Introduction: The past decade demonstrated a 300% increase in the number of surgical/diagnostic procedures performed in US ambulatory surgical centres. [1] While the incidence of major adverse events in ambulatory surgical centers appears to be low [2], the management of critical events can be complicated by the lack of resources that are usually available in a hospital. The purpose of this study was to determine the effectiveness of Critical Event Checklists (CECs) [3] in the management of 8 high-fidelity simulation scenarios designed for use in an ambulatory surgery setting.

Methods: After REB approval, 7 multidisciplinary teams (1 surgeon, 1 anesthetist and 3 RN/RPNs) from a single ambulatory facility consented to participate in a realistic high fidelity simulation in an after hour single OR setting. Each team was oriented to the study and simulation equipment. Using an ABAB design (A=no CEC, B=use of CEC), each team managed a total of 8 distinct simulation scenarios designed to include the common perioperative critical events described by Ziewacz et al.[3]. Teams completed 4 scenarios at session 1 and 4 different scenarios at session 2, 5-11 months later. Four independent raters evaluated non-technical performance using the Team Emergency Assessment Measure (TEAM) [4]. Adherence to key processes (how closely the team followed evidence based management guidelines) was evaluated live by a research team member. [3] Given the small sample size, we used a standardized approach of visual inspection of means and standard error values to evaluate the observed patterns in the two data sets.

Results: While the team’s adherence to key processes did not appear to depend on the presence or absence of the CEC in session 1, a pattern emerged in session 2 (Figure
1), suggesting an improved adherence when the CEC was present. The intraclass correlation (ICC) for TEAM scores was 0.47, indicating only moderate agreement. TEAM scores did not appear to depend on either the presence of the CEC or the session timing.

Discussion: This study suggests that the use of Critical Event Checklists may lead to improved adherence to evidence-based management of critical events if teams are familiar with its use. Teamwork, as measured by the TEAM score, however did not demonstrate any difference with use of checklists. A larger study with more teams and a more diverse set of scenarios would allow more robust statistics and hence more substantive recommendations.

References:

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Introduction  Diagnosing the patients with moderate-to-severe (AHI >15) and severe (AHI >30) obstructive sleep apnea (OSA) is important because of the increased risk of perioperative complications. Polysomnography (PSG) - the gold standard for the diagnosis of OSA - is time consuming and costly. The STOP-Bang questionnaire is a validated screening tool for obstructive sleep apnea. We conducted this meta-analysis to determine the predictive probability of moderate-to-severe (AHI >15) and severe (AHI >30) OSA by the STOP-Bang questionnaire.

Methods: A search of the literature databases MEDLINE (from 2008 to April 2014), Embase (from 2008 to May 2014), Cochrane Databases of Systematic Reviews (from 2008 to March 2014) and PubMed (from 2008 to August 2014) was carried out. The search yielded 340 citations. Irrelevant papers were excluded by title, abstract and full-text review, leaving 5 manuscripts for analysis. Inclusion criteria were: 1) Studies that used STOP-Bang questionnaire as a screening tool for moderate-to-severe and severe OSA in adult subjects (>18 year); 2) The accuracy of the STOP-Bang questionnaire was validated by polysomnography - a gold standard for diagnosing OSA; 3) Availability of data on AHI or respiratory disturbance index (RDI) ≥15; 4) and probability of moderate-to-severe and severe OSA at the different STOP-Bang scores 5) Publications in the English language. Validity criteria assessing the internal and external validity were explicitly described and coded according to the Cochrane methods group on screening and diagnostic tests. The data about the probability of moderate-to-severe and severe OSA and the different STOP-Bang scores were pooled and presented as a bar graph.

Results: The meta-analysis was carried out in 5 prospective studies including a total of 2,792 patients (3 studies in the sleep clinic patients, n=1835 and 2 studies in the surgical patients, n=957). The data on the predictive probabilities for the different severities of OSA with the corresponding STOP-Bang scores were shown in Figure.

In the sleep clinic population, the probability of moderate-to-severe OSA for a score of 3 is 52%. With a stepwise increase of the STOP-Bang score to 4, 5, 6 and 7/8, the probability rises proportionally to 62%, 72%, 82% and 92% respectively (Fig 1A). Similarly, the same pattern exists for severe OSA. With a stepwise increase of the STOP-Bang score of 4, 5, 6 and 7/8, the probability of severe OSA climbs to 35%, 45%, 55% and 75% respectively (Fig 1B).
In the surgical population, the probability of moderate-to-severe OSA for a score of 3 is 40%. With a stepwise increase of the STOP-Bang score to 4, 5, 6 and 7/8, the probability soars proportionally to 48%, 60%, 68% and 80% respectively (Fig 1C). With a stepwise increase of the STOP-Bang score of 4, 5, 6 and 7/8, the probability of severe OSA escalates to 25%, 35%, 45% and 65% respectively (Fig 1D). A higher STOP-Bang score reflects a higher cumulative score of the known risk factors and the greater the probability of moderate-to-severe and severe sleep apnea.

**Conclusion:** In the sleep clinic and the surgical patients, the higher the STOP-Bang score, the greater the probability of patients suffering from moderate-to-severe and severe sleep apnea.

**References:**

83559 - UNIVERSAL TXA PROTOCOL REDUCES TRANSFUSION IN HIP & KNEE ARTHROPLASTY

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Introduction: Randomized clinical trials and observational studies have demonstrated that tranexamic acid (TXA) reduces blood loss and allogeneic red blood cell (RBC) transfusion in cardiac and non-cardiac procedures (1,2). Despite this data, our institutional use of TXA for total hip and knee arthroplasty was relatively low (46%). To address this translational gap in TXA utilization, we implemented a quality of care policy to initiate a universal protocol for treating all eligible patients with TXA perioperatively. We hypothesized that successful implementation of the universal TXA policy would increase TXA utilization and reduce allogeneic RBC transfusion. Additional outcomes included postoperative hemoglobin (Hb), length of stay (LOS) and adverse events.

Methods: After institutional ethics committee approval was obtained, we implemented a quality of care policy to provide universal administration of intravenous TXA (20 mg/kg perioperatively) to all eligible patients undergoing total hip and knee arthroplasty between October 21, 2013 and April 30, 2014. We compared data from an equal number of patients before and after protocol implementation (n=422 per group). The primary outcome was RBC transfusion. Secondary outcomes included postoperative Hb and LOS. Adverse events including death, myocardial infarction, stroke, acute kidney injury, venous thromboembolism, and seizure were identified from the electronic patient records. Data were analyzed by adjusted logistic and linear regression analysis and Chi-square test with significance assessed at p < 0.05.

Results: We observed an increase in TXA utilization [45.8% vs. 95.3%, change of 49.5
which resulted in a reduction in RBC transfusion rate [8.8% vs. 5.2%; change of 3.6 (0.1 -7.0) %, p=0.043]; and an increase in postoperative day 3 Hb from 97.1 (95.6 – 98.5) to 100.8 (99.5 – 102.2) g/L (p < 0.001). An analysis of the impact of anemia was performed by stratifying patients with preoperative Hb < 120 g/L (anemic patients) vs. those with a preoperative Hb ≥ 120 g/L (nonanemic patients). This analysis demonstrated a high incidence of RBC transfusion in anemic patients not treated with TXA (53.2%) which was reduced to 18.9% in anemic patients who received TXA therapy (p < 0.001). The RBC transfusion rate in nonanemic patients who did not receive TXA was lower than that observed in anemic patients (9.9%). TXA treatment resulted in a further reduction on RBC transfusion in these non-anemic patients (4.0%). No change in LOS was observed and there was no increase in incidence of adverse events.

**Conclusion:** In this observational quality improvement study we demonstrated that the implementation of a universal TXA policy for total hip and knee arthroplasty resulted in an increase in TXA utilization and a reduction in RBC transfusion. We also observed an increase in postoperative Hb suggesting that the reduction in transfusion rate did not result in worsened post-operative anemia. No increase in adverse events was observed suggesting that this protocol was safe. Broader application of TXA therapy for major joint arthroplasty may improve patient outcome.

**References:**

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2. BMJ. 2014; 349:g4829
85813 - SITTING POSITION MAY ALLEVIATE POSITIONAL OBSTRUCTIVE SLEEP APNEA

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Introduction: The severity of obstructive sleep apnea (OSA) has been shown to increase postoperatively. Elevated head position has been used in the management of OSA in the general population, but not postoperatively. In this pilot trial, we hypothesized that the use of a semi-upright position versus a non-elevated position will prevent postoperative worsening of OSA in patients undergoing non-cardiac surgeries.

Methods: Following research ethics board (REB) approval, adult patients (>18 years), ASA I to IV, undergoing elective inpatient surgery, were consented to undergo a home portable sleep study. Patients with OSA (AHI >5 events/h), were randomized into a treatment group, semi-sitting position (45 degrees incline, Group S), or a control group (no head-end elevation, Group C). The bed angle was measured by using either an in-built bed-angle monitor or a goniometer, at the beginning and end of night. All patients were monitored for three postoperative nights using oximetry and underwent a PSG on the postoperative night 2 (N2) or night 3 (N3). The primary outcome measurement was postoperative AHI. Subgroup analysis was performed to examine the effects in patients with positional or supine-related OSA, defined as preoperative overall AHI > 5 events/h, and, supine AHI more than two times of the non-supine AHI. ANCOVA analysis was used to compare change of AHI as a continuous variable from baseline between two groups.

Results: Eighty-three OSA patients undergoing mainly orthopedic and general surgeries were randomized (Group S: 41 and Group C: 42). There was no difference between the two groups in baseline demographics and comorbidities. Forty-six patients (Group S: 25 and Group C: 21) completed PSG on the postoperative N2/N3. The AHI increased postoperatively within the groups (Group S: pre-op AHI vs. postop AHI: 22.0±11 vs. 22.9±27 events/hr, p=0.001; Group C: Pre-op AHI vs postop AHI: 20.2±14 vs. 25.0±26 events/hr, p < 0.001), indicating worsening of the severity of OSA. Based on the intention-to-treat analysis, no significant difference was observed in AHI on postoperative N2 and N3 between the two groups (p >0.05). Subgroup analysis showed that patients classified as "supine-related OSA" (n=12) had a significantly lower AHI postoperatively in the semi-sitting position than those who were not (n=34) (p < 0.05),
Conclusion. This pilot trial demonstrated the feasibility of the use of semi-sitting position amongst OSA patients postoperatively. Patients with supine-related OSA benefitted from the semi-sitting position and had a significantly lower AHI postoperatively. Future trials with sufficient power are needed to establish this relationship further.

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Introduction/Objectives: Postoperative hyperglycemia increases the risk of surgical site infections, length of hospital stay, and can increase mortality. Although recent studies have shown that elevated glycosylated hemoglobin (HbA1c > 6.0%) is common among hospitalized patients, it is not known if this is predictive of postoperative hyperglycemia. The objectives of this prospective observational study were to 1) determine the incidence of postoperative hyperglycemia (blood glucose > 10 mmol/L) in elective surgical patients with no previous history of diabetes 2) assess whether preoperative elevated HbA1c is associated with postoperative hyperglycemia and 3) identify other factors that may predict postoperative hyperglycemia. Thus, future interventional studies could target this group with strategies to prevent postoperative hyperglycemia and its associated adverse effects.

Methods: Following local ethics committee approval, 275 patients consented to participate in the study. Patients > 18 years of age having elective surgery requiring hospital admission postoperatively were eligible to participate. Patients with planned ICU admission and patients taking oral hypoglycemic agents or insulin were excluded. Preoperatively, participants had capillary blood glucose (CBG) and HbA1c measured and they completed the CANRISK diabetes-screening questionnaire. Standard demographic and perioperative data were collected. CBG was ordered on arrival to PACU, before meals and at 22:00h for 2 days or until discharge. Postoperatively, if CBG>10 mmol/L on two or more occasions, the surgical service was notified and they determined the most appropriate management. The incidence of postoperative hyperglycemia was calculated as the percent of participants with CBG>10 mmol/L on at least one occasion. The chi square test was used to assess for potential risk factors for postoperative hyperglycemia including elevated HbA1c, CANRISK score, and fasting blood glucose on the first morning postoperatively (FBG-POD1).
**Results:** Thirty-four participants were excluded because they were discharged home from PACU. Of participants admitted to hospital, 14.5% (35/241) had at least one episode of postoperative hyperglycemia. HbA1c was elevated in 18.4% (44/239) of all participants and 6.7% (16/239) had a value that was consistent with a provisional diagnosis of diabetes (HbA1c ≥ 6.5%). Postoperative hyperglycemia was common (68.8%) in participants with HbA1c ≥6.5%. However, 11% of participants with a normal HbA1c also had at least one episode of hyperglycemia. Those participants with the combination of an elevated HbA1c and FBG-POD1 had the highest incidence of postoperative hyperglycemia (91.7%, 11/12). (See table for details of potential risk factors).

**Discussion/Conclusions:** A significant number (14.5%) of elective surgical patients with no previous diabetic history experienced postoperative hyperglycemia. Approximately two thirds of those with postoperative hyperglycemia had a provisional diagnosis of diabetes based on their HbA1c value. The best predictor of postoperative hyperglycemia was the combination of elevated HbA1c and elevated fasting blood glucose on POD1.

**References:**

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*Can J Diab* 33.4 (2009): 381-385  
*Can J Anesth* 61.5 (2014): 393-7
Introduction: Post-operative urinary retention (POUR) after lower limb total joint arthroplasty (TJA) is a common cause of morbidity. The incidence of POUR is highly variable, but is commonly reported as 30-50% (1,2). More recently, peri-operative care has been streamlined toward a multi-modal, fast-track approach, which may have affected the incidence. Our primary objective was to assess the incidence of POUR, as defined by need for a catheter, following lower limb TJA. Our secondary objectives were to identify risk factors associated with the onset of POUR, and describe the association between POUR and postoperative length of stay (LOS).

Methods: This prospective, observational study was conducted after institutional research ethics board approval and informed consent. All consecutive patients undergoing lower limb TJA from June to September 2014 were included. Pre-operatively, subjects completed an International Prostate Symptom Score (IPSS) questionnaire and a post-void residual (PVR) bladder scan was completed. Peri-operative management was consistent with the current standard of care. In our institution, patients are not routinely catheterized unless they are unable to void within 6-8 hours and a PVR is >500ml, at which time an intermittent catheterization (IC) is performed and consideration is given to an indwelling catheter if >1 IC is needed. Standard demographic and peri-operative data were collected in addition to bladder volume prior to discharge from the Post-Anesthetic Care Unit and LOS. Chi-square tests, t-tests and nonparametric (Mann-Whitney) tests were used to determine the association between postoperative urinary retention and baseline parameters. Regression analysis was performed to determine the contribution of individual factors to POUR.

Results: Of 128 patients, the incidence of POUR was 37.5%. For male participants, the incidence was 50.7% (38/75). In univariate analysis, factors associated with any need for catheterization included gender, age, IPSS and pre-operative PVR. Contrary to
previous reports, POUR was not associated with type of anesthetic, use of intrathecal opioids, postoperative opioid use, or ASA classification. In multivariate analysis, the only factors independently associated with POUR were age (OR:1.59, 95% CI: 1.05-2.40, p=0.028 for every 10 years of age) and male gender (4.78, 2.02-11.30, p < 0.001). While pre-operative IPSS fell just short of significance (1.06, 0.99-1.13, p=0.056) in the whole cohort, it was significant for male participants (1.08, 1.002-1.170, p=0.045). In multivariate analysis, POUR was independently associated with increased LOS (p=0.002), as was age (p < 0.001), blood loss (p=0.025), and opioid requirements on postoperative day #1 (p = 0.007). Indeed, presence of POUR appeared to increase LOS by almost one full day.

**Discussion:** A significant number of patients still suffer from POUR following TJA even with contemporary peri-operative management, and this complication is highly associated with increased LOS. Older men, particularly those with higher IPSS scores, are at highest risk of POUR. Further investigation and intervention should target this group.

**References:**

86003 - REDUCTION IN POST OPERATIVE COMPLICATIONS WITH ACTIVE PRE-WARMING.

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Introduction: It has been shown that perioperative hypothermia can cause adverse outcomes in surgical patients [1,2,3,4]. Recent research has shown that pre-warming patients can reduce peri-operative complications [5,6]. Our primary objective was to determine if active pre-warming reduced the incidence of intra- and postoperative hypothermia in non-cardiac surgery. Our secondary objectives were to determine if active pre-warming reduced the incidence of PACU complications and rates of transfusion and surgical site infection.

Methods: After ethics approval from our local ethics committee we carried out a retrospective cohort study. We included patients undergoing non-cardiac surgery scheduled for greater than 90 minutes duration from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. We compared patients from our baseline cohort (October 2011 to May 2012 (N=323) to a similar cohort after we introduced an active pre-warming program (May to Aug 2013 (N=191)). Patients were warmed with Bair Paws forced air gowns. Temperature was recorded pre-operatively, intra-operatively and on arrival to the recovery room. We compared the rates of hypothermia and PACU complications in each group as well as transfusion and surgical site infection rates. All statistical analysis was performed with Graphpad Prism 5.0, using t-tests or Fisher’s exact tests where appropriate.

Results: The average period of pre-warming was 60 + 40 minutes (SD). Active pre-warming resulted in a significant decrease in the incidence of patients arriving in PACU hypothermic, 33% pre intervention versus 5.4% pre-warmed, p < 0.01. The percentage of time intraoperatively below 36° decreased from 27.3% to 21%, p=0.03. PACU complications including desaturation and excessive pain were significantly decreased in the pre-warmed group, 13.6% vs 3.2%, p < 0.01 and 27.6% vs 12.7%, p < 0.01 respectively. We were unable to demonstrate a statistical difference in transfusion or SSI rates between the groups.
Discussion: Implementation of an active pre-operative warming program was associated significant reductions in intraoperative hypothermia, hypothermia on arrival to PACU, desaturation and excessive pain in PACU. We hypothesize that reductions in pain and desaturations were secondary to reduced hypothermia following pre-warming, since shivering can contribute to thermal pain and increase oxygen requirements. A limitation of this study is that there was more use of thoracic epidurals in the pre-warmed population, which may have contributed to a reduction in PACU pain scores. In addition, the study was underpowered to detect any reduction in transfusion and surgical site infection rates for specific procedures.

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Introduction: Postoperative visual loss (POVL) is usually a rare, devastating and immediate complication of nonocular surgery[1]. However, less severe cases may not be immediately recognized and some POVL subtypes become symptomatic only several days after surgery[2]. Previous POVL epidemiology studies have been restricted to clinical case series or analyses of hospital discharge abstracts databases (HDA)[1]; they may have unintentionally excluded late and less dramatic presentations. We employed a relatively unique longitudinal, provincial administrative database repository to determine the frequency with which POVL may present after hospital discharge.

Methods: With local ethics committee approval, surgeries considered to be high-risk for POVL[1,3,4] were identified in HDA between 1987 and 2013. These included cardiac, vascular, lung, lower extremity joint replacement, spine, head and neck, major pelvic, shoulder and trauma surgery. In addition, low-risk surgeries performed on similar populations but not associated with POVL (percutaneous coronary intervention and ambulatory orthopedic, gynecologic and general surgeries) were identified to provide a comparison estimate of the baseline incidence of acute vision loss. We only included surgeries where the patient had been continuously registered in the repository for at least 5 years prior to the date of surgery, in order to have sufficient data to identify exclusion criteria (see below). Cases of POVL were identified by the occurrence of relevant International classification of diseases version 9 (ICD-9) diagnoses in the HDA, and within 14 days of discharge in the medical service (MS) databases, which includes physician and optometry visits. We excluded patients with pre-existing diagnoses consistent with vision loss and, as the MS database is only coded to 3 digits, we also excluded patients with comorbidities that could confound the outcome of POVL (i.e. diabetics were excluded because ICD-9 code 362 includes both diabetic retinopathy and retinal vascular occlusion). Chi-squared and Fisher Exact tests were used for this preliminary analysis, with cell sizes of < 6 suppressed as a privacy requirement.

Results: Of 242 POVL cases in 184,263 high-risk surgeries and 236 cases in 402,509
low-risk surgeries, 35.6% were diagnosed after discharge. The incidence of POVL overall and after hospital discharge varied substantially by surgical subtype (Table 1). Some high-risk surgeries had rates comparable to low-risk surgeries. The risk of POVL was lower after 2008 compared to before in high-risk (p = 0.05), but not low-risk surgery (p=0.68). The proportion of post discharge diagnoses increased significantly (p = 0.01) after 2008 compared to before.

Discussion: Previous studies likely missed a significant number of cases of POVL that presented after hospital discharge, particularly in cardiac surgery patients. The number of these late presentations is increasing, even as overall rates of POVL decrease. More detailed analyses and ultimately clinical studies, will be required to better characterize these outpatient presentations.

References:


Introduction: Burst suppression (BS) is a feature of the electroencephalogram (EEG), in which electrical bursts alternate with isoelectric periods. It can be identified with clinical monitors that use a processed EEG to measure depth of hypnosis. Deep anesthesia is a predictor of postoperative mortality [1], especially in combination with low blood pressure and low anesthetic concentrations [2]. BS is associated with deep anesthesia [3] and one recent report found that BS was a significant predictor of postoperative mortality when it was coincident with low blood pressure during anesthesia [4]. However, the incidence, mechanism, and consequences of BS are poorly understood [5]. One recognized predictor of BS in adults is advanced age [5], but its incidence in children requires further study. The aim of this analysis is to evaluate EEG data we have collected during two recent studies of closed-loop controlled anesthesia to identify BS in children and adults undergoing propofol anesthesia.

Methods: Two investigational trials were conducted with Health Canada authorization, ethical approval and written informed consent. The cohort of study 1 comprised 102 children aged 6-17 years, ASA I-II, undergoing gastrointestinal endoscopy. Study 2 involved 82 adults aged 22-82 years, ASA I-III, undergoing elective surgery. In both studies, induction and maintenance of anesthesia was closed-loop controlled with propofol administered according to a EEG feedback measure (WAV\textsubscript{CNS}) obtained from the NeuroSENSE monitor (Neurowave, Cleveland, OH), which calculates a Burst Suppression Ratio (BSR) based on the proportion of EEG epochs with BS over the previous minute.

Results: Median [IQR] of the overall lowest WAV\textsubscript{CNS} observed during anesthesia was 36.4 [32.5, 39.1] in study 1, and 21.8 [14.9, 32.2] in study 2 (Figure 1). Only 2/102 (2%) children had BSR>0 (maximum BSR 5% for \leq 2.5% of case duration). Both were 15 year
old, ASA I males. In contrast, 60/82 (73%) of adults had BSR shortly after induction of anesthesia and 39/82 (48%) had BSR at some point during maintenance of anesthesia. In the adult sample, a positive correlation between age and percent of case with BSR > 10 ($r_s = 0.425, p < 0.001$) was observed.

**Discussion:** Differences in protocols and procedure types prevent direct comparison of these datasets: in study 1, stimulation began immediately after induction of anesthesia, which may decrease BSR [6]; in study 2, intubation was followed by a period of unstimulating surgical preparation. Nonetheless, very little BS was detected in our pediatric sample, despite low WAV_CNS values. Our adult sample was much more prone to BS, and our data agree with the observation that age is a significant risk factor for BS during anesthesia [5], suggesting that BS is not simply a byproduct of deep hypnosis. The large variability in individual BS levels suggest further studies are required to elucidate the causes and effects of BS during anesthesia.

**References:**
