration 32% versus 42%, p<0.05), and microbead cytokine analyses (IL1 alpha, ILbeta, TNFalpha, IFN). Treatment with rosuvastatin did not decrease this inflammatory response and was consistent among all tests performed.

Conclusion
Data from our in vivo rodent model of bioprosthetic valve implantation confirms that prosthesis failure is associated with a localized inflammatory response. Treatment with daily rosuvastatin was unable to attenuate this response.
Protective Roles of Stem Cell Factor High Mobility Group A2 (HMGA2) Against Temozolomide in Glioblastoma

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Introduction
Telomeres are the ends of mammalian chromosomes. Among the six telomere-associated proteins which form the shelterin complex, Telomere repeat-binding factor 2 (TRF2) has key protective functions and prevents genomic instability, DNA damage repair activation and cell death. Telomeres are a target for alkylating temozolomide (TMZ). Alkylated DNA constitutes a significant cytotoxic, teratogenic and carcinogenic threat. Removal of the most abundant TMZ-induced adducts, 7-MeG and 3-MeA is performed by the Base Excision Repair (BER) pathway. The AP/dRP lyase activity of the DNA-binding AT hooks of the chromatin binding protein High Mobility Group A 2 (HMGA2) protects HMGA2+ embryonic stem (ES) cells and cancer (stem) cells from alkylating DNA damage.

Methods
We employed protein detection by Western blot and immunofluorescence of HMGA2, TRF2, telomeric DNA and AP sites in human primary glioblastoma cells.

Results
We identified a number of different mechanisms by which HMGA2 exerts its cytoprotective effect against alkylating agents. This involves AP/ dRP lyase activity of the AT hooks and the in-vivo interaction of HMGA2 with Ataxia telangiectasia and Rad3-related kinase (ATR). This results in sustained activation of checkpoint kinase 1 signaling, prolonged G2/M arrest and reduced apoptosis. HMGA2 is present in primary human GB cells and in GB cells of a mouse model of primary GB. We identified TRF2 as a new interaction partner of HMGA2. Diminished cellular HMGA2 coincided with reduced TRF2 levels at telomeres and appearance of telomere fusions which was aggravated in the presence of alkylating agents.

Conclusion
We conclude that (i) TMZ mediated telomere damage is a key determinant of chemoresistance in GB and (ii) the HMGA2-TRF2 protein interaction at telomeres ameliorates the cytotoxic effects of TMZ by increasing the DNA damage repair capacity and survival of GB and GBIC.
A Porcine Knee Model is Valid for Use in the Evaluation of Arthroscopic Skills in a Residency Program

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Introduction

The aim of the following study was to validate a porcine model of the knee for knee arthroscopy skills evaluation in a residency program and to develop a model of meniscus tear for skills development in knee arthroscopy.

Methods

Participants, including orthopaedic residents, fellows, and staff surgeons, were recruited and asked to complete pre-study surveys including level of training and arthroscopic surgical experience. Each participant completed a diagnostic knee arthroscopy on a human cadaveric specimen and a porcine knee specimen. Ten minutes were allotted for each diagnostic arthroscopy but unlimited time was given to perform a partial meniscectomy on the porcine specimen. A hand view and an arthroscopic view were recorded in conjunction with each arthroscopic procedure. The previously validated Objective Assessment of Arthroscopic Skills form and a published diagnostic knee arthroscopy checklist evaluation were utilized for un-blinded global skills assessment of each participant. The internal consistency was measured using Cronbach’s alpha. Pearson’s correlation coefficient was used to associate previous arthroscopic experience with global and checklist scores.

Results

Internal consistency for each of the three procedure simulations, as well as between the procedure simulations, was found to be high in the human cadaver diagnostic arthroscopy (0.94), the porcine diagnostic arthroscopy (0.96), and the porcine meniscectomy (0.96). There was a strong correlation between years in practice and arthroscopic skill level which increased as the difficulty of the surgical simulation increased (human diagnostic arthroscopy: 0.75, porcine diagnostic arthroscopy: 0.80, porcine meniscectomy: 0.84).

Conclusion

A porcine model has shown initial validity as a knee model for the evaluation of arthroscopic skills in a residency program. Given a 40-fold reduction in cost, the porcine knee may represent a viable alternative to infrequent cadaver courses or skill development in the operating room. Further blinded assessment is necessary to demonstrate reliability of the results found above.
Introduction
Hemifacial spasm (HFS) is relatively rare with an estimated incidence of 0.8/100,000/year. It is a unique movement disorder in that a neurosurgical procedure, microvascular decompression surgery (MVD), is potentially curative although less than 10% of those afflicted with HFS in North America undergo this surgery. We examine the rate and outcomes of MVD for HFS in our province.

Methods
Baseline demographics and disease characteristics were recorded for all Manitoba patients undergoing MVD for HFS between 2001 and 2010, from a prospective database established at our centre that provides the exclusive neurosurgical services for a relatively constant provincial population of 1.26 million people. The annual rate of first surgical intervention for HFS was calculated. Postoperative outcomes were determined by review of hospital records and telephone interviews.

Results
During the 10-year enrollment period, we performed approximately 500 MVDs at our centre. This included 69 for Manitobans with HFS, a surgery rate of approximately 0.55/100,000/year. At surgery their ages were 21-74 years (55 +/- 11), disease duration 1-31 years (7.6 +/- 6.3) and 77% had tried serial botulinum toxin injections before electing MVD. Postoperative spasm relief was excellent in 86% and good relief (>75%) in another 6% at most recent follow up, 0.5 – 12 years (7 +/- 4) after MVD; this included the 9 of the 69 patients (13%) who required a repeat MVD. No patients suffered permanent or severe complications of death, stroke, new deafness or facial paralysis.

Conclusion
Based upon the disease incidence and our calculated rate of surgery, over two-thirds of Manitoba HFS sufferers annually elected MVD. This is 8-fold higher than the annual rate of surgery across North America. The difference in utilization of MVD for HFS may be related to regional availability of subspecialty neurosurgical centres as well as operative success and safety outcomes.
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