07:15 Breakfast, Registration
Location: Arcadian Court – Ballroom, 8th Floor

08:00 Welcome
Location: Arcadian Court – Ballroom, 8th Floor
Brian Kavanagh, Chair, Anesthesia
Bob Bell, Deputy Minister, Ministry of Health and Long-Term Care: “Changes to Healthcare in Ontario”
Zeev Friedman, Chair, Annual Shields Research Day 2016

08:30 Session A – Oral Presentations
Location: Arcadian Court – Ballroom, 8th Floor
Chairs: Dr. Chan, Dr. Tarshis

A1 Anesthesia technique and mortality after total hip or knee arthroplasty: A retrospective, propensity-matched cohort study
Kariem El-Boghdadly – Fellow
UHN – Toronto Western Hospital

A2 The efficacy of surgical revascularization in improving peri-operative deficits in cerebral hemodynamics and clinical outcomes in intracranial steno-occlusive disease
Jay Shou Han – Resident
UHN – Toronto Western Hospital

A3 Risk of adverse perioperative outcomes for children with congenital heart defects undergoing noncardiac surgery: A matched cohort study
Anne-Marie Leo – Fellow
The Hospital for Sick Children

A4 A novel behavioral animal model for postoperative delirium and cognitive deficits
Junhui Wang
Sunnybrook Health Sciences Centre

A5 Type of anesthesia and outcomes after transcatheter aortic valve implantation
Carla Andrea Luzzi – Fellow
UHN – Toronto General Hospital

A6 Norepinephrine to prevent hypotension after spinal anesthesia for Cesarean delivery: A dose finding study
Desire Onwochei – Fellow
Mount Sinai Hospital

A7 Pectoralis and serratus fascial plane blocks similarly improve analgesic outcomes following breast tumor resection
David MacLean – Resident
UHN – Toronto Western Hospital
**09:15 Session B - Moderated Poster Session**  
Location: Gallery Level, 9th Floor  
Moderators: Dr. Avramescu, Dr. Balki, Dr. Khanduja, Dr. Rucker, Dr. Siddiqui, Dr. Tarshis

| B1 | Ketamine increases extrasynaptic GABA(A) receptor activity in the hippocampus and cortex  
**Dian-Shi Wang**  
Sunnybrook Health Sciences Centre |
| B2 | Myometrial contractility in advanced age and morbidly obese women  
**Alice Luca**  
Mount Sinai Hospital |
| B3 | Cerebrovascular reactivity maps vary with magnitude and direction of the carbon dioxide stimulus  
**Casey Rosen**  
UHN – Toronto Western Hospital |
| B4 | Prolonged isoflurane critical care sedation and the association between fluoride levels and renal function  
**Susan Bragg – Resident**  
UHN – Toronto General Hospital |
| B5 | An analysis of non-analgesia effects of epidural use on perioperative outcomes in hepatectomy patients  
**James Khan – Resident**  
Sunnybrook Health Sciences Centre |
| B6 | A randomized controlled trial of nabilone (Cesamet®) for the prevention of postoperative nausea and vomiting in elective surgery  
**David Levin – Resident**  
St. Michael’s Hospital |
| B7 | Prediction of correct placement of thoracic epidural catheter by epidural electrical stimulation test  
**Archana Malavade**  
Mount Sinai Hospital |
| B8 | Comparison of landmark and ultrasound guided approaches for trochanteric bursa injection: A cadaveric study  
**Alex Mu – Fellow**  
UHN – Toronto Western Hospital |
| B9 | The nerves of the adductor canal and the innervation of the knee: An anatomic study  
**Anthony Short – Fellow**  
UHN – Toronto Western Hospital |
| B10 | Subtenon block in pediatric strabismus surgery: A meta-analysis  
**Ushma Shah – Fellow**  
The Hospital for Sick Children |
| B11 | Caudal anesthesia effect on postoperative outcome in pediatric cardiac surgery patients  
**Malak Maharramova**  
The Hospital for Sick Children |
| B12 | Chronic postsurgical pain outcomes following breast reconstruction with the perioperative placement of Transversus Abdominis Plane (TAP) catheters at the donor site: A prospective cohort follow-up study  
**Justin Oh – Medical Student**  
UHN – Toronto General Hospital |
| B13 | Intraosseous access for anesthesiologists – Establishing a novel simulation-based resident education program  
**Pablo Perez d’Empaire – Resident**  
Sunnybrook Health Sciences Centre |
| B14 | Lidocaine preloaded in the ETT cuff reduces emergence cough  
**Papu Nath – Fellow**  
The Hospital for Sick Children |
B15  Can we intubate with the Leksell headframe in-situ?  
**Melissa Brockerville – Fellow**  
UHN – Toronto Western Hospital

B16  Anesthetic management for upper extremity Vascularized Composite Allotransplantation (VCA) surgery  
**Siaw May Leong – Fellow**  
UHN – Toronto Western Hospital

B17  Anesthetic management of narcolepsy patients during surgery: A systemic review  
**Sally Hu – Invited Guest**  
UHN – Toronto Western Hospital

B18  Effect of different surgical positions on the cerebral venous drainage: A pilot study on healthy volunteers  
**Tze Yeng Yeoh – Fellow**  
UHN – Toronto Western Hospital

10:00 Session C – Oral Presentations
Location: Arcadian Court – Ballroom, 8th Floor
Chairs: Dr. Carvalho, Dr. Maynes

C1  Tranexamic acid and post-operative seizures in patients suffering from kidney dysfunction and undergoing cardiac surgery  
**Justin Chan – Research Medical Student**  
UHN – Toronto General Hospital

C2  Cardiac output monitoring in renal transplantation: Minimal change fluid administration with evidence of improved graft function  
**Davide Corbella – Fellow**  
UHN – Toronto General Hospital

C3  3D printing of the aortic root from 3D transesophageal echocardiography imaging: A proof-of-concept  
**Maged Metias – Medical Student**  
UHN – Toronto General Hospital

C4  Perioperative critical incidents in pediatric anesthesia: A six-year review  
**Erika Nguyen – Fellow**  
The Hospital for Sick Children

C5  A randomized cross-over physiologic study of high flow nasal oxygen cannula versus non-invasive ventilation in adult patients with cystic fibrosis: The HIFEN Study  
**Michael Sklar – Resident**  
St. Michael’s Hospital

C6  Astrocytes play a critical role in dexmedetomidine prevention of postanesthetic memory deficits  
**Fariya Mostafa – Graduate Student**  
Sunnybrook Health Sciences Centre

C7  The phenomics of chronic postsurgical pain following cardiac surgery  
**Michael Poon – Medical Student**  
UHN – Toronto General Hospital
### 10:45 Session D – Moderated Poster Session

**Location:** Gallery Level, 9th Floor  
**Moderators:** Chairs: Dr. Avramescu, Dr. Balki, Dr. Khanduja, Dr. Rucker, Dr. Siddiqui, Dr. Tarshis

| D1 | The effect of gabapentin on delayed discharge from the post anesthesia care unit: A retrospective analysis  
**Amir Yousefzadeh**  
Mount Sinai Hospital | D2 | Transitional pain service: Smoking is associated with more intense pain and a lower likelihood to wean from opioid medications after surgery  
**Janice Montbriand – Fellow**  
UHN – Toronto General Hospital |
|---|---|
| **D3** | Combination pharmacotherapy for the treatment of neuropathic pain in adults: A Cochrane Review Update 2016  
**Luis Enrique Chaparro – Resident**  
Sunnybrook Health Sciences Centre | **D4** | Prevalence of post-thoracotomy pain syndrome in pediatric patients undergoing thoracic surgery: Retrospective chart review  
**Baljoet Bhangoo – Fellow**  
The Hospital for Sick Children |
| **D5** | Pain reductions associated with improvements in pain interference and depressive symptoms in patients of surgery receiving psychological services in the transitional pain service  
**Abid Azam**  
UHN – Toronto General Hospital | **D6** | Chronic post-surgical pain and persistent opioid use following surgery: The need for a transitional pain service  
**Howard Meng – Resident**  
UHN – Toronto General Hospital |
| **D7** | Agreement in cardiac index monitoring during orthotopic liver transplantation: A comparison of Flotrac/Vigileo at two monitoring sites with pulmonary artery catheter thermodilution  
**Matthew Lee – Fellow**  
St. Michael’s Hospital | **D8** | Massive transfusion protocol: Does it translate into improved outcomes in postpartum hemorrhage? A cohort study  
**Thiago Ribeiro – Fellow**  
Sunnybrook Health Sciences Centre |
| **D9** | Respiratory complications following posterior occipitocervical spine fusion  
**Veena Sheshadri – Fellow**  
UHN – Toronto Western Hospital | **D10** | Bleeding complications in post-percutaneous coronary intervention patients having non-cardiac surgery: A prospective cohort study  
**Deep Grewal**  
UHN – Toronto General Hospital |
| **D11** | Defining Outcomes for perioperative bleeding and transfusion for the Standardized Endpoints for Perioperative Medicine (STEP) collaborative: A scoping review  
**Justyna Bartoszko – Resident**  
UHN – Toronto General Hospital | **D12** | Postoperative outcomes in obstructive sleep apnea patients undergoing cardiac surgery: A meta-analysis of comparative studies  
**George Ho**  
UHN – Toronto Western Hospital |
| **D13** | Increasing uptake of cognitive aids in pediatric operating room critical events  
**Asad Siddiqui – Resident**  
The Hospital for Sick Children | **D14** | Developing a structured competency-based training program in interventional pain management  
**Rami Kamel – Fellow**  
St. Michael’s Hospital |
D15 Using a checklist to improve intra-operative handovers among anesthesiologists
Melinda Li – Resident
UHN – Toronto General Hospital

D16 Hands-on small group sessions using ultrasound to teach anatomy at medical school
Adrian Koziak – Resident
UHN – Toronto Western Hospital

D17 3D printing low cost, task specific, medical training simulators
Joshua Qua Hiansen
UHN – Toronto General Hospital

D18 Development of a 3D printed silicone heart phantom to teach focused cardiac ultrasound
Stephanie Zhou
UHN – Toronto General Hospital

11:30 Session E – Oral Presentations
Location: Arcadian Court – Ballroom, 8th Floor
Chairs: Dr. Baker, Dr. Laffey

E1 Expert validation of a low-cost and patient specific 3D printed spine phantom for ultrasound guided neuraxial anesthesia training
Azad Mashari – Staff Anesthesiologist
UHN – Toronto General Hospital

E2 GABAergic anesthetics, but not ketamine, trigger a persistent increase in a “memory blocking” tonic inhibitory current in hippocampal neurons
Kirusanthry Kaneshwaran – Graduate Student
Sunnybrook Health Sciences Centre

E3 Impact of psychological and physiological variables on efficacy of perineural local anesthetic and steroid injections for peripheral neuropathic pain
Rajendra Sahoo – Fellow
UHN – Toronto Western Hospital

E4 Retrospective review of discharge opioid prescription in patients undergoing total knee arthroplasty
Lisa Li – Fellow
Sunnybrook Health Sciences Centre

E5 Novel model of moderate anemia induces organ specific tissue hypoxia
Nikhil Mistry – Graduate Student
St. Michael’s Hospital

E6 Etomidate increases α5GABAA receptor cell-surface expression through convergent actions of p38 MAPK and AKT
Gang Lei – Fellow
Sunnybrook Health Sciences Centre

E7 Perioperative monitoring of regional cerebral oxygen saturation and postoperative delirium post complex cardiac surgery: an RCT
Lei Lei – Fellow
UHN – Toronto General Hospital

12:15 Lunch Break and Poster Viewing

13:00 Annual Shields Lecture:
Dr. Evan D. Kharasch: “Perioperative application of long-duration opioids”

13:45 Anesthesia in the News:
Dr. Jason Maynes: “Converting knowledge to patient care: developing personal therapies for heart disease”
14:15 Shields Day Award Presentation Session
Bateman, Hammell, Rothbart, Byrick, Bryan, Best Poster at Shields Day, Awards for Clinical Excellence, Residents and Fellows Tuition Awards, Laws Travel Awards

14:45 Departure

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, approved by Continuing Professional Development, Faculty of Medicine, and University of Toronto up to a maximum of 3.5 Hours

Annual Shields Lecture – Dr. Evan D. Kharasch

“Perioperative application of long-duration opioids”

Evan D. Kharasch, MD, PhD is the Russell and Mary Shelden Professor of Anesthesiology, and Director of the Division of Clinical and Translational Research, in the Department of Anesthesiology at Washington University in St. Louis. He leads an active research program in basic, translational and clinical pharmacology, which has been funded by the NIH for over 20 years; he is a practicing anesthesiologist. His research and commercialization includes the development of novel non-invasive tests, with a focus on renal cancer – for which he holds several patents. An author of over 250 research papers, multiple chapters, he is the editor of two major textbooks on anesthetic pharmacology. He is an elected member of the Institute of Medicine of the National Academies, and served as the Vice Chancellor for Research at Washington University in St. Louis, where he led a university-wide initiative in research innovation and entrepreneurship. Dr Kharasch is the incoming Editor-in-Chief for Anesthesiology, the highest-ranked journal in the specialty.
The Awards

**Dr. Evelyn Bateman Award**

Named in honor of Dr. Evelyn Bateman, Chief of Anesthesia at the Women’s College Hospital from 1956-1972, this award recognizes excellence in anesthesia at the undergraduate level.

**Dr. David Bevan Award**

The Dr. David Bevan Award is awarded to the presenter of the best overall research poster at the Annual Shields Research Day.

**Dr. A.C. Bryan Award**

The A.C. Bryan Award is awarded to a graduate student judged to have presented the best research project at the Annual Shields Research Day.

**Dr. R.J. Byrick Award**

The R.J. Byrick Award recognizes the best fellow’s research paper presented at the Annual Shields research Day. Dr. Byrick was the Department’s 6th Chair of Anesthesia, serving from 1993-2003. He was then Vice-Dean of Clinical Affairs for the Faculty of Medicine, University of Toronto, until 2007. Dr. Byrick is currently a clinician at St. Michael’s Hospital.

**Awards for Clinical Excellence**

For excellent clinical skills (Anesthesia and Critical Care Medicine) and consistent demonstration of exemplary patient service.

**Dr. Thomas Donald Hammell Award**

The Thomas Donald Hammell Memorial Award in Anesthesia recognizes outstanding contributions to the Residency Program (as chosen by other residents).

**Dr. Alan K. Laws Travel Fellowship Award**

The Laws Travel Fellowship Award one of two awards given by the Department of Anesthesia in honor and memory of Dr. Alan Laws. This award provides travel support for senior residents or fellows to advance their research programs in anesthesia.

**The Marion and Earl Orser Prize in Anesthesia and Sleep Medicine**

The Marion and Earl Orser Prize in Anesthesia and Sleep Medicine is awarded to residents, clinical fellows, post-doctoral fellows or graduate students in support of research in clinical sciences as well as basic/translational sciences.

**Dr. Hynek Rothbart Award**

The Dr. Hynek Rothbart Award is awarded to the best paper presented by a resident at the Annual Shields Research Day.

**UT Anesthesia Resident and Fellows Tuition Awards**

Awarded to meritorious Anesthesia residents and/or fellows who are engaged in graduate studies that are clearly integrated into their existing residency/fellowship program, and are linked with their overall career plan.
Abstracts

A1 • Anesthesia technique and mortality after total hip or knee arthroplasty: A retrospective, propensity-matched cohort study

Kariem El-Boghdadly, Anahi Perlas, Vincent Chan, Scott Beattie
UHN – Toronto Western Hospital

Background: This propensity-score matched cohort study evaluates the effect of anesthetic technique on 30-day mortality following lower limb total joint arthroplasty (TJA).

Methods: Following REB approval, all patients who underwent TJA at the Toronto Western Hospital between January 1st, 2003 and December 31st, 2014 were evaluated. The principal exposure was anesthetic technique (spinal vs. general anesthesia). The primary outcome was 30-day mortality. Secondary outcomes were: a) perioperative myocardial infarction, b) a composite of major adverse cardiac events (MACE) that includes cardiac arrest, myocardial infarction or newly diagnosed arrhythmia, c) pulmonary embolism, d) major blood loss (defined as >2 units transfusion), and e) hospital length-of-stay. A propensity-score matched-pairs analysis was performed using a multi-variate logistic regression model.

Results: We identified 10868 patients, of whom 8553 received spinal and 2315 received general anesthesia. Ninety-two percent (n=2135) of the patients who received general anesthesia were matched to a similar patient who did not according to a propensity score model that included multiple relevant demographic, clinical and laboratory data (Table 1). Following propensity score matching, both cohorts were similar in all clinically significant pre-determined co-variates. Thirty day mortality was significantly lower for those patients receiving spinal anesthesia 0.19% vs. 0.8% (RR 0.42, 95% CI 0.21-0.83, p = 0.0045). Spinal anesthesia was also associated with a shorter hospital length-of-stay by approximately 1 day (5.7 vs. 6.6 days, p < 0.001).

Table 1 Baseline patient characteristics in the propensity-matched cohorts

<table>
<thead>
<tr>
<th></th>
<th>General Anesthesia (n = 2135)</th>
<th>Spinal Anesthesia (n = 2135)</th>
<th>Absolute standardized difference (after matching)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (median ± IQ range)</td>
<td>65.8 (65.3-66.4)</td>
<td>65.7 (65.2-66.2)</td>
<td>0.008</td>
</tr>
<tr>
<td>Female Gender</td>
<td>842</td>
<td>39.44</td>
<td>859</td>
</tr>
<tr>
<td>Surgical Procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hips</td>
<td>1109</td>
<td>51.94</td>
<td>1103</td>
</tr>
<tr>
<td>Knees</td>
<td>1026</td>
<td>48.06</td>
<td>1032</td>
</tr>
<tr>
<td>Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>217</td>
<td>10.16</td>
<td>181</td>
</tr>
<tr>
<td>2004</td>
<td>233</td>
<td>10.92</td>
<td>251</td>
</tr>
<tr>
<td>2005</td>
<td>273</td>
<td>12.78</td>
<td>271</td>
</tr>
<tr>
<td>2006</td>
<td>185</td>
<td>8.66</td>
<td>203</td>
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<tr>
<td>2007</td>
<td>254</td>
<td>11.9</td>
<td>300</td>
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<tr>
<td>2008</td>
<td>182</td>
<td>8.52</td>
<td>177</td>
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<tr>
<td>2009</td>
<td>216</td>
<td>10.12</td>
<td>217</td>
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<tr>
<td>2010</td>
<td>133</td>
<td>6.22</td>
<td>135</td>
</tr>
<tr>
<td>2011</td>
<td>83</td>
<td>3.76</td>
<td>57</td>
</tr>
</tbody>
</table>
## Conclusions:

Our results suggest a strong association between spinal anesthesia and reduced mortality following TJA. In addition to the previously documented advantages of reduced thromboembolic events and blood transfusion, these results suggest that spinal anesthesia should be considered a first line anesthetic technique for TJA.

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### A2 • The efficacy of surgical revascularization in improving peri-operative deficits in cerebral hemodynamics and clinical outcomes in intracranial steno-occlusive disease

**Jay Shou Han**, David J Mikulis, Lashmi Venkatraghavan, Joseph A Fisher

UHN – Toronto Western Hospital

**Background:** In large cerebral vessels with steno-occlusive disease (SOD), stroke risk is not related to the degree of stenosis but its hemodynamic significance, i.e., whether there is adequate collateral compensation. At our institution induced fixed targeted changes in end-tidal PCO2 (PETCO2) - as a vasodilatory stimulus - , and Blood Oxygen Level Dependent (BOLD) MRI - a high spatial and time

<table>
<thead>
<tr>
<th>Year</th>
<th>Diabetic</th>
<th>Cancer</th>
<th>COPD</th>
<th>MI</th>
<th>CHF</th>
<th>CVD</th>
<th>PVD</th>
<th>CRF</th>
<th>Anemie</th>
<th>Baseline Hemoglobin (g/L)</th>
<th>Baseline Serum Creatinine (μm/L)</th>
<th>ASA classification</th>
<th>RCRI</th>
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</thead>
<tbody>
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<td></td>
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</tr>
<tr>
<td>2012</td>
<td>104</td>
<td>4.88</td>
<td>106</td>
<td>4.96</td>
<td>-0.006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>134.6 (133 – 135)</td>
<td>135.4 (124.5 – 136.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>139</td>
<td>6.52</td>
<td>130</td>
<td>6.08</td>
<td>0.017</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2014</td>
<td>116</td>
<td>5.44</td>
<td>107</td>
<td>5.02</td>
<td>0.013</td>
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</tbody>
</table>

### Co-morbidities

- **Diabetes**: 65 (61, 5.8)
- **Cancer**: 24 (1.12, 0.84)
- **COPD**: 193 (18.6, 18.8)
- **Previous MI**: 84 (3.94, 3.0)
- **CHF**: 56 (2.62, 2.34)
- **CVD**: 62 (2.90, 2.48)
- **PVD**: 25 (1.18, 0.98)
- **CRF**: 43 (2.02, 1.82)
- **Anemia**: 350 (16.4, 15.18)

### Chronic CV Meds

- **Beta-blockers**: 453 (21.2, 21.2)
- **ACE inhibitors**: 459 (21.5, 12.1)
- **Calcium Channel B**: 346 (16.2, 19.0)
- **Aspirin**: 314 (30.2, 16.0)
- **Statin**: 585 (27.4, 27.5)

### ASA classification

- **I**: 59 (2.8, 2.4)
- **II**: 987 (46.2, 44.8)
- **III**: 1015 (47.5, 49.6)
- **IV**: 74 (3.5, 3.1)

### RCRI

- **0**: 1692 (78.7, 79.3)
- **1**: 346 (16.2, 16.2)
- **2**: 81 (3.8, 4.1)
- **3**: 16 (0.7, 0.3)
resolved measure of cerebral blood flow (CBF) – are used to measure cerebrovascular reactivity (CVR). CVR is defined as a change in CBF in response to a vasodilatory stimulus. Decreasing CVR is associated with increased stroke risk during the peri-operative period and signals disease progression. In this study, we evaluated the efficacy of surgical revascularization in improving pre-operative hemodynamic CVR impairments and symptoms in patients with unilateral intracranial SOD who have failed best medical therapy.

**Method:** 14 patients with symptomatic unilateral SOD despite medical therapy, scheduled to undergo a direct superficial temporal artery to middle cerebral artery (STA-MCA) bypass were recruited. Patients were assessed pre and post operatively by CVR, structural imaging and modified Rankin Scale (mRS) scores. CVR was quantified in the grey and white matter according to the six brain vascular territories - left and right, anterior (ACA), middle (MCA) and posterior (PCA) cerebral arteries.

**Results:** Pre operatively, decreases in CVR were observed in both grey and white matter of the ACA and MCA territories in the diseased hemisphere when compared to the non-diseased hemisphere (p < 0.05). The CVR of the grey and white matter of the PCA territory in the diseased hemisphere was not different from the non-diseased hemisphere (p >0.05). Post revascularization an improvement in CVR was observed in the diseased hemisphere grey matter MCA territory (P <0.05) but not in the white matter (P >0.05). No improvement in CVR was observed in the diseased hemisphere ACA territory in either grey or white matter (P >0.05). The grey and white matter CVR of the PCA territory in the diseased hemisphere remained unchanged post revascularization (p >0.05). Structurally, no new cortical infarcts were detected on follow up imaging and all patients had stable or improved mRS clinical outcome scores on follow up.

**Conclusions:** Surgical revascularization of intracranial steno occlusive lesions improves cerebral hemodynamics regionally and symptoms at follow up. Additionally, peri-operative CVR studies are able to identify brain parenchyma at risk of ischemic insult pre operatively and at continued risk post operatively.

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**A3 ● Risk of adverse perioperative outcomes for children with congenital heart defects undergoing noncardiac surgery: A matched cohort study**

**Anne-Marie Leo, Mark W Crawford, Duminda N Wijeysundera, Sylvain Mauron, Edward Hickey, James D O’Leary**

The Hospital for Sick Children

**Background:** Children with congenital heart defects (CHD) have profound differences in anatomy and physiology with the potential to adversely affect perioperative outcomes. The aim of this study was to estimate risks of adverse perioperative outcomes for children with CHD undergoing noncardiac surgery.

**Methods:** With research ethics board approval, we conducted a matched cohort study of individuals (age ≤ 17 yr) who underwent noncardiac surgery in Ontario, Canada, between 2002 and 2013. Using provincial health administrative and demographic databases, we identified 1,537 children with CHD who
matched exactly on five important confounding factors to 7,613 children without CHD. The primary outcome was all-cause 30-day mortality; secondary outcomes were perioperative complications (table) and measures of healthcare utilization. Generalized estimating equation-based multivariable logistic or negative binomial regression models were used to estimate the association between CHD and outcomes as appropriate. Results are presented as OR and 95% CI; statistical significance was defined as two-tailed P < 0.05.

Results: The risk of 30-day all-cause mortality was increased in children with CHD compared with children without CHD, 1.2% (19/1,537) vs 0.4% (29/7,613) (OR 3.12, 95%CI 1.78-5.49; P<0.001). The odds of having one or more perioperative complication was also significantly increased in children with CHD (OR 6.30, 95%CI 5.39-7.36; P<0.001). Age, time interval between cardiac and noncardiac surgery, and type of cardiac surgery each influenced perioperative outcomes in this population (table). Children with CHD had increased healthcare utilization after noncardiac surgery (length of stay [P<0.001], readmission to the emergency room [P<0.001], and readmission to hospital [P<0.001]).

Table 1. Odds of all-cause 30-day mortality and complications for children with CHD after noncardiac surgery compared with similar children without CHD.

<table>
<thead>
<tr>
<th>Subgroups</th>
<th>All-cause 30-day mortality</th>
<th>Major complications*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95%CI)</td>
<td>P</td>
</tr>
<tr>
<td><strong>Age category (at noncardiac surgery):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neonate (0 - 28 days)</td>
<td>6.88 (1.59, 29.9)</td>
<td>0.01</td>
</tr>
<tr>
<td>Infant (29 - 364 days)</td>
<td>3.25 (1.60, 6.61)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1-7 yr</td>
<td>1.42 (0.29, 6.88)</td>
<td>0.66</td>
</tr>
<tr>
<td>8-17 yr</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Time interval between cardiac and noncardiac surgery:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1.93 (0.80-4.66)</td>
<td>0.15</td>
</tr>
<tr>
<td>&lt;6 months</td>
<td>5.64 (2.26-14.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥6 months</td>
<td>3.00 (0.71-12.6)</td>
<td>0.13</td>
</tr>
</tbody>
</table>
### Type of cardiac surgery:

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Risk Ratio</th>
<th>p-value</th>
<th>Risk Ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reconstruction (without artificial material)</td>
<td>5.20 (0.30-90.3)</td>
<td>0.01</td>
<td>6.25 (1.67-23.3)</td>
<td>0.01</td>
</tr>
<tr>
<td>Repair or reconstruction of great vessels</td>
<td>4.20 (1.26-14.0)</td>
<td>0.02</td>
<td>1.83 (1.14-2.92)</td>
<td>0.01</td>
</tr>
<tr>
<td>Repair of septal defects</td>
<td>4.96 (0.30-81.1)</td>
<td>0.3</td>
<td>13.0 (6.51-26.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Staged interventions for palliation</td>
<td>-</td>
<td>-</td>
<td>4.60 (2.35-9.03)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Valve reconstruction</td>
<td>-</td>
<td>-</td>
<td>9.07 (5.07-16.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Multiple procedures</td>
<td>6.05 (1.83-20.0)</td>
<td>&lt;0.001</td>
<td>9.09 (7.00-11.8)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Complications included: acute renal failure; cardiac arrest; complications of anesthesia; complications of procedures (not specified elsewhere); conduction system disorders and arrhythmias; deep venous thrombosis, endocarditis; graft or implant complications; hemorrhage or hematoma complicating a procedure; heart failure; infection of surgical site; major disruption of wound; myocardial Infarction; myocarditis; pericarditis; pneumonia; post-procedural respiratory disorders; pulmonary collapse/atelectasis; pulmonary embolism; sepsis; seizure; stroke; unspecified adverse effect of a drug

**Conclusions:** Children with CHD have increased risks of both perioperative mortality and complications after noncardiac surgery. These findings will help optimize perioperative outcomes in this vulnerable population.

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**A novel behavioral animal model for postoperative delirium and cognitive deficits**

**Junhui Wang, Kirusanthy Kaneshwaran, Nathan Chan, Fariya Mostafa, Dianshi Wang, Sinziana Avramescu, Gang Lei, Beverley A Orser**

**Sunnybrook Health Sciences Centre**

**Background:** Postoperative delirium and cognitive dysfunction are common after anesthesia and surgery. At least 20% of the 12.5 million patients over 65 years of age hospitalized each year in the US experience complications because of delirium. Furthermore, 40% of elderly patients have postoperative cognitive deficits (POCD) at the time of discharge, and 10% have persistent cognitive deficits three months later. Delirium and POCD increase hospital costs and negatively impact the quality of life of patients. Unfortunately, the mechanisms underlying these deficits remain elusive and there are no effective treatment strategies. A barrier is the lack of animal models that accurately mimic the human pathology. The goal of this study was to develop a high-throughput animal model for postoperative delirium and cognitive deficits that has good construct, face, and predictive validity. The puzzle box (PB) is a non-aversive assay whereby mice are presented with progressively more difficult obstacles to complete a task and the time mice require to go from an illuminated start box to a goal dark box is measured (Fig 1A). This assay also provides a quick and reliable test of memory. Here we evaluated the performance of mice in the PB after a single dose of the injectable anesthetic, etomidate. To test predictability for drugs that improve cognition, some mice were treated with L-655,708 (L6), a nootropic (cognitive-enhancing) drug.
Methods: Studies were approved by the University of Toronto Animal Care Committee. Adult C57BL/6 mice were randomized to receive an anesthetizing dose of etomidate (20 mg/kg, i.p.) or vehicle, and then allowed to recover in a warm, oxygenated chamber. The PB was performed 24h after anesthesia. Another group of mice was treated with L6 (5 mg/kg, i.p.) or vehicle and tested 30 min later.

Results: Relative to sham animals, etomidate-treated mice required more time to reach the goal box (p<0.05, Fig 1B). Animals treated with L6 had a shorter latency than vehicle treated controls to perform the tasks (p<0.05, Fig 1C).

Conclusion: Our data demonstrate that an anesthetic dose of etomidate leads to impairment in executive function that persists for at least 24h. Treatment with L6 improves cognitive function in the PB assay. Collectively, the results first demonstrate the utility of the PB as an effective screening tool for anesthetic-induced cognitive deficits in mice. This tool will be used in future studies to decipher the mechanisms and identify interventions to treat delirium and improve cognition after anesthesia.

![Diagram of the puzzle box assay](image)

Fig 1. Etomidate impairs executive function and L-655,708 improves cognition. (A) Diagram of the puzzle box assay. Each day the mice are exposed to progressively more difficult tasks which test their executive function and memory performance. (B) 24h after Etomidate (20mg/kg, red squares) mice show impairment on difficult executive function tasks compared to vehicle-treated animals (black circles). Specifically, mice demonstrate increased latency to solve more difficult cognitive tasks (p<0.05, 1-way ANOVA, n=5). (C) L655, 708 (5mg/kg, blue squares) improves cognitive function after etomidate (p<0.05, 2-way ANOVA, n=5).
Type of anesthesia and outcomes after trans-catheter aortic valve implantation

Carla Andrea Luzzi, David Orlov, George Djaiani, Coimbatore Srinivas, Massimiliano Meineri, Eric Horlik, Mark Osten, Robert James Cusimano
UHN – Toronto General Hospital

Background: The purpose of this study was to compare postoperative outcomes after general anesthesia (GA) with tracheal intubation and conscious sedation with dexmedetomidine in patients undergoing trans-femoral trans-catheter aortic valve implantation (TAVI) procedures. We hypothesized that conscious sedation with dexmedetomidine would be a non-inferior anesthetic modality compared to historical controls with GA approach.

Methods: After the Research Ethics Board approval, a prospective cohort of 50 consecutive patients undergoing trans-femoral TAVI under conscious sedation with dexmedetomidine (DEX group) were matched by age and sex on 1:1 basis with 50 historical controls receiving general anesthesia (GA group). In the GA group, anesthesia was induced with fentanyl 1-3mg/kg, and propofol 0.5-2mg/kg. Tracheal intubation was facilitated with rocuronium 0.6mg/kg. Anesthesia was maintained with isoflurane 0.5-2.0%, or sevoflurane 1.5-2.5%. In DEX group, patients received dexmedetomidine bolus 0.4-1μg/kg over 10-20min followed by an infusion 0.5-1.4μg/kg/h until the end of procedure. Transesophageal and transthoracic echocardiography were utilized in GA and DEX groups respectively. Both groups were compared with respect to demographic data, past medical history, medications, surgical characteristics, postoperative morbidity and mortality, and length of hospital stay. Statistical analysis was performed on the intent-to-treat basis. P < 0.05 was considered statistically significant.

Results: Both groups were similar with respect to demographic data and surgical characteristics. Four patients in DEX group were converted to GA during the TAVI procedure. All patients in GA group were extubated in the operating room (OR). The OR times were 133 ± 42min in DEX group vs 158 ± 41min in GA group, p=0.0036. There was no difference with respect to postoperative morbidity and mortality between the two groups. (Table) The median difference in hospital length of stay was 2 days favoring DEX group, however, this difference did not reach statistical significance, p =0.07.

Conclusion: Conscious sedation with dexmedetomidine resulted in a non-inferior anesthetic modality compared to historical controls with general anesthesia approach. Potential benefits included shorter OR times and expedited hospital discharge.
Postoperative Morbidity and Mortality

<table>
<thead>
<tr>
<th></th>
<th>DEX Group (n = 50)</th>
<th>GA Group (n = 50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial Infarction</td>
<td>1 (2)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Stroke/Transient Ischemic</td>
<td>1 (2)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Attack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest creatinine, mmol/L</td>
<td>104 [55, 311]</td>
<td>103.5 [65, 576]</td>
</tr>
<tr>
<td>Dialysis</td>
<td>1 (2)</td>
<td>2 (4)</td>
</tr>
<tr>
<td>Delirium</td>
<td>3 (6)</td>
<td>5 (10)</td>
</tr>
<tr>
<td>Hospital length of stay, days</td>
<td>5 [1, 64]</td>
<td>7 [2, 41]</td>
</tr>
<tr>
<td>Death</td>
<td>0 (0)</td>
<td>1 (2)</td>
</tr>
</tbody>
</table>

Data expressed as number of patients (%), and median [range].

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A6 • Norepinephrine to prevent hypotension after spinal anesthesia for Cesarean delivery: A dose finding study

Desire Onwochei, W Ngan Kee, L Fung, K Downey, X Ye, J Carvalho
Mount Sinai Hospital

**Background:** Norepinephrine (NE) has recently been proposed as an alternative to phenylephrine (PE) for management of hypotension during Cesarean delivery (CD) under spinal anesthesia [1]. A concern with PE is its propensity to reduce maternal heart rate and cardiac output, which may be detrimental in a compromised fetus [1,2]. NE is a potent alpha agonist with some beta agonist activity, which leads to less negative chronotropic effects. The optimum bolus dose of NE required to prevent hypotension in this setting has not been established. The purpose of this study was to determine the ED90 of NE in this context.

**Methods:** With Institutional Ethics Committee approval, this was conducted as a double-blind, sequential allocation dose-finding study, using the biased coin up-and-down design targeting ED90. Women for elective CD under spinal anesthesia were recruited. SBP was assessed every minute until delivery and NE given whenever SBP decreased to less than 100% of baseline. A 3 mcg dose was used for the first patient. The dose given to subsequent patients varied by increments or decrements of 1.0 mcg (range 3-8 mcg), and was determined by the primary outcome, SBP maintained above 80% of baseline in the previous patient. If a patient did not respond to the current dose, it was considered to have failed and the dose for the following patient was increased to the next higher dose level. If the patient did respond to the dose, this was considered a success, and the dose for the next patient was decreased to the next lower dose with a probability of 1/9, otherwise it remained unchanged. The primary outcome
was success of the NE dose to maintain SBP at or above 80% of baseline, from induction to delivery of
the fetus.

**Results:** So far we have recruited 33 of the 40 patients needed, and will have recruited the last by March
2016. Preliminary results show 82% successful maintenance of SBP at or above baseline with a range of
1-12 boluses of the study dose of NE over a 15-32 min time frame from induction to delivery. Incidences
of hypotension, hypertension, bradycardia, nausea and vomiting were 18%, 9%, 9%, 24% and 0%,
respectively.

**Conclusion:** NE boluses appear to be effective at maintaining SBP post spinal anesthesia in elective CD,
with a small incidence of bradycardia. The ED90 will be calculated at the end of the study. Final
discussion and conclusion will be presented at the meeting.


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**A7 ● Pectoralis and serratus fascial plane blocks similarly improve analgesic outcomes following
breast tumor resection**

**David MacLean, Faraj Abdallah, Richard Brull**

UHN – Toronto Western Hospital

**Background:** Pectoralis and serratus fascial plane blocks are of uncertain analgesic benefit for breast
surgery. This cohort study evaluated the addition of pectoralis or serratus blocks to conventional
analgesia in patients undergoing breast tumor resection at Women’s College Hospital in Toronto from
July 2013 to July 2015. We hypothesized the blocks would i) reduce opioid consumption in the post-
anesthesia care unit (PACU), and; ii) decrease the incidence of post-operative nausea and vomiting
(PONV).

**Methods:** Following REB approval, retrospective chart review identified patients undergoing ambulatory
breast surgery (n=225). Subjects were propensity matched and three groups (n=75 each) were
identified: i) pectoralis block; ii) serratus block, and; iii) conventional opioid-based analgesia. Patients
were allocated to their group according to attending anesthesiologist practice and patient preference.
Multivariable linear regressions within cohorts were used to model oral mg morphine equivalent (MME)
consumption and risk of PONV as primary outcomes. Pectoralis and serratus blocks were compared for
non-inferiority; significance was considered only if both primary outcomes were met (margins: 10 MME;
10% difference in PONV). Secondary outcomes included intra-operative fentanyl consumption, PACU
pain scores, time-to-first analgesic request, and time to PACU discharge.

**Results:** Patient characteristics were similar between groups. Pectoralis and serratus blocks both
reduced opioid consumption versus no block (12.3±17.7 and 15.2±16.7, respectively, vs. 24.7±21.8
MME) and decreased the incidence of PONV (30.3 and 33.3 vs. 88.7%) in the PACU. Pectoralis block was
non-inferior and not superior to serratus block. Both blocks reduced intra-operative fentanyl
consumption (131.0±84.5 and 136.1±75.6 vs. 179.2±93.5 µg), prolonged time-to-first analgesic request
(45.3±13.1 and 42.6±17.3 vs. 22.0±11.9 minutes), and expedited time to PACU discharge (81.0±10.3 and
81.6±11.6 vs. 99.4±19.1 minutes) compared to subjects receiving no block (all p<0.01). Remaining outcomes were not different.

**Conclusion:** Pectoralis and serratus blocks are similarly effective for reducing PACU opioid consumption and PONV versus standard opioid-based analgesia alone. Both blocks appear to be effective analgesic adjuncts in patients undergoing ambulatory breast tumor resection.

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**B1 ● Ketamine increases extrasynaptic GABA(A) receptor activity in the hippocampus and cortex**

**Dian-Shi Wang,** Antonello Penna, Beverley A Orser  
Sunnybrook Health Sciences Centre

**Background:** Ketamine is a “dissociative” general anesthetic and is also administered at low doses for its sedative, analgesic and antidepressant effects. Ketamine primarily acts as an antagonist of excitatory NMDA receptors whereas most other general anesthetics increase the activity of inhibitory GABA(A) receptors. It remains uncertain whether ketamine modulates GABA(A) receptors. Given the multiple clinical properties of ketamine, we postulate that ketamine increases GABA(A) receptor activity in many brain regions, including the hippocampus and cortex. The specific aim of this study is to determine whether ketamine modifies the function of extrasynaptic and synaptic GABA(A) receptors in the hippocampus and cortex, two brain regions that are important for ketamine’s clinical effects.

**Methods:** Studies were approved by the local ethics committee. Whole-cell voltage clamp recording was performed in cultured murine hippocampal and cortical neurons. All experiments were performed in the presence of a NMDA receptor blocker, DL-APV (20 µM).

**Results:** Ketamine, at clinically relevant concentrations (10-100 µM), preferentially increased the tonic inhibitory current generated by extrasynaptic GABA(A) receptors whereas the synaptic currents were unaffected. The ketamine increase in tonic current was observed in both hippocampal and cortical neurons. Ketamine shifted the GABA concentration-response curve to the left, but only for the low concentrations of GABA. Thus, the selective increase in extrasynaptic GABA(A) receptor activity is attributed to ketamine increasing the potency of GABA. Finally, high concentrations of ketamine directly gated the opening of GABA(A) receptors.

**Conclusion:** The results provide the first evidence that ketamine, at clinically relevant concentrations, preferentially increases the activity of native extrasynaptic GABA(A) receptors in multiple brain regions. In contrast, synaptic GABA(A) receptors are unaffected. Ketamine up-regulation of extrasynaptic GABA(A) receptor activity likely contributes to the acute direct anesthetic effects as well as its long-term sustained analgesic and antidepressant properties.
Myometrial contractility in advanced age and morbidly obese women

Alice Luca, JC Carvalho, N Ramachandran, J Kingdom, M Balki
Mount Sinai Hospital

Background: Women with advanced maternal age (AMA) and morbid obesity (MO) are at a greater risk for postpartum hemorrhage (PPH). Oxytocin is the first line drug in the treatment of PPH. Prolonged exposure to oxytocin can result in desensitization of the oxytocin receptors, which may result in poor uterine tone after delivery, with attenuated response to oxytocin. It is not known if the higher incidence of PPH seen in these women is due to poor uterine contractility. It is also not known if oxytocin desensitization specifically affects contractility in AMA and MO women when compared to younger or normal weight women. We aimed to investigate the effect of oxytocin on myometrial strips of AMA and MO women in-vitro.

Methods: The study was conducted after REB approval and written informed consent from women undergoing elective cesarean deliveries. Three groups of patients were studied: control (≤35 yr, BMI 20–24.9 kg/m2), AMA (≥40 yr, BMI 20–24.9 kg/m2), and MO (≤35 yr, BMI≥40 kg/m2). Myometrial tissue was dissected into strips, and each strip was mounted in a single organ bath and pretreated with oxytocin 10-5M (desensitization model) or left in physiological salt solution (untreated) for 2 hours. This was followed by a dose-response to oxytocin 10-10M to 10-5M. The primary outcome was motility index (MI; amplitude x frequency) of myometrial contractions.

Results: So far 126 experiments have been performed (required n=168) with samples from 33 women: control (n=56), AMA (n=48), MO (n=22). The MI, calculated as a cumulative dose-response average, was higher in the control group (457%) compared to the AMA (414%) and MO (321%) groups in untreated samples. In the oxytocin-pretreated samples, the MI was lower in the control group (111%) compared to the AMA (158%) and MO (281%) groups (Fig 1). We plan to complete this study by April 30, following recruitment of 7 more patients.

Conclusions: Our results suggest that women with AMA and particularly those with MO may exhibit poor intrinsic uterine contractility as compared to younger and normal weight women. Furthermore, their uterine contractility is further impaired by pre-exposure to oxytocin.
Cerebrovascular reactivity maps vary with magnitude and direction of the carbon dioxide stimulus

Casey Rosen, JA Fisher, DJ Mikulis
UHN – Toronto Western Hospital

Background: Cerebrovascular reactivity (CVR) is a cerebrovascular stress test where the vasoactive stimulus is carbon dioxide (CO2) measured as end-tidal CO2 (PETCO2), and the MRI BOLD signal (S) is used as a high spatial and time resolved surrogate of cerebral blood flow (CBF). CVR is defined as Δ S / Δ PETCO2. In healthy subjects, the relationship between PETCO2 and S is near linear. However, some patients demonstrate regional cerebrovascular pathology, whereby there is a paradoxical decrease in CBF with hypercapnia. This paradoxical relationship is known as the vascular steal phenomenon, and is relatively common in patients with intracranial steno-occlusive disease. Abnormal CVR is a marker for an enhanced risk of stroke and cognitive decline. Currently, the size of the CO2 stimulus is not controlled, thereby leading to the uncertainty of how the steal phenomenon varies with the direction and magnitude of PETCO2. We hypothesize that the sensitivity of CVR, and thus the appearance of this steal phenomenon, is proportional to the ΔPETCO2.

Methods: 18 patients (10F, mean age 45 years ±17) with intracranial steno-occlusive disease were included in this study. We measured the BOLD signal at 3T MRI while applying continuous increases in PETCO2 (30-55mmHg) over four minutes using a computer controlled gas blender and a sequential breathing circuit. CVR values were calculated and colour-coded according to a pre-defined spectrum, from red indicating a positive correlation to blue indicating a negative correlation (i.e. steal). These values were then mapped voxel-by-voxel onto the patients’ anatomical images. For each patient, CVR maps were produced at 2mmHg increments of PETCO2.

Results: The CVR maps varied with the magnitude of PETCO2. As well, the magnitude of changes in CVR maps differed in the hypocapnic and hypercapnic ranges. The appearance of steal and the extent of the steal depended on the PETCO2. Threshold levels varied from patient to patient, and 2mmHg changes
affected the interpretation of the maps. The subtler the patients’ vascular dysfunction, the higher the PETCO2 required to induce steal.

**Conclusions:** The sensitivity of CVR is proportional to the change in PETCO2. The tight regulation of PETCO2 is important in developing a repeatable standardized stimulus for clinical testing, as this remains a critical consideration for not only patients with intracranial pressure but also for patients with intracranial steno-occlusive disease.

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**B4 ● Prolonged isoflurane critical care sedation and the association between fluoride levels and renal function**

*Susan Bragg, M Wasowicz, M Parotto, A Steel, ND Ferguson, A Jerath*

*UHN – Toronto General Hospital*

**Background:** Volatile anesthetic agents contain fluoride. Historical data using methoxyflurane demonstrated that serum fluoride levels > 50 umol/L were associated with acute renal dysfunction.1 Modern day volatile agents such as isoflurane and sevoflurane can be used to provide critical care sedation. However, there is limited data assessing the association between fluoride levels and renal function, particularly during prolonged use. The ‘Use of Volatile Anesthetic Agents for Long-Term Critical Care Sedation’ (VALTS) Trial is a safety pilot trial assessing the use of isoflurane for long term ICU sedation. This report assesses fluoride levels and the effect on renal function.

**Methods:** VALTS is a parallel RCT recruiting patients who require mechanical ventilation > 48h. With consent and REB approval, patients are randomized to receive inhaled isoflurane or intravenous propofol/midazolam using a bedside analgo-sedation protocol. Serum fluoride levels and glomerular filtration rate (GFR) are measured every 48 h until sedation is discontinued.

Continuous data is reported as median (IQR) and analysed using a Mann Whitney U test. Categorical data is expressed as a percentage and analysed using a Chi or Fisher’s Exact test. Multivariable linear regression random intercept model was used to assess the association between GFR and fluoride levels with risk adjustment for chronic renal dysfunction (CRD), diabetes, APACHE II score, hemoglobin and admission type. A second model was used to assess factors that raise serum fluoride levels. Natural logarithm of fluoride was used to ensure normality of data. Analyses were conducted in SAS v.9.4 (Cary, N.C.).

**Results:** 27 patients received isoflurane and 6 received propofol/midazolam sedation. Serum fluoride levels rose with duration of sedation, to a maximum of 130umol/L. Fluoride levels were significantly higher in the isoflurane vs. IV sedation group and surgical vs. medical/non-operative surgical patients. Risk adjusted analysis showed GFR was statistically significantly associated with CRD (-30.2, 95% CI -53.1 - -7.3, p=0.01) and had near significance with haemoglobin (0.34, 95% CI -0.01-0.70, p=0.06), Table 1.

Serum log fluoride levels were associated with isoflurane sedation (1.32, 95%CI 0.36-2.28, p=0.008) and surgical patients (0.98, 95%CI 0.23-1.73, p=0.01).
Conclusions: Isoflurane sedation raises serum fluoride levels. However, this is not associated with reduced renal function.


### Table 1

<table>
<thead>
<tr>
<th>Variables</th>
<th>Adjusted Beta Coefficient (95% CI)</th>
<th>Test Statistic</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
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<tr>
<td>Fluoride</td>
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<td>Volatile sedation</td>
<td>3.78 (-23.3730.93)</td>
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<td>Surgical group</td>
<td>-9.77 (31.9512.41)</td>
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<tr>
<td>Diabetes</td>
<td>-6.47 (-29.1516.22)</td>
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<td>0.5719</td>
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<tr>
<td>Chronic renal dysfunction</td>
<td>-30.22 (-53.127.33)</td>
<td>-2.63</td>
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<td>APACHE II</td>
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<tr>
<td>Haemoglobin</td>
<td>0.34 (-0.010.70)</td>
<td>1.93</td>
<td>0.0575</td>
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</tbody>
</table>

*p < 0.05

Conclusions: Isoflurane sedation raises serum fluoride levels. However, this is not associated with reduced renal function.


B5  An analysis of non-analgesia effects of epidural use on perioperative outcomes in hepatectomy patients

James Khan, Rogeh Habashi, Madeline Lemke, Yannick LeManach, Julie Hallet, Sherif Hanna, Natalie G Coburn, Calvin HL Law, Paul J Karamicholas
Sunnybrook Health Sciences Centre

Background: While epidural analgesia is effective for postoperative pain management, there is uncertainty regarding their non-analgesia effects in patients undergoing liver resections. Our objective was to examine non-analgesia effects of epidural analgesia on perioperative outcomes in hepatectomy patients.

Methods: We collected data from 750 adult patients undergoing a liver resection from a single institution from 2002 to 2012. Five-hundred and six (67.5%) received a thoracic epidural catheter, whereas 244 (32.5%) received no epidural (i.e., patient-controlled analgesia). We conducted a propensity score matched analysis to determine the relative impact on intraoperative and postoperative outcomes. Logistic regression was used to estimate the propensity to receive an epidural catheter using preoperative factors (i.e., sex, age, surgeon, laparoscopic technique, liver disease, previous liver resections, number of segments to be resected, Charlson Comorbidity Index, coronary artery disease, hypertension, diabetes, COPD, preoperative INR, bilirubin, creatinine, hemoglobin, and platelets). Patients were then matched (ratio 1:1) using a nearest neighbour strategy with a caliper of 20% of the standard deviation of the propensity score. Covariate balance was assessed using standardized differences (SD) with any SD greater than 15% was considered as a significant imbalance. Comparisons were made using univariate linear regression modelling.
Results: The matched population consisted of 414 patients (207 pairs of patients). No SD exceeded 15% suggesting appropriate balance of preoperative factors.

Patients with epidurals had lower intraoperative nadir of systolic blood pressure (80.7 (SE 0.6) versus 82.8 (SE 0.7) mmHg, p=0.024) and received more intraoperative fluids (3962.2 (SE 159.0) versus 3031.6 (SE 140.4) mL, p<0.001). Postoperatively, those with epidural analgesia had lower hemoglobin levels immediately after surgery (106.9 (SE 1.3) versus 111.1 (SE 1.4) g/L, p=0.03) and on postoperative day one (105.5 (SE 1.2) versus 109.3 (SE 1.2) g/L, p=0.03). There was no difference in length of OR, intraoperative estimated blood loss, intraoperative or postoperative transfusions, postoperative INR, platelets, creatinine, bilirubin, urine output, minor or major complications, hospital length of stay, readmission, or mortality.

Conclusions: Our data suggest that epidural analgesia in patients undergoing liver resection is associated with intraoperative hypotension, greater fluid administration, and anemia immediately after surgery. These outcomes were benign and did not translate into differences in postoperative morbidity or mortality. Further investigations are needed to verify these findings.

B6 ● A randomized controlled trial of nabilone (Cesamet®) for the prevention of postoperative nausea and vomiting in elective surgery

David Levin, Zachary Dulberg, An-Wen Chan, Greg Hare, C. David Mazer, Aaron Hong
St. Michael’s Hospital

Background: Nabilone (Cesamet®) is a synthetic cannabinoid with properties that make it an appealing candidate as a postoperative nausea and vomiting (PONV) prophylactic adjunct. Nabilone has proven clinical utility in chemo-therapy related nausea and vomiting and has not been adequately tested as a PONV prophylactic.

Methods: Single centre randomized blinded trial assessing prophylactic oral nabilone versus placebo for the prevention of PONV. Eligible patients scheduled for elective surgery under general anaesthesia who had a pre-operative risk of PONV greater than 60% received either nabilone 0.5 mg or placebo orally within 3 hours prior to surgery. The primary outcome was incidence of PONV. Secondary outcomes included the effect on pain, speed of recovery and drug side effects. This study received REB approval and was registered with ClinicalTrials.gov. Identifier: NCT02115529

Results: 340 patients were randomized, 172 received nabilone and 168 received placebo. There was no difference in the incidence of PONV, which occurred in 20.9% in the nabilone group and 21.4% in the placebo group (95%CI= 0.89 to 1.11, RR = 0.98, p=1.00). Subjective sensation of PONV and/or treatment with antiemetic in the PACU occurred in of 41.7% and 41.8% of the nabilone and placebo groups respectively (95%CI= 0.77 to 1.28, RR = 0.995, p=1.00). There were no differences in pain scores or opioid consumption. Patients who received nabilone achieved a rest and recovery score (RRS) >8 (meeting PACU discharge criteria) 4 minutes earlier (nabilone: median time = 31 minutes; Q1=30; Q3=40), Placebo: median time = 35 minutes; Q1=30; Q3=65; p=0.025)
**Conclusions:** Nabilone 0.5 mg given orally as a single dose prior to surgery is ineffective in reducing PONV.

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**B7 ● Prediction of correct placement of thoracic epidural catheter by epidural electrical stimulation test**

**Archana Malavade, Uma Tharamaratnam, Philip Ye, Mrinalini Balki**  
Mount Sinai Hospital

**Background:** The failure rate of thoracic epidural anesthesia due to inadequate catheter placement has been reported to be 30% [1]. The purpose of this study was to compare the responses of Epidural Electrical Stimulation Test (EEST) and test dose, and determine the agreement between them for predicting functioning thoracic epidural catheter.

**Methods:** After REB approval and informed consent, this prospective observational cohort study was done in patients requiring thoracic epidural analgesia for abdominal surgeries. Epidural block was performed by the anesthesiologist at mid-thoracic level using a 17G Tuohy needle followed by insertion of a 19G catheter. EEST was performed with a nerve stimulator (Stimpod NMS450) with a gradual increase in current from 0 to 20 mA (frequency 2Hz, pulse width 0.2ms). This was followed by a test dose of 3ml 2% lidocaine. Sensory block level in response to ice and pinprick was tested. Functioning of epidural catheter was determined based on the need for intraoperative opioids, postoperative pain scores and sensory block. The primary outcomes were responses to EEST and test dose. Kappa was estimated to assess the agreement of the response based on the two methods.

**Results:** Sixty five patients were included in the study. Six catheters were removed as their responses to both EEST and test dose were negative. Data analysis was done in 59 cases where epidural catheters were used intra and postoperatively; of these 9 patients had inadequate blocks. The mean (SD) age and BMI of patients were 54.45 (12.8) years and 27.82 (6.72) kg/m2, respectively. ESST and test dose were positive in 52 (88%) and 45 (76%) patients, respectively, with working epidurals. The two tests were in moderate agreement (kappa=0.48). The sensitivity (95% CI) of the two tests in predicting functioning epidural was 0.88 (0.76, 0.95) and 0.75 (0.62, 0.86) for EEST and test dose methods, respectively. Similarly, for predicting adequate block, the sensitivity was 0.90 (0.78, 0.97) and 0.74 (0.60, 0.85) for EEST and test dose, respectively. The mean ESST current required to elicit motor response was 5.9 (3.4) mA. The response was unilateral in 65% cases and bilateral in 35%.

**Conclusions:** Our study shows that EEST and test dose have moderate agreement, however, EEST has a higher sensitivity compared to test dose. EEST should be adopted as a method of testing thoracic epidural blocks to ensure functioning epidural catheters.

Comparison of landmark and ultrasound guided approaches for trochanteric bursa injection: A cadaveric study

Alex Mu, Philip Peng, Anne Agur
UHN – Toronto Western Hospital

Background: Greater trochanteric pain syndrome (GTPS) affects 5.9-11.7% of the population between 50-79 years of age. Literature suggests that it is due to pathology in the gluteal tendons or surrounding structures. Subgluteus maximus (greater trochanteric) bursa injection with corticosteroid and local anesthetic is a treatment for those suffering from greater trochanteric pain syndrome. Ultrasound has emerged as a popular tool in many pain interventions but its accuracy in trochanteric bursa injection has not been tested.

Methods: With Research Ethics Board approval, 24 hip specimen from 12 cadavers were used for subgluteus maximus bursa injection after left-right randomization for either landmark (LM) or ultrasound guided (US) approach by an experienced interventionist. The methylene blue, used as the injectate, was then classified based on its spread found on dissection. Fisher’s exact test was used to determine significance in the accuracy of the two techniques.

Results: Subgluteus maximus bursa was exclusively targeted in 83.4% of the US guided injections while LM guidance provided 58.4% success. This was not a significant difference between LM and US based injection technique (p=0.37).

Conclusions: Landmark based intervention for greater trochanteric pain syndrome remains simple and effective. Although not a significant improvement in this study, ultrasound may provide guidance in certain situations such as failed LM injection, inability to palpate the greater trochanter, or specific injections into the other trochanteric bursas. Future randomized trials with larger sample size are needed to elucidate whether ultrasound can provide any improvement in clinical outcomes.

Table 1. Anatomical location of the injections

<table>
<thead>
<tr>
<th>Location types</th>
<th>LM-guided % successful (n)</th>
<th>US-guided % successful (n)</th>
<th>Details of location</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>58.4 (7)</td>
<td>83.4 (10)</td>
<td>All in deep SG maximus bursa</td>
</tr>
<tr>
<td>II</td>
<td>33.3 (4)</td>
<td>8.3 (1)*</td>
<td>LM: SG medius bursa (1), SG medius bursa+surface of gluteus minimus (1); vastus lateralis distal to GT (1); deep to ITT 2.5cm distal to GT (1) US: in subcutaneous tissue superficial to gluteus maximus muscle (1)</td>
</tr>
<tr>
<td>III</td>
<td>8.3 (1)</td>
<td>8.3 (1)</td>
<td>Deep to SG maximus bursa and superficial to gluteus maximus tendon (one in both LM and US group)</td>
</tr>
</tbody>
</table>

LM, landmark; US, ultrasound; SG, subgluteus; GT, greater trochanter; ITT, iliotibial tract. * in the one unsuccessful attempt the specimen when dissected was not fully thawed, likely resulting in the difficulty in layer identification during injection.
The nerves of the adductor canal and the innervation of the knee: An anatomic study

Anthony Short, David Burckett-St. Laurant, Philip Peng, Laura Giron Arango, Ahtsham U Niazi, Vincent WS Chan, Anne Agur, Anahi Perlas
UHN – Toronto Western Hospital

Background: Total knee replacement is associated with severe postoperative pain. Adductor canal block can provide effective analgesia, as part of a multi-modal regimen, with minimal quadriceps weakness [1,2]. However, significant controversy exists regarding the target nerves and the ideal site of local anesthetic administration. The objective of this cadaveric study was to identify and determine the trajectory of all nerves that course in the adductor canal and describe their relative contributions to the innervation of the knee joint.

Methods: Following research ethics board approval, 20 cadaveric lower limbs were dissected. The superficial tissues were excised, the sartorius muscle mobilized and the vasto-adductor membrane retracted medially to expose the neuro-vascular structures coursing in the adductor canal. All visible branches of the femoral and obturator nerves were explored along the adductor canal and followed to their termination.

Results: Both the saphenous nerve (SN) and the nerve to vastus medialis (NVM) were consistently identified while branches of the anterior obturator nerve (ON) were inconsistently present. The NVM had a more significant contribution to the knee capsule than anticipated, through intramuscular, extramuscular and deep genicular nerves. The saphenous nerve had a relatively more modest contribution through inconsistent superficial infrapatellar and posterior branches as well as contributing to the origin of the deep genicular nerves (Fig 1).

Conclusions: The results suggest that both the SN and NVM contribute to the innervation of the anteromedial knee joint and are therefore important targets of adductor canal block, while an inconsistent branch of the anterior ON is of likely marginal clinical relevance. Given the site of exit of both SN and NVM in the distal third of the adductor canal, our observations suggest that the mid portion of the canal could be an optimal site for local anesthetic administration, proximal enough to block both the NVM and SN while distal enough to minimize local anesthetic spread to the femoral triangle.

Background: Strabismus surgery is associated with significant intraoperative oculocardiac events, postoperative pain, nausea and vomiting (PONV). Subtenon block has been shown to provide postoperative analgesia after strabismus surgery in children (1), and may be associated with a decreased incidence of oculocardiac reflex, nausea and vomiting (2, 3). We conducted a systematic review and meta-analysis on the safety and effectiveness of subtenon block for postoperative pain in children undergoing strabismus surgery.

Methods: We searched Medline, Embase, Cochrane, Scopus and Web of Science up to December 2015 for articles comparing the use of subtenon block with control in children undergoing strabismus surgery. We also searched reference lists of included trials and ClinicalTrial.Gov for completed or ongoing trials. Outcomes included severity of pain on admission to the postoperative anesthesia unit (PACU), and pain at 20-40 minutes and 6, 12 and 24 +/-2 hours postoperatively, number of children requiring opioid and non-opioid analgesia, PONV, intraoperative oculocardiac events and block-related adverse events. Local ethics board approval was not required for doing a meta-analysis. Risk of bias was assessed using the
Cochrane Risk of Bias instrument and the quality (certainty) of evidence for each outcome was assessed using GRADE methods. We analyzed the data using the statistical package in Review Manager (version 5.3). Using a random effects model, we pooled continuous outcomes as a Mean Difference or Standardized Mean Difference with corresponding 95% confidence intervals and dichotomous outcomes as a Relative Risk with corresponding 95% confidence intervals.

**Results:** Among 217 articles identified, 8 studies involving 447 participants were included for the review. Risk of bias was low in two studies and high or unclear in six. Pain scores on admission to PACU (SMD = 1.53; 95% CI 1.07-2.00) and 12 hours postoperatively (MD 4.0; 95% CI 3.29-4.71), number of children requiring postoperative opioid analgesia (RR 0.59; 95% CI 0.37, 0.92), incidence of oculocardiac events (RR 0.45; 95% CI 0.23-0.85) and vomiting (RR 0.41; 95% CI 0.18, 0.93) was lower in subtenon group compared with control respectively. There was no difference between subtenon block and control in the remaining outcomes. The quality of evidence for the majority of outcomes was low due to high risk of bias and imprecision.

**Conclusion:** Low quality evidence suggests that subtenon block decreases the immediate postoperative pain, opioid consumption, incidence of intraoperative oculocardiac events and postoperative vomiting.

**References:**

**B11 ● Caudal anesthesia effect on postoperative outcome in pediatric cardiac surgery patients**

**Malak Maharramova, Katherine Taylor**
The Hospital for Sick Children

**Background:** Caudal Anesthesia is a common technique in pediatrics, due to its high success and low complication rates. Increasingly pediatric cardiac surgery patients are ‘fast-tracked’. Possible benefits include reduced ventilator associated complications, reduced sedative use, reduced parental stress, reduced length of stay (LOS) and costs. Some circulations benefit from improved hemodynamics in spontaneous ventilation. Our systematic review answered the question: “In pediatric cardiac surgery does caudal anesthesia promote early extubation, reduce pain scores, stress response and LOS?”

**Methods:** MEDLINE, Embase, Web of Science and hand-searching references from 1947-February 2016 was performed. (See PRISMA chart for article selection). Relevant studies selected were randomized or
controlled clinical trials. Any caudal medication was included. Caudal anesthesia and early extubation, pain scores, hemodynamic and stress response and LOS were examined.

**Results:** The combined reviews include 1769 patients. Caudal medications included dexmedetomidine, bupivacaine, sufentanil, morphine, fentanyl and neostigmine. Seven (2,3,4,5,6,7,8) of the 18 studies reported earlier extubation with caudal. CPB and surgical duration are confounders to early extubation. Three studies showed reduced pain scores and need for opiates; (9,10,11) one study showed no difference.(5) Two of three studies showed a reduction in stress response and two of two showed improved hemodynamics with caudal anesthesia. Four studies showed reduced hospital LOS.

**Conclusions:** Caudal anesthesia is safe and popular in pediatrics with modest experience in cardiac surgery. Caudal anesthesia may be favorable for early extubation, improved pain and hemodynamics and reduced LOS. Our review is limited by heterogeneous populations, variable pain measurement scales and variable endpoints for extubation. Others have shown young age, long CPB precludes early extubation. Our review suggests caudal anesthesia may be an option for older patients, with short CPB times who may benefit from its advantages.

**B12**  
**Chronic postsurgical pain outcomes following breast reconstruction with the perioperative placement of Transversus Abdominis Plane (TAP) catheters at the donor site: A prospective cohort follow-up study**

**Justin Oh, M Gabrielle Page, Toni Zhong, Stuart McCluskey, Coimbatore Srinivas, Joel Katz, Stefan Hofer, Hance Clarke**  
UHN-Toronto General Hospital

**Background:** Chronic postsurgical pain (CPSP) is a debilitating and costly condition, but risk factors for CPSP after autologous breast reconstruction have not been clearly established. Previously, we demonstrated that transverses abdominis plane (TAP) catheters delivering intermittent local anesthetic reduced postoperative morphine consumption. This prospective follow-up study aims to 1) compare the incidence of CPSP after autologous breast reconstruction between patients who received post-operative intermittent TAP catheters with bupivacaine or saline boluses and 2) assess the factors that contribute to the development and maintenance of CPSP in this sample.

**Methods:** Patients who underwent deep inferior epigastric artery perforator or muscle-sparing transverse rectus abdominis breast reconstruction were randomized to receive TAP catheters with bupivacaine or saline post-operatively. Subsequently, patients were followed for a year to assess persistent pain, pain severity, quality of life scores, and functional disability at 6 and 12 months after surgery.

**Results:** 23% and 21% of patients reported CPSP at 6 and 12 months, respectively. There were no significant differences between groups (bupivacaine vs. placebo) on pain-related variables, including incidence of CPSP. Patients who reported greater variability in pain scores over the first 48-hours post-operatively were more likely to have CPSP 6 months, but not 12 months, later.
Conclusions: Acute post-operative pain variability may contribute to the development of CPSP up to 6 months after autologous breast reconstruction surgery. Neither postoperative use of bupivacaine vs. saline in the TAP catheter nor acute pain severity influences the 6- or 12-month incidence of CPSP.

B13 • Intraosseous access for anesthesiologists – Establishing a novel simulation-based resident education program

Pablo Perez d’Empaire, Tobias Everett
Sunnybrook Health Sciences Centre

Background: Intraosseous (IO) access has been shown to be a useful and safe alternative to intravenous access during resuscitation; its early use has been recommended in the advanced trauma and cardiac life support guidelines. Anesthesiologists are often expected to bring expertise in vascular access and yet we identified a deficit in their education in this technique. The objective of this study was to determine the perception of an educational intervention to improve the knowledge about the use of IO access in anesthesia.

Methods: This was a prospective observational study. Learners were surveyed before and after an educational intervention that included a didactic lecture and a practical hands-on simulation session using a battery-powered IO needle driver in anatomical models. Learners were twenty first year anesthesia residents with no previous training in IO access. The survey used a number of Likert scales to evaluate knowledge about and willingness to use IO access during resuscitation.

Results: The survey response rate was 16(80%) and 11(55%) for the before and after educational session respectively. Close to all the residents (94%) agreed that IO skills should be part of anesthesia residency training. After attending the educational session more residents were able to describe the indications for IO access (90% vs. 38%), more residents were able to describe the equipment needed to place an IO (82% vs 38%). In addition, having the opportunity to perform hands-on IO insertion in anatomical models improved the knowledge about the steps to insert an IO increasing the number of residents able to describe it (91% vs 19%) as well as locating the anatomical sites for IO insertion (91% vs 31%). Following the educational intervention a large proportion of residents expressed they would move to an IO insertion earlier (82% vs 31%)

Conclusions: Incorporating an educational session for IO insertion to the junior anesthesia resident’s curriculum can improve the understanding of this technique that is crucial in resuscitation situations and it is recommended by the advanced trauma and cardiac life support guidelines. After the implementation of the educational intervention the number of residents that were familiar with the IO procedure and indications increased. Further and larger studies would be needed to explore how this knowledge translates into clinical practice outcomes. Further sessions are planned to extend this program to other learner groups.
B14 • Lidocaine preloaded in the ETT cuff reduces emergence cough

Papu Nath, Stephan Williams, Luis Herrera, Monique Ruel, Nathalie Massicotte
The Hospital for Sick Children

Background: Alkalinized lidocaine in the endotracheal tube (ETT) cuff decreases the incidence of cough and throat pain on emergence after surgery lasting more than two hours. However, as alkalinized lidocaine needs 90-120 minutes to cross the ETT cuff membrane, its usefulness in shorter duration surgery is unknown. This prospective double-blind RCT tested the hypothesis that prefilling ETT cuffs with alkalinized lidocaine > 90 minutes before intubation would reduce the incidence of emergence cough after surgeries lasting less than 120 minutes.

Methods: After local Ethics Board approval, 200 ASA I-III patients consented to be randomized into one of two groups receiving either alkalinized lidocaine (group AL) or saline (group S) to inflate the ETT cuff. Cuffs were prefilled > 90 minutes before intubation with either 2 ml of 2% lidocaine and 8 ml of 8.4% bicarbonate (group AL) or 10 ml of normal saline (group S). Cuffs were emptied immediately before intubation. After intubation, either 2 ml of 2% lidocaine (AL) or 2 ml of saline (S) were injected into the cuff. Additional 8.4% bicarbonate (AL) or saline (S) was injected into the cuff until there was no air leak. Anesthesia was maintained using desflurane, rocuronium and either fentanyl or sufentanil in order to maintain vital signs within 20% of baseline values. Opioids administered in prophylaxis of extubation cough were proscribed. A standardized “no touch” emergence technique was used. A blinded assessor noted any cough above 0.2 MAC of expired desflurane. At 0.2 MAC, once every 30 seconds, the patient was instructed to open his eyes and extubation occurred once a directed response was noted. Sample size calculation was based on a local incidence of emergence cough of 30%. One hundred patients per group were necessary to detect an absolute 15% reduction in cough in the AL group (power: 80%; alpha 5%). Results were assessed using Student’s t test and Fisher’s Exact test as appropriate. Logistic regression with the Lack of Fit P being reported evaluated the relation between cough and continuous variables.

Results: The total amount of opioids administered, ETT cuff pre-loading times, duration of surgery and extubation times were not significantly different. The incidence of extubation cough in group AL was 12%, significantly (p=0.04) lower than the 22% incidence in the saline group. Emergence cough was not significantly influenced by smoking (p=0.16) or the use of ACE inhibitors (p= 0.71). Fentanyl dosage was inversely correlated with the incidence of cough (p=0.01), while preloading time (P=0.67) and age (P=0.28) showed no significant correlation.

Conclusion: Preloading alkalinized lidocaine in the ETT cuff significantly decreased general anesthesia emergence cough after surgeries with an average duration of less than one hour.
**Background:** Deep brain stimulation (DBS) insertion involves the placement of electrodes into specific deep brain structures that are identified using stereotactic frame-based imaging, microelectrode recordings and macrostimulation of the awake patient. The electrodes are placed in the brain structures via burr holes while the patient is in the OR; for the procedure, the patient is given local anesthesia with monitored anesthesia care (MAC) or conscious sedation. The Leksell headframe used for stereotactic frame-based imaging remains in situ during the procedure. The frame provides limited access to the airway because it covers all or part of the mouth and nose and limits neck extension. There are currently no studies in the literature examining the ease of emergency airway management with the Leksell headframe in situ.

**Methods:** The study was approved by the local research ethics board. Twenty-six anesthesia-provider volunteers were recruited. A Leksell headframe was placed on a mannequin in the OR. The OR table was placed in a semi-sitting position (30 degrees) to simulate the standard surgical position. The anesthesia providers were asked to insert a #3 LMA with the Leksell headframe in situ. The OR table was then leveled. Next, anesthesia providers were asked to intubate the mannequin using DL and VL (CMAC®) with the Leksell headframe in situ. The anesthesia providers’ number of attempts and time to successful LMA insertion and intubation were recorded.

**Results:** A total of 26 volunteers participated in the study (6 residents, 11 fellows and 9 consultants). Ninety-six percent of participants (25/26) were able to insert the LMA on the 1st attempt. The average time to insert the LMA was 38 seconds (+/-13 seconds). Ninety-six percent of participants (25/26) were able to intubate the mannequin with DL on the first attempt. The average time to intubate the mannequin with DL was 59 seconds (+/- 23 seconds). All participants were able to intubate the mannequin on the 1st attempt using VL, and the average time taken to intubate was 56 seconds (+/- 29 seconds).

**Conclusions:** This study provides useful information for anesthesia providers about the ease of emergency airway management during surgery for DBS insertion in patients with a Leksell headframe in situ. It is the first study to report that LMA insertion and intubation with DL and VL can be performed with the Leksell headframe in situ.
B16 ● Anesthetic management for upper extremity Vascularized Composite Allotransplantation (VCA) surgery

Siaw May Leong, Anthony Short, Lavarnan Sivanathan, Atul Prabhu, Vincent Chan
UHN – Toronto Western Hospital

Background: Upper extremity transplantations are vascularized composite allografts which are composed of multiple tissues. More than 100 transplanted hand/upper extremities have been recorded globally and there have been extensive publications on surgical technique and immunomodulation. However, there are very few publications on its anesthetic management. The Pittsburgh Upper Extremity Transplant Anesthesiology Protocol developed from the United States’ largest cumulative single-center experience with upper extremity transplants, offers important guidelines and recommendations for the anesthetic management of upper extremity transplant recipients, addressing considerations in regional anesthesia strategies, effects of immunosuppressants, fluids & hemodynamic management, and intraoperative monitoring. We describe the anesthetic management for the first upper extremity transplantation in Canada, highlighting the unique challenges & anesthesia considerations in accordance to the procedural techniques & recipient’s factors.

Clinical Details: A 49 year old lady, with traumatic left forearm amputation 10 years prior, was accepted into our upper extremity transplantation program. A thorough preoperative assessment was undertaken considering the need for prolonged anesthesia, continuous brachial plexus blockade and possible massive blood transfusion. Intraoperative management was planned to optimize graft perfusion with a normovolemic state & decreased sanguineous viscosity, maintaining homeostasis, and preventing thrombi formation. An infraclavicular brachial plexus catheter was utilized to provide sympatholysis and analgesia. Due vigilance was undertaken in this prolonged surgery of 17 hours noting the multiple surgical steps from preparation of the recipient’s stump, bone fixation and anastomoses of arteries, veins, tendons, muscles, nerves & soft tissues. We had in place invasive continuous measurements of hemodynamic parameters including FloTrac cardiac output monitor, patient’s temperature maintenance, measures to prevent pressure injuries & venous thromboembolism, and laboratory investigations were done at set intervals. Although we did not encounter massive blood loss, we faced challenges in fluid management & hemodynamic responses requiring albumin transfusion & low-dose dopamine infusion. Postoperatively, the patient was extubated and transferred to the intensive care unit. Analgesia was provided by means of continuous local anesthetic infusion via the infraclavicular catheter and oral analgesics.

Conclusions: We hope that this endeavor will spearhead further development of anesthesia guidelines in this logistically complex and evolving surgical endeavor involving potential for significant fluid shifts, coagulopathy & blood loss and ensuring optimal graft function.
Anesthetic management of narcolepsy patients during surgery: A systematic review

Sally Hu, Mandeep Singh, Jean Wong, Frances Chung
UHN – Toronto Western Hospital

Background: Narcolepsy is characterized by excessive daytime sleepiness, hypnagogic hallucinations, sleep paralysis, and cataplexy, and is evaluated by overnight and daytime sleep studies. Perioperative considerations include increased sensitivity to anesthetic agents, delayed recovery from anesthesia, increased risk of postoperative respiratory failure, and status cataplecticus. The objective of this systematic review was to summarize current evidence on the anesthetic consideration for narcolepsy patients as such reviews are lacking.

Method: Electronic literature search of Medline, Medline In-Process, Embase, Cochrane Database of Systematic Reviews databases, international conference proceedings and abstracts was conducted. Inclusion criteria included case studies/series, cohort studies and randomized controlled trials of narcolepsy patients undergoing surgical procedures under anesthesia or sedation. Outcome measures included preoperative narcolepsy symptoms and sleep study data, anesthetic technique, and perioperative complications. Screening of included articles, data extraction and summarization were conducted by two independent reviewers.

Results: Our search generated 3757 articles, of which 25 studies (20 case reports, 2 case series, and 3 retrospective cohort studies) met the inclusion criteria. In these studies, 31 patients undergoing non-obstetric procedures and 82 cases of C-sections were described. There were no randomized controlled trials. Pre-op narcolepsy medications, type of surgery, anesthetic information, intra and postoperative complications were summarized (Table 1). Pre-op objective sleep study data was provided in only 2 case reports. Narcolepsy medications were continued preoperatively in majority (81%) of the procedures. Regional anesthetic techniques were used for obstetric procedures predominantly. In the non-obstetric procedures, general anesthesia (GA) was used for most cases. Reported anesthetic complications were few, including hypertension (n=2), hypotension (n=3), bradycardia (n=1), sleep paralysis (n=1), cataplexy (n=4), and respiratory depression (n=2).

Conclusion: Our review shows that GA and regional anesthesia are generally safe for narcolepsy patients undergoing surgery. Our review reveals a lack of clinical trials on the anesthetic management of narcolepsy patients. Further studies should include preoperative sleep study data to objectively define the peri-operative risk in this special patient population.

Table 1. Brief Summary of Studies. General Anesthesia (GA). Caesarian-section (C-section).

<table>
<thead>
<tr>
<th>Author (year)</th>
<th>Study Design</th>
<th>Number of Patients</th>
<th>Pre-op Narcolepsy Medications</th>
<th>Type of Surgical Procedure</th>
<th>Type of Anesthesia</th>
<th>Intraoperative and Postoperative Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamekura (2014)</td>
<td>Case report</td>
<td>1</td>
<td>Modafinil; Methylphenidate</td>
<td>Open repair and fracture fixation with metal plating</td>
<td>GA</td>
<td>-</td>
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<tr>
<td>Mesa</td>
<td>Case</td>
<td>1</td>
<td>Dextroamphetamine</td>
<td>Open surgery – thigh</td>
<td>GA</td>
<td></td>
</tr>
<tr>
<td>Reference</td>
<td>Type</td>
<td>Authors</td>
<td>Year</td>
<td>Patients</td>
<td>Medication(s)</td>
<td>Procedure</td>
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<tr>
<td>--------------------</td>
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<td>--------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
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<tr>
<td>Staikou (2007)</td>
<td>Case report</td>
<td>Caffeine</td>
<td>1</td>
<td>-</td>
<td>Laparoscopic cholecystectomy</td>
<td>GA</td>
</tr>
<tr>
<td>Morimoto (2011)</td>
<td>Case report</td>
<td>Modafinil</td>
<td>1</td>
<td>-</td>
<td>Endoscopic sinus surgery</td>
<td>GA</td>
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<tr>
<td>Fam (2015)</td>
<td>Case report</td>
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<td>1</td>
<td>-</td>
<td>Right parietal tumour resection</td>
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<tr>
<td>Goald (1968)</td>
<td>Case report</td>
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<td>1</td>
<td>-</td>
<td>Lumbar subarachnoid fallopian shunt</td>
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<td>Nakano (1995)</td>
<td>Case report</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>Marsupialisation of arachnoid cyst</td>
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<td>Neustein (2009)</td>
<td>Case report</td>
<td>Methylphenidate</td>
<td>1</td>
<td>-</td>
<td>Laparoscopic ventral hernia repair</td>
<td>GA</td>
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<td>Ozkose (2007)</td>
<td>Case report</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>Bilateral breast reduction</td>
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<td>Pelaez (2004)</td>
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<td>Amphetamine; Modafinil; Clomipramine</td>
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<td>-</td>
<td>Quadruple coronary artery bypass grating</td>
<td>GA</td>
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<td>Spector (1977)</td>
<td>Case report</td>
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<td>1</td>
<td>-</td>
<td>Exploratory laparotomy and left ovarian cystectomy</td>
<td>GA</td>
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<td>Stoicica (2014)</td>
<td>Case series</td>
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<td>Number of Cases</td>
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<td>Type of Surgical Procedure</td>
<td>Type of Anesthesia</td>
<td>Intraoperative and Postoperative Complications</td>
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<td>Ajayi (2012)</td>
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<td>Clomipramine; Dexamphetamine</td>
<td>Elective C-section</td>
<td>Regional – spinal</td>
<td>-</td>
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<td>Case report</td>
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<td>–</td>
<td>Emergency C-section</td>
<td>-</td>
<td>Status cataplecticus during labour lasting 3 hours prior to emergency C-section</td>
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<tr>
<td>Honca (2013)</td>
<td>Case report</td>
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<td>–</td>
<td>Emergency C-section</td>
<td>GA</td>
<td>-</td>
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<td>Soltanifar (2010)</td>
<td>Case report</td>
<td>1</td>
<td>Fluoxetine; Modafinil</td>
<td>Elective C-section</td>
<td>Regional - Epidural</td>
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<td>Williams (2008)</td>
<td>Case report</td>
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<td>Elective C-section</td>
<td>Regional - spinal</td>
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<td>Maurovich-Horvat (2013)</td>
<td>Retrospective Cohort Study</td>
<td>3</td>
<td>–</td>
<td>Emergency or elective C-section</td>
<td>-</td>
<td>Cataplexy during delivery in 1 patient prior to C-section</td>
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**B18 • Effect of different surgical positions on the cerebral venous drainage: A pilot study on healthy volunteers**

**Tze Yeng Yeoh,** Audrey Tan, Pirjo Manninen, Vincent Chan, Lashmi Venkatraghavan  
UHN – Toronto Western Hospital

**Introduction:** Excessive neck flexion and rotation in different surgical positions may cause kinking of the internal jugular vein (IJV) and obstruct cerebral venous blood flow, potentially resulting in intracranial pressure elevation. Our objective was to measure the IJV flow and potential venous flow impediments in the supine, prone, and park bench positions in non-anesthetized volunteers.

**Methods:** After Institutional Research Ethics Board approval, we evaluated IJV flows bilaterally in awake adult volunteers placed in the supine, prone, and park bench positions. The venous flow rate was derived from ultrasound measurements of the vessel cross sectional area and flow velocity.
Results: Twenty-seven volunteers were recruited. A change from supine to prone position produced a significant increase in both jugular vein cross sectional areas without affecting the venous flows. In the right park bench position, the right IJV cross sectional area decreased from 1.2 cm² to 0.9 cm² (p = 0.027) without substantive changes in mean venous flow rate (p = 0.91), when compared to supine.

Conclusion: Careful positioning may prevent kinking of the jugular vein and cerebral venous flow obstruction in non-anesthetized adults. Further studies in anesthetized and ventilated neurosurgical patients are needed to validate these results.

C1 ● Tranexamic acid and post-operative seizures in patients suffering from kidney dysfunction and undergoing cardiac surgery

Justin Chan, Angela Jerath, Nikita Lobby, Barbara Bojko, Marcin Wasowicz
UHN – Toronto General Hospital

Background: Tranexamic acid (TXA) is an anti-fibrinolytic drug administered to patients undergoing cardiac surgery involving the use of cardiopulmonary bypass (CBP) to reduce perioperative bleeding. TXA is cleared predominantly by renal elimination. There is growing evidence demonstrating an association between high TXA plasma levels and post-operative, non-ischemic seizures. However, this hypothesis and the impact of renal dysfunction have never been addressed in a prospective study. Therefore, our aim was to prospectively detect the incidence of post-operative seizures in cardiac surgical patients with various levels of chronic renal dysfunction receiving TXA.

Methods: Following REB approval and after obtaining informed consent, we recruited 48 patients. Twenty-six patients received 50 mg/kg of TXA after induction of anesthesia (low-risk surgery). Twenty-two were administered TXA according to the BART protocol – 30 mg/kg loading dose after induction of anesthesia, followed by infusion of 16 mg/kg/hr throughout the surgery until sternal closure with an additional 2 mg/kg bolus given in the CPB pump prime (high-risk surgery). TXA levels were measured using solid-phase microextraction coupled with mass spectrometry.

Results: Four patients (8.3%) within the high-risk group had post-operative seizures. Mean (SD) age was 67.5 (10.7) years and 3 patients were male. Three patients seized on first post-operative day and 1 seized on the day of surgery. Mean (SD) peak TXA level was 249 (13.7) µg/mL. TXA levels remained elevated throughout the surgery and, in one patient, up to 48 hours post-operatively. Three patients had chronic kidney disease (CKD) stage 5 and 1 patient had CKD stage 3 (National Kidney Foundation). Mean (SD) creatinine was 485.00 (291.92) µmol/L at baseline, 330.75 (165.63) on POD 0, and 380.75 (177.70) on POD 1. CT and EEG results were available for 3 patients. CT scans revealed no evidence of acute intracranial processes and EEGs demonstrated non-epileptiform encephalopathy. In-hospital mortality was seen in 2 (50%) patients.

Conclusions: Our study has demonstrated that dosing of TXA according to the BART protocol results in high plasma levels of TXA. Levels were exceeding 2-3 fold the recommended level of 100 µg/mL required...
for 100% inhibition of fibrinolysis. High levels were the result of poor GFR in patients with renal dysfunction. Our model simulations previously conducted predicted TXA levels would be 3-4 times higher for patients with renal dysfunction. The results of this study will allow formulating a precise dosing scheme of TXA for patients suffering from kidney disease and undergoing cardiac surgery.

C2 ● Cardiac output monitoring in renal transplantation: Minimal change fluid administration with evidence of improved graft function

Davide Corbella, Jason Toppin, Rohan Kothari, Nour Ayach, Anand Ghanekar, Jeffrey Schiff, Stuart McCluskey
UHN – Toronto General Hospital

Background: Delayed graft function (DGF) is defined as the need for dialysis in the first week of renal transplantation (KTX) and is associated with an increased morbidity, mortality, length of stay, acute rejection and reduced long term graft function. Factors associated with DGF include patient characteristics, donor organ retrieval, and perioperative management i.e.intraoperative fluid therapy. Despite the risk of fluid overload there is a need to optimize the cardiac pre-load and therefore cardiac output/stroke volume (SV) to ensure early graft function. Esophageal Doppler Cardiac Monitor (EDCM) gives a reliable estimate of the patient SV and can be used to monitor preload requirements. This may allow for the safe administration of larger volumes of fluids without increasing the incidence of volume overload. The objective of this pilot study was to determine if EDCM could safely alter the volume of fluids administered in the operating room.

Method: This randomized, single-center, interventional clinical trial, IRB (FYI 11-0055-A) was conducted on consecutive, deceased donor renal transplant patients from (06/2013 to 07/2015). Written informed consent was obtained. Data collected included: demographic, length and type of dialysis; fluid type and volumes, stroke volume index (EDCM parameter); need for dialysis postoperative, creatinine level postoperative and on day 3 and 7, complications. All patients received the EDCM probe. At the start of each surgery, patients in the intervention group received intravenous boluses (500 ml) crystalloid until the SV was not increase (≥ 10%) by the fluid administrated. All patients were received a maintenance infusion of 2 ml/kg/hr. If the SV decreased by > 25% an additional fluid bolus (500 ml) was given to return the SV within 25% of the maximum SV. In the control group the anesthesiologist was blinded to data from EDCM and fluid therapy was based on clinical judgment.

Results: 50 patients were enrolled. No difference in baseline characteristics: age (51.6±16.1 vs 58.9±9.5, control vs intervention), sex (male/female: 12/12 vs 6/20), weight (75.8±18.4 vs 80.4±25.3), years on dialysis (5.0±3.3 vs 5.6±3.1), ASA Classification (III/IV: 3/21 vs 6/20). The volume of fluid administered was not different (37±14 ml/kg vs 32±11ml/kg, p=0.231), overall complications were similar (Y/N 15/9 vs 17/9, p=1.00), as DGF (8/16 vs 11/15, p=0.359), and postoperative serum creatinine concentrations were lower in the intervention group until discharge from hospital (Fig. 1).
**Conclusion:** This study failed to show a clinically relevant increase of fluid administration with the use of EDCM. However, EDCM based goal directed fluid management may improve renal function post transplantation.

Figure 1. Serum creatinine post renal transplant. Postoperative day (POD), Post Anesthetic Care Unit (PACU)

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**C3 • 3D printing of the aortic root from 3D transesophageal echocardiography imaging: A proof-of-concept**

*Maged Metias, Azad Mashari, Joshua Qua Hiansen, Matt Ratto, Tirone David, Massimiliano Meineri*  
UHN-Toronto General Hospital

**Background:** Three-dimensional *(3D) printing has slowly been employed as a surgical tool for prosthetic implants, surgical planning and creating educational models of pathology [1,2]. Several reports printing of aortic roots and congenital defects from CT scan have been recorded [3,4]. 3D intraoperative transesophageal echocardiography (TEE) is become standard of care in complex cardiac surgery. This study set out to create a 3D rendition of the aortic root from intraoperative 3D TEE for 3D printing.

**Methods:** 3D TEE images of the aortic root acquired intraoperatively during routine surgical operation at Toronto General Hospital from 2014 to 2016 were reviewed. Good quality datasets of five normal and five dilated Aortic Roots valves were selected. The 3D DICOM files were imported into Materialise MimicsTM software. Blood-filled areas were to create a 3D surface model. The blood model was imported into Materialise 3-maticTM where it was shelled out using thickness measurements of the aortic wall taken from the TEE images. The final result was post-processed and converted to a STL file. Finally, 3D slicrTM, a G-code generator for 3D printing was used and the final model was printed from in-house 3D printers.
**Results:** A rendition of 3D surface models of the aortic valve was successfully for all ten datasets. A dilated aortic root was directly printed using different 3D printing techniques (Fig. 1) on low-cost desktop 3D printers. We tested Poly Lactic Acid and Ninja-Flex on a fused deposition modelling 3D printer, Taz Lulzbot 5TM and photo-curable resin on a stereo-lithography printer Autodesk Ember TM. These materials captured good spatial resolution of complex anatomy but did not reproduce the physical human tissue characteristics. Commercial silicon was unsuccessfully tested using a 3D extruder. Aortic root was finally casted in silicon using a Poly vinyl acid dissolvable negative print. All printed models were deemed accurate by surgical experts.

**Conclusion:** We proved the feasibility of 3D printing of aortic root anatomy from 3D TEE data sets and on a wide range of materials using desktop 3D printers.

**References:**

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**C4 ● Perioperative critical incidents in pediatric anesthesia: A six-year review**

**Erika Nguyen**
The Hospital for Sick Children

**Background:** The rate of anesthesia-related critical events in pediatric anesthesia has been reported at 0.5 – 3.6%. However, most research to date is flawed as a consequence of exclusive focus on mortality and overreliance on voluntary reporting. This study examined perioperative critical events at SickKids Hospital PeriOperative Care Unit (POCU) from July 1st 2009 to June 30th 2015.
Methods: The Department of Anesthesia and Pain Medicine Quality Program collects data on all perioperative critical events. Whenever a situation develops in POCU, any healthcare provider can push an easily accessed button to obtain rapid assistance from nearby colleagues. REB approval was secured to analyze and present the data prospectively collected during each of these emergent scenarios.

Results: 77 469 procedures were performed in POCU. A total of 318 events (0.4%) triggered the internal code system, of which 68 events were excluded from this analysis. Critical events occurred at a rate of 3.2 per 1000 procedures. Table 1 demonstrates the contribution of ASA status urgency (elective or emergency) and age on critical events. In 84% of cases, the cause was of respiratory/airway nature with laryngospasms being the diagnosis in 36% of all cases. Most events (59%) occurred either during the emergence or the recovery phase of anesthesia and CPR was required in 13 of the 250 cases analyzed. Some specific procedures appear to confer additional risk. For microlaryngoscopies, cleft lip repairs, inguinal hernia repairs and laparoscopic pyloric stenosis repairs, the number of events per 1000 procedures were respectively 13.2, 15.3, 15.0 and 51.0.

Conclusion: Our findings confirm established knowledge that higher ASA class, age less than one month and emergency procedure are risk factors for experiencing a perioperative critical event. However, our analysis provides new knowledge on such factors as the phase of anesthesia where greatest risk lies, which procedures confer added risk, and where we might focus future resources and interventions in order to improve the safety of paediatric anesthesia at a time of increasing financial restriction.

Table 1

<table>
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<th>No. of Anesthetics (%)</th>
<th>No. of Critical Events (%)</th>
<th>Events per 1000</th>
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<tr>
<td>Total</td>
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<td>250</td>
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<tr>
<td>ASA Physical Status</td>
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<tr>
<td>ASA 1</td>
<td>31 028 (40.1)</td>
<td>71 (28.4)</td>
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</tr>
<tr>
<td>ASA 2</td>
<td>20 522 (26.5)</td>
<td>47 (18.8)</td>
<td>2.2</td>
</tr>
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<td>ASA 3</td>
<td>19 840 (25.6)</td>
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<td>3221 (4.2)</td>
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<td>ASA 5</td>
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<td>Age</td>
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<tr>
<td>&lt; 1 month</td>
<td>1509 (1.9)</td>
<td>27 (10.8)</td>
<td>17.9</td>
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<td>1 month – 1 year</td>
<td>8865 (11.4)</td>
<td>64 (25.6)</td>
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<td>1 year – 4 years</td>
<td>18 932 (24.4)</td>
<td>74 (29.6)</td>
<td>3.9</td>
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<td>4 years – 10 years</td>
<td>22 618 (29.2)</td>
<td>39 (15.6)</td>
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<td>10 years – 18 years</td>
<td>24 385 (31.5)</td>
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Table:

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<th>76 (30.4)</th>
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<tr>
<td>Induction</td>
<td>80 (32.0)</td>
<td>68 (27.2)</td>
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C5 • A randomized cross-over physiologic study of high flow nasal oxygen cannula versus non-invasive ventilation in adult patients with cystic fibrosis: The HIFEN Study

Michael Sklar, N. Rittayamai, M. Dres, M. Rauseo, B. West, E. Tullis, L. Brochard
St. Michael’s Hospital

Background: Non-invasive ventilation (NIV) is the first option for the treatment of cystic fibrosis (CF) patients with moderate-to-severe respiratory distress. High flow nasal oxygen cannula (HFNC) is a heated humidified, high flow oxygen delivery system that has demonstrated physiologic and clinical benefits in different patient groups. This device may also help CF patients with acute exacerbations to improve gas exchange and to reduce respiratory workload. We hypothesize that HFNC will not be inferior to NIV in CF patients requiring ventilator support.

Objectives: To compare the HFNC vs. NIV induced changes in diaphragmatic workload assessed by thickening fraction of the diaphragm (TFdi), gas exchange, respiratory variables, and hemodynamics.

Methods: REB approval was obtained at St. Michael's Hospital. CF patients requiring ventilator support were ventilated with HFNC and NIV for 30 minutes in random order. Work of breathing, as assessed by TFdi was measured using ultrasound at baseline, at 15 and 25 minutes during each device. Pulse oximetry (SpO2), transcutaneous CO2 (PtcCO2), respiratory rate (RR), tidal volume (Vt), minute ventilation (MV) as measured by bio-impedance techniques, hemodynamics, and level of dyspnea and comfort by visual analog scales were also recorded.

Results: Twelve patients were enrolled (mean age 31.3 years, 58% female, mean FEV1/FVC 49.9%, mean FEV1%predicted 28.4%). Results are expressed as mean (±SD) with each intervention compared to baseline conditions. HFNC resulted in a significant decrease in RR (-21.2% (±18.0) vs -0.2% (±18.7), p=0.0126) and in a significant increase in mean arterial pressure (MAP) (+5.7% (±4.8) vs 0.3% (±5.6), p=0.0175). No significant differences were found in heart rate, SpO2, PtcCO2, VT, MV, TFdi, comfort and dyspnea.
Conclusion: HFNC were not inferior to NIV with respect to diaphragmatic work of breathing in CF patients who had an indication for ventilator support. This preliminary data suggests that HFNC may confer physiological benefits of decreasing RR and increasing MAP compared to NIV, but larger trials are needed to corroborate these findings.

Figure 1: Representative Ultrasound Image of Diaphragm Thickening with Respiration. A- thickness at end inspiration, B- thickness at end expiration.

C6  ●  Astrocytes play a critical role in dexmedetomidine prevention of postanesthetic memory deficits

Fariya Mostafa, Dian-Shi Wang, Junhui Wang, Irene Lecker, Beverley A Orser
Sunnybrook Health Sciences Centre

Background: Increasing evidence suggests that general anesthetics contribute to postoperative cognitive deficits (POCD) and delirium. We recently showed that anesthetics trigger a sustained increase in the activity of γ-aminobutyric acid type A receptors (GABAARs) in neurons and this increase in current causes postanesthetic memory loss (JCI, 2014). Furthermore, anesthetics activate GABAARs in astrocytes to trigger the release of soluble factors that, in turn, increase the tonic current in neurons. Dexmedetomidine (Dex) is an alpha2-adrenergic receptor agonist that is commonly used as sedative in
the ICU. Dex reduces post-op delirium (Psychosomatics, 2009) and may prevent anesthetic-induced neurotoxicity (N Engl J Med., 2015). The goal of this study was to determine whether Dex prevents postanesthetic memory deficits by targeting alpha2-adrenergic receptors in astrocytes.

Methods: All studies were approved by the local ethics committee. Whole-cell voltage clamp methods were used to record from hippocampal neurons grown in neuron-astrocyte co-cultures or from neurons treated with astrocyte-conditioned medium (ACM). Tonic currents were recorded from neurons 24 h after treatment with ACM. Neuron-astrocyte co-cultures were treated with Etom + alpha2-adrenergic receptor agonist (clonidine, 100 µM) or antagonist (yohimbine, 5 µM). All data are expressed as mean ± SEM and were analyzed by ANOVA (p < 0.05).

Results: The tonic GABA current was increased by 180% in neurons with Etom treated-ACM (Control: 0.50 ± 0.052 pA/pF, Etom: 0.90 ± 0.08, n = 10); and this effect was prevented by co-treatment with Dex (Etom + Dex: 0.64 ± 0.06, n = 9). Etom + clonidine mimicked the effects of Dex in neuron-astrocyte co-cultures (Control: 0.90 ± 0.05 pA/pF, Etom: 1.51 ± 0.13 pA/pF, Etom + clonidine: 0.85 ± 0.12 pA/pF, n = 10-13), whereas yohimbine abolished the effects of Dex (Etom + Dex + yohimbine: 1.30 ± 0.17 pA/pF, n = 12).

Conclusions: Dex acts on alpha2-adrenergic receptors in astrocytes to prevent anesthetic-induced increase in tonic current. Studies are currently underway to determine whether Dex can be ‘repurposed’ as a strategy to reduce postanesthetic memory loss.

C7 ● The phenomics of chronic postsurgical pain following cardiac surgery

Michael Poon, Joel Katz, Ze’ev Seltzer, Vivek Rao, George Dijaini, Scott Beattie, Hance Clarke
UHN – Toronto General Hospital

Objective: It has been reported that up to 40% of patients develop chronic postsurgical pain following cardiac surgery. In this study, we sought to investigate the phenomic differences among patients that developed chronic pain post-cardiac surgery.

Methods: A REB-approved, cross-sectional phenomic study of post-cardiac surgery pain was conducted at Toronto General Hospital from 2011 to 2015. 634 patients consented to participate and completed a short survey that included pain scores and the short-form McGill Pain Questionnaire-2. Of these patients, 367 completed a longer series of 8 validated pain phenomics questionnaires. 207 patients completed psychophysical assessments (e.g., thermal QST, pressure algometry, cold pressor, thermal grill). Patients were stratified by chronic pain status and analyzed using descriptive statistics.

Results: Mean time post-surgery for the cohort was 41.5 weeks. 27.44% of patients reported chronic postsurgical pain. Patients reporting previous chronic pain were more likely to have chronic postsurgical pain. Of the 174 patients that reported chronic postsurgical pain 1% reported mild, 78% reported moderate, and 21% reported severe pain using a chronic pain index (CPI). These patients also reported significantly greater scores on phenomic scales and subscales for anxiety, fear, and pain catastrophizing across 8 validated questionnaires. Psychophysical assessments demonstrated lower forearm thermal
pain and sensory thresholds ($p < 0.036$), increased cold pressor pain rating ($p < 0.0013$), and lower baseline systolic vasoconstrictor inspiratory gasp ($p < 0.027$).

**Conclusions:** Phenotyping questionnaires and psychophysical tests directly correlate with the presence of chronic pain after cardiac surgery. This work will inform future genome-wide association studies on chronic postsurgical pain.

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**D1 ● The effect of gabapentin on delayed discharge from the post anesthesia care unit: a retrospective analysis**

_Amir Yousefzadeh, Naveed Siddiqui, Zeev Friedman, Maaz Yousuf, Farah Khan Choudhry_

_Mount Sinai Hospital_

**Background:** Enhanced Recovery After Surgery (ERAS) programs have incorporated gabapentin as a part of the multimodal analgesia protocol. The preemptive use of gabapentin was found to be beneficial due to its opioid sparing effect in the postoperative period. Since gabapentin was merged into the ERAS program at our hospital, a high incidence of sedation in the recovery room has been anecdotally observed. The objective of this audit was to examine the effect of gabapentin administration on delayed discharge from the PACU.

**Methods:** Following Research Ethics Board approval, we conducted a cross sectional retrospective analysis over a period of two months when we started ERAS program in our hospital. All patients who underwent elective surgical procedures, and required a longer than two hours stay in PACU, were included. In our institution, patients are discharged from the PACU within 2 hours, and two-hour mark is the most consistent definition for delayed PACU discharges. The use of preoperative gabapentin at two different dosages of 300mg and 600mg was noted. Prolonged PACU stays caused by pain, excessive sedation, ventilation inadequacy, nausea, vomiting and hemodynamic instability were also recorded. The data was collected from patients’ charts, and nursing flow sheets.

**Results:** A total of 808 patients were admitted to the PACU. Out of 294 patients eligible for recruitment, 6 patients were excluded because of missing data. For the purpose of analysis, all patients were grouped into 300mg gabapentin administration (n=108), 600 mg gabapentin administration (n=41), and no gabapentin administration (n=139). No significant difference was observed between the groups in terms of perioperative opioid consumption, ventilation inadequacy, nausea, vomiting and hemodynamic instability. Gabapentin administration groups had significantly lower postoperative pain scores ($p<0.001$). Postoperative pain was less severe in the 600-mg group, compared to 300-mg group ($p<0.001$). Excessive sedation was significantly higher in a dose related fashion in the gabapentin groups and led to a longer stay in PACU ($p<0.001$).

**Conclusion:** Preemptive use of gabapentin resulted in a dose related increase in sedation and delayed PACU discharges. Future studies are needed to evaluate the utility of gabapentin in ERAS protocols.
D2 ● Transitional pain service: Smoking is associated with more intense pain and a lower likelihood to wean from opioid medications after surgery

Janice Montbriand
UHN – Toronto General Hospital

**Background:** Smoking is associated with poorer outcomes for patients with chronic pain; less is known regarding smoking and postsurgical pain. We investigated the relationship between smoking, postsurgical pain and opioid use in Transitional Pain Service (TPS) patients within a median of 8 weeks of hospital discharge. This study was approved by the Toronto General Hospital Research Ethics Board.

**Methods:** Smoking status was abstracted from medical records. Pain (0-10 NRS), opioid use (morphine equivalents), and pain-interference (BPI) were collected as patients were followed by the TPS.

**Results:** Of the 186 participants, 27% were smokers (S), 39% were past smokers (PS) and 34% were never smokers (NS). Pack-years (log) correlated significantly with early outpatient pain scores (R=.22, p=.028; median: 21 days after discharge) even after controlling for preoperative chronic pain (B = .28, p=.045). ANOVA followed by post-hoc analyses indicated that numeric rating scale pain scores were higher (p=0.02) in smokers (6.2±2.1) versus non-smokers (4.7±2.3). Smokers had higher early outpatient pain-interference scores compared to non-smokers (p=.03). Male smokers used more opioids than female smokers (p=0.01) and more females than males were able to completely wean off opioids regardless of smoking status (p=0.02). Those who reduced opioid use to zero had significantly fewer pack-years than those still using opioids by their last time point (p=.04, 7.0 vs. 18.8 pack-years). Standardized residual change scores for opioid use were positively correlated with pack-years.

**Conclusion:** Smoking status and pack-years were related to greater postsurgical pain severity and more pain interference, and predicted less successful opioid weaning. Female smokers were more successful in opioid weaning than male smokers.


Luis Enrique Chaparro, Phil J. Wiffen, R. Andrew Moore, Ian Gilron
Sunnybrook Health Sciences Centre

**Introduction:** Pharmacotherapy is an important modality for the treatment of neuropathic pain (NP). Combining two or more different drugs may improve analgesic efficacy and, in some situations, reduce overall side effects. This is an update of a Cochrane review published in 2012.

**Methods:** We identified double blind, randomized controlled, trials (RCTs) of drug combinations for NP from CENTRAL, MEDLINE, EMBASE and hand-searches of other reviews and trial registries. The most recent search was performed on February 23 2016. Data extracted included: proportion of participants a) reporting ≥ 30% pain reduction from baseline OR ≥ moderate pain relief OR ≥ moderate global
improvement; b) dropping out of the trial due to treatment-emergent adverse effects; c) reporting each specific adverse effect of ≥ moderate severity. The primary comparison of interest was between study drug(s) and one or both single-agent comparators. We combined studies if they evaluated the same drug class combination at roughly similar doses and durations of treatment. We used RevMan 5.3 to analyse data.

**Results:** We identified and added 6 new studies to the 21 that were included in the original review: five trials (n: 837) evaluated the combination of an opioid with gabapentin or pregabalin; three (n: 116) evaluated an opioid with a tricyclic antidepressant (TCAs); two (n: 125) of TCAs with gabapentinoids; one (n: 290) of duloxetine and pregabalin; one (n: 15) of duloxetine and methadone; one (n: 15) of nabilone and gabapentin; one (n: 120) of gabapentin and alpha-lipoic acid, three (n: 90) of fluphenazine with a TCAs; three (n: 90) of an NMDA blocker with an agent from a different drug class; five (n: 604) of various topical medications; one (n: 313) of tramadol with acetaminophen; and another one (n: 44) of a cholecystokinin blocker with morphine. Most of combinations evaluated drugs that share some element of central nervous system (CNS) depression, which is reflected in similar or higher dropout rates for the combination. Most of the studies demonstrated superior efficacy of two-drug combinations over the other trial comparator(s).

**Conclusion:** The available studies for any one specific combination, as well as other study factors, preclude the recommendation of any combination for NP. We recommend for future studies of two-drug combinations include comparisons with placebo and both single-agent components. The development of non-sedating neuropathic pain agents could lead to the identification of more favorable analgesic drug combinations in which side effects are not compounded.

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**D4 ● Prevalence of post-thoracotomy pain syndrome in pediatric patients undergoing thoracic surgery: Retrospective chart review**

Baljoet Bhangoo, Suresh Thomas
The Hospital for Sick Children

**Introduction:** Post-thoracotomy pain syndrome is a well-documented medical diagnosis in the adult population and can affect about half of adults who undergo a thoracotomy. However, the incidence in the pediatric population is less well known and there is little research investigating the prevalence.

**Methods:** A retrospective chart review was conducted examining thoracotomy cases at the DMC Children’s Hospital of Michigan from 2000 to 2013. Inclusion criteria consisted of pediatric patients aged 0-18 who underwent a thoracic procedure/surgery that involved a thoracotomy. Patients with depression, other chronic pain conditions, anxiety, or developmentally delayed were excluded from the chart review. Hospital database was utilized to gather information only on patients who underwent thoracotomies. Anesthetic and surgical charts were obtained from electronic medical records, billing records, or hospital paper records. The following data was extracted from the medical records: age at surgery, sex, date of surgery, type of surgery, and presence of post-thoracotomy pain syndrome.
**Results:** The dates of surgery ranged from 2001 to 2013. Of the 141 thoracotomy cases that met criteria for the chart review, the mean age at time of surgery was 6.7 years old. There were 75 (53%) male patients and 66 (47%) female patients. Among the patients, 3/141 (2.1%) were diagnosed with post-thoracotomy pain syndrome.

**Conclusion:** Our study demonstrates the prevalence of chronic pain in the pediatric population post-thoracotomy to be significantly lower than the adult population. Approximately 2.1% of pediatric patients undergoing a thoracotomy are diagnosed with post-thoracotomy pain syndrome.

**References:**

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**D5 • Pain reductions associated with improvements in pain interference and depressive symptoms in patients of surgery receiving psychological services in the transitional pain service**

**Abid Azam,** Aliza Weinrib, Janice Montbriand, Hance Clarke, Joel Katz

UHN – Toronto General Hospital

**Aim:** The Toronto General Hospital Transitional Pain Service (TPS) uses interdisciplinary methods to help patients scheduled for major surgery manage pain before admission, while in hospital and after hospital discharge. We evaluated postsurgical patients (N=186, 105M, 81F, age=51.9 years, SD=14.7) based on usage of TPS psychological services.

**Methods:** Thirty-eight patients received multiple (2 or more) sessions, 35 patients received a single session comprising assessment only or assessment plus intervention, and 113 patients did not receive psychological services. Patients completed an 11-point pain intensity NRS, the BPI, and the HADS-Depression (D) subscale at post-hospital discharge TPS visits. Residualized change scores were calculated for NRS pain, BPI, and HADS-D using in-hospital postoperative values and values at the last TPS visit. Pearson correlations were calculated among residualized pain scores, BPI, and HADS-D scores. Type I error rate was set at $\alpha<0.016$ to adjust for multiple comparisons. This study was approved by the University Health Network Coordinated Approval Process for Clinical Research; there was no financial compensation for participants. Data were collected, maintained and analyzed by the Pain Research Unit at the Toronto General Hospital, Toronto, Canada.

**Results:** Complete data were available for n=17 multiple session users, n=8 single session users, and n=13 non-users. Change in NRS pain was significantly positively correlated with change in BPI ($r=0.742$, $p=0.001$) and HADS-D ($r=0.662$, $p=0.004$) as was change in BPI and change in HADS-D ($r=0.629$, $p=0.007$) for multiple session users but not the other groups.
**Conclusion:** TPS patients who received multiple sessions of psychological services showed reductions in pain that were associated with improvements in pain interference and depression scores. Preliminary results support the usefulness of TPS psychological services for complex patients after surgery but more rigorous evaluation is needed to confirm these initial results.

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**D6  ●  Chronic post-surgical pain and persistent opioid use following surgery: The need for a transitional pain service**

**Howard Meng**, Alexander Huang, Abid Azam, Salima Ladak, Aliza Weinrib, Joel Katz, Hance Clarke  
UHN-Toronto General Hospital

**Background:** As many as 50% of surgical patients develop chronic post-surgical pain (CPSP) and a subset of these patients are at an increased risk for persistent opioid use. In Ontario, Canada, our data demonstrates that almost 50% of patients who had undergone a major surgical procedure are discharged with an opioid prescription. Furthermore, 3.1% of post-surgical patients who were opioid-naïve remained on an opioid medication 3 months after hospital discharge. CPSP can persist beyond one year after surgery and has significant impact on quality of life and patient well-being.

**Objectives:** To identify the 3-month incidence of chronic post-surgical pain and long-term opioid use in patients at the Toronto General Hospital. Secondary objectives included evaluation of pain disability, quality of life measurements and overall patient satisfaction with their pain management while in hospital and after hospital discharge.

**Methods:** This study was approved by the Toronto General Hospital Research Ethics Board (REB# 13-6892-AE). This was a single center study that enrolled two hundred consecutive patients presenting for elective major surgery. Patients completed standardized questionnaires by telephone at 3 months after surgery. Validated pain disability, quality of life measurements and overall patient satisfaction scores were collected in addition to demographic and surgical data.

**Results:** Fifty-one patients enrolled reported a preoperative pain condition, with 12 taking opioids preoperatively. Three months after surgery, 35% of patients reported having surgical site pain and 13.5% continued to use opioids for post-surgical pain relief. Postoperative opioid use was associated with interference with walking and work, and lower mood.

**Conclusions:** Chronic post-surgical pain and ongoing opioid use are concerns that warrant the implementation of a Transitional Pain Service to modify the pain trajectories and enable effective opioid weaning following major surgery.

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**D7  ●  Agreement in cardiac index monitoring during orthotopic liver transplantation: a comparison of Flotrac/Vigileo at two monitoring sites with pulmonary artery catheter thermodilution**

**Matthew Lee, L Weinberg, B Pearce, N Scurrah, DA Story, P Pillai, PR McCall, PL McNicol, PJ Peyton**  
St. Michael’s Hospital
**Aim:** We studied agreement between radial and femoral arterial pulse contour derived cardiac index measurements and pulmonary artery catheter bolus thermodilution derived cardiac index measurements to assess whether measurement devices and arterial cannulation sites are interchangeable in adults undergoing orthotopic liver transplantation.

**Methods:** 25 patients were enrolled. Radial and femoral arteries were cannulated with a standardised Flotrac/Vigileo arterial transducer kit. Cardiac index and stroke volume variation were measured at four time points. Agreement was assessed by the method of Bland and Altman. Acceptable agreement for cardiac index was a percentage error ≤30% per the standard of Critchley and Critchley.

**Results:** Neither radial nor femoral pulse contour derived cardiac index had good agreement with bolus thermodilution cardiac index. There was poor agreement in cardiac index between radial and femoral arterial cannulation sites. Agreement between radial and femoral stroke volume variation was marginally acceptable.

<table>
<thead>
<tr>
<th></th>
<th>Mean Difference (L/min/m^2)</th>
<th>Standard deviation (L/min/m^2)</th>
<th>Limits of agreement (L/min/m^2)</th>
<th>Percentage error (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI rad-fem</td>
<td>-0.43</td>
<td>1.51</td>
<td>-3.39 – 2.53</td>
<td>70.4</td>
</tr>
<tr>
<td>CI rad-PAC</td>
<td>-1.17</td>
<td>1.49</td>
<td>-4.09 – 1.75</td>
<td>64.4</td>
</tr>
<tr>
<td>CI fem-PAC</td>
<td>-0.71</td>
<td>1.81</td>
<td>-4.26 – 2.84</td>
<td>74.2</td>
</tr>
<tr>
<td>SVV rad-fem</td>
<td>0.68%</td>
<td>2.44%</td>
<td>-4.10 – 5.46%</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion:** For adults undergoing liver transplantation, FloTrac/Vigileo derived cardiac index cannot substitute for pulmonary artery catheter thermodilution cardiac index, regardless of measurement site in this population. Stroke volume variation measurements may be interchangeable between radial and femoral sites for determining fluid responsiveness.

**D8 ● Massive Transfusion Protocol: Does it translate into improved outcomes in postpartum hemorrhage? A cohort study**

**Thiago Ribeiro, Stephen Halpern, Jeannie Callum, Charles Knapp, Andrea Hards**
Sunnybrook Health Sciences Centre

**Background:** Over the past decade, Massive Transfusion Protocols (MTP) have been developed and proposed to advance the severe postpartum hemorrhage (PPH) management. MTPs goal is to synchronize surgical, anesthesia, laboratory and blood bank responses in an immediate and sustainable manner. The MTPs clinical impact in obstetrics is yet to be determined. This study was undertaken to compare the massive transfusion management and clinical outcomes in a labor and delivery unit where MTP is implemented (MTP+) to a labor and delivery unit where no MTP is implemented (MTP-).

**Methods:** After obtaining Local REBs approval, Health Record archives of two centres were approached to identify all patients that required at least 5 units of RBC transfusion in the first 24h after delivery. In
one centre, there was a specific obstetrical MTP implemented (MTP+) and in the MTP- centre, no MTP was in place. The sampling method was a convenient one including all consecutive obstetric patients between Sep2010 and Jan2015.

Demographic, Obstetrical, management data (hysterectomy, tranexamic acid usage, transfusion profile number of units and FFP:RBC ratio) and outcomes (48h survival; mechanical ventilation, length of stay in ICU and hospital; sepsis, acute renal failure; acute respiratory distress syndrome and multiple organ failure) were extracted retrospectively from patient hospital records.

Statistical analysis: Student t and Chi-square tests were applied when appropriate (SPSS V20 package; statistical significance at P<0.05).

**Results:** The results are presented in Table 1. The 48h survival was 100% in both centres.

**Conclusion:** The frequency of tranexamic acid administration was significantly higher in the MTP+ centre (P=0.003). Of note, both centres presented low FFP:RBC transfusion ratio (below 0.5). In the MTP+ centre patients stayed longer in hospital but shorter in ICU (P=0.008 and P<0.001, respectively). As it is a retrospective study, reporting bias and confounding factors cannot be ignored. Massive Transfusion in Obstetric is an important but rare event. Larger multicentre studies are warranted to determine the MTP clinical impact in obstetrical settings.

Table 1. Demographic, obstetrical, management and outcomes data (mean± standard deviation/frequencies and percentages)

<table>
<thead>
<tr>
<th></th>
<th>MTP+</th>
<th>MTP-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal age (years)</td>
<td>30±7.5</td>
<td>31.1±7.8</td>
</tr>
<tr>
<td>Primipara</td>
<td>12 (57.1%)</td>
<td>9 (45%)</td>
</tr>
<tr>
<td>BMI (Kg/cm²)</td>
<td>28.03±4.5</td>
<td>26.97±3.9</td>
</tr>
<tr>
<td>Induced Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe Pregnancy</td>
<td>1 (4.8%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Cesarea delivery</td>
<td>10 (47.6%)</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>Induction of labor</td>
<td>6 (28.6%)</td>
<td>7 (35%)</td>
</tr>
<tr>
<td>Abnormal placentation</td>
<td>6 (28.6%)</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>Placental abruptio</td>
<td>4 (19%)</td>
<td>3 (15%)</td>
</tr>
<tr>
<td>Chorioamnionitis</td>
<td>2 (9.5%)</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>Obstetrical Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APH (antenat partum hemorrhage)</td>
<td>10 (47.6%)</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>Cesarea delivery</td>
<td>10 (47.6%)</td>
<td>15 (75%)</td>
</tr>
<tr>
<td>Induction of labor</td>
<td>6 (28.6%)</td>
<td>7 (35%)</td>
</tr>
<tr>
<td>Abnormal placentation</td>
<td>6 (28.6%)</td>
<td>5 (25%)</td>
</tr>
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<td>4 (19%)</td>
<td>3 (15%)</td>
</tr>
<tr>
<td>Chorioamnionitis</td>
<td>2 (9.5%)</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>Management Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tranexamic acid</td>
<td>12 (57.1%)</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>24h- RBC (units)</td>
<td>9.05±4.15</td>
<td>10.45±3.73</td>
</tr>
<tr>
<td>24h- FFP (units)</td>
<td>6.40±4.29</td>
<td>4.26±2.28</td>
</tr>
<tr>
<td>24h- Platelet units</td>
<td>2.07±1.14</td>
<td>1.15±0.67</td>
</tr>
<tr>
<td>FFP:RBC ratio</td>
<td>0.41±0.34</td>
<td>0.38±0.17</td>
</tr>
<tr>
<td>Mechanical ventilation (hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.75±8.78</td>
<td>13.53±9.55</td>
<td></td>
</tr>
<tr>
<td>LOS ICU (hours)</td>
<td>23.38±10.4</td>
<td>42.85±19.41</td>
</tr>
<tr>
<td>LOS Hospital (days)</td>
<td>12.57±13.39</td>
<td>7.65±4.68</td>
</tr>
<tr>
<td>Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td>0 (10%)</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>0 (5%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>ARDS</td>
<td>0 (5%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>MOF</td>
<td>0 (5%)</td>
<td>1 (5%)</td>
</tr>
</tbody>
</table>

APH = antepartum hemorrhage; 24h = transfusion within 24 hours after delivery; LOS = length of stay; ARDS = acute respiratory distress syndrome; MOF = multiple organ failure

D9 ● Respiratory complications following posterior occipitocervical spine fusion

Veena Sheshadri, Rebecca Moga, Pirjo Manninen, Lashmi VenkatRaghavan
UHN – Toronto Western Hospital

Background: The management of the airway may be challenging in patients undergoing occipitocervical spine fusions (OCF). Limited information is available regarding the incidence, severity, the mechanism, and the risk factors for postoperative airway complications after OCF. Changes in the occipitocervical angle (dOC2A) of fusion after surgery may result in acute airway obstruction, dyspnea and/or dysphagia.1,2 The aim of this study was to determine the incidence, nature, and risk factors for
postoperative airway complications in patients undergoing OCF and to determine the relationship between the dOC2A and airway complications.

**Methods:** After REB approval, we retrospectively reviewed the charts of all patients who underwent OCF from 2005-2013. We excluded patients who had combined anterior/posterior or revision surgeries and those already intubated or with tracheostomy. Data collected included patient demographics, airway management, anesthesia and surgical data, and postoperative complications. Plain lateral radiographs or computed tomography were used to measure the dOC2A. Immediate postoperative airway complications included in the analysis were the need for reintubation and the delay of extubation in the operating room. Delayed complications were tracheostomy, pneumonia and mortality.

**Results:** Records of 59 patients were reviewed. Common indications for surgery included degenerative, rheumatoid arthritis, metastases and fracture. Following extubation in the operating room (OR), there were no complications in 43 (73%) patients (Group 1). Airway complications were seen in 16 (27%) patients (Group 2); 4 patients required reintubation (2 in the OR, 2 in post anesthetic care unit), and 12 had delayed extubation and were taken to the intensive care unit intubated. The number of vertebral levels fused, presence of difficult intubation and duration of surgery were significantly associated with airway complications. There was no significant difference in the dOC2A between the groups (-1.070±5.527 versus -4.375±10.788, p=0.127).

**Conclusion:** Airway management in patients undergoing OCF poses a challenge for anesthesiologists. The incidence of airway complications was 27%. The decision to extubate needs to be individualized, and factors such as difficult intubation, number of vertebral levels fused and the duration of the surgery has to be considered. We could not find a significant correlation between dOC2A and postoperative airway complications. The risk factors for postoperative airway complications are multifactorial and there is a need for prospective study to identify the risk factors.


Figure 1: Measurement of Occipitocervical angle. The OC2 angle was defined as the angle between McGregor’s line and the line parallel to the inferior end plate of C2. Mc Gregor’s line is the posterolateral aspect of the hard palate to the most caudal point on the midline occipital curve. The difference in the OC2 angle (dOC2A) was defined as follows: dOC2A = postoperative OC2 angle - preoperative OC2 angle
Table 1: Demography and baseline data

<table>
<thead>
<tr>
<th></th>
<th>No complications</th>
<th>Complication</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs) (mean±SD)</td>
<td>65.11±13.7</td>
<td>57.69±15.73</td>
<td>0.08</td>
</tr>
<tr>
<td>M: F (n)</td>
<td>22:21</td>
<td>10:6</td>
<td>0.333</td>
</tr>
<tr>
<td>Levels of vertebrae (n) ≤6</td>
<td>29</td>
<td>5</td>
<td>0.012*</td>
</tr>
<tr>
<td>Levels of vertebrae (n) &gt;6</td>
<td>14</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Duration of Surgery (min) (mean±SD)</td>
<td>333.87±83</td>
<td>493.12±138.11</td>
<td>0.0001*</td>
</tr>
<tr>
<td>Estimated blood loss (ml) (mean±SD)</td>
<td>726.97±1085.29</td>
<td>772.18±584.94</td>
<td>0.875</td>
</tr>
<tr>
<td>Fluid intake (ml) (mean±SD)</td>
<td>3927.30±1654.25</td>
<td>4572.5±1666.42</td>
<td>0.195</td>
</tr>
<tr>
<td>Difficult Intubation (n)</td>
<td>4</td>
<td>8</td>
<td>0.002 *</td>
</tr>
</tbody>
</table>

* p<0.05

Table 2: Morphological Measurements

<table>
<thead>
<tr>
<th>Occipitocervical angle (OC2A)</th>
<th>No complications</th>
<th>Complications</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative OC2A (mean±SD)</td>
<td>14.512±10.079</td>
<td>20.375±16.268</td>
<td>0.193</td>
</tr>
<tr>
<td>Postoperative OC2A (mean±SD)</td>
<td>13.442±8.370</td>
<td>16±17.859</td>
<td>0.633</td>
</tr>
<tr>
<td>Differences in OC2A (mean ±SD)</td>
<td>-1.070±5.527</td>
<td>-4.375±10.788</td>
<td>0.127</td>
</tr>
</tbody>
</table>
D10 ● Bleeding complications in post-percutaneous coronary intervention patients having non-cardiac surgery: a prospective cohort study

Deep Grewal, M Wąsowicz, S Syed, DN Wijeysundera1, Ł Starzyk, T Ragoonanan, P Harsha, J Carroll, K Karkouti, WS Beattie
UHN – Toronto General Hospital

Introduction: Patients who have undergone percutaneous coronary intervention (PCI) and require non-cardiac surgery (NCS) pose a significant challenge to anesthesiologists and perioperative physicians (1). Bleeding complications due to peri-operative anticoagulation management (DVT prophylaxis or a bridging strategy) in patients with a requirement for antiplatelet therapy is poorly understood. Therefore, the aim of this prospective cohort study on post-PCI patients undergoing NCS was to analyze: (1) the role of peri-operative risk factors in prediction of bleeding complications and (2) the impact of anti-platelet and anti-coagulation management on postoperative bleeding complications.

Methods: With REB approval and written informed consent, 201 post-PCI patients scheduled for NCS were enrolled in the study. Their anti-platelet therapy was continued in the preoperative period and resumed after surgery. If anti-platelet therapy could not be continued bridging therapy was introduced, as per American College of Cardiology/American Heart Association Guidelines. We analyzed the following outcomes: (1) Incidence of major bleeding defined as transfusion requirements of more than 2 units of red blood cells (RBC) or blood loss exceeding 1000 cc during the perioperative period. (2) Association between anticoagulation management and postoperative bleeding (3) Association between perioperative bleeding and major adverse cardiac events (MACE) defined as perioperative MI, exacerbation of congestive heart failure or death.

Results: Excessive blood loss was seen in 25 (12.4%) patients. Major transfusions occurred in 34 (17%) patients. Clinically important bleeding was seen in 66 patients; 29 of these patients experienced MACE. There was no association with adequate platelet inhibition and clinically important bleeding. We found that there was significant post-operative bleeding in patients who received low molecular weight heparin (LMWH). Our analysis found that LMWH therapy resulted in 3-fold risk of clinically important bleeding.

Conclusion: The incidence of clinically important bleeding is a common complication (15%) in post-PCI patients undergoing NCS and is associated with MACE. Post-operative therapy with LMWH in this patient population is also associated with significant risk of bleeding.
Defining Outcomes for perioperative bleeding and transfusion for the Standardized Endpoints for Perioperative Medicine (StEP) collaborative: A scoping review

Justyna Bartoszko, Leon Vorobeichik, Duminda Wijeysundera
UHN – Toronto General Hospital

Background: ‘Standardized Endpoints for Perioperative Medicine’ (StEP) is an international collaboration tasked with developing consistent consensus-based criteria for outcomes in perioperative clinical trials. Existing inconsistency makes interpretation of trial results more difficult, especially in the presence of conflicting evidence. Furthermore, it impedes effective evidence synthesis and meta-analyses. The goals of StEP are to define clinically meaningful definitions across a broad range of clinical outcomes, and specify standards for outcome reporting to be used in clinical trials. We report the progress of a scoping review to inform the Transfusion and Blood Loss subgroup in StEP, which will focus on defining outcomes for clinically important bleeding and transfusion in surgical patients.

Methods: We undertook a scoping review using a widely used framework to address 3 objectives: (1) identify definitions of significant blood loss used in large perioperative randomized trials (≥500 patients); (2) identify consensus definitions for significant blood loss in perioperative medicine and related fields; and (3) describe the association between blood loss or transfusion with patient outcomes in previous perioperative studies. Electronic database searches were conducted using Medline, Embase, and others specific to each search. Across all searches, 18,763 unique articles were identified. Two independent reviewers then conducted a multi-stage article selection process, after which 443 articles were chosen for data extraction (1, 2).

Results: The search identified 23 unique and applicable consensus definitions for clinically important blood loss in a broad range of medical specialties. By comparison, many perioperative trials used inconsistent and ambiguous outcome definitions. Nonetheless, these definitions can be grouped into 9 categories with common components, of which 6 are similar to consensus definitions from other fields. Elements from the International Society on Thrombosis and Hemostasis (ISTH) and European Medicines Agency (EMEA) definitions were widely used (3,4). A total of 133 studies were identified which evaluated the association between bleeding or transfusion with clinically important outcomes in perioperative patients.

Conclusion: The mapping of a broad quantity of literature will be used to inform the decision-making process for an international panel of experts within the Blood Loss and Transfusion subgroup of StEP. Candidate outcomes will be shortlisted, and a Delphi process will be conducted to develop standards for the reporting of blood loss and transfusion in perioperative clinical trials.

References:
Postoperative outcomes in obstructive sleep apnea patients undergoing cardiac surgery: A meta-analysis of comparative studies

George Ho, Mahesh Nagappa*, Jean Wong, Roop Kaw, Davy Cheng*, Frances Chung
UHN – Toronto Western Hospital

Background: Obstructive sleep apnea (OSA) is a common co-morbidity in patients undergoing cardiac surgical procedures and may predispose patients to postoperative complications (1). The objective of this meta-analysis is to determine the evidence of postoperative complications associated with OSA patients undergoing cardiac surgery.

Methods: A literature search of Medline, Medline In-process, Web of Science, Scopus, EMBASE, Cochrane Database of Systematic Reviews, and Cochrane Central Register of Controlled Trials, and CINAHL up to March 2016 was conducted. The search was restricted to cohort controlled studies in adult patients who were diagnosed with OSA or screened as at high risk for OSA undergoing cardiac surgery. All included studies in the English language must report at least one postoperative complication. Studies of OSA patients with upper airway surgery were excluded. The postoperative outcomes included atrial fibrillation, re-intubation, myocardial infarction, cardiac arrest, intensive care unit (ICU) transfer, and length of hospital and ICU stay. The analysis was planned in accordance with the MOOSE (Meta-analysis Of Observational Studies in Epidemiology) guideline for nonrandomized studies (2). Statistical analysis was conducted using Review Manager 5.3.

Results: Eleven comparative studies were included in the final analysis (n=1820). OSA was associated with significantly higher odds ratio of postoperative adverse events (OSA vs. Non-OSA: 37.39% vs. 26.06%; OR 2.36; 95% CI: 1.68 – 3.31, P < 0.00001; Heterogeneity I² = 23%, P = 0.22), atrial fibrillation (OSA vs. Non-OSA: 34.35% vs. 30.81%; OR 2.08; 95% CI: 1.22 – 3.56, P = 0.008; I² = 56%, P = 0.04), and death (OSA vs. Non-OSA: 3.81% vs. 1.41%; OR 3.04; 95% CI: 1.21 – 7.60, P = 0.02; I² = 15%, P = 0.32). ICU length of stay (Mean Difference 0.41 day; 95% CI: -0.08 – 0.90, P = 0.10) and hospital length of stay (MD 0.34 day; 95% CI: -0.30 – 0.98, P = 0.30) was not different.

Conclusion: This study demonstrated that the incidence of postoperative adverse events, atrial fibrillation and death were higher in OSA patients undergoing cardiac surgery.

References:
Increasing uptake of cognitive aids in paediatric operating room critical events

Asad Siddiqui, Elaine Ng
The Hospital for Sick Children

Background: Crises in the operating room (OR) during a pediatric case are fortunately rare with the incidence of cardiac arrest in non-cardiac patients being 2.7/10000 [1]. This rarity means that increasingly few anesthesiologists can claim personal experience of the full range of potential OR emergencies. In order to address this, the Society for Pediatric Anesthesia developed cognitive aids in the form of Critical Event Checklists (SPA CECs). Several studies have demonstrated the benefit of cognitive aids in improving adherence to guidelines, performing critical tasks and improved Anesthesia Non-Technical Skills [2,3]. However, despite the presence of cognitive aids, individuals often do not use the aids frequently or use them incorrectly [4,5]. The way that trainees utilize cognitive aids can potentially be augmented through improved education/orientation surrounding the tool. The objective of the study was to investigate whether the presence of SPA CECs improve the performance of anesthesiology trainees during simulations and whether the mode of orientation (e-module vs. didactic) results in improved uptake of the cognitive aids.

Methods: REB approval was attained from the local institution. A randomized, 2 x 2 factorial design was used. The first randomization was whether the SPA CEC was available to the participant during the simulations. The second randomization was the mode of orientation (e-module vs. didactic). The simulations were videotaped and will be rated by two Pediatric Anesthesiologists using the Managing Emergencies in Pediatric Anesthesia (MEPA) scenario specific checklist and GRS.

Results: In this work in progress, we have conducted 36 MEPA simulations. Preliminary results demonstrate that in 28% of simulated scenarios, residents use a cognitive aid when it is available to them. Of the seven MEPA scenarios that residents were exposed to, cognitive aids were utilized exclusively on two scenarios (Malignant Hyperthermia and Local Anesthetic Toxicity). The uptake rate of cognitive aids in these two specific scenarios was 62.5% amongst residents that underwent the simulation and had cognitive aids available. Additional results, specifically performance impact of the CECs, will be available for presentation at the time of the conference.
Conclusions: Preliminary results suggest that uptake of the cognitive aid is dependent on the type of critical event occurring as opposed to the orientation that residents receive. Specifically, participants are more likely to use the SPA CEC in events that are task list oriented (i.e. Malignant Hyperthermia and Local Anesthetic Toxicity). The significance of these results is that they indicate that cognitive aids should be created for specific critical events; therefore, this lends insight into ways to improve currently existing resources (i.e. SPA CEC) and direction towards creation of future resources.

References:

D14 ● Developing a structured competency-based training program in interventional pain management

Rami Kamel, Ewen Chen, Jeffrey Cheung, Michael Gofeld
St. Michael's Hospital

Introduction: Intensive competency-based training with simulation has shown to improve skill acquisition and retention, and even improve patient outcomes in clinical settings where trainees are involved.[1] Although, simulation drills have been implemented in teaching airway management, critical care scenarios, and trauma management; these approaches remain in an early development state with respect to interventional pain medicine.[2] Surgical training programs in Canada have implemented Competency Based Education (CBE), which carries many benefits including proficient training and increased patient safety.[3]

Objective: As part of our goal to develop a structured simulation “boot camp” curriculum for resident and fellow training, we developed and tested a simulation training session for interventional pain medicine.

Methods: After obtaining REB approval, study participants were approached via a recruitment letter to provide consent. All participants watched an instructional video of the procedure. They were randomized into High-Intensity Training (HIT) and Low-Intensity Training (LIT) Groups. HIT group had a one-on-one learner-tailored training with the PI based on the repetition of a routine buildup of steps addressing ergonomics, machine setup, standardized scanning and needle placement. The LIT group’s knowledge of setup and procedure was based on the video. Then, both groups were asked to perform the procedure. Two independent assessors recorded primary outcomes later on the same day. Primary outcomes include modified composite Global Rating Scores (GRS) of technical performance, the number of attempts and procedural time.

Results: Recruitment of subjects is still ongoing. Pilot results from 4 subjects show the average GRS to be 20.75 and 12.25 (on a scale of 25 points), the average time taken by the study subjects to perform the technique was 225 and 385 seconds and the average number of attempts for successful performance was 2.75 and 5.25 for the HIT and LIT groups respectively. For GRS, Cohen’s d is 2.462 suggesting a large effect size. Once recruitment is completed, group outcomes will be compared using inferential statistics.
Conclusion: Preliminary results suggest a large positive effect of high-intensity simulation training in the ultrasound-guided facet joint injection. Further data collection is still needed to confirm these findings and to guide further refinement of the educational method.


D15 • Using a checklist to improve intra-operative handovers among anesthesiologists

Melinda Li, Adam Snyman
UHN – Toronto General Hospital

Background: Handovers are inevitable in healthcare and are prone to communication errors and incomplete transfer of information that may result in adverse events, inefficiencies, and patient harm. The objective of this study was to develop a tool to help improve communication during intra-operative handovers, as there is a lack of a standardized system for the handover process.

Methods: A handover checklist was developed with input from anesthesiologists at Toronto General Hospital (TGH) through the use of surveys. The purpose of the checklist was to act as a guide for anesthesiologists on important information to include during the handover to the incoming anesthesiologist taking over the case. The checklist tool was then distributed to anesthesiologists at TGH over a two-week period for use during intra-operative handovers. Surveys were emailed to anesthesiologists pre- and post-intervention. The survey that anesthesiologists completed after using the checklist, focused on the user’s experience with the checklist tool and its impact on the handover.

Results: The results from the pre-intervention survey (n = 40) found that 68% of the respondents felt that information was "occasionally" missed or incorrectly communicated during handovers, while 18% reported that this happened "often." The post-intervention survey was completed by anesthesiologists (n = 15) after using the checklist tool for handovers. Eighty percent reported increased satisfaction with their handover with the use of the checklist tool, compared to their usual handovers without using the checklist. The majority of respondents reported improved communication of information including the patient’s allergies, antibiotics given, blood loss, intra-operative complications, and post-operative plans. The results showed that 93% of respondents felt that the handover checklist helped improve patient safety and would like a handover checklist to become standard of practice at TGH.

Conclusion: Many factors may affect intra-operative handovers and could potentially lead to communication errors. The use of a checklist tool improves user satisfaction with intra-operative handovers and many anesthesiologists felt that it may help improve patient safety. Future research to investigate the impact of handover checklists on patient morbidity and mortality would be useful.
Hands-on small group sessions using ultrasound to teach anatomy at medical school

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UHN – Toronto Western Hospital

Background: Over the last two decades medical schools have incorporated the use of ultrasound into their undergraduate medical programs. The integration of ultrasound to traditional anatomy undergraduate medical programs in small-group sessions in Canada and Ireland has been implemented since 2013 on an annual basis. This project aimed to assess this integration during the 2015 session.

Methods: During the 2015 winter term, small-group interactive hands-on teaching sessions were delivered to first year students in the undergraduate University of Toronto Medical School program. Each session commenced with a synopsis of basic ultrasound imaging principles. An S-Nerve Sonosite ultrasound machine was used by the demonstrator to visualize neck and brachial plexus anatomy on volunteers, after which students performed scans to identify structures. Student feedback was then sought (1-5, 1 poor, 5 excellent).

Results: Five hundred and eight questionnaires were returned (90% response rate). The following categories were rated as very good (4 or greater) in the respective percentage of learners: Preparedness (96%), stimulating enthusiasm (94%), positive learning environment (97%), effective questions (95%), clear explanations (95%), clear objectives (97%), helpful material (98%), and objectives achieved (97%).

Conclusions: Ultrasound can provide real-time minimally invasive bedside information and has become widespread in for diagnosis in modern clinical practice. However, interpretation of ultrasound images is partly a matter of pattern recognition. Early exposure to ultrasound would therefore be valuable to medical trainees to facilitate an appreciation of the ultrasound appearance of normal anatomy. Learning in small-group environments has been shown to be beneficial to undergraduate students. Therefore, combining small-group learning with hands-on application can further expedite this appreciation for normal ultrasound anatomy. This project provides evidence, consistent with annual sessions since 2013 between two different geographic sites that teaching modern medical trainee’s anatomy with ultrasound in hands-on sessions elicits positive feedback. Further work is required to determine whether this has an impact on learning and retention of knowledge.

D17  ●  3D printing low cost, task specific, medical training simulators

Joshua Qua Hiansen, Azad Mashari, Stephanie Zhou, Eitan Aziza, Massimiliano Meineri
UHN – Toronto General Hospital

Background: Widespread use of medical simulators in curricula has been hampered due in part to exorbitant costs. Advancements in 3D printing technologies have brought capabilities of additive manufacturing to affordable prices. In conjunction with open-source segmentation and 3D modelling software, it is possible to fabricate low-cost and patient specific medical anatomical models which can be customized to suit training-specificities. The objective of this study was to demonstrate the cost-effectiveness of 3D printed task-specific medical training simulators.

Methods: Anonymized patient-CT DICOM files were downloaded from www.osirix-viewer.com/datasets. Automated segmentation of the region of interest was done with freeware ITK-Snap. Models were exported as a stereolithographic file and were post-processed within freeware 3D modelling software Meshmixer. Open-source slicing software Slic3r was used to export models as 3D printer readable .gcode files. Models were fabricated on a fused deposition modelling 3D printer utilizing various thermoplastic filaments. Models were assessed for viability as learning tools by senior anesthesiologists. Three heart simulators were produced to demonstrate standard cardiac ultrasound views and a flexible airway model was produced to train lung isolation via double-lumen intubation.

Results: Heart models of standard ultrasound views, transgastric, apical four chamber and several short axis views, were fabricated from a single patient source CT file. Each cardiac model cost ~$10.00 CAD in raw material cost and required ~30 hours of print time/model. Flexible airway model cost ~$10.00 CAD in raw material cost and required ~10 hours of print time. Insertion of the double lumen tube was possible and bronchoscopy allowed for viewing of physiological landmarks including designed carina and longitudinal muscles.

Conclusion: The use of commercially available 3D printers and free/open-source software has allowed us to develop a range of affordable anatomic models for educational purposes. Future research will develop simulators with specific patient pathophysiologies and disease states.
Development of a 3D printed silicone heart phantom to teach focused cardiac ultrasound

Stephanie Zhou, Eitan Aziza, Joshua Qua Hiansen, Azad Mashari, Massimiliano Meineri Nyman
UHN – Toronto General Hospital

Background: Current simulators for teaching transthoracic and transesophageal echocardiography (TTE/TEE) are costly and limited in pathologies. 3D printing provides a viable method to produce patient-specific medical-anatomical models. When coupled with free, open-source 3D modelling software, detailed, yet inexpensive models for training can be easily fabricated. This study presents a workflow for creating a 3D-printed heart model for demonstrating Focused Cardiac Ultrasound (FCU) views.

Methods: An anonymized patient cardiac CT was segmented using ITK-Snap to yield a 3D anatomical cast model that was exported as a .stl (stereolithographic) file. This was imported into freeware 3D rendering program Meshmixer (Autodesk Inc.) for smoothing and mesh repairs. Subsequently, this was imported into free, open-source slicing software Slic3r to yield a .gcode file, and printed using PVA material from a TAZ-5 Fusion Deposition Modeling 3D printer. The cast was filled with echogenic two-part silicone, and the PVA DICOM-based printed cast was removed. The resulting heart model was embedded in a gelatin-based matrix to mimic human tissue and create a tissue-myocardium ultrasound interface. The phantom was scanned using a TTE/TEE probe for both anatomical and ultrasound accuracy.

Results: Full size heart models required approximately 26 hours to print (Fig. 1) with a filament material cost of $15.30 and silicone cost of $71.00 most of which was lost as waste during the casting process for a total model price of $86.30 (CAD). Comparable commercial phantoms cost well in excess of $5000. Imaging the heart with ultrasound resulted in a hyperechoic surface quality; however, anatomical features were discernible and accurate (Fig. 2).

Conclusion: Using a low-cost workflow, a 3D-printed silicone TTE/TEE phantom was produced. Future studies will evaluate this model for further teaching applications.
Expert validation of a low-cost and patient specific 3D printed spine phantom for ultrasound guided neuraxial anesthesia training

Azad Mashari, Joshua Qua Hiansen, Mario Montealegre, Lu Yeh, Robina Matyal, Stephanie Zhou, Eitan Aziza, Massimiliano Meineri
UHN – Toronto General Hospital

**Background:** Currently there are two training modalities for neuraxial anesthesia: supervised learning on patients or practice on commercial simulators. Neither is ideal owing, on one hand, to potential patient harm and on the other, to high costs and limited availability of simulators which cannot replicate the anatomical variety seen in real-life. Using low-cost 3D printers and free/open-source (FOS) software we have developed patient-specific spine models with realistic ultrasound properties and tactile feedback.
comparable to commercial simulators for neuraxial anesthesia. The purpose of this study was to compare the fidelity of these printed phantoms against a commercially available model.

**Methods:** Lumbar spine CT scans were obtained from a free online repository (www.osirix-viewer.com). A lumbar section of a healthy spine was segmented using 3D SlicerTM, and exported as a stereolithographic 3D model. Using CAD software (OpenSCAD), a box was designed around the spine to hold an echogenic gel. This complete model was exported to an open-source fused deposition modelling 3D printer, Taz Lulzbot 5TM, using the free slicing software Cura. The ligamentum flavum were simulated by a commercial silicone sealant (Devcon SiliteTM). A gelatin-based tissue mimicking gel containing psyllium husk as scattering agent was poured into the Spine Box. A water-filled, molded silicone tube was used as the thecal sac. 22 staff anesthesiologists were asked to ultrasound scan, perform a spinal and an epidural on the Spine Box and a commercially available SimulabTM spine phantom. Participants were asked to rate the ultrasound and tactile fidelity of both phantoms on a 5 point Likert scale questionnaire (Fig. 1).

**Results:** There was no significant difference between the 3D printed phantom versus the Simulab phantom in either tactile or ultrasound imaging fidelity. The unit cost of the Spine Box phantom is approximately $40, more than 95% lower than the SimulabTM phantom.

**Conclusion:** Our results indicate that in-house fabrication of spine phantoms using 3D printing can provide results comparable to commercial models. Furthermore the techniques used allow the creation of models with varying anatomy and levels of difficulty.
Background: Anesthetics contribute to postoperative delirium (POD) and postoperative cognitive dysfunction (POCD). Understanding the causes of these disorders and developing treatments is important because POD and POCD are associated with prolonged hospital stays, increased costs, loss of independence and increased mortality. We previously showed that persistent memory deficits caused by etomidate (ETOM) result from an increase in tonic GABA(A) receptor-mediated inhibitory current in the hippocampus (J Clin Invest, 2014). The underlying mechanisms are uncertain. The same tonic current is increased by the pro-inflammatory cytokine IL-1Beta via its downstream factor p38-MAPK (Cell Rep, 2012). The two aims of this study were to determine whether persistent increase in the tonic current: 1) can be induced by other anesthetics and 2) is mediated by an IL-1Beta-dependent signaling pathway.

Methods: All experiments were approved by the local ethics review committee. Co-cultures of murine hippocampal neurons and cortical astrocytes were treated with drugs for 1 h. The drugs were then washed out and whole-cell voltage clamp techniques were used to record tonic current 24 h later. Western blotting was performed to measure IL-1Beta and phosphorylated p38-MAPK levels in hippocampal tissue collected from mice 24 h after injection with ETOM (8 mg/kg, i.p.). All data are expressed as mean ± SEM and were analyzed by ANOVA with Tukey post hoc test (P < 0.05).

Results: Isoflurane, sevoflurane, propofol and midazolam, but not ketamine, increased the amplitude of the tonic current (Fig. 1). The anti-inflammatory drug minocycline (MINO; 100 µM) prevented the ETOM-induced increase in tonic current (ETOM: 1.25 ± 0.33, MINO + ETOM: 0.56 ± 0.10). ETOM enhanced IL-1Beta levels (Control: 0.26 ± 0.03, ETOM: 0.41 ± 0.02) and p38-MAPK phosphorylation (Control: 0.41 ± 0.13, ETOM: 0.62 ± 0.93). ETOM-induced increase in tonic current was reversed by the IL-1Beta receptor antagonist, IL-1Ra (100 ng/mL) (ETOM: 1.45 ± 0.06, ETOM + IL-1Ra: 1.13 ± 0.16), and an inhibitor (SB 203,580, 20 µM) of p38-MAPK (ETOM: 1.85 ± 0.20, ETOM + SB 203,580: 0.98 ± 0.13).

Conclusion: Isoflurane, sevoflurane, propofol and midazolam, but not ketamine, triggered a persistent increase in tonic GABA current. The ETOM-induced increase in tonic current is mediated by an inflammatory signaling pathway involving IL-1Beta and p38-MAPK. Thus, anesthetics may trigger a pro-inflammatory signaling pathway to increase the tonic current, and likely thereby cause persistent memory deficits.
Objectives: Perineural steroid injection can provide analgesia in refractory post-traumatic neuropathic pain. Prediction of likelihood of benefit can help optimize resources and avoid interventions in subjects unlikely to respond. Objective hemodynamic and psychological parameters can be used to predict treatment outcomes.

Methods: We did a retrospective study of patients who received local anesthetic and steroid injections around the injured nerves supplying the foot and ankle from July 1, 2011 to Feb 29, 2016. Systolic, diastolic, mean blood pressure (BP), heart rate (HR) and sedation requirement were collected before and after the first intervention. Baseline pain catastrophizing score (PCS), patient health questionnaire-9 (PHQ-9) score, numerical pain rating score (NRS) and NRS pain score at 6 weeks following first block was recorded. Patients with at least 30% reduction in NRS at 6 weeks were considered “responders”. Univariable analysis was done using appropriate statistical tests.
**Results:** Out of 135 patients, 52 were excluded because of insufficient data. From 83 patients whose charts were available for analysis, 34 (41%) were responders and 49 (59%) were non-responders. The median (inter-quartile range) for NRS pain score before intervention and at 6 weeks follow-up in responders and non-responders were 7 (6, 7.87), 3 (2, 4), and 7 (6, 7.5), 6 (5.5, 7) respectively. The mean reduction in HR, SBP, DBP and MAP were 5.58 (SD 7.45), 10.55 (SD 13.43), 5.53 (SD 12.10) and 7.58 (SD 11.11) in responders and 7.2 (SD 10.07), 8.24 (SD 13.40), 8.10 (SD 11.71) and 7.97 (SD 10.74) in non-responders respectively with no significant changes. The mean PCS was 21.8 and 27.9 in responders and non-responders respectively (p<0.5). In terms of sedation, 26.47% did not require any sedation for the procedure in responders as compared to 12.24% in non-responders while heavy sedation requirement was 50% and 67.34% respectively (p<0.5).

**Conclusion:** There was no difference in HR and BP changes in responders compared to non-responders having perineural steroid injection for refractory post-traumatic neuropathic. There was significant difference in PCS which was lower in responders. Pain catastrophizing score and sedation requirement during the procedure were higher in non-responders than in responders. This suggests that patients with high PCS and higher sedation requirement may not respond to interventions for neuropathic pain.

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**Retrospective review of discharge opioid prescription in patients undergoing total knee arthroplasty**

Lisa Li, K Flores, S Choi, IT Awad
Sunnybrook Health Sciences Centre

**Background:** Total knee arthroplasty (TKA) may result in significant post-operative pain requiring postoperative opioids. We hypothesize that post-discharge opioids are being prescribed following TKA in a uniform, potentially suboptimal pattern that could under or over-estimate postoperative patient requirements. We conducted a retrospective review to determine the amount of opioid prescribed upon discharge from hospital and examined the correlation with in-hospital opioid use. Handovers are inevitable in healthcare and are prone to communication errors and incomplete transfer of information that may result in adverse events, inefficiencies, and patient harm. The objective of this study was to develop a tool to help improve communication during intra-operative handovers, as there is a lack of a standardized system for the handover process.

**Methods:** After obtaining REB approval, a retrospective chart review of randomly selected patients who underwent TKA between March 2013 and Jan 2014 was conducted. Patients on preoperative opioids, transferred to an extended rehabilitation facility or had incomplete data, were excluded. Data collected included age, sex, BMI, surgical procedure, anesthetic type, 48h opioid consumption, and discharge opioid prescription. The primary outcome was to determine the mean oral morphine equivalent on the discharge prescription. The secondary outcome was to determine if there was a correlation between 48h opioid consumption and the discharge prescription using linear regression analysis.
Results: Two hundred and thirty-nine patients undergoing TKA were identified and met inclusion criteria. Demographic data are shown in Table 1. Regression analysis demonstrated a statistically significant correlation between in-hospital use and discharge prescription (p=0.005) that was of minimal clinical significance (R²=0.032).

Conclusion: Based on our study, there appears to be little clinically significant correlation between in-hospital opioid consumption and discharge opioid prescription. Although there was a correlation between in-hospital opioid use and discharge prescription, the regression analysis indicates only 3% of the observed variability in discharge prescription is explained by in-hospital opioid use. Future prospective studies are needed to determine how to best optimize discharge opioid prescribing following TKA.

Retrospective Review of Discharge Opioid Prescription in Patients Undergoing Total Knee Arthroplasty

Table 1. Demographic data (data are expressed as percentage and mean)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total n = 239</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>47 – 90 years (67)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>145 (60.7%)</td>
</tr>
<tr>
<td>Males</td>
<td>94 (39.3%)</td>
</tr>
<tr>
<td>ASA</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>8</td>
</tr>
<tr>
<td>II</td>
<td>114</td>
</tr>
<tr>
<td>III</td>
<td>117</td>
</tr>
<tr>
<td>IV</td>
<td>0</td>
</tr>
<tr>
<td>BMI</td>
<td>18.9 – 60.1 (32.4)</td>
</tr>
<tr>
<td>Anesthetic Modality</td>
<td></td>
</tr>
<tr>
<td>Spinal</td>
<td>227 (95%)</td>
</tr>
<tr>
<td>General anesthesia</td>
<td>12 (5%)</td>
</tr>
<tr>
<td>Regional Analgesia</td>
<td></td>
</tr>
<tr>
<td>Femoral Catheter</td>
<td>238 (99.6%)</td>
</tr>
<tr>
<td>Femoral + Sciatic</td>
<td>65 (27.2%)</td>
</tr>
<tr>
<td>48 Hour In Hospital Opioid Use*</td>
<td>193 mg (SD 96.4)</td>
</tr>
<tr>
<td>Discharge Opioid Prescription*</td>
<td>804 mg (SD 291.5)</td>
</tr>
</tbody>
</table>

* Oral morphine equivalent
E5  ●  Novel model of moderate anemia induces organ specific tissue hypoxia

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St. Michael’s Hospital

Background: Moderate preoperative anemia (hemoglobin concentration (Hb) between 80-110g/L) has been associated with increased risk of organ injury (brain, heart, kidney) and mortality by undefined mechanisms (1-3). We hypothesize that a disruption in oxygen (O2) delivery/homeostasis leads to tissue hypoxia, acting as a unifying mechanism of anemia-induced mortality. To test this, we developed an antibody mediated model of moderate anemia, and then assessed its corresponding cardiovascular and hypoxic cellular adaptations. We aim to compare these responses to other models of anemia including hemodilutional and sickle cell anemia (SCA).

Methods: All experiments were reviewed and approved by institutional animal care committees. A transgenic mouse model with luciferase fused to hypoxia inducible factor (HIF)-1α was used, and moderate anemia was induced with red blood cell (RBC)-specific antibody TER119. Peripheral O2 saturation (SpO2) was measured by pulse oximetry. A novel approach of phosphorescence quenching of O2 was used to measure tissue PO2. Real-time in vivo levels of HIF-luciferase bioluminescence were also measured.

Results: Antibody specific to RBC induced moderate anemia, reducing baseline Hb from 146±7g/L to 90±8g/L at day 3 and 89±12g/L at day 4 post-induction (n=16, p<0.001), with minor increases in plasma free Hb (peak increase to 1.1±0.4g/L at 6 hours post-induction, n=5). Moderate anemia increased SpO2 to 98.1±0.2% versus control levels of 97.4±0.4% (n=6, p<0.018). Brain tissue O2 was maintained during moderate anemia; however, hypoxia was detected in the kidney (Control kidney: 20.8±4mmHg O2 vs. Anemic kidney: 13.0±4mmHg O2; p<0.001). Moderate anemia caused a 19±17% increase in HIF-luciferase radiance (n=12, p=0.039) from baseline values in the dorsal right liver+kidney region. These
responses are comparable with cardiovascular and cellular changes associated with hemodilutional anemia and SCA.

**Conclusion:** Our novel model of antibody-mediated anemia causes characteristic cardiovascular and hypoxic cellular responses, comparable with other forms of anemia. This anemia did not primarily occur via intravascular hemolysis, supporting a mechanism of extravascular RBC clearance in the reticuloendothelial system. Lung injury was not observed, as SpO2 increased after 4 days of anemia. Kidney tissue hypoxia and the appropriate cellular HIF response were observed, suggesting that anemia-induced tissue hypoxia is sensed at the molecular level. Brain PO2 did not change, suggesting that adaptive increases in cardiac output and cerebral blood flow compensated for the reduction blood O2 content. These data support that this model of anemia may enable us to further assess the mechanisms associated with anemia-induced morbidity and mortality.


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E6 ● Etomidate increases α5GABAA receptor cell-surface expression through convergent actions of p38 MAPK and AKT

**Gang Lei,** Dianshi Wang, Junhui Wang, Kirusanthy Kaneshwaran , Shelly Au, Beverley A Orser
Sunnybrook Health Sciences Centre

**Background:** The general anesthetic etomidate (Etm) increases the expression of α5 subunit-containing GABAA receptors (α5GABAARs) on the surface of neurons and increases a tonic inhibitory conductance in the hippocampus (Zurek et al., 2014). This increase likely plays a causal role in cognitive deficits in post-operative cognitive decline (POCD). We previously reported that SB203580, an inhibitor of both p38 MAPK (p38) and protein kinase B (PKB/AKT) reduces α5GABAAR–generated tonic currents in neurons treated with the endotoxin, lipopolysaccharide (Wang et al., 2012). We hypothesize that the two kinases AKT and p38 also jointly regulate Etm – induced potentiation of tonic conductance and cell-surface expression of α5GABAARs. Further inhibiting these kinases could attenuate α5GABAAR function, improve memory performance and may benefit patients with POCD.

**Methods:** The studies were approved by the local ethics committee and experimenters were binded to treatment conditions. Male (Gabra5+/+) mice were treated with Etm (8 mg/kg, i.p.) or vehicle, and ex vivo hippocampal slices and tissues were prepared 24 hrs after the injection. Western blot (WB) was performed to measure the activity of p38 and AKT. The cell surface biotinylation assay followed by WB was used to measure α5GABAAR surface expression.

**Results:** In the Etm-treated mice, an increase in phosphorylated AKT was observed, either at the threonine308 (Etm: 3.11±0.74; Control: 2.42±0.75; P < 0.05, n= 4), or serine473, (Etm: 0.204 ± 0.09; Control: 0.131±0.04, P <0.05, n=3). The AKT activity increase was observed 6 hrs after Etm injection and did not return to the basal level 24 hrs after. Etm also increased the phosphorylated p38 (Etm: 0.62 ±
Conclusion: Etm increases activities of AKT and p38. These kinases are down-stream regulators of GABAAR surface trafficking, particularly for α5GABAAR. Pharmacological inhibition of these kinases attenuated α5GABAAR cell-surface expression. The results suggested that specific kinase inhibitors could be used to improve memory performance, such as in POCD.

E7 • Perioperative monitoring of regional cerebral oxygen saturation and postoperative delirium post complex cardiac surgery: an RCT

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Background: Postoperative delirium (POD) may occur in up to 50% of patients after cardiac surgery. It is a serious morbidity that results in prolonged length of stay, increased health care costs, and is associated with higher mortality. The use of near-infrared spectroscopy (NIRS) to measure regional cerebral oxygen saturation (rSO2) during cardiac surgery can detect a real time cerebral ischemia. The objective of the current study was to assess effectiveness of restoring cerebral desaturation in reducing the incidence of POD after cardiac surgery.

Methods: After Institutional Ethics Review Board approval, and informed consent, a prospective randomized controlled trial was conducted in patients ≥ 60 years of age undergoing cardiac surgery. Patients with a history of serious mental illness, delirium, and severe dementia were excluded. Anesthesia and surgical management were conducted according to routine institutional practice. Patients were randomized to either interventional NIRS group or controls. Bilateral rSO2 monitoring was used intra-operatively and during the 24h postoperative period in the intensive care unit (ICU). If rSO2 value decreased below 75% of baseline for 1 min or longer, a predetermined algorithm was followed in an attempt to restore rSO2 values in the intervention group. In control group, the NIRS monitor screen was electronically blinded, however, the data was recorded continuously throughout the study period. Baseline and minimum values of rSO2, as well as area under the curve of rSO2 values below 75% of baseline (AUCrSO2 < 75% baseline) were determined. Assessment of delirium was performed with confusion assessment method (CAM) for ICU, or CAM after discharge from ICU, at 12-hour intervals during the first 7 postoperative days or until discharge. We hypothesized that perioperative restoration of rSO2 desaturation would result in lower POD rates after cardiac surgery.

Results: Demographic data and surgical characteristics were similar between the interventional and control groups. POD was present in 30 of 123 (24.4%), and 31 of 126 (24.6%) patients in the interventional and control groups respectively, p = 0.97. There was no significant difference between the two groups with respect to incidence or duration of cerebral desaturation. In the interventional group, a total of 38 (31%) and 47 (38%) patients desaturated below 75% of baseline in the OR and ICU,
respectively; 29 (23.6%) in both the OR and ICU, 10 (26%) only in OR, and, 19 (40%) only in ICU. The median number of desaturations was 2[1 - 9] in OR, and 3[1 - 14] in ICU. In the control group, a total of 44 (35%) and 48 (38%) patients desaturated in the OR and ICU, 23(18.3%) in both the OR and ICU, 21(47.7%) only in OR, and, 25 (53.2%) only in ICU. Median number of desaturations was 2[1 - 10] in OR and 2 [1 - 16] in ICU. Median AUCrSO2 < 75% baseline for interventional group was 36 [2 – 12520] vs 80 [2 – 10831] controls, p=0.9. Baseline rSO2 ≤ 50% was present in 25 patients (12 interventional group and 13 controls). Delirium was present in 19 of these 25 patients (8 interventional group and 11 controls), compared to 42 of 224 patients with baseline rSO2 > 50%, p=0.0001.

**Conclusion:** Attempts to restore rSO2 desaturation during the perioperative period did not result in lower POD rates after cardiac surgery. However, preoperative rSO2 ≤ 50% should be considered a significant risk factor for POD after cardiac surgery.
Save the Date!
Faculty Development Day 2016
Friday, November 11, 2016
89 Chestnut Residence and Conference Centre
University of Toronto

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, approved by Continuing Professional Development, Faculty of Medicine, University of Toronto up to a maximum of 5.0 hours.

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