Effect of Recombinant Factor VIIa on Rabbit Vascular Graft Patency

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INTRODUCTION:
Cardiovascular surgery is still associated with significant morbidity and mortality due to bleeding. Several case reports have suggested that a new agent, recombinant Factor VIIa (rVIIa), may reduce bleeding in patients failing conventional treatment (1; 2). The purpose of this study was to determine if adding rVIIa to the already thrombogenic environment of new vascular anastomoses could result in higher incidence of graft occlusion.

METHODS:
With Animal Care Committee approval, 19 rabbits were anesthesized with ketamine (10mg/kg), xylazine (2mg/kg), and 1-2% isoflurane in 100% oxygen. Through a midline neck incision, the right jugular and both carotid arteries were exposed. The animals were anticoagulated with heparin, and a 2-3 cm section of right jugular vein was then excised and grafted to the right carotid artery with two end to side anastomoses. The left carotid artery was ligated and re-anastomosed in an end to end fashion. Following protamine administration the grafts were inspected before skin closure to ensure adequate flow. Animals then received either placebo or 300ug/kg of rVIIa intravenously. An ultrasound was performed at 3 hours and 24 hours to assess graft flow, and the presence of occlusive clot. On sacrifice, the grafts were visually inspected for thrombus. The primary outcome was ultrasound evidence of no flow or presence of occlusive thrombus in the graft. Data was analyzed using ANOVA, chi-square or fisher's exact test where appropriate, with $p<0.05$ considered significant.

RESULTS:
Three animals were excluded for technical reasons. rVIIa treated animals had a significantly higher incidence of graft occlusion (vein 7/8 vs 1/8, $p=0.01$; artery 7/8 vs 2/8, $p<0.05$) and lower average vein graft flow (26.7 +/- 15.34 vs 5.5 +/- 13.47 ml/min, $p<0.05$) . There was no significant difference between the two groups in graft diameter, physiological variables, hemodynamics or anticoagulation.

DISCUSSION:
This study suggests that high dose rVIIa (300ug/kg) leads to an increased incidence of fresh vascular graft thrombosis. It is still unknown if these results would be obtained with lower doses. Our findings may guide further research and clinical use of rVIIa

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REGIONAL ANESTHESIA VS GENERAL ANESTHESIA FOR AMBULATORY HAND SURGERY

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INTRODUCTION: Regional anesthesia (RA) is associated with superior analgesia and fewer adverse effects compared to general anesthesia (GA) during in-hospital recovery after ambulatory hand surgery [1], but longer duration of benefit is unknown. This study investigates whether RA or GA provides superior analgesia with fewest adverse effects up to two weeks following ambulatory hand surgery.

METHODS: After IRB approval and informed consent, 100 patients undergoing ambulatory hand surgery were randomized to RA (n=50) or GA (n=50). RA comprised of axillary brachial plexus block using 1.5% lidocaine with epinephrine. GA included fentanyl, propofol, and desflurane. All patients received ketorolac. Fentanyl and oral opioid preparations were administered postoperatively as needed. Preoperatively, all patients rated their hand pain (Visual Analog Scale;VAS) and pain-related disability (Pain-Disability Index[2];PDI). Postoperatively, eligibility for bypassing PACU ("fast-track") was determined (Modified Aldrete score[3]), and pain (VAS) and home-readiness scores (Postanesthesia Discharge Scoring System[4]) were recorded. On postoperative days (POD) 1, 7, and 14, patients documented pain (VAS), opioid consumption, nausea/vomiting, weakness and paresthesia in the operative extremity, and satisfaction (VAS). Patients repeated the PDI on POD 14. Intention-to-treat analysis was undertaken by t-test, Mann-Whitney U, or χ^2 with $p<0.05$ considered significant.

RESULTS: Demographics, medical history, preoperative pain and PDI, and procedure types were similar. More RA patients were fast-track eligible ($p<0.001$), while duration of stay in PACU was shorter in the RA group ($p<0.001$). During in-hospital recovery, the time to first analgesic requirement was longer in the RA group ($p<0.001$), and fentanyl consumption ($p<0.001$), oral morphine equivalent consumption ($p<0.001$), and pain (fig.1) were lower in the RA group. More GA patients suffered nausea/vomiting during in-hospital recovery ($p<0.05$). RA patients achieved home-readiness earlier ($p<0.001$). On POD 1, 7, and 14, there were no differences in pain (fig.1), opioid consumption, nausea/vomiting, weakness, paresthesia, or satisfaction. There was no difference in PDI on POD 14.

DISCUSSION: During in-hospital recovery, RA provides superior analgesia, fast-track eligibility, and home-readiness compared to GA after ambulatory hand surgery. Neither RA nor GA affects analgesia or adverse effects at home up to two weeks following ambulatory hand surgery.

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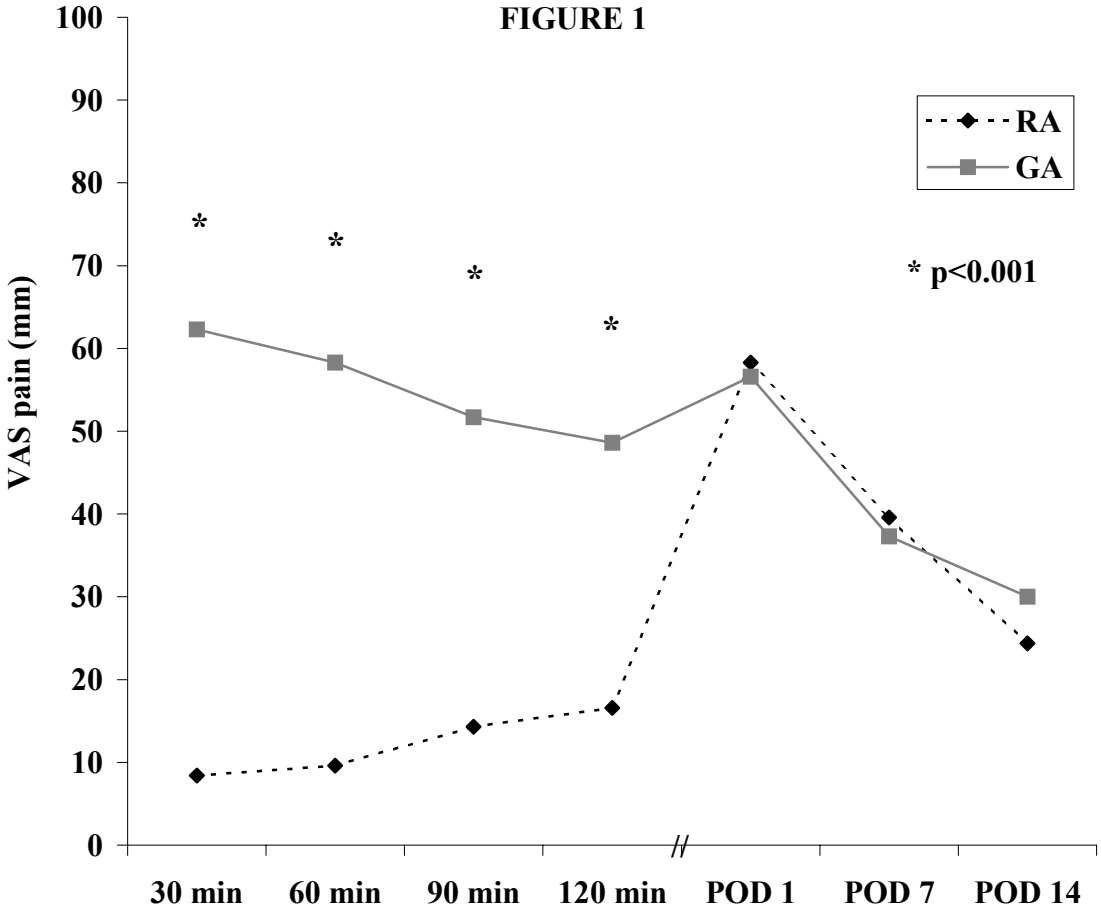
FIGURE 1


100
90
80
70
60
50
40
30
20
10
0
VAS pain (mm)
RA
GA
*
*
*
*
* p<0.001
30 min
60 min
90 min
120 min
POD 1
POD 7
POD 14

COMPARISON BETWEEN THE PAXPRESS™ AND THE PROSEAL™ LARYNGEAL MASK AIRWAY DURING ANESTHESIA

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INTRODUCTION: The PAxpress (PAx) is a new pharyngeal airway device. It has been shown to be effective and easy to insert(1). This prospective, randomized study compares the efficacy of the PAx with that of the ProSeal laryngeal mask airway (PLMA) during anesthesia in terms of ease of insertion, efficacy of seal, adequacy of ventilation and incidence of regurgitation.

METHODS: Hospital ethics committee approval and patients' informed consent were obtained. One hundreed anesthetized, paralyzed adults undergoing elective procedures were randomized to receive either the PAx (n=50) or the PLMA (n=50). Each patient had swallowed a methylene blue capsule prior to anesthesia. Insertion time and number of attempts were noted. Oropharyngeal leak pressures were measured at 50% and 100% of the maximum recommended cuff volumes. A fiberscope was used to view the glottis through the devices. Peak airway pressure and EtCO2 were noted two minutes later (standardized tidal volume). Airway devices were inspected for blood or blue staining upon removal. An interview was conducted 24h later to inquire about dysphagia and dysphonia.

RESULTS: The two groups were comparable with respect to demographic and surgical characteristics. Study results are shown in the table:

Variable		PAx	PLMA	P value
Insertion time (s)		52±44	34±23	0.0003
Attempts (1/2/3/Failure)		38/8/2/2	42/5/1/2	NS
Oropharyngeal leak pressure				
-50% recommended volume		18±8	22±7	0.016
-100% recommended volume		27±7	30±7	NS
Peak airway pressure (cmH2O)		19±6	16±4	0.0268
EtCO2 (mmHg)		33±4	31±3	0.04
Fiberscopic view of the cords (obstructed 1/2/3/4 unobstructed)		8/16/9/15	4/10/19/15	NS
Blood on device (yes/no)		28/20	9/39	0.0001
Blue stains upon removal (yes/no)		5/43	4/44	NS
24h postoperatively				
(none /light	Dysphagia	10/13/15/6	24/15/7/2	0.002
/moderate/ severe)	Dysphonia	27/11/6/0	33/12/2/1	NS

DISCUSSION: The PAx is an acceptable alternative to the PLMA for positive pressure ventilation during routine surgery. However, it takes more time to insert and is associated with slightly higher peak airway pressures and end-tidal CO2. The PAx is also more traumatic and is associated with more postoperative discomfort.

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SUB-MAC CONCENTRATIONS OF ISOFLURANE TARGET NOVEL MURINE $GABA_ARs$

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INTRODUCTION

Sub-anesthetic concentrations of propofol, midazolam and volatile anesthetics produce amnesia without causing sedation, immobility and unconsciousness.[1-2] The mechanisms by which sub-anesthetic concentrations produce amnesia are unknown. It is believed that enhancement of inhibitory current mediated by synaptic $GABA_A$ receptors ($GABA_ARs$) is the predominant mechanism of action of most anesthetics. Our laboratory showed that an extrasynaptic tonic inhibitory conductance in hippocampal neurons is sensitive to low concentrations of intravenous anesthetics[3] . Here, we test the hypothesis that the tonic inhibitory conductance is highly sensitive to volatile anesthetics due to the unique subunit composition of the underlying $GABA_ARs$.

METHODS

Animal protocols were approved by the University of Toronto Animal Care Committee. Whole-cell currents were recorded from HEK 293 cells transfected with human $GABA_ARs$ cDNA ($\alpha1\beta3\gamma2L$ or $\alpha5\beta3\gamma2L$), and from cultured hippocampal neurons obtained from wild-type and genetically modified mice lacking the α5-subunit of the $GABA_ARs$ (α5-/- knock-out mice). Data are expressed as mean ± SEM and $p<0.05$ was considered significant.

RESULTS

Sub-MAC concentrations of isoflurane (25 μM; 0.1 MAC) reversibly enhanced the tonic current (166 ± 24.9%, $n = 10$, $p < 0.01$). Moreover, results from transfected HEK 293 cells and hippocampal neurons of α5-/- knock-out mice indicate that isoflurane enhanced the tonic conductance by selectively targeting $GABA_ARs$ containing the α5 subunit.

DISCUSSION

Volatile anesthetics can cause amnesia at concentrations well below those required to cause sedation, unconsciousness and immobility. These results suggest that volatile anesthetics induce the amnestic effects through enhancement of the tonic current in hippocampal neurons by targeting α5-containing $GABA_ARs$. Our data also implicate the α5-containing $GABA_ARs$ as playing a critical role in learning and memory processes[4].

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A SIMPLE CALCULATION FOR WARMING SALINE USING A MICROWAVE

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INTRODUCTION

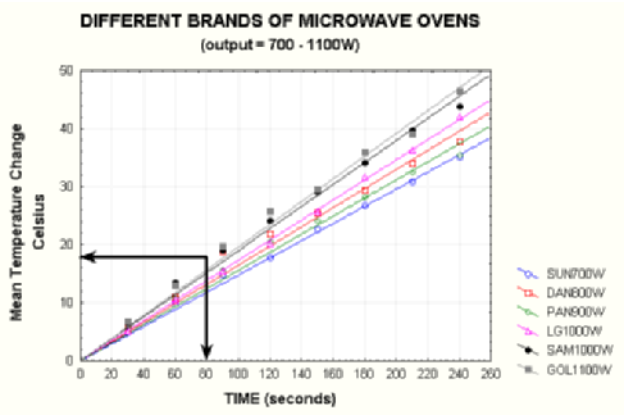
The use of microwave ovens to heat IV (crystalloid) fluid has long been utilized. There is no simple method to estimate the temperature of IV fluid after a certain time exposure in the microwave oven. We hypothesize that a linear function exists which relates the temperature rise of IV fluid to the time of exposure and the output of the microwave oven. If so, this function could be used to perform a simple calculation to predict the temperature of a 1L bag of saline after a specific time exposure based on the power of the microwave oven.

METHODS

Six different brands of microwave ovens were tested (700-1100W). For each microwave oven, a total of 40 (1L) saline bags at room temperature were tested. The initial temperature of each saline bag was measured prior to heating. Five saline bags were individually heated for 30 seconds on high power. The final temperature and temperature difference were then recorded. This procedure was repeated with new saline bags for 60, 90, 120, 150, 180, 210 and 240 seconds.

RESULTS

The figure shows that the rate at which the temperature of IV fluid rises is linear to the duration of exposure for all microwave ovens tested (R^2 >0.98). The rate of temperature rise is also linear to the manufacturer's stated output of each individual microwave oven.



DISCUSSION

Based on these results, a simple algorithm (temperature rise = 0.185 x output (kW) x time (sec)) (R^2=0.99) can be used to estimate the time required to increase the temperature of a 1L bag of normal saline based on the stated output of the individual machine. Limiting the microwave heating time of room temperature saline to less than 80 seconds would safely avoid overheating (i.e. < 18º temperature rise).

EFFECT OF REACTIVE HYPEREMIA ON FOREARM VEIN AREA – A PILOT STUDY

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INTRODUCTION

Reactive hyperemia is a transient increase in organ or limb blood flow following a brief period of ischemia. The purpose of this study was to determine the effect of reactive hyperemia on human forearm vein area.

METHODS

Following University of Saskatchewan Biomedical Research Ethics Board approval, twenty consenting adult subjects were studied. Exclusion criteria included: hypertension, neural or vascular limb disorders, pregnancy, and allergy to ultrasound gel. Ischemia was achieved with a tourniquet inflated on the upper arm to 200 torr, or to 25 torr for non-ischemic comparison.

All subjects received four treatments. The tourniquet was inflated on: 1) one arm to 25 torr for 2 minutes; 2) the same arm to 200 torr for 2 minutes; 3) the alternate arm to 25 torr for 5 minutes; and 4) the alternate arm to 200 torr for 5 minutes. Subjects were randomized by computer generated number table as to arm and as to order of treatment. After each treatment, serial ultrasound measurements of a predetermined forearm vein were made and recorded. A ten minute rest period preceded the next treatment.

RESULTS

Following a 2 minute ischemic period, the median vein area increased by 1.46 times compared to a non-ischemic tourniquet of 25 torr ($P<0.0001$), and by 1.17 times after a 5 minute ischemic period ($P<0.001$). After 5 minutes of ischemia, the vein area was transiently smaller prior to dilation, with the median vein area decreasing by 0.769 times ($P<0.01$). Order of treatment had no effect.

DISCUSSION

Numerous studies have demonstrated the effect of reactive hyperemia on the arterial system in human limbs.[1,2] However, the effect of reactive hyperemia on venous area has not been well studied.[3] This study demonstrates that reactive hyperemia briefly decreases, then increases, forearm vein area. The placement of peripheral intravenous catheters may be facilitated by using reactive hyperemia to dilate the veins.

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METOPROLOL AFTER VASCULAR SURGERY (MaVS)

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INTRODUCTION: In vascular surgery, β-blockers are increasingly used to prevent peri-operative cardiac complications. This is a report of a RCT on the peri-operative use of metoprolol.

METHODS: After REB approval, patients undergoing abdominal aortic surgery, infra-inguinal or extra-anatomical revascularization were recruited to a double-blind RCT of peri-operative metoprolol versus placebo. Consenting eligible patients were randomized to either IV/oral metoprolol or placebo 2 hours pre-op. Study medication was continued IV q6h or po bid until hospital discharge or maximum 5 days post-op. The primary outcome on an intent-to-treat basis was the 30-day post-op composite incidence of non-fatal MI; unstable angina; new CHF; new atrial or ventricular dysrhythmia requiring treatment; or cardiac death.

RESULTS: 497 patients consented and were randomized: 247 metoprolol and 250 placebo. The groups were balanced in demographics and pre-op co-morbidities. Early study drug discontinuation was 12% in placebo and 13% in metoprolol patients. One or more events in the primary outcome cluster occurred in 30 (12.0%) placebo and 25 (10.1%) metoprolol patients. The risk difference, -1.9% (CI -7.6% to 4.0%), was not significant (p=0.40). The observed effects in the primary cluster are shown (Table). Intra-operatively, more metoprolol patients had bradycardia requiring treatment (53/247 vs 19/250, p=0.00001) and hypotension requiring treatment (26/250 vs 84/247, p=0.0046).

DISCUSSION: This is the largest peri-operative β-blocker RCT completed to-date. An unblinded study [1] on 112 patients found a 10-fold reduction in MI and cardiac mortality. Our study was double-blinded and our patients were considered moderate/high risk. Another study reported 17-32% cardiovascular event rate[2]. It was under-powered to detect 30-day treatment effects although an effect beyond 6 months was noted. Our event rate was lower than previous reports, decreasing the study's calculated power to detect 50% RRR from 80% to about 40%. In summary, our preliminary 30-day results did not support a clinically useful metoprolol effect in reducing the cardiac event rate in these vascular patients. The 6-month and longer-term follow-ups have yet to be completed.

	Primary Outcome	Cardiac Death	Non-fatal MI	New CHF	Unstable Angina	Dysrhythmia	Non-cardiac Death
Metoprolol	25(10.1%)	0(0.0%)	19(7.7%)	5(2.0%)	0(0.0%)	7(2.8%)	1(0.4%)
Placebo	30(12.0%)	1(0.4%)	21(8.4%)	3(1.2%)	1(0.4%)	10(4.1%)	6(2.4%)
p-value	0.4	1	0.87	0.5	1	0.62	0.12

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EFFICACY OF PCEA vs PCEA + CIEA FOR AMBULATORY LABOUR ANALGESIA

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INTRODUCTION: The utilization of patient controlled epidural analgesia (PCEA) delivery systems for labour reduces the amount of epidural medication (1,2) and need for anesthesiologist-delivered supplemental analgesia (1,3) compared to continuous infusion epidural analgesia (CIEA). To date, no studies have evaluated the efficacy of ambulatory labour analgesia (4) nor need for Anesthesiologist-administered "top ups" when PCEA alone is compared to PCEA + CIEA. Therefore, the purpose of this prospective, randomized, double-blinded study was to compare the impact of PCEA vs PCEA + CIEA on labour analgesic efficacy and need for Anesthesiologist-administered "top ups".

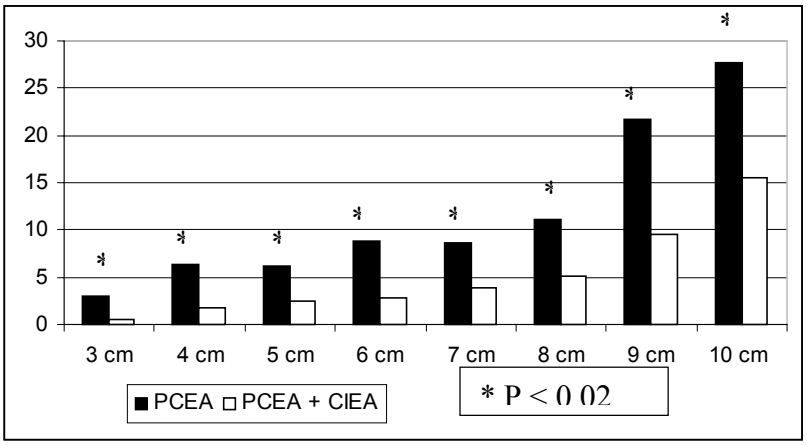
METHODS: This study was conducted between Jan 2000 and Dec 2003. Following IRB approval and written informed consent, 300 nulliparous women undergoing induced labour, determined to be in established labour, <6 cm dilated and requesting labour epidural analgesia (LEA) were randomized. LEA was established with 20 ml of 0.8% Ropiv + 2 μg/ml Fent (4), with each woman then randomized to receive this same analgesic solution either via PCEA alone (5 ml bolus; 10 min lockout, No 4 hour limit) alone or PCEA (5 ml bolus; 10 min lockout, No 4 hour limit) plus CIEA (10 ml/hr) in a double-blind manner to maintain LEA. LEA and obstetric management were predetermined using strict protocols. An "a priori" decision was made to analyze only the data for a vaginal delivery to eliminate the potential impact of "dystocia" which has a higher analgesic requirement. Data analysis included 2-tailed unpaired T-test and Chi square with $P<0.05$ considered significant.

RESULTS: 211 women of the 300 randomized, 104 (73.8%) PCEA alone and 107 (73.6%) PCEA + CIEA delivered vaginally and were included in the analysis. There were no statistical differences in demographics, method of labour induction, cervical dilation at time of LEA initiation, gestational age, VAS pain scores prior to LEA and 30 min post LEA initiation and neonatal weight. 3 PCEA (2.8%) withdrew due to inadequate analgesia and 1 PCEA + CIEA (0.9%) withdrew. VAS Pain scores were significantly higher ($P<0.02$) at each cervical dilation between 3-10 cm in PCEA vs PCEA + CIEA (Figure 1). Significantly more women required Anesthesiologist-administered supplemental "top ups" with 43 PCEA (41.3%) requiring a total of 64 "top ups" and 29 PCEA + CIEA (27.1%) requiring a total of 45 "top ups" ($P<0.03$). Mean postpartum analgesic satisfaction was significantly greater at 2 hrs with PCEA + CIEA (90.3 ± 12.6) vs PCEA (84.2 ± 20.9) and 24 hrs with PCEA + CIEA (90.6 + 10.9) vs PCEA (84.7 + 21.1), both $P<0.02$.

DISCUSSION: PCEA + CIEA at 10 ml/hr, utilizing 0.08% Ropiv + 2 μg/ml Fent, provides more effective labour analgesia with significantly fewer Anesthesiologist-administered supplemental "top ups" and greater maternal postpartum labour analgesia satisfaction compared to PCEA alone.

REFERENCES: 1. CJA 40:211-7, 1993; 2. CJA 35:249-54, 1988; 3. IJOA 2:73-7, 1993; 4. Anesth Analg 90: 1384-9, 2000

Figure 1: Labour VAS Pain Scores at Cervical Dilatation



RCT COMPARING PCEA vs PCEA + CIEA ON LABOUR OUTCOME

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INTRODUCTION: Patient controlled epidural analgesia (PCEA) delivery systems permits labouring women to determine the amount and timing of epidural analgesic medication for labour pain relief. Although PCEA reduces the amount of epidural medication received by labouring women compared to continuous infusion epidural analgesia (CIEA) (1,2), there have been no studies of sufficient size to detect differences in obstetrical outcomes when PCEA alone is compared to PCEA + CIEA. Importantly, the impact of PCEA $\pm$ CIEA on the outcome of labour has yet to be properly evaluated using ambulatory epidural analgesics (3). Therefore, the purpose of this prospective, randomized, double-blinded study was to compare the impact of PCEA vs PCEA + CIEA, using ambulatory labour analgesia, on the incidence of cesarean delivery (**C-D**) and instrumented (forcep or vacuum) vaginal delivery (**IVD**).

METHODS: This study was conducted between Jan 2000 and Dec 2003. Following IRB approval and written informed consent, 300 nulliparous women undergoing induced labour, determined to be in established labour, <6 cm dilated and requesting labour epidural analgesia (LEA) were randomized. LEA was established with 20 ml of 0.8% Ropiv + 2 μg/ml Fent (3), with each woman then randomized to receive this same analgesic solution either via PCEA (5 ml bolus; 10 min lockout, No 4 hour limit) alone or PCEA (5 ml bolus; 10 min lockout, No 4 hour limit) plus CIEA (10 ml/hr) in a double-blind manner to maintain LEA. LEA and obstetric management were predetermined using strict protocols. Data was analyzed using an intent-to-treat model, major protocol violations (MPV) excluded. Data analysis included 2-tailed T test with $P<0.05$ considered significant.

RESULTS: 150 women were randomized in each group with no statistical differences in demographics, method of labour induction, cervical dilatation at time of LEA, gestational age, VAS pain scores prior to LEA and neonatal weight. Several MPV were identified in each group including 9 PCEA (1 “wet tap”; 8 epidural catheter replacements) and 6 PCEA + CIEA (1 “wet tap”; 3 epidural catheter replacements; 1 undiagnosed breech in 2nd stage; 1 PCEA pump programmed incorrectly). Therefore, the treatment allocations were administered to 141 women in the PCEA group and 144 women in the PCEA + CIEA group. Women in the PCEA group received significantly less epidural Ropiv (45.2 $\pm$ 34.1 mg) compared to PCEA + CIEA (78.6 $\pm$ 39.9 mg) $P<0.0001$. There were no statistical differences in the duration (min) of the 1st stage of labour with PCEA (414 $\pm$ 249) and PCEA + CIEA (455 $\pm$ 254) and 2nd stage with PCEA (127 $\pm$ 86) and PCEA + CIEA (144 $\pm$ 114) or incidence of **C-D** with 37 PCEA (26.2%) and 37 PCEA + CIEA (25.7%), **IVD** with 43 PCEA (30.5%) and 48 PCEA + CIEA (33.3%), or neonatal pH <7.20 and APGARS <7.

DISCUSSION: LEA using 0.08% Ropiv + 2 μg/ml Fent delivered by PCEA alone and PCEA + CIEA (10 ml/hr), provides effective analgesia throughout labour. Although, PCEA alone significantly reduces the amount of ambulatory epidural medication parturients receive during labour, our investigation did not identify any benefit to utilizing PCEA alone with regard to labour or neonatal outcome.

REFERENCES: 1. CJA 40:211-7, 1993; 2. CJA 35:249-54, 1988; 3. Anesth Analg 90: 1384-9, 2000

IN CARDIAC SURGERY, BLOOD VOLUME ACCOUNTS FOR THE INCREASED RISK IN WOMEN

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BACKGROUND: The risk of death after cardiac surgery is higher in women than in men. The reason for this difference is still unclear. It has been known that women have a substantially smaller circulation blood volume (CBV) than men, which means that they become more anemic during surgery and receive red blood cell (RBC) transfusions more often. The objective of this study was to determine if these two variables account for the increased risk of death in women after cardiac surgery with CPB.

METHODS: After REB approval, data were prospectively collected on consecutive patients undergoing cardiac surgery with CPB from 1999 to 2003 in an academic hospital. Two multivariable logistic regression models were constructed to determine the independent predictors of in-hospital, all-cause mortality. Model 1 mimicked previous studies and assessed the relationship between gender and mortality by adjusting for multiple perioperative variables excluding those related to intraoperative anemia and RBC transfusion. Model 2 included the latter variables (measured as nadir hematocrit during CPB (nHct) and transfusion of ≥ 2 units of RBCs on the day of surgery) as well as the variables included in model 1. The relationships between gender and mortality in these models were examined.

RESULTS: Of the 9215 patients who underwent cardiac surgery with CPB, 169 (1.8%) died. The unadjusted risk of death was higher in women than men [68/2316 (2.9%) vs. 101/6899 (1.5%); $P<0.0001$ (chi-squared test)]. Compared to men, women were more anemic during surgery [mean nHct 20% vs. 24%; $P<0.0001$ (t-test)] and received ≥ 2 units of RBCs more often [52% vs. 22%; $P<0.0001$ (chi-squared test)]. In model 1, gender was independently related to risk of death, with the odds of death 1.6 times higher in women (95% C.I. 1.1 – 2.3; $P=0.015$). In model 2, however, gender was no longer independently related to risk of death ($P=0.2$); it was replaced by nHct ($P=0.01$) and RBC transfusion ($P=0.001$).

CONCLUSION: Female gender is not independent risk factor for death during cardiac surgery with CPB when factors related to perioperative anemia and RBC transfusion are adjusted for. The increased risk of death in women, therefore, is due to their smaller CBV.

ANEMIA INCEASES RAT CEREBRAL CORTICAL nNOS PROTEIN LEVELS

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INTRODUCTION: Increased cerebral cortical neuronal nitric oxide synthase (nNOS) expression has been identified following exposure to hypoxic environmental conditions (1) and may mediate the associated compensatory increase in cerebral blood flow (CBF) observed during hypoxia (2). As such, nNOS may contribute to neuroprotective mechanisms directed at optimizing CBF during hypoxia. The current study tests the hypothesis that acute hemodilutional anemia causes cerebral hypoxia triggering an increase in cerebral nNOS protein levels at clinically relevant hemoglobin concentrations.

METHODS: With Animal Care Committee approval, anesthetized rats underwent tail artery and vein cannulation to monitor arterial pressure and performing hemodilution. Hemodilutional anemia was achieved by exchanging 30 $ml \cdot kg^{-1}$ of blood with pentastarch over 10 minutes. Hemoglobin concentrations were assessed by co-oximetry. Control animals were not hemodiluted. Animals exposed to hypoxia (10% oxygen) served as positive controls. Rats were recovered for 6,12, 24, 48 hours, 4 and 7 days (n=6 rats/group/time). Cerebral cortical nNOS levels were assessed by Western blot analysis. Band density was quantified digitally and reported as $pixels \cdot \mu g\ protein^{-1}$. A two-way ANOVA and post hoc Tukey test were used to assess data. Significance was assigned at $p < 0.05$ (Mean ± SD).

RESULTS: The hemoglobin concentration in anemic rats decreased to 64 ± 11 $g \cdot L^{-1}$ following hemodilution ($p<0.05$) and then increased toward control values by 7 days. At 12 hours, there was a significant increase in cerebral cortical nNOS protein in both anemic (1,847 ± 195) and hypoxic rats (2,145 ± 138), relative to controls (1121 ± 295) ($p<0.05$). At 24 hours, nNOS protein remained significantly elevated in hypoxic rats but returned toward control values in anemic rats (1,643 ± 302).

DISCUSSION: Acute hemodilutional anemia caused a transient increase in cerebral cortical nNOS protein, which diminished as the hemoglobin concentration recovered toward control values. Hypoxia produced a more sustained increase in nNOS, supporting the hypothesis that hypoxia may have triggered the increase in nNOS observed in anemic rats. Increased nNOS may contribute to endogenous cerebral neuroprotective mechanisms invoked to protect the brain during anemia. (CAS, PSI Support).

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IMPACT OF FAST-TRACKING ON RECOVERY TIME AND NURSING WORKLOAD

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INTRODUCTION: Bypassing the post anesthesia care unit (PACU) may decrease recovery time after ambulatory surgery and may result in cost savings from a reduced nursing workload. This prospective randomized study evaluated the effects of bypassing PACU on patient recovery time, nursing workload and costs.

METHODS: After obtaining institutional ethics committee approval, 207 adult patients undergoing hysteroscopy, arthroscopy or gynecological laparoscopy were enrolled in this study. Anesthesia was induced with propofol and fentanyl and maintained with desflurane or sevoflurane. All patients received analgesic and anti-emetic prophylaxis. The electroencephalographic bispectral index values were maintained at 40-60 intraoperatively. On completion of the procedure, patients were randomized to either fast-tracking or routine recovery group. Patients in the fast-tracking group were transferred directly to the ambulatory surgery unit (ASU) when they achieved a fast-tracking score of ≥ 12 [1] within 10 minutes. All other patients were transferred to PACU prior to the ASU. Postoperative nursing workload was recorded using a Patient Care Hour (PCH) chart, based on the type and frequency of nursing interventions in the PACU and ASU. A cost associated with this nursing workload was calculated. Postoperative pain, nausea, overall patient satisfaction and time to discharge home was also recorded.

RESULTS:

	Fast-tracking Recovery				Routine Recovery			
	Overall	Lapar-oscopy	Hyster-oscopy	Athros-copy	Overall	Lapar-oscopy	Hyster-oscopy	Arthros-copy
Number (n)	110	36	44	30	97	28	42	27
Patients bypassing PACU (n, %)	89,81	26,72	34,77	29,97	0	0	0	0
Satisfaction with recovery (excellent / good/ fair/ poor) (n)	(44/61 5/0)	(14/19 3/0)	(18/26 0/0)	(12/16 2/0)	(40/55 2/0)	(11/16 1/0)	(18/24 0/0)	(11/15 1/0)
Time to discharge home (min)	123±54*	142±49	106±70*	98±23*	140±50	144±35	149±72	133±42
Patient Care Hour	2.1±0.8	2.2±1.1	2.2±0.6	1.9±0.4*	2.3±0.7	2.3±0.5	2.3±0.4	2.3±0.4
Nursing cost (PACU + ASU) ($)	249±103	267±134	261±101	212±42*	269±44	273±54	271±41	262±40

Values expressed as mean ± standard deviation ; *P < 0.05

DISCUSSION: Bypassing PACU significantly decreased the patient's recovery time in hospital without increasing postoperative side-effects or compromising patient satisfaction. However, the nursing workload and the associated cost were not significantly affected.

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DO ANESTHESIOLOGY RESIDENTS WANT TO BE INVOLVED IN RESEARCH?

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INTRODUCTION: Controversy continues regarding the role of research activity during residency training.[1] This study was undertaken to assess perceptions and attitudes towards research training in Canadian anesthesiology residency training programs.

METHODS: With institutional approval, a national mail survey was distributed in November 2003 to all 476 anesthesiology residents and 16 program directors.

RESULTS: Descriptive analysis of 171 resident questionnaires was completed, to date. Approximately 60% of residents are involved in a research project, which include case reports, poster presentations, or abstract submission. Despite the finding that 85% of residency programs have mandatory research requirements, 60% of residents feel research should not be a mandatory component of residency training. Program directors indicate a lack of resident and faculty interest in research as the two main impediments to resident participation. However, residents indicate that continuing a project during non-anesthesia rotations is one of the most common institutional barriers (35%). Rationale for lack of research participation provided by the residents includes: lack of interest; the need to learn 'clinical' anesthesia; and the time commitment required. The majority of resident (90%) and program director (85%) respondents see the importance of acquiring protected time to undertake a research project and ranked this as somewhat to very influential. Interestingly, 74% of residents suggest alternatives to undertaking a research project. Transesophageal echocardiography (TEE) skills, teaching courses, and administration programs, were cited most often. One third of residents indicate an interest in an academic career, involving research.

DISCUSSION: Is a mandatory research project during residency necessary? Although most programs require residents to undergo an intellectual inquiry of some form, 75% of residents would prefer spending time in an alternate learning endeavor. Currently, residents feel the biggest barrier to research is the lack of time. Many residents feel that it is important to add to the body of anesthesiology knowledge – not necessarily during residency.

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MANAGEMENT OF ARRHYTHMIAS USING HIGH-FIDELITY SIMULATION

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INTRODUCTION

The Department of Anesthesia introduced a "Simulation Day" as part of the fourth year undergraduate rotation providing opportunities to apply pharmacological principles in the management of common cardiac arrhythmias in a high-fidelity Simulation Centre. Students were given the Advanced Cardiac Life Support (ACLS) guidelines and applied this knowledge by managing cases using a high-fidelity patient mannequin.

METHODS

Four scenarios were developed which included management of an unstable cardiac arrhythmia. Faculty involved in undergraduate education determined performance expectations for each scenario and identified 1 or 2 critical management items that, if omitted, could negatively affect patient outcome.

After ethics approval was granted, students were notified of the program. An anesthesia faculty member or resident facilitated each session. Student teams managed a patient scenario using the simulator and faculty completed the performance expectations checklist. After each pretest scenario was completed, feedback was given using a videotape of their performance as a template for discussion.

Students reviewed the ACLS current guidelines for the management of unstable cardiac arrhythmias and repeated the practise scenarios with the same team members. Faculty completed the performance expectations checklist for each posttest scenario.

RESULTS

The faculty identified four critical item expectations. Each scenario had one critical item identified and one scenario had 2 critical items identified. The number of student teams who did not omit the management item in the pre and posttest are summarized in Table 1. There was a statistically significant improvement in performance of critical items between pretest and posttest, $t=-4.538$, $p=0.02$. Most students increased the rate of intravenous infusion but the verbalization of their management plan or differential diagnosis remained an issue.

Table I: Percentage of student teams correctly identifying critical item

Critical issue addressed	N=29	N=29
	pre-test	post-test
Intravenous fluids increased	82.76	96.55
Give oxygen	76.5	83
Chest auscultation	86	93
Express possible cause	67	73

DISCUSSION

Significant improvement in team scores of critical items was noted following simulation-based education. Verbalization issues showed the least improvement following the simulation intervention. More attention should be paid to guiding students in the importance of communication in team management of critical events.

GLOBAL RATINGS TO ASSESS UNDERGRADUATE TEAM PERFORMANCES

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Global ratings are commonly measured outcomes in standardized examinations such as the Objective Structured Clinical Examinations (OSCE). Acceptable correlation between global ratings and performance checklist scores has been demonstrated. In a previous study using high-fidelity simulation, individual student performance checklist scores showed high correlation with global ratings of performance. [1] This study was designed to determine if global rating of *team* performance correlated with *team* performance checklist scores of undergraduates managing scenarios in a high-fidelity simulation centre.

METHODS

After a needs assessment, the undergraduate committee at the University of Toronto developed four scenarios which incorporated the management of unstable cardiac arrhythmias. Faculty developed performance checklists geared to the expectations of an undergraduate medical student. In addition, a global rating scale of performance using a 5-point Likert scale was developed (unacceptable, borderline, acceptable, good and superior). Each point on the scale had descriptors identifying performance criteria. Student teams managed a simulated case scenario before and after an educational session. Team management was scored by faculty using the performance checklists and global rating scale. Correlation between pretest and posttest performance checklist scores and global ratings scores were undertaken using SPSS 11.0.1.

RESULTS

Fifty-nine teams completed the study. Pearson's correlations between pre and posttest checklist scores to global ratings scores are summarized in Table 1.

Scenario	Pretest: Checklist/Global Rating	P value	Posttest: Checklist/Global Ratings	P value
1	.181	.519	.438	.102
2	.220	.431	.341	.213
3	.747*	.001	.531**	.042
4	.667*	.009	.658**	.011
ALL	.493*	.000	.472*	.000

* Correlation is significant at the 0.01 level (2-tailed)
**Correlation is significant at the 0.05 level (2-tailed)

Discussion

Overall, there was significant correlation between pre and posttest checklist scores and global ratings. The lack of correlation between the scores for scenarios 1 and 2 may reflect the validity of the checklists or observer bias. From the results of this study, both methods of evaluation should be done to capture the necessary information.

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MARKET SALARY IMPROVES RESEARCH PRODUCTIVITY UNDER AN AFP

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INTRODUCTION

The Department of Anesthesiology at Queen's University has been funded by an alternate funding plan (AFP) since 1994. Global funding is received for coverage of clinical, academic and administrative work. The amount of funding is negotiated based upon the number of full time equivalent (FTE) anesthesiologists and a salary per FTE position. Geographic full-time (GFT) and non-GFT positions comprise the staff. Both positions have clinical responsibilities but GFT staff also have academic and administrative duties. We hypothesize that a competitive market salary is important to attract sufficient numbers of GFT anesthesiologists to support an academic program.

METHODS

Retrospective data was collected from financial statements and annual reports of the Department of Anesthesiology at Queen's University from fiscal years 1994-2003. Data of the 75th percentile earnings of anesthesiologists in Ontario was obtained from the Ontario Medical Association. Pearson's correlation coefficient was used to assess the relationship between AFP salary per FTE (as a percentage of provincial 75th percentile earnings) and the number of GFT-FTE staff, abstract presentations, publications and the amount of research funding per year. Significance is reported at $P<0.05$.

RESULTS

There were significant positive correlations between AFP salary and number of GFT-FTE staff (r=0.795), number of abstracts (r=0.841), number of publications (r=0.907) and research funding (r=0.700).

Year	AFP Salary per FTE (% of 75th percentile)	GFT-FTE	Abstracts	Publications	Research Funding
1994	77%	17.8	5	14	$ 130,000
1995	76%	20.0	1	12	$ 256,702
1996	74%	19.0	12	16	$ 254,202
1997	74%	18.3	14	17	$ 300,464
1998	70%	15.0	13	13	$ 248,297
1999	81%	17.7	12	16	$ 563,551
2000	94%	21.3	28	39	$ 1,789,600
2001	93%	20.7	38	55	$ 201,785
2002	91%	23.4	31	37	$ 1,267,482
2003	85%	21.4	22	32	$ 934,741

DISCUSSION

The positive correlation seen above, and in particular, the increases in salary and research productivity after the year 2000 suggest that a competitive market salary has a significant impact upon academic productivity under an AFP. This results, in part, from the ability to recruit additional GFT staff.

CAS WEBSITE: HOW USEFUL IS THE SITE TO THE PUBLIC?

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INTRODUCTION: Providing appropriate information about anesthesia may improve patient safety and assists anesthesiologists in fulfilling their medico-legal implications. Information about anesthesia is available on the Canadian Anesthesiologist's Society (CAS) website for the public but is it accessed, read and the content understood by patients?

METHODS: Following ethics approval, 303 attending a tertiary care pre-admission clinic were asked to answer questions regarding internet access and were shown a printed copy of the public access material available on the CAS website. In addition, we requested the "Plain Word Services Division" of the Canadian Public Health Association to determine the readability of the CAS documentation. Standard measures of readability were used (Flesch-Kincaid readability test and the Simple Measures Of Gobbledygook (SMOG).1

RESULTS: All patients completed the survey questions: 48% had Internet access at home, 31% at work; 9 % knew that the CAS had a website; 76 % preferred to read a booklet instead of accessing a website. The anesthesia information on the CAS website is written at a level 11 to 13.

DISCUSSION: The Internet is not a perfect information tool for patients at this time, because few patients have access to it. Mortality and morbidity is increased in patients with medical illiteracy, consequently most educators recommend that written information provided to patients be at a grade 8 reading level. A Statistics Canada survey of reading ability indicates that illiteracy in Canada may be more severe a problem than heretofore recognized.2 These data suggest that written information aimed at the general public should be written at a grade 6 reading level. Of those who access the CAS website many may not understand the content adequately, since it is written at an inappropriate reading level.

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INFO BOOKLET: ENHANCING PATIENT COMPREHENSION ABOUT ANESTHESIA?

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INTRODUCTION: Providing a booklet to patients containing information about anesthesia is the simplest and least costly method of education. To be an effective means of communication, such material should be readable, concise and comprehensive. In optimal circumstances print based medical information should be written at a grade six reading level.[1] In this study we assessed what anesthesiologist discuss with patients, patients retention of information following provision of an information booklet and if this intervention altered the work load of the anesthesiologist subsequently assessing the patient.

METHODS: We initially surveyed our group to determine what issues they routinely discussed with patients, then wrote an anesthesia information booklet at a grade six reading level with the help of the Plain Word Services Division of the Canadian Public Health Association. The content of the booklet was drawn from patient information material published by Canadian Anesthesiologist Society and the French Anesthesiologist's Society. Following ethics approval, patients were randomized into 2 groups: Group 1 read the booklet and then met the consulting anesthesiologist; group 2 did not receive the booklet prior to consult. Subsequently, all patients and anesthesiologists completed a questionnaire.

RESULTS: Our pre-survey suggested that key anesthesia related risks (aspiration, awareness and intubation complications) were not routinely discussed by anesthesiologists in our group. The questionnaire was completed by 303 patients. There were no differences in demographic data between groups. Access to the booklet resulted in a better-informed patient with respect to the role of the anesthesiologist and safety issues. The 43 anesthesiologists who participated did not find that the number of questions asked by patients was reduced by the use of the booklet.

DISCUSSION: Providing adequate information to patients about the role of the anesthesiologist and the risks and complications of anesthesia is important but repetitive process. Our data suggests that education of patients could be considerably improved by the provision of an information booklet written at a grade 6 reading level prior to the preoperative anesthesia consultation.

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SUBCUTANEOUS KETOROLAC FOR POST OPERATIVE PAIN RELIEF

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INTRODUCTION: Subcutaneous route of analgesia has several advantages: low dose, less side effects, easy administration, patient safety and clinical effectiveness. This study was conducted to assess the efficacy of s/c infusion of ketorolac for post operative pain relief.

METHODS: The study was approved by institution ethics committee. 60 adult patients (asa i-ii) scheduled for major orthopedic surgery under ga were included. They were premedicated with tab diazepam 10 mg 90 minutes before surgery. Iv ketorolac 30mgs was injected just prior to induction. Ga was induced with sleep dose of inj.thiopentone and intubation after inj.suxamethonium (1.5mg/kg). Anesthesia was maintained with oxygen: nitrous oxide (33:66) vecuronium, halothane(0.5-1%). 3 hours after induction, they were randomly divided into 2 groups. Group**a**(n=30) received s/c ketorolac infusion 2mg(in 3ml)/hr and i/m saline (placebo) 1ml every 6 hours for 24 hours. Group **b** received s/c infusion of saline (placebo) 3ml/hour and i/m ketorolac 30 mg (1ml) every 6 hours. Monitoring was done using propaq 102 el monitor. Pain was assessed using vas, time for first rescue analgesia, 24 hours analgesic requirement.

RESULTS: Vas revealed higher pain scores in group **b** at 6,12,18,24 hours ($p<0.05$) (fig 1). 20 patients in group **a** and 22 patients in group **b** required rescue analgesiawithin 6 hours after surgery. The total dose was 48 mgs in group a and 120 mgs in group b. The cardio-respiratory parameters were comparable. Both s/c infusion and i/m bolus provided effective analgesia.(vas <5). However, the effect was sustained with s/c infusion and intermittent with i/m route.

DISCUSSION: Subcutaneous infusion of analgesics (opioids and non opioids) have been tried for pain relief with encouraging results (1-4) opiates are known to cause respiratory depression. Ketorolac trimethamine, an nsaid has been reported to be safe and effective (1-2).in the present study, ketorolac when given by i/m or s/c infusion produced effective analgesia for post operative pain. However,s/c infusion (48mgs) provided more sustained analgesia than i/m route (120mgs).

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THE PREVALENCE OF CHRONIC POST SURGICAL PAIN IN CANADA

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INTRODUCTION: Each year, there are approximately five million surgeries performed in Canada[1]**.** Invariably, acute pain will be associated with those surgeries. The literature suggests that if acute pain is not adequately managed, chronic pain can ensue[2,3]. The incidence of chronic pain after procedures such as thoracotomy may be as high as 50%[3].
METHODS: Discharge data on six common surgical procedures was obtained from the Canadian Institute of Health Information[1]. Chronic post surgical pain incidence and prevalence data were taken from the literature. Annual estimates of chronic post operative pain in Canada were calculated by multiplying the incidence or prevalence of chronic post surgical pain by the number of surgeries performed for each procedure.
RESULTS: In 1999-2000, over 72,000 new cases of chronic post surgical pain may have occurred in Canada after selected surgeries were performed (Table).
DISCUSSION: If, as suggested by the literature, the management of acute pain postoperatively has an impact on the development of chronic post surgical pain then adequate management of postoperative pain may alleviate both acute and chronic pain and suffering and their resultant costs. This study provides important information regarding the potential prevalence of chronic post surgical pain in Canada, however large prospective cohort studies are required in order to adequately determine the impact of acute pain management on the epidemiology of chronic post surgical pain.

Procedure	No. performed	Prevalence estimates	Estimated prevalence
Hysterectomy	55,404	16%-50%	8,865-27,702
Cholecystectomy	>50,000	21%-27%	>10,500->13,500
Hip Replace	19,853	3%-35%	596-6,949
Knee Replace	21,649	30%	6,495
Breast surgery	14,438[+]	13%-49%	1,877-7,219
Thoracotomy	16,305[++]	7%-67%	1,141-10,924
Total	**>177,649**	3%-67%	**29,474->72,789**

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PORTABLE COMPUTING AND ACUTE PAIN

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INTRODUCTION: The availability of real-time accessible clinical information at the point-of-care can facilitate evidence-based decisions[1] and contribute to continuous quality improvement[2], research[3], administrative and policy inititiatives[4]. The combination of wireless technology and hand-held computers facilitates data capture at the point of care. The advantages of handheld computers are their relatively low cost, their portability and unobtrusiveness, and their ease of data sharing.

METHODS: A portable wireless system utilizing handheld computers, tablets and a wireless infrastructure was created to advance clinical management and outcomes studies in acute pain management. Interfaces were developed with laboratory, pharmacy, and diagnostics allowing for real time access to patient information at the point-of-care. Clinical alerts provide clinicians with notification of the availability of test results, including alerts of abnormal laboratory values and potential medication interactions. Goals of the system include error reduction, access to evidence at the bedside, improved clinical productivity, and the availability of data for research, quality improvement and administrative purposes. Preliminary studies before implementation of the wireless infrastructure indicated that the acute pain software on a handheld computer was both valid and efficient[1,5].

RESULTS: This study included data captured from June to November 2002, on 3,454 patients who had an average of 4 assessments each. The average length of stay on the acute pain service was 2.5 days. Twenty-nine percent of patients had experienced general surgery, 28% orthopedic, and 13% gynecologic. The median Visual Analogue Scale pain scores were 0 (25^{th}, 75^{th} percentiles = 0, 2.0) at rest and 3.0 (0, 4.0) with activity. The incidence of nausea was 11%. Gynecology patients had the highest incidence of pain and nausea.

DISCUSSION: As a result of the findings of the pilot study, other electronic modules are being developed, including preoperative assessment, patient self-assessment, and intraoperative anesthetic management. Future studies will assess these electronic systems in terms of perioperative management and patient outcomes.

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CRITICAL INCIDENTS AMONGST 10033 ACUTE PAIN PATIENTS

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INTRODUCTION:

The purpose of this study was to determine the incidence of notable events and serious side effects that could lead to patient morbidity or mortality (critical incidents) amongst APS patients in four academic hospitals in Canada.

METHODS:

This was a prospective cohort study. A computerized clinical database (APS Manager) was designed to capture relevant outcomes from APS patients, including: baseline demographics, surgery, acute pain treatment, visit information, and critical incidents. The database was installed in three hospitals in Hamilton in February 2002 and in the Toronto General Hospital in March 2003. Acute pain nurses, who rounded on the patients daily from Monday to Friday, collected data prospectively. Critical incidents that occurred on weekends or holidays were investigated retrospectively. Data was extracted in January 2004 for analysis. Percentages were calculated from total enrollments except for epidural related events (abscess and hematoma).

RESULTS:

A total of 10033 patients were enrolled representing 15673 patient visits for all 4 hospitals. These patients were treated with 7490 PCAs, 4300 epidurals, 65 intrathecal catheters, 21 continuous nerve blocks and 261 adjunctive analgesics (non-PCA narcotics or NSAIDs). The number and percentage of critical incidents are shown in Table 1.

Table 1. Critical Incidents

	Overall	McMaster University	Henderson General	Hamilton General	Toronto General
Number of patient enrollments	10033	2639	3314	1886	2194
Days of data collection	695	658	695	645	312
Critical Incidents					
Severe hypotension	137 (1.37%)	18 (0.94%)	31 (.94%)	74 (3.98%)	15 (0.53%)
Respiratory depression	61 (0.61%)	34 (1.21%)	8 (0.24%)	11 (.58%)	8 (0.28%)
Death	3 (0.03%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	3 (0.11%)
Cardiac arrest	3 (0.03%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	3 (0.11%)
Unresponsive	2 (0.02%)	1 (0.04%)	0 (0.00%)	0 (0.00%)	1 (0.04%)
Epidural abscess	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Spinal hematoma	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Error in pump programming	19 (0.19%)	4 (0.02%)	0 (0.00%)	9 (0.48%)	7 (0.25%)

Severe hypotension – SBP ≤ 80 mmHg

Respiratory depression – respiratory rate < 6 or requirement of naloxone for resuscitation

DISCUSSION:

Overall, a critical incident occurred in 1 in out of every 44 patients. Severe hypotension, respiratory depression and pump programming errors were the most common events. In order to collect relevant data on rare APS outcomes it is necessary for multiple sites to collaborate in their data collection. Although the pain treatments employed by Acute Pain Services have advanced the quality of analgesia therapy it is important to note that there is risk associated with them. Further research is ongoing to ascertain the risk factors for critical incidents.

SELF-ADMINISTERED NITROUS OXIDE FOR INCIDENT PAIN IN TERMINALLY ILL

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INTRODUCTION: Incident pain occurs in opioid-dependent terminally ill patients during mobilization, and diagnostic and therapeutic procedures. It is often acute, severe and of short duration, thus an ideal analgesic modality to treat incident pain would be potent, rapid onset, titratable and short-acting, without significant impairment of consciousness. Previous unblinded work showed mixed results using nitrous oxide for this problem.[1] We conducted a double-blinded, crossover pilot protocol comparing the effects of self-administered nitrous oxide with a placebo gas for the treatment of incident pain.

METHODS: After institutional ethics approval and consent, 7 adult hospital in-patients were studied. All patients were terminally ill with metastatic cancer, requiring chronic opioid therapy. Patients enrolled were anticipated to have stable symptoms and medication requirements over the following two days. The protocol consisted of a 10 hour monitoring period on each of two consecutive days, in which patients had access to the blinded apparatus administering either 50% nitrous oxide in oxygen, or an oxygen enriched air mixture in a randomized order. Patients were encouraged to use the apparatus prior to and during incidents anticipated to cause increased pain. Pain scores, drowsiness scores and hemodynamic values at baseline and during incidents were documented, as well as rescue opioids.

RESULTS: Patients were heterogeneous at baseline with respect to disease, opioid requirements, type of pain, coanalgesics, and radiotherapy treatment. In 5 patients, there was a reduction in mean pain change due to incidents. The other 2 patients showed no effect on pain scores, but indicated a preference for the nitrous oxide day. There was no difference in requirement for breakthrough opioids, no hemodynamic changes, and no increase in drowsiness scores associated with nitrous oxide.

DISCUSSION: This pilot study suggests a benefit for self-administered nitrous oxide in most patients, without impairment of consciousness, in contrast with previous reports. [1] The effects are variable, possibly due to the heterogeneity of the population, the multiplicity of concurrent analgesic regimens, and a possible cross tolerance effect with opioids.[2] However nitrous oxide remains an option for opioid dependent patients with this difficult pain problem.

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COST-IDENTIFICATION ANALYSIS OF AN ACUTE PAIN SERVICE.

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INTRODUCTION

Economic studies are needed to support decision-making and planning of perioperative services. In spite of high interest to the economic implications of an acute pain service (APS), there is a shortage of publications on this issue. The data about costs related to an APS are controversial. The purpose of this study is to evaluate two models of an APS staffing in terms of costs.

METHODS

To identify costs of an APS we used monthly cost center reports for six consecutive months. To evaluate different models of APS functioning we used break-even analysis. The analysis calculates a break-even point based on fixed costs, variable costs per patient, and savings per patient. Physicians' reimbursement cost calculations was not included in the evaluated models since it is not a part of the APS budget.

RESULTS

The APS, staffed with 1.5 Acute Care Nurse Practitioner's (ACNP's) and supervised by anesthesiology, consuls an average of 278 new patients/month. The average duration of patients on the APS is 4 days. Based on the results of cost-identification and break-even analysis and considering one- months APS budget average per-patient variable cost of the APS is 67.02CAD. Increasing the APS staff at Sunnybrook campus to three ACNP's will increase average per-patient variable cost up to 122.72CAD. According to this model the APS budget would increase from 239,670CAD to 439,172CAD/year, whilst keeping the break-even point at only 34 patients per month.

DISCUSSION

Reported average per-patient APS costs are highly variable from 3 USD to 242 USD. The costs are related to many factors, including the type of healthcare system organization, APS staffing and functioning, and whether the calculations are made for patients in a ward or an ICU (43 – 247 USD). Our findings correspond to these data. According to the break-even analysis, increasing the APS staffing to three ACNP's will have a relatively small impact on the budget, while striving for a reduced length of stay, improvement in patients satisfaction and meeting accreditation standards in pain management.

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ASSESSMENT OF PATIENT SATISFACTION WITH AWAKE CRANIOTOMY

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INTRODUCTION

Awake craniotomy with brain mapping allows for optimal resection of brain tumors close to eloquent cortex. Different anesthetic techniques have been described. The aim of this study was to assess the satisfaction of patients with awake craniotomy performed completely under local anesthesia and conscious sedation.

METHODS

With IRB approval we prospectively assessed the subjective experience of awake craniotomy by conducting interviews at 1, 4 and 24 hr postoperatively. Patients were questioned about recall of procedure, intraoperative pain, discomfort and anxiety, and overall satisfaction. Anesthetic agents used, perioperative complications, discharge time and outcome were documented.

RESULTS

Thirty-two patients (16 males, 16 females) with mean ±SD age 47±13yr, weight 76±17kg were studied. All patients had Glasgow Coma Score of 15. Local anesthesia (bupivacaine) was used for insertion of head pins and incision. Conscious sedation included 2.2±1.8mg midazolam (n=32), 599±583mg propofol (n=30), 180±137ug fentanyl (n=31), and 0.25±0.15mg remifentanil (n=13). Duration of procedure was 193±95min. 11 patients (34%) were discharged same day, remainder at 2.2±2.2days. Satisfaction results are in table. At 24 hours 91% of patients were completely satisfied with their experience. For most patients there was consistency in their responses over the 24 hours.

DISCUSSION

Awake craniotomy with local anesthesia and conscious sedation is an acceptable technique that provides good patient satisfaction.

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Postoperative patient satisfaction (n=number of patients)

Event	Severity	1 hour	4 hours	24 hours
Recall of procedure	No/Partial/ Complete	5/19/8	4/20/8	4/20/8
Recall of intraoperative pain	Nil/Mild/Mod/severe	10/16/6/0	10/18/3/1	10/18/3/1
Recall of intraoperative discomfort and anxiety	Nil/Mild/Mod/severe	14/10/7/1	14/10/7/1	14/10/7/1
Patients' satisfaction rating	No/Partial/Complete	0/2/30	0/3/29	0/3/29

IV MORPHINE OR IM CODEINE FOR POST CRANIOTOMY ANALGESIA

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INTRODUCTION: There has been controversy regarding how much pain is experienced and what is the best analgesic for patients following a craniotomy. The aim of this study was to document the severity of pain and compare effectiveness and side effects of intravenous (IV) morphine to our current standard, intramuscular (IM) codeine.

METHODS: With IRB approval and informed consent, 29 patients undergoing craniotomy for supratentorial pathology were randomized to receive either IV morphine (max 5mg) with codeine rescue, or 30-60mg IM codeine with morphine rescue if they requested analgesia in the first postoperative hour in PACU. A standard anesthetic including fentanyl, remifentanil and granisetron was used. Dose of analgesia given, verbal pain scores (0=no pain, 10 =worst pain possible), nausea and vomiting, sedation and neurological deficits were recorded for 48 hours postoperatively and compared between the 2 groups using statistical methods.

RESULTS: Mean (+/-SD) age was 54 (+/-13)yrs, weight 72(+/-15)kg, and 66% of patients were female. Only 17 (59%) patients received some analgesia in the first hour (8 codeine, 9 morphine). Rescue medication was required in 6 patients (75%) receiving morphine and 2 (22%) receiving codeine. During the next 47 hr 8 (28%) more patients received codeine , while 4 (14%) had no opiate analgesia. Mean dose of opiate given (codeine dose converted to morphine equivalents where 12mg codeine = 1mg morphine[1]) in 24 hours was 11 mg of morphine (range 0-35mg). There was a wide distribution of pain scores at all times (fig). 17 (59%) patients had nausea and 15 (52%) vomited. There was no statistical difference between those who had morphine or codeine in the first hour with respect to pain, total dose of opiate given over 24 hours**,** if rescue analgesia was needed, nausea, vomiting or sedation**.**

DISCUSSION: We found a wide variation in pain and opiate requirements post craniotomy. Incidence of PONV was high. No difference in the effectiveness or side effects between morphine and codeine was demonstrated, but a larger study is needed to confirm this.

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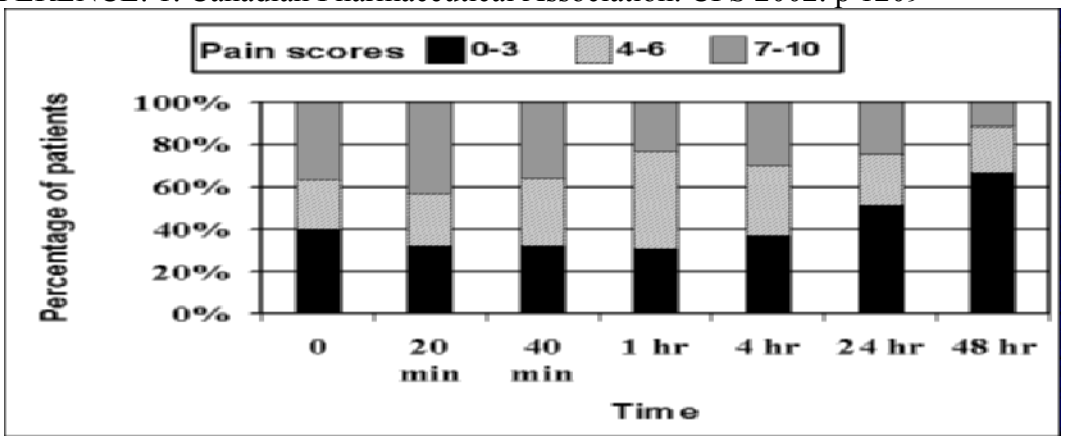

Figure: Distribution of pain scores by time.

INTUBATION IN UNSTABLE CERVICAL SPINE: ILMA OR MACINTOSH LARYNGOSCOPE?

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INTRODUCTION

In patients with unstable cervical spine, manipulation during airway management may precipitate a neurological disaster.[1] Intubating Laryngeal Mask Airway [ILMA] is best placed with head and neck in neutral position [2] and therefore may offer a safer and better option for securing airway in such patients. The present study was undertaken to compare and evaluate the ease of tracheal intubation using ILMA v/s Macintosh Laryngoscope in patients with simulated unstable cervical spine.

METHODS

After Institutional Research Board approval and informed consent, 50 adult patients of ASA physical status I & II of either sex, with essentially normal airway assessment, scheduled to undergo elective surgery under general anaesthetic were chosen. Patients were randomized into 2 groups; Group ML and Group IL.The cervical spine was immobilized by applying manual-in-line stabilization [MLS] and trachea was intubated using Macintosh Laryngoscope in Gp. ML and ILMA in Gp. IL. In all patients, MLS was applied by the same assistant and intubation was performed by the same investigator. The ease of tracheal intubation was assessed using an indigenously devised Intubation Difficulty Scoring System [IDSS] based on 4 parameters; a) number of attempts, b) time taken, c) aids used and d) trauma sustained during intubation.

RESULTS

The ease of intubation as assessed by IDSS was found to be significantly greater in Gp. IL than Gp. ML, with a mean value of 14.4 & 28.8 respectively[$p<0.001$] Mean time taken for intubation in Gp. ML was greater than in Gp. IL [32secs v/s 25secs], which, however was not found to be statistically significant. Rate of complications like oropharyngeal trauma, was higher in Gp. ML than in Gp. IL [24% v/s 12%].

CONCLUSION

In patients with cervical spine immobilized with MLS, tracheal intubation through ILMA is easier, faster and associated with fewer complications, compared to Macintosh Laryngoscope. ILMA therefore would be a safer technique for intubating patients with an unstable cervical spine.

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INCIDENCE AND TYPES OF COMPLICATIONS FOLLOWING CERVICAL SPINE SURGERY

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INTRODUCTION

Complications, especially airway compromise following cervical spine surgery can lead to disastrous consequences [1]. We conducted a survey to assess the incidence and types of post-operative complications following cervical spine surgery in a university teaching hospital.

METHOD

After IRB approval, a prospective audit was carried out for 18 months (2002-3). All patients who had cervical spine surgery were followed up till discharge. Statistical analyses were performed by Chi-square test.

RESULTS

Data of 156 patients was collected. The overall complication rate was 15%. Airway complication (neck swelling, hematoma, macroglossia) rate was 5% overall in which four patients required re-intubation and surgery. Two of them required emergency tracheotomy. Other complications include hemodynamic instability, myocardial infarction, heart failure, delirium, respiratory failure, aspiration, speech difficulties and CSF leak. The mean discharge time was 7.6 days. There was no statistical difference between complications following anterior or posterior procedures.

Site*	Complications (overall)	Airway	Hemodynamic Instability	Dysphagia	Others	Chi-Square
Anterior (n=100)	14%	6%	2%	3%	3%	P=0.7 (overall)
Posterior (n=55)	18%	4%	7%	4%	4%	P=0.6 (airway)

*(On patient had combined anterior and posterior approach with no complication.)

DISCUSSION

According to previous published data [2], our overall airway complication rate is comparable. This has the potential to lead to great morbidity and even mortality if not recognized and treated promptly. Anterior and Posterior approach carry similar incidence of complications. We recommend patients undergoing cervical spine surgery to be monitored closely for high incidence of post-operative airway compromise.

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DANTRIUM® OR MANNITOL CARDIOPRPOTECTS IN RATS WITH RAISED ICP

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INTRODUCTION

Traumatic brain injury with raised ICP is complicated by abnormal cardiac function. Sympathetic hyperactivity has been proposed to play a central pathogenic role in the cardiac complications. Using a rat model to determine whether the cardiac dysfunction associated with raised ICP is the result of abnormal Ca^{2+} flux; we examined the effects of dantrolene, a blocker of intracellular Ca^{2+} release.

METHODS

In accordance with the guidelines set forth by the Canadian Council on Animal Care and Queen's University Animal Care Committee, halothane-anesthetized male Sprague-Dawley rats were divided into 5 treatment groups (n=7-9): Dantrium® (dantrolene sodium 10 mg in 15% mannitol solution, DANT), dantrolene (10 mg, DANT-Na), low dose mannitol (3%, MAN), high dose mannitol (15%, MAN) or pentaspan (5%, PS). Drugs were infused (10 ml volume) over 30 minutes. After pretreatment, an intracranial subdural 3F Fogarty catheter was inflated over the left frontoparietal cortex for 60 seconds to induce raised ICP. Intracranial, arterial (MAP), and left ventricular (LV) pressures, heart rate (HR), plasma catecholamine levels and electrocardiographic changes were monitored.

RESULTS

Following pretreatment with low dose mannitol (3%), dantrolene or pentaspan, raised ICP (> 200 mmHg) resulted in transient increases in MAP and HR, an increase in LV pressures, a surge in plasma catecholamine levels, cardiac dysrhythmias and other electrocardiographic abnormalities. Following this transient hyperdynamic phase, LV function deteriorated in a temporal manner. Despite a similar increase in ICP (> 200 mmHg) following subdural balloon inflation, Dantrium® or high dose mannitol (15%) blunted the hemodynamic and LV pressure changes during raised ICP, and prevented the deterioration in cardiac function (Table 1).

DISCUSSION

Dantrium® or high-dose mannitol (15%) alone attenuated cardiac complications associated with raised ICP. Dantrolene was without effect. Since mannitol exhibits free radical scavenging properties, protection could be the result of a decrease in oxidative stress.

Table 1. Hemodynamic function 30 minutes after an acute increase in ICP.

Group	MAP*	HR*	LVP*	LVDP*	RPP*	LV +dP/dt*	LV -dP/dt*
DANT	82±25	119±16	89±19	96±21	116±37	93±25	87±24
DANT-NA	62±22	93±13	76±16	78±18	75±26	75±22	71±32
MAN 3%	64±4	86±17	72±7	74±9	65±22	66±8	60±10
MAN 15%	99±16	126±16	106±14	117±20	149±41	111±20	112±24
PS 5%	67±12	87±8	79±6	82±5	71±8	75±8	67±10

Results reported as % of baseline ± SD. *$P < 0.05$ DANT or MAN 15% vs DANT-NA, MAN 3%, PS 5%

CURRENT PRACTICE OF THORACIC EPIDURAL ANESTHESIA IN ATLANTIC CANADA

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INTRODUCTION

Thoracic epidural anesthesia (TEA) provides excellent pain relief and other significant medical benefits – yet the practice of TEA remains controversial [1,2]. There is no literature on Canadian practice patterns of perioperative TEA.

METHODS

A survey was administered to all anesthesiologists attending the Atlantic Regional Meeting of the Canadian Anesthesiologists Society, and all adult anesthesiologists of Atlantic Canada's largest medical teaching institution – Dalhousie University. The survey covered consent for TEA, sterility and placement practices of TEA, procedures for which TEA is utilized, and situations in which TEA may be controversial.

RESULTS

Survey response rate was 57%. 82% of anesthesiologists performed TEA at an average rate of 27/year (range 5 – 150/year). TEA was used most commonly for major abdominal (89%), major urologic(74%), thoracic(59%), and major vascular procedures(46%). 59% of anesthesiologists require a preoperative INR prior to TEA placement – with the average maximum tolerated INR being 1.3 (range 1.2 - 1.5). TEA was sited awake by 100% of anesthesiologists – to confirm placement 83% used a local anesthetic test dose, and 28% used the Tsui test. Consent was verbally obtained the vast majority of the time (96%); the risks discussed being PDPH (96% of anesthesiologists), neural injury (85%), infection(72%), and paralysis(61%). 93% of anesthesiologists will perform TEA on patients taking ASA, and decreasing numbers on those patients taking conventional NSAIDS(85%), Cox-2 inhibitors(83%), SC Heparin (43%), and LMWH (6%). 92% of anesthesiologists wore a mask for epidural placement, and 4% wore a sterile gown. The most common prep solutions were povidone iodine (68%) and chlorhexidine (32%).

DISCUSSION

TEA practice in Atlantic Canada is different from that in either Europe or the USA[1,2,3]. Atlantic Canadian anesthesiologists tend to site thoracic epidurals awake prior to surgery, be stringent on which patients obtain TEA (especially those with possible deranged coagulation parameters), and obtain verbal consent for TEA after discussing pertinent risks. However, there still remains a wide range of practice difference in informed consent, sterility during epidural placement, TEA practice in patients on medications that affect coagulation, procedures TEA is utilized for, and the individual yearly experience for TEA in Atlantic Canadian anesthesiologists.

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SYMPATHETIC BLOCK AND SENSORY BLOCK LEVELS AFTER EPIDURAL ANALGESIA

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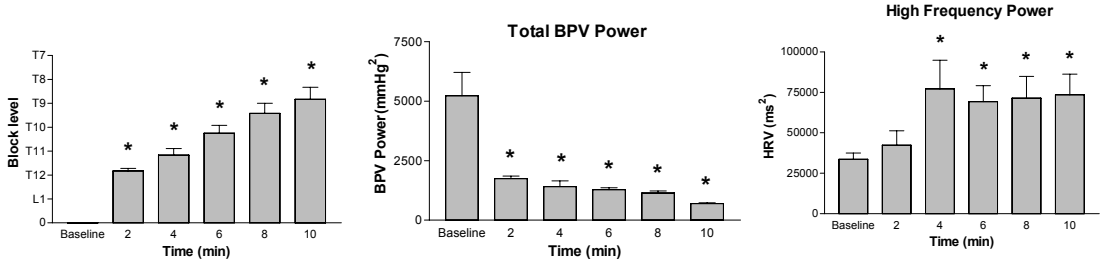
INTRODUCTION: Somatosensory block, essential for pain relief, is typically evaluated by sensation to ice or pinprick, while autonomic nervous system changes are largely recognized by changes in heart rate and blood pressure. No clear relationship between the progressions of these two processes has been established to date. Thus, the objective of this study was to determine the relationship between changes in autonomic outflow through heart rate variability (HRV) and blood pressure variability (BPV) and the progression of the sensory block with loss of sensation to ice following epidural anesthesia.

METHODS: With hospital ethics approval, beat-to-beat R-R intervals and non-invasive continuous blood pressure were obtained and saved for HRV and BPV analysis in 12 laboring patients. Baseline ECG, BP, respiratory rate, and fetal heart rate were recorded for 10 minutes before 20 ml of 0.125% bupivacaine and 50 mcg of fentanyl were injected through the epidural catheter. The measurements were repeated for 10 minutes after the block, and sensory block levels were measured bilaterally with ice at 2 minute intervals. Analysis of HRV and BPV was obtained by Wavelet Transform every 2 minutes post-epidural. Changes in high-frequency power of HRV have been shown to indicate changes in parasympathetic activity, while changes in all frequencies of BPV have been correlated to changes in sympathetic activity.

RESULTS: The sensory block level increased steadily with time post-epidural analgesia to a mean height of T9 level. This increase in block level was nicely reciprocated by a progressive decrease in sympathetic activity as estimated by the total power of BPV. Conversely, there was an abrupt one-step increase in high-frequency HRV following epidural analgesia indicating an increase in parasympathetic activity. (See Figure) Heart rate, blood pressure, respiratory rate, or fetal heart rate remained stable.

DISCUSSION: We conclude that the gradual increase in height of the sensory block after epidural analgesia correlates well with the decrease in sympathetic activity as measured by the decrease in BPV. Such a relationship was not found with the changes in HRV, which reflect changes in parasympathetic activity.



Changes in block height, total BPV Power, and High Frequency Power of HRV before and every 2 minutes for 10 minutes following epidural analgesia. N = 12. *, $p < 0.05$ from baseline.

THE SPEED IN EPIDURAL INFUSION OF MEPIVACAINE AFFECTS THE DEGREE OF NERVE BLOCKADE

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Background
It is widely known that epidural administration of local anesthetics may provide effective pain relief. When used for intraoperative analgesia, mepivacaine can produce a satisfactory sensory block with more rapid effect and less toxicity compared to bupivacaine or ropivacaine. However, little detailed information is available concerning the factors that affect the spread of sensory blockade in epidural analgesia. We therefore examined whether the speed in epidural infusion of mepivacaine involves the degree of nerve blockade.

Methods
Twenty-six patients scheduled for gynecological abdominal surgery underwent lumbar epidural catheterization before light general anesthesia. An epidural catheter was inserted a distance of 4 cm cranially in the midline at L1/2. Epidural administration was performed with plain 1% mepivacaine. Three minutes after the test dose of 2 ml, 8 ml was injected epidurally at either rate of 0.8 ml/sec (rapid group) or 3 ml/min (slow group). Sensory and motor blockade, blood pressure, and heart rate were assessed at 5, 10, and 15 min after the epidural injection.

Results
The spread of sensory blockade in rapid group was rapid, resulting in no difference between at 5 and 15 min after the epidural injection. There was significant difference in the spread of sensory blockade at 5 min after the epidural bolus between the two groups, although no difference at 10 and 15 min. Blood pressure at 5 and 10 min was slightly decreased and recovered at 15 min in rapid group, while not changed in slow group. Little difference was found in motor blockade between before and after the epidural injection in both the groups.

Conclusion
Higher speed in lumber epidural infusion of mepivacaine may lead to more rapid spread of sensory blockade with trivial hypotension.

THE INTERNATIONAL NORMALIZED RATIO BEFORE AND AFTER HEPATECTOMY

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INTRODUCTION

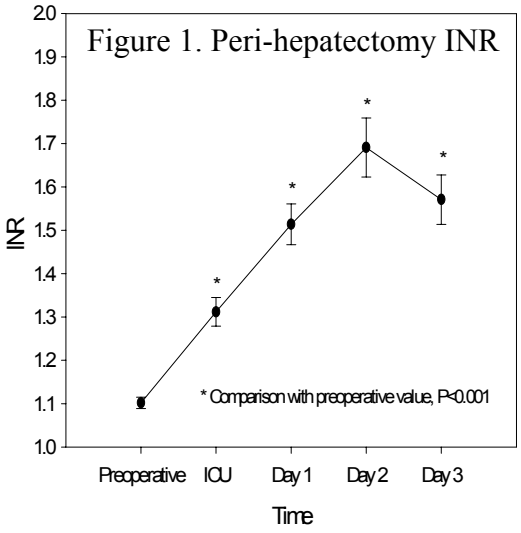
Patients undergoing hepatectomy may have underlying liver dysfunction due to hepatitis, cirrhosis, and carcinoma. Liver resection, intraoperative ischemia and blood loss may further compromise liver function and lead to coagulopathy. Coagulopathy may influence postoperative management and the decision whether to institute neuraxial blockade. We sought to determine the degree of postoperative coagulopathy in hepatectomy patients.

METHODS

After securing institutional ethics approval, we reviewed the charts of all patients who had undergone partial hepatectomy at the Prince of Wales Hospital between Jan 99 and Oct 03. Patients requiring re-exploration for bleeding were excluded. Only patients who had complete INR data up to the third postoperative day were included. Patient demographics, co-morbidity, and operative data were also recorded.

RESULTS

There were 220 adult hepatectomies during the study period. Three patients were excluded due to early re-exploration. 67 patients were excluded due to incomplete data. The data of 150 patients were analyzed. Bonferroni correction was applied when comparing postoperative data to preoperative data. Figures shown below are mean and 95% confidence intervals (95%CI).



The INR peaked around the second postoperative day with a peak of 1.69 (1.62 to 1.76). Thereafter, it started to improve. The INR was above 1.40 between days 1 and 3. There was an overall significant difference in the INR values over time ($F_{4,144}$ =87.06, P<0.001). All postoperative INR were higher than preopearative values.

All 150 patients received patient controlled morphine and had satisfactory recovery.

DISCUSSION

The results suggest that there was significant postoperative coagulopathy. Insertion or removal of an epidural catheter between the first and third postoperative days may be associated with an

increased risk of spinal hematoma. Clinicians should balance the risks and benefits that could be derived from this form of anesthesia and analgesia.

EPIDURALS IN MORBIDLY OBESE PATIENTS

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Introduction:

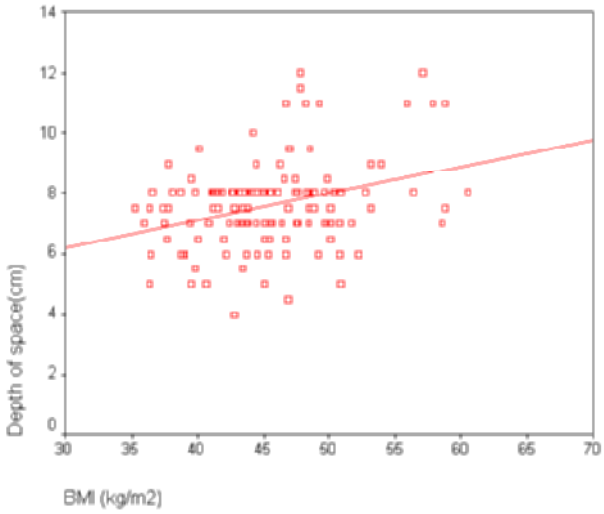
General anaesthesia in obese patients carries a significant risk. This patient group easily become hypoxic under anaesthesia due to difficult airways, poor respiratory reserve and high oxygen consumption. Regional anaesthesia is often the safest approach to obese patients, but may be technically challenging for the anaesthetist. Our department has recorded 139 epidurals in obese patients over a 7year period. Patient demographics, technical difficulty, epidural effectiveness and complications were assessed.

Methods:

Data was collected prospectively using a standardized form. Demographic data included Body Mass Index (BMI), age and ASA. Epidural details including reason for request, level of epidural placement, depth of epidural space, patient position (sitting or lateral), and number of epidural attempts, grade of anaesthetist and effectiveness of the epidural were recorded.

Results:

Out of 139 patients; 50 were obstetric patients and 89 non-obstetric. All had successful epidurals except 2 unilateral and 4 patchy blocks. There were 3 dural taps (2.17%) and one of them needed epidural blood patch. A long Touhy needle was needed in 34 cases.



Correlation of epidural depth and BMI: Correlation coefficient 0..33

The following are expressed as mean +/- SD

BMI 45.61 +/- 6.4 (range 35.2-60.5)

Depth 7.72 +/- 1.53 (range 4-12.0)

Attempts 2.4 (range 1- 8)

Position - sitting 70, lateral 69.

Level Lumbar –120, Thoracic –18, Cervical - 1.

Conclusion:

Our results show that the depth of the epidural space in obese patients is usually deeper, but that the correlation of BMI and epidural space is poor, and so of little predictive value for the anaesthetist. This means that the usual precautions must be taken at shallow depths to avoid dural puncture and that long epidural needles should also be available. Although more attempts were made before successfully siting epidurals in this patient group, we found effective epidurals were sited safely in the vast majority of these obese patients.

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A COMPARISON BETWEEN THE MEDIAN AND PARA MEDIAN APPROACH IN EPIDURAL ANESTHESIA

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INTRODUCTION:

Median Epidural Block technique is often faces some difficulties due to ossification of Inter-spinous ligament and improperly patient positioning. Back pain is common between patients with Median approach, which probably puncture of the ligaments on the line of epidural needle passage is the cause of much pain. In Para Median approach, needle does not pass through the ligaments so theoretically back pain can be less.

METHODS:

A single blind clinical trial study conducted on 40 patients (in 3 stages) to compare the pain at the needle insertion point, back pain and the patient's satisfaction in both Median and Para Median approach. Then thay were divided in two equal groups, **"A"** for **Median** and **"B"** for **Para Median**. Epidural block was done in sitting position and by hanging drop maneuver for all of patients.

The pain at needle insertion point calculated by Pain Score and the pain of Angiocath insertion on the back of hand was evaluated by the questioner ($P< 0.05$).

RESULTS:

The following is a comparison between the Para median and Median approach:

- In the group "A", 12 patients complained of high-grade pain but in the group "B", 12 patients had low pain.
- Post operation low back pain was 50% in group "A" versus 10% in group "B".
- Patient satisfaction was 20% among the group "A" versus 50% in the group "B".

CONCLUSION:

This study showed that the Para median approach has more satisfaction and lesser pain than Median approach among patients and to mention that it can be done easier. I emphasize that ligamentom flavum should be punctured at mid line in two approaches

THRESHOLD CURRENT IN THE INTRATHECAL SPACE OF CHILDREN

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INTRODUCTION

Previously, it was hypothesized that with electrical stimulation it would require < 1mA to observe motor activity in the intrathecal space.[1,2] This has been shown in individual case reports and in a porcine model, but never in a formal study. This study was designed to determine the threshold current necessary to elicit motor activity in the intrathecal space of pediatric oncology patients undergoing diagnostic or therapeutic lumbar punctures.

METHODS

After IRB approval, pediatric oncology patients scheduled for lumbar puncture were recruited. Following sedation with propofol, patients were turned to the lateral position and prepped in a sterile fashion. An 18- or 20-gauge introducer was inserted at the L4-5 level followed by an insulated 24-gauge Pajunck unipolar needle (with a Sprotte-tip and stylet). The needle was then advanced into the intrathecal space and confirmed by the presence of cerebrospinal fluid (CSF). At this point, an independent observer attached the insulated needle to a nerve stimulator and the current was increased until the minimal threshold current for motor activity was observed.

RESULTS

Twenty pediatric oncology patients (ASA II or III) aged 7.9 ± 4.0 years (1.6 yrs-16 yrs) were studied. The mean patient weight was 28.2 ± 15.0 kg. There were 10 male and 10 female patients. The mean current to elicit motor activity in the intrathecal space was 0.6 ± 0.3 mA (range 0.1-1mA). Nineteen twitches were at the L3-5 myotomes and one patient had twitches at L2. 19 twitches were unilateral and 1 was bilateral.

DISCUSSION

This study demonstrated that the mean threshold current necessary to elicit motor response in the intrathecal space of pediatric patients was 0.6 ± 0.3mA and confirms the hypothesis that the minimal threshold current in the intrathecal space is < 1mA. As this differs from the threshold currents reported for electrical stimulation in the epidural space, one may potentially distinguish the epidural space from the intrathecal space.

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ELECTRICAL STIMULATION CAN DISTINGUISH EPIDURAL & INTRATHECAL SPACE

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INTRODUCTION

Muscle twitches elicited with electrical stimulation (6-17mA) during epidural insertion indicate correct epidural needle placement while muscle twitches at a lower current (< 1mA) may indicate intrathecal needle placement.[1,2] This study examined whether applying continuous electrical stimulation at 6mA could indicate needle entry into the epidural space (ES) without inadvertently penetrating the intrathecal space (IS).

METHODS

After IRB approval, pediatric patients scheduled for lumbar puncture were studied. Following sedation with propofol, an 18-gauge introducer was inserted in the L4-5 region followed by an insulated 24-gauge Pajunck unipolar needle. After penetrating the skin, the needle was connected to a nerve stimulator set at 6mA and advanced. At the first sign of muscle twitching, the advancement was stopped and the current was adjusted to the lowest threshold for motor activity. The current was then turned off, the stylet removed and the needle was checked for cerebrospinal fluid (CSF). If CSF was not present, the needle was advanced into the intrathecal space (as confirmed by the presence of CSF). The distance from the presumed ES to the IS was noted. The threshold current for motor response in the IS was recorded.

RESULTS

Ten pediatric patients (ASA II or III) aged 6.8 ± 4.0 years (2.8-16 yrs) were studied. All patients had two distinguishable threshold currents as the needle advanced. The mean threshold current to elicit muscle twitch (presumed to be in the ES) was 4.2 ± 1.2mA. CSF was not present in any of the patients at this location. The mean threshold current in the IS (CSF present) was 0.8 ± 0.4mA. The average estimated distance from the first threshold location to the IS was 3mm. All muscle twitches were at the L3-5 myotomes. Nine muscle twitches were unilateral and 1 was bilateral.

DISCUSSION

This study suggests that monitoring an insulated needle with electrical stimulation at 6 mA may prevent unintentional placement of epidural needles into the IS and may be a useful monitoring tool to be used in conjunction with a loss of resistance technique.

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BLUNTING 22-GAUGE NEEDLES FOR REGIONAL BLOCK IN PEDIATRIC PATIENTS

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INTRODUCTION

An ideal ilioinguinal/iliohypogastric (IG/IH) nerve block should be effective, specific and simple to administer with minimal equipment. A special short-beveled needle can be used to distinguish the classic fascial "pop" felt as the needle reaches the aponeurosis of the external abdominal oblique muscle. This is not always possible using regular 22-gauge sharp needles but is feasible by blunting the tips of these needles by tapping them four times into a sterile needle cap. Some anesthesiologists in our institution have been using this blunting technique and believe it assists in identifying the correct plane of tissue and increases the success of IG/IH blocks.

METHODS

Retrospective data from 9 patients who had received an IG/IH nerve block with a blunted needle technique was reviewed. Type of surgery, coexisting conditions, ASA, preoperative investigations, as well as general demographic data was noted. Analgesic success was assessed from the patient's anesthetic chart and postoperative opioid requirements.

RESULTS

The nine patients studied were ASA I or II, aged 3.3-16.8 years and an average of 39 ± 33 kg. The classic fascial "pop" was felt and documented in all patients. 4-10 mls of 0.25% bupivacaine (with or without 1:200,000 epinephrine) was administered for the IG/IH blocks. An average of 0.05 mg/kg of morphine was only administered immediately following induction. All patients awoke comfortable and did not require additional opioid.

DISCUSSION

All IG/IH nerve blocks performed with a blunted needle technique were deemed successful based on the fact all patients awoke comfortable and did not require additional opioid. In retrospect, the morphine administered immediately following induction may have been unnecessary as there were no significant hemodynamic changes in response to the surgical incision. Blunting the tip of regular 22-gauge sharp needles may be a cheaper and comparable alternative to specialized, short-beveled needles to distinguish the classic fascial "pop" and administer effective IG/IH blocks for pediatric patients.

A NEW CONTINUOUS AUDITORY MONITOR DISPLAY FOR MEAN ARTERIAL PRESSURE

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INTRODUCTION

At times when the anesthesiologist is most concerned about a patient's blood pressure, it is often difficult to continuously observe the anesthetic monitor. Currently, monitor displays only provide information about blood pressure visually. In contrast, information about the heart rate (HR) and oxygen saturation (O_2sat) is conveyed in both a visual and an auditory manner. The goal of this study is to assess an auditory signal that clearly represents changes in mean arterial pressure (MAP) without disrupting the anesthesiologist's ability to detect changes in HR or O_2sat.

METHODS

We developed and tested an auditory display where a single repeating beep has 3 varying parameters mapped to MAP, HR, and O_2sat. The length of the beep corresponds to the MAP, with a longer beep indicating a higher MAP. HR and O_2sat are conveyed in a standard manner. The auditory display is available online: www.dekoven.ca/duration/demo. Thirty anesthesiologists, anesthesia residents, and respiratory therapists underwent a training session and a testing period. In the 9 minute training session subjects familiarized themselves with the auditory display and underwent a practice test. During the testing period, using the auditory display, subjects tried to identify which variable(s) had changed for 8 separate trials. They then listened to 4 trials and attempted to identify each trial as being one of 5 predefined anesthetic events.

RESULTS

A trial was considered correctly identified if the direction or absence of change was correctly identified for all three variables: MAP, HR and O_2sat. Subjects successfully identified 88.1% of the trials. The direction or absence of change of individual variables within a trial was correctly identified for MAP alone 91.4%, HR alone 97.2% and O_2sat alone 97.5% of the time. The percentage of correct trials identified was greater for anesthesiologists (90%) and residents (93.3%), than for respiratory therapists (71.7%) ($p<0.01$). Subjects were somewhat better at recognizing predefined anesthetic events (90.8 % correct trials) than events unrelated to anesthesia scenarios (86.7%, $p = 0.33$).

DISCUSSION

We conclude that this auditory display permits clinicians to successfully detect changes in MAP, while preserving their ability to discern changes in HR or O_2sat.

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None

REDUCING CUFF RELATED TRACHEAL MORBIDITY: A COMPARATIVE STUDY

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INTRODUCTION

Diffusion of Nitrous oxide into the air filled cuff of an endotracheal tube leads to an increase in cuff pressure & resultant laryngotracheal (LT) morbidity. [1,2] Two different mediums (Saline & Anaesthetic gas mixture - Nitrous oxide in Oxygen) besides air were used for cuff inflation to determine whether LT morbidity is related to excess in tracheal cuff pressure during General Anaesthesia with nitrous oxide.

METHODS

After Institutional Research Board approval and informed consent, 62 adult patients of ASA status I & II undergoing general anaesthesia with tracheal intubation of minimum one hour duration were randomized into 3 groups. In group A, Group S & Group G; air, saline & Anesthetic gas mixture (67%N_2O in O_2) respectively were used for cuff inflation. Cuff pressure was measured following intubation & at every 15 minutes interval thereafter. At the time of extubation, fiberoptic examination was performed by an independent observer. The tracheal mucosa in the cuff contact area was scored from 0 to 3, 0 being normal mucosa and 3 being mucosal erosion or hemorrhage at more than one site. The patients were evaluated at 4 & 24 hours postoperatively for symptoms of Laryngotracheal morbidity i.e. sore throat, cough and hoarseness.

RESULTS

Cuff pressure increased throughout the procedure in group A ($p<0.001$) as compared to group S & group G. Tracheal mucosal lesions in the area of the cuff were more frequent in group A (57%) vs. Gp. S & Gp.G (4.7% & 15%) respectively. ($P< 0.0001$). Tracheal mucosal injury significantly correlated with changes in cuff pressure ($p<0.001$). Incidence of sore throat was greater in Gp.A (61.9%) than in Gp. S & Gp. G (14.2% & 45%) at 4 hours & 24 hrs post extubation (47% Gp. A, 9.5% Gp S, 25% Gp. G) respectively. However, no significant correlation between tracheal lesion & postoperative sore throat was found ($p<0.001$).

CONCLUSION

Saline & Anaesthetic gas mixture ($N_2O + O_2$) were found to be significantly better than air for endotracheal tube cuff inflation in avoiding increase in cuff pressure and resultant laryngo tracheal mucosal damage.

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LARYNGOSCOPE LIGHT INTENSITY MEASUREMENT

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INTRODUCTION: The light illumination of fibreoptic blades (FOB) deteriorates with usage and repeated sterilization [1]. Some studies in the past have used luminance measurements which are clinical relevant but not readily available in the clinical setting [2]. The goal of the study was to determine the light intensity (illumination) of the fibreoptic blades that we currently used in our clinical setting and to compare the improvement in light intensity with a new 2.5-volt and a new 3.5-volt handle with this fleet of FOB.

METHODS: We used a LUX light meter (Tenma® digital light meter) and a prototype attachment to measure the light illumination of all the laryngoscope blades. The lux values were measured for 160 Heine (Herrsching, Germany) FOB with the 2.5-volt handles. These measurements were repeated for every blade with a new 2.5-volt and a new 3.5volt handle, batteries and bulb.

RESULTS: The mean (± SD) light intensity for all laryngoscope blades and handles as they were found on the 30 anesthesia carts at our institution was 869 (±519) lux. The light intensity was significantly improved with the new batteries. The mean (± SD) light intensities for all the laryngoscopes with the new 2.5 and 3.5-volt handle were 2091 (±813) and 4066 (± 1790) lux respectively. The impact of putting a new FOB on each of our existing fibreoptic (FO) handles (with no consideration for batteries) was also measured. The average light intensity increased from 869 lux to 1740 lux.

DISCUSSION: Our data suggest that the light intensity of routinely used laryngoscopes was substantially increased with new batteries and blades. In fact, the light intensity improved by more than 2 fold and 4 folds with the use of a new 2.5 and new 3.5 volt laryngoscope handle respectively. Our cleaning process is low temperature pasteurization (70°C) which does not seem to decrease the illumination to the same degree as earlier reported [1]. While there is currently no information regarding the acceptable illumination sufficient for an effective laryngoscopy, our data suggest that vigilance with the battery power can substantially improve the illumination and perhaps enhance the visualization of the upper airway during direct laryngoscopy.

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PORTABLE LARYNGOSCOPE LIGHT INTENSITY MEASUREMENT APPARATUS

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INTRODUCTION**:** Adequate light may be critical to successful tracheal intubation. Currently there is no reliable apparatus to evaluate the illumination of laryngoscopic tools. To better evaluate and maintain the fiber optic laryngoscope blades for our clinical practice, a prototype apparatus was created for measuring light intensity in lux units. We designed a device that will consistently measure all Macintosh fiber optic blades (FOB) (#3 and 4) in the clinical setting. The device was designed to be portable and reliable for users with little training so that consistent measurements of illumination can be achieved for different operator.

METHOD: A prototype device was created using a PVC tube with a specially designed cap and base and a nylon ledge to hold the tip of the blade in place. Different specialized cap adaptors allow for the evaluation of other laryngoscope blades, such as the miller blades, and the illumination intensity of the handle alone. The tube measures 8 cm in diameter and 10 cm in height. A Tenma® Digital lux light meter was used to record the light intensity in lux from the blades. This device has a sensor with the lux measurement accuracy of $\pm$ 5%. With this apparatus, the tip of the blade will be placed precisely at 1 cm from the sensor and the light source shines directly at the center of the senor surface. To evaluate the precision of the measurements of the apparatus, ten different Heine® fiber optic blades (MAC#3,4) blades were separately placed in the device for 10 sec and measurements were recorded. This was repeated at 30 sec intervals. To determine the interrater reliability**,** eight staff were given a short (5 min) in-service on the use of the device. Each staff was asked separately to evaluate 3 different blades that would produce low, medium, and high levels of light intensities. The mean and the standard deviation for each tester were calculated and the standard deviation was represented as a percentage of mean.

RESULTS: The precision of the apparatus as a value for the % of standard deviation to the mean was calculated for the 10 different blades and was found to be 2.6%. The interrater reliability from the testing of blades at three levels of light intensity resulted in of 3.5 % of the standard deviation of the mean.

DISCUSSION: Our data show that this portable and inexpensive prototype device can measure the laryngoscope illumination with good precision. This device may be useful clinically to evaluate the laryngoscope illumination prior to intubation to ensure adequate light source for the procedure.

SARS TRANSMISSION DURING INTUBATION: CAREGIVERS' EXPERIENCES

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INTRODUCTION

The purpose of the study was to identify factors that contributed to the infection of Health Care Workers (HCWs) who intubated SARS patients. We sought recommendations from "front-line" HCWs regarding the future care of SARS patients. Based on these recommendations, a risk analysis tool was created to identify common factors across disease outbreaks. This information will be used to improve the guidelines for caring for highly infectious patients and strategies for risk management.

METHODS

The study was approved by the SWCHSC Ethics Committee and formed a subsection of a larger public health SARS investigation. HCWs who performed intubations were identified by a chart audit. Anesthesiologists administered a questionnaire that was comprised of three sections: patient information (demographics, clinical history, drugs and intubation procedure), HCW information (demographics, personal protection, SARS infection and its clinical history) and HCW recommendations for future outbreaks. Recommendations were collated and iteratively grouped to create a broadly applicable risk management framework.

RESULTS

We interviewed 31 HCWs who performed 36 intubations of 32 SARS patients in 10 Toronto-area hospitals. Of the HCWs, 23(74%) were anesthesiologists, 4(13%) were respiratory therapists, 3(10%) were internists and 1(3%) was a surgeon. 3(10%) HCWs, all anesthesiologists, acquired SARS (Figure 1). The recommendations directed the development of a high level framework consisting of three broad categories: Process, People and Technology & Infrastructure. Process recommendations relate to infection control and airway management protocols, education, new knowledge and communication. People recommendations relate to experience or availability of HCWs while Technology & Infrastructure recommendations relate to patient equipment, HCW equipment and hospital infrastructure.

Figure 1: Results

	HCW Experience		Emergency Intubation?[b]		# of Intubation Attempts		HCW Protective Suit Used?		Sedation During Intubation?		Paralysis During Intubation?	
	Resident	Staff	Yes	No	1	2+	Yes	No	Yes	No	Yes	No
SARS acquired	2(67%)	1(33%)[a]	3(100%)	0	1(33%)	2(67%)	0	3(100%)	3(100%)	0	2(67%)[c]	1(33%)
No SARS	5(18%)	23(82%)	10(30%)	23(70%)	26(79%)	7(21%)	13(39%)	20(61%)	32(97%)	1(3%)	25(76%)[d]	8(24%)

a. >15 years clinical experience
b. Impending respiratory arrest
c. Both with Succinylcholine
d. 14 Succinylcholine and 11 Rocuronium

DISCUSSION

All infected intubators (10%) were anesthesiologists. Ad-hoc, consensus-based guidelines were clearly insufficient. Management requires a framework that rapidly integrates experience into guidelines for the treatment of infectious patients.

DEVELOPMENT, CHARACTERIZATION, AND INITIAL ASSESSMENT OF CAPNOGRAPHY-GUIDED INTUBATION

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INTRODUCTION

A unique hollow intubation stylet, which connects to suction and allows for the immediate measurement of the partial pressure of aspirated carbon dioxide, has been developed and is currently being assessed. This device appears to be potentially useful, as an aid for endotracheal intubation, in situations in which the glottis may be difficult to visualize secondary to the presence of tumor or aberrant anatomy.

METHODS

The stylet is a hollow yet malleable plastic tube the distal end of which fits inside of standard endotracheal tubes. Using readily-available components, its proximal end is connected to a mainstream capnograph and suction. With an applied suction of 180 mmHg, a turbulent airflow of 0.5 liters/second is generated with a corresponding Reynolds number of 9,375.

After IRB approval and informed consent, preliminary results, on 12 intubations, have shown that this device immediately differentiates between tracheal and esophageal intubations.

RESULTS

Esophageal intubations were consistently associated with aspirated CO_2 ($aspCO_2$) partial pressures of < 5 mmHg while tracheal intubations were associated with $aspCO_2$ partial pressures of > 5 mmHg.

Specifically, $aspCO_2$ from tracheal intubations had a mean partial pressure of 23.25 mmHg with a standard deviation of 14.01 mmHg. Whereas esophageal intubations had a mean $aspCO_2$ partial pressure of 2.25 mmHg with a standard deviation of 2.06 mmHg ($P = 0.0036$).

These $aspCO_2$ partial pressures were obtained and observed immediately during the intubation process; as the tracheal tube was placed into either the trachea or esophagus. False negative readings were obtained from two patients due to copious pulmonary secretions obstructing the mainstream capnograph.

DISCUSSION

Thus, used in this manner, this device may be helpful in the management of difficult intubations. Furthermore, identification of correct tracheal tube placement appears to be faster than conventional methods utilizing side stream or colormetric capnography. In addition, esophageal intubations are potentially identifiable without stomach insuffilation.

Continued engineering development and patient-based assessment, of capnography-guided intubation, using this apparatus, is ongoing.

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ACEI BEFORE CABG: EFFECTS ON HEMODYNAMY AND RENAL FUNCTION

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INTRODUCTION

Angiotensin converting enzyme inhibitors (ACEI) cause intraoperative hemodynamic instability (IOHI) during CABG (1). They are associated with postoperative renal dysfunction (PORD) in vascular surgery (2). Omitting ACEI on the day of surgery (DOS) seems to improve hemodynamic stability during vascular surgery (3). This retrospective study was designed to assess if chronic ACEI treatment or ACEI omission on DOS influence the incidence of IOHI and PORD during CABG.

METHOD

We evaluated the incidence of IOHI, the use of vasopressive drugs, and the incidence of PORD which was defined as an increase of creatinine>50µmol/L or an increase of creatinine>25% or a decrease of creatinine clearance>25% from preoperative values at POD-2 and discharge. We realized multivariate analyses controlled for factors known to influence PORD.

RESULTS

1228 patients have undergone CABG in 2002; 50% were on chronic ACEI and 75% of them omitted it on DOS. In the ACEI group patients, there were more frequent IOHI (MAP< 40 mmHG (2.42% vs 0.66%; p=0.0274)) and an increase use of vasopressive drugs (17.4% vs 8.7%; p=0.0410) during CPB compared with patients on other cardiovascular medications. No difference in PORD was found. Finally, no significant difference was observed whether the ACEI was continued or not on DOS.

DISCUSSION

More IOHI were found in patients treated with chronic ACEI but there were no difference whether the ACEI was omitted or administered on DOS. Also, chronic ACEI did not increase the incidence of PORD. Our results are reassuring if we consider the benefits of being on ACEI therapy when undergoing CABG (4,5). We hypothese that the delay between the cessation of ACEI and CABG (< 24 hours) might be too short to induce a significant difference, because of the long pharmacologic half time of the ACEI molecules. A prospective study with ACEI omitted 3 or 4 days before CABG instead of on DOS maybe useful to corroborate these results.

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OFF-PUMP CABG SURGERY FOR REDUCTION OF PERIOPERATIVE MORTALITY AND MORBIDITY: A META-ANALYSIS

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BACKGROUND: Despite its theoretical benefits, the effects of off-pump coronary bypass surgery (OPCAB) on perioperative mortality and morbidity remain unclear. This systematic review assessed the effects of OPCAB on short- and long-term outcomes.

METHODS: MEDLINE, EMBASE, and reference lists were searched without language restriction for relevant randomized controlled trials (RCT) and observational studies. Included observational studies had to employ appropriate risk-adjustment techniques, namely multiple logistic regression or propensity-score techniques. Pooled treatment effects were calculated as odds ratios (OR) with 95% confidence intervals (CI).

RESULTS: Twenty-three RCTs (N = 1861) and 16 observational studies (N = 294,413) were included. Among RCTs, OPCAB was associated with trends towards reduced 30-day mortality (OR 0.81 95%CI 0.26-2.55), stroke (OR 0.52; 95%CI 0.18-1.47), and myocardial infarction (OR 0.74; 95%CI 0.38-1.46); as well as significant reductions in atrial fibrillation (OR 0.48; 95%CI 0.31-0.74). Among observational studies, OPCAB was associated with significantly reduced 30-day mortality (OR 0.75; 95%CI 0.69-0.82), stroke (OR 0.62; 95%CI 0.55-0.69), and atrial fibrillation (OR0.77; 95%CI 0.72-0.83); as well as trends towards reduced infarction (OR 0.77; 95%CI 0.48-1.23). In the few studies reporting long-term (1-2 years) outcomes, OPCAB remained associated with trends towards reduced mortality and infarction, but also trends towards increased need for repeat revascularization (RCT data: OR 1.72; 95%CI 0.73-4.06).

CONCLUSIONS: RCTs and risk-adjusted observational studies demonstrate qualitatively similar improvements in short-term perioperative mortality and morbidity following OPCAB. Future research must address the paucity of long-term outcome data, especially given that OPCAB may be associated with an increased need for repeat revascularization.

HEMODYNAMIC EFFECTS OF PROPOFOL VS. MIDAZOLAM INFUSION AFTER CORONARY ARTERY BYPASS SURGERY

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Introduction:

Hemodynamic Fluctuations(such as tachycardia & hypertension) in 24 to 48 hours after CABG enhance cardiac dysfunction and increase adverse cardiac outcomes(MI).The majority of previous studies focused on the relationship between hemodynamic responses & intraoperative stimulation whereas the most fraction of cardiac morbidity & mortality occurred in the first few postoperative hours. Therefore, prevention from homodynamic fluctuations can reduce postoperative cardiac events. Hemodynamic control (as heart rate & arterial blood pressure) is the essential route to prevent myocardial ischemia & it´s adverse results after CABG. The aim of the current study is to assess propofol effects on hemodynamic fluctuations in this period

Methods:

This study designed as a double blinded controlled clinical trial. Eighty patients from 26 to 75 years old scheduled for elective CABG anesthetized with standard regimen & allocated randomly into two groups. Then propfol(treatment group) or midazolam(control group) infusion administered for 4 hours. Heart rate & arterial blood pressure(SBP,DBP, AP) were recorded at 30 minutes intervals. Data analyzed with repeated measure ANOVA by SPSS 10 software.Differences were considered statistically significant when $p< 0.05$. Results are expressed as mean(%95 confidence intervals).

Results:

Mean heart rate in treatment & control groups before & after study(the last measurement) was equale to (85.95, 86.57) with $p>0.05$ & (89.30, 98.15) with $p<0.001$ consequently. Mean arterial pressure equale to (77.53, 75.55) with $p > 0.05$ & (82.77, 90.76) with $p<0.001$consequently. Mean systolic blood pressure was equale to (111.75, 111.15) with $P>0.05$ & (117.47, 125.65) with $p<0.001$ consequently. Mean diastolic blood pressure was equale to (60.12, 57.75) with $p>0.05$ & (65.30, 73.32) with $p<0.001$ consequently. This suggests significant differences & a true effect for propofol on hemodynamic variables.

Conclusion:

Compared with a standard sedation regimen(midazolam), infusion of sedative doses of propofol in early hours after CABG can result in less hemodynamic fluctuation or more hemodynamic stability. In other words, propofol sedation after CABG can assist to modulate hemodynamic fluctuations.

Keywords: Propofol, Sedation, Cardiopulmonary bypass, Midazolam, Hemodynamic

CARDIAC ANESTHESIA: A CANADIAN SURVEY

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INTRODUCTION

The developments in cardiac surgery, including "fast-tracking", warm cardiopulmonary bypass (CPB), minimal access and off-pump CPB, have resulted in various anesthetic techniques.[1,2] The purpose of this survey was to document the current Canadian practice of anesthesia for cardiac surgery.

METHODS

The questionnaire was sent to 16 Canadian university departments of anesthesia. Responses were analyzed anonymously in aggregates by center and by an individual anesthesiologist. Mean drug doses and operating room time were calculated for each center. The overall median drug dosage was calculated. Anesthesiologist's technique, drug of choice and port of infusion (IV) were analyzed. Finally, total cases of awareness were counted.

RESULTS

129/200 (64.5%) anesthesiologists responded from 14 centers. Four responses were from pediatric cardiac anesthesiologists, and were analyzed separately. During adult CPB, sufentanil 71.2% (S) and fentanyl 27% (F) were used most. Mean S dose ranged from 50-500 mcg (median178.5mcg). Mean F dose ranged from 500-1333 mcg/center. Two centers reported using spinal morphine (0.5 mg). Midazolam dose ranged from 2-32 mg (median 5.5). However, 6 % of the anesthesiologists reported not using any benzodiazepines for their cardiac cases. Anesthetic techniques during CPB included volatile (V) only, propofol (P) infusion (I) + V, PI only, narcotic (N) I + benzodiazepine (B) I + V, NI + BI, N bolus + V ± B, N bolus ± B, and a combination of two or more techniques were also described.

The side port of the pulmonary artery catheter (PAC) was used 81% as the port of infusion for intravenous anesthesia during CPB. 7.2% used a peripheral line, while the remaining (11.8%) used the proximal PAC port. Mean operating room time was 4.4 hours. Knowledge of awareness was reported in 14 cases in different centers.

DISCUSSION

This survey found at least seven different anesthetic techniques used during adult CPB period. The concept that a cardiac anesthetic is primarily "narcotic-based" may no longer hold true. Anesthetic drugs infused through the PAC ports may not reach the systemic circulation during CPB, due to lack of pulmonary circulation and migration of the PAC[3]. Awareness during cardiac anesthesia is still being reported. Outcome studies on these various anesthetic techniques may be warranted to determine the "best" cardiac anesthetic.

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HIGH SPINAL ANESTHESIA FOR PATIENTS WITH CRITICAL AORTIC STENOSIS

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INTRODUCTION

Our experience has suggested a beneficial role of high spinal anesthesia in patients undergoing coronary artery bypass graft surgery. In this retrospective case series we describe the administration of high spinal anesthesia without complications to 20 patients with critical aortic stenosis undergoing aortic valve replacement.

METHODS

Patients who underwent aortic valve replacement surgery for stenotic lesions under high spinal anesthesia from 1998 to 2003 were identified and their charts were reviewed. In all cases, the spinal needle was inserted with the patient in the lateral decubitis position and 20 degrees of Trendelenburg. On average 31.3 ± 5.8 mg of 0.75% bupivacaine with dextrose and 260.0 ± 55.3 mcg of epidural morphine was administered. This was followed by induction of general anesthesia. Anesthesia was maintained with isoflurane.

RESULTS

All 20 patients underwent aortic valve replacement while 7 patients also had coronary artery disease requiring surgical revascularization. The average age was 69.8 ± 7.0 years and many co-morbidities were present. The mean aortic valve area was 0.8 ± 0.2 cm^2 with peak and mean gradients of 82.8 ± 25.2 and 53.0 ± 21.1 mmHg. The average ejection fraction was 59.4 ± 12.2% however 3 patients were less than 40%. Of note, 50.0% of patients were receiving vasodilators preoperatively. Spinal anesthesia decreased the mean heart rate form 77.5 ± 7.9 to 72.1 ± 5.4 bpm, whereas the average systolic blood pressure went from 143.9 ± 26.5 to 119.1 ± 13.9 mmHg. All patients were easily weaned from cardiopulmonary bypass. Average time to extubation was 29.4 ± 24.8 minutes, and only 4 patients required the intensive care unit. There was 1 perioperative death (5.0%), on day 91, due to sepsis. whereas the average time to discharge was 6.3 ± 2.1 days. There were no neurological complications.

DISCUSSION

Although afterload reduction is considered dangerous in patients with aortic stenosis, these patients showed little effect to the afterload reduction caused by the spinal anesthetic. This retrospective case series suggests high spinal anesthesia is safe in patients with critical aortic stenosis. Prospective trials are required to assess the efficacy and possible benefits of this technique.

CARDIOVASCULAR COLLAPSE AFTER ANESTHESIA INDUCTION IN CARDIAC SURGICAL PATIENTS

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INTRODUCTION

Cardiovascular collapse after anesthesia induction is a rare but catastrophic complication that may seriously compromise patient outcome. This study sought to determine the incidence and predisposing factors of that complication in cardiac surgical patients.

METHODS

With approval from our Human Research Ethics Committee, 5532 consecutive cardiac surgical patients participated in this prospective observational single center study. All preoperative and intraoperative data were first entered by the attending anesthesiologists. Data accuracy was confirmed within 24 hours by research assistants who had access to patients' charts and computerized anesthesia records. Cardiovascular collapse was defined as severe hypotension requiring cardiopulmonary resuscitation and/or immediate cardiopulmonary bypass within 10 minutes after anesthesia induction. The association between all potential risk factors and cardiovascular collapse was first determined by univariate analysis, using a ^{2} test or a Fisher's exact test. All factors with a $P < 0.20$ were included in a multivariate analysis to account for confounding and interaction between risk factors. Odds ratios (OR) and their 95% confidence intervals (CI) are presented. $P < 0.05$ was used to determine statistical significance.

RESULTS

There were 12 (0.2%) cases of cardiovascular collapse after anesthesia induction. Urgent surgery, immediate emergency surgery, recent (< 6 weeks) unstable angina, recent myocardial infarction, previous cardiac arrest, congestive heart failure class 3 or 4, pulmonary edema, preoperative intra-aortic balloon pump, intravenous inotropes, ejection fraction < 30%, systolic pulmonary artery pressure > 50 mmHg, plasma creatinine > 125 mmol/L and one of the staff anesthesiologists were significant univariate predictors. After multivariate analysis, only preoperative inotropes (OR: 23.8; 95%CI: 2.8-201.1), one staff anesthesiologist (OR: 10.5; 95%CI: 2.7-40.6), immediate emergency (OR: 6.7; 95%CI: 1.3-35.0) and previous cardiac arrest (OR: 4.3; 95%CI: 1.1-16.8) were significant risk predictors.

CONCLUSION

Although limited by the low prevalence of cardiovascular collapse after anesthesia induction, this study suggests that in addition to certain patient-related risk factors, anesthesia practice may play a significant role in this adverse event. Consequently, careful monitoring and appropriate

appraisal of each event is needed to potentially prevent this serious complication and assure patient safety.

INTRAOPERATIVE ADVERSE EVENTS AND MORTALITY AFTER CARDIAC SURGERY

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INTRODUCTION

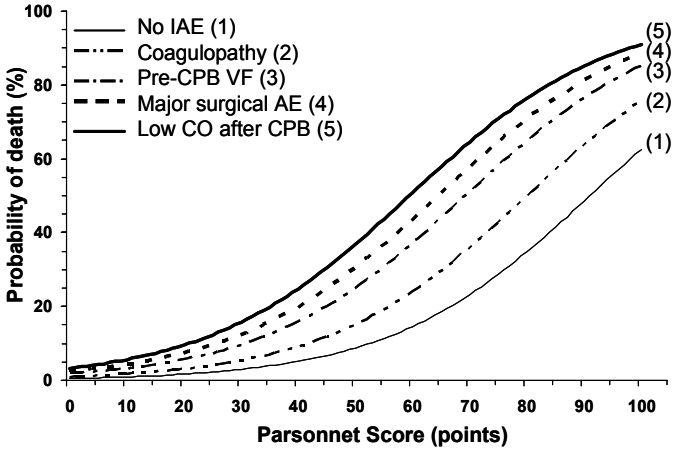
Cardiac surgical patients frequently suffer intraoperative adverse events (IAE). This study determined the incidence of various IAE and their risk-adjusted contribution to mortality in cardiac surgery.

METHODS

With approval from our Human Research Ethics Committee, 5532 consecutive cardiac surgical patients participated in this prospective observational study. A preoperative Parsonnet risk score was calculated in each case. The studied IAE were: *pre-cardiopulmonary bypass* (CPB) — cardiovascular collapse on anesthesia induction, major airway problem, hypotension requiring immediate CPB, low cardiac output (CO) requiring inotropes, ventricular fibrillation (VF), respiratory AE, surgical AE and others; *during CPB* — hypoxemia, acidosis, CPB circuit failure, respiratory AE, difficult CPB weaning, surgical AE and others; *after CPB* — low CO requiring intra-aortic balloon pump (IABP) or ≥3 inotropes, coagulopathy, severe protamine reaction, VF, respiratory AE, surgical AE and others. Surgical AE were classified by 4 surgeons as major (= immediate threat to life) or minor (= not life-threatening, but providing suboptimal result). The association between each IAE and mortality was first determined by univariate analysis, using a χ^2 test, then by multivariate analysis. Odds ratios (OR) and their 95% confidence intervals are presented.

RESULTS

There were 1563 IAE in 982 (17.8%) patients. The overall mortality was 3.8%: 14.2% in patients with IAE and 1.5% in those without ($P < 0.001$). The multivariate analysis identified 7 predictors of death: Parsonnet score (OR: 1.06 for each point; 1.05-1.07), prolonged CPB (OR:1.3 per hour; 1.1-1.6), coagulopathy (OR: 1.9; 1.1-3.1), pre-CPB VF (OR:3.4; 1.3-9.3), CPB (OR:5.6; 1.6-19.4) and post-CPB major surgical AE (OR:4.5; 1.3-15.6), and post-CPB low CO (OR:6.0; 3.7-9.9). The figure shows the probability of death associated with separate IAE for each Parsonnet risk score.



DISCUSSION

The high incidence of IAE and their association with mortality highlight the prognostic significance of the intraoperative period. Many high-risk patients (score >20) have acceptable mortality if they do not have IAE. Our results suggest that strategies to decrease IAE, particularly major surgical AE and low CO after CPB, are needed to improve outcome in cardiac surgery.

HEART RATE VARIABILITY: PREDICTOR OF CARDIAC MORBIDITY AFTER CABG SURGERY

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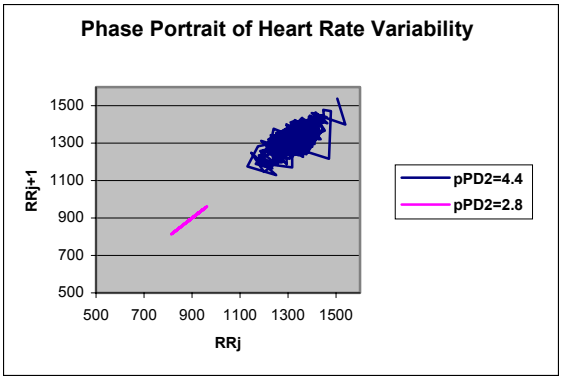
INTRODUCTION: The objective of this study was to determine if preoperative heart rate variability (HRV) is a predictor of postoperative arrhythmias in patients undergoing coronary artery bypass graft (CABG) surgery.

METHODS: After REB approval, 76 patients scheduled for elective CABG surgery underwent 10-min electrocardiogram recordings 1-2 hours prior to surgery. Patients with a previous history of heart surgery, atrial fibrillation, sinus node dysfunction, or requiring pacemaker were excluded. Time Domain, spectral and point correlation dimension (PD2) analysis were used to calculate HRV. The incidence of heart rhythm abnormalities were documented daily for 5 days post operatively. Based on presence of postoperative arrhythmia patients were categorized into two groups; arrhythmia group and controls.

RESULTS: 22 out 76 patients developed postoperative arrhythmias. Patients in arrhythmia group were significantly older (65 ± 9 vs. 58 ± 11 yrs, p=0.0046). High baseline peak point correlational dimension 2 (pPD2) was a risk factor for developing postoperative arrhythmias (4.2±0.8 vs. 3.8±0.7, p=0.042, Figure below). Low and high frequency ratio was lower in the arrhythmia group (3.0 ±2.45 vs.4.25 ±3.70, p= 0.085). There was no difference with respect to gender, inotropic use, cardiopulmonary bypass and cross-clamp time between the two groups.

DISCUSSION: Postoperative arrhythmia is a common morbidity after cardiac surgery. Disruption of autonomic balance between sympathetic and parasympathetic nervous systems may be one of the etiological factors involved. The pPD2 (analyzing HRV) appears to be a promising and novel predictor of post-operative arrhythmia in patients undergoing cardiac surgery.

Figure 1. Phase Portrait of Heart Rate Variability



This Phase portrait reflects heart rate variations, by plotting each R-R interval(RRj) against the immediately following one(RRj+1). This relationship is the first step in the algorithms used in non-linear analysis. The dark blue points represent the data from one patient with high HRV index, while the bright pink points were collected from the Pt with low HRV.

THE DEGREE OF HEMODILUTION IN CPB IS RELATED TO RENAL FAILURE IN CARDIAC SURGERY

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INTRODUCTION: This observational study sought to determine if the degree of hemodilution during cardiopulmonary bypass (CPB) is independently related to perioperative acute renal failure (ARF).

METHODS: Following REB approval data were prospectively collected on consecutive patients undergoing cardiac surgery with CPB from 1999 to 2003 at a quaternary care hospital. The independent relationship between degrees of hemodilution during CPB, as measured by nadir hematocrit concentration (nHct), and ARF was assessed by multivariable logistic regression to control for variables known to be associated with perioperative renal failure and anemia.

RESULTS: Of the 9080 patients included in the analysis, 1.5% (n=134) developed ARF. There was an independent, u-shaped relationship between nHct during CPB and ARF. Moderate hemodilution (nHct 21-26%) was associated with the lowest risk of ARF, with the risk increasing as nHct deviated from this range in either direction. Compared to moderate hemodilution, the adjusted odds ration for ARF with severe hemodilution (nHct<21%) was 2.2 (95% C.I. =1.4-3.5), and for mild hemodilution (nHct>26%) was 2.1 (95% C.I. = 1.1-4.0): P= 0.03.

CONCLUSION: Since there is an independent relationship between the degree of hemodilution during CPB and perioperative ARF, patient outcomes may be improved if the nHct during CPB is kept within the identified 'optimal' range. Randomized clinical trials, however, are needed to determine if this is a cause-effect relationship or simply an association.

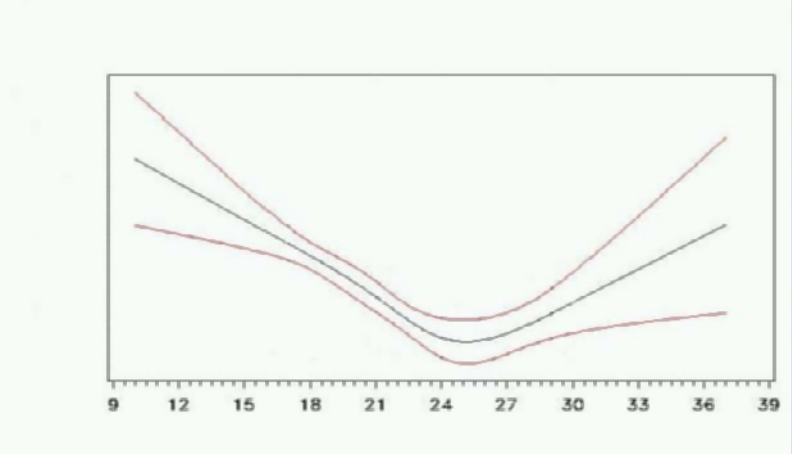

Figure 1. Estimated spline transformation and 95% confidence interval for nadir hematocrit and ARF

GLUCOSE, INSULIN, AND POTASSIUM (GIK) IN CORONARY ARTERY SURGERY

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INTRODUCTION: While there have been many positive studies of GIK in the setting of acute myocardial infarction and a number of positive studies of GIK in the setting of heart failure during cardiac surgery (#1), GIK has not been widely used as therapy in perioperative heart failure. We used a risk score from the Northern New England Cardiovascular Disease Study Group (NNE) (#2) to select a group of patients prospectively at high risk for perioperative low output failure during coronary artery bypass grafting (CABG), and then randomized them to receive GIK or routine therapy.

METHODS: After institutional review board approval, we randomized 228 CABG patients with NNE scores in the 10% at greatest risk for perioperative low output failure (LOF) to either a GIK group or a control group. The GIK group received GIK (1000 ml dextrose 25% with 100units regular insulin and 100 meq of KCL) at 1ml/kg/hour in the operating room and 0.33ml/kg/hour for a total of 24 hours. Therapy was otherwise the same for both groups. LOF was defined as two or more inotropes at 48 hours post-op.

RESULTS: There were no differences between the two groups in terms of age, gender, weight, diabetes, peripheral vascular disease, renal failure, pre-operative ejection fraction, number of bypass grafts, and NNE risk score. Outcomes are summarized in table 1.

TABLE 1 (Continuous data reported as mean +/- standard deviation.)

OUTCOME	GIK	CONTROL	P VALUE
30 day mortality	3.6%	3.4%	1.0
intensive care length of stay	4 +/-8	3 +/-4	0.30
hospital length of stay	11 +/-12	11 +/-11	0.60
intra-aortic balloon pump	11%	7%	0.29
pre bypass cardiac output	4.5 +/-1.4	4.7 +/-1.2	0.38
post bypass cardiac output	5.9 +/-2.0	5.4 +/-1.4	0.03
first intensive care cardiac output	4.9 +/-1.2	4.9 +/-1.4	0.93
post operative day 1 cardiac output	5.0 +/-1.2	5.0 +/-1.4	0.92
LOF	9%	9%	0.90

DISCUSSION: The first cardiac output after CPB was marginally higher in the GIK group with a $p = 0.03$. All other outcomes were similar for both groups. While others have shown some benefit to GIK in certain cardiac surgical patients, we demonstrated no clinical value in a subset of patients prospectively identified as at high risk for peri-operative LOF. GIK cannot be recommended for routine use even in a high-risk cardiac surgical population.

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A COMPARISON OF SPINAL HYPERBARIC ROPIVACAINE AND HYPERBARIC BUPIVACAINE FOR ELECTIVE CESAREAN SECTION

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INTRODUCTION:
We compared hyperbaric bupivacaine with hyperbaric ropivacaine for elective cesarean section in a double blind, randomized study. We determined the efficacy and the duration of motor blockade for the two agents.

METHODS:
The University of Manitoba Ethics Committee and the Research Review Boards of the Health Science Center and St. Boniface General Hospital approved the study. Sixty-six parturients were assigned to receive either 11.25 mg of hyperbaric bupivacaine or 15 mg of hyperbaric ropivacaine. All spinal anesthetics also contained 0.1mg of morphine and 0.01 mg fentanyl. We assessed sensory block with ice and motor block with the Bromage scale[1] at 3, 6, and 9 min after injection. We recorded APGAR scores, cord gases, and hypotension, vomiting, nausea, pain and pruritus intra-operatively. Patients were followed in PACU at 15-minute intervals until full motor function and sensation to L_4 returned. We obtained the obstetricians' assessments of the anesthetics. All patients were interviewed at 24 hours. Results are presented as mean ± standard deviation.

RESULTS:
Demographics were not different between the two groups. The median level of sensory blockade (ropivacaine - T_3, bupivacaine - T_2) did not differ. Duration of sensory block was shorter in the ropivacaine group (174 ± 24 min vs. 217 ± 46 min; $P< .0001$). Time for sensory block to recede to T_{10} (50 ± 10 min vs. 75 ± 15 min; $P< 0.0001$) and duration of motor block (85 ± 26 vs. 159 ± 56 min; $P< .0001$) was shorter in the ropivacaine group. The obstetricians rated intra-operative anesthesia as excellent in both groups. Side effects did not differ between the two groups. The patients in the ropivacaine group expressed significantly greater satisfaction compared to the bupivacaine group ($P< .0016$).

DISCUSSION:
We have determined that 15 mg of hyperbaric ropivacaine with 0.1 mg morphine and 0.01 mg fentanyl, provided excellent intra-operative anesthesia for cesarean section. The advantages of hyperbaric ropivacaine are faster regression of the block and greater patient satisfaction.

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COMPARISON OF SKIN DISINFECTANTS FOR PARTURIENT EPIDURALS

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INTRODUCTION

Chlorhexidine as an antiseptic solution for placement of intravascular catheters decreases incidence of central line colonization and blood stream infection when compared to povidone-iodine [1,2]. The low incidence of infection following lumbar epidural analgesia/anesthesia (LEA) makes its use as an endpoint impractical; however when infection occurs, the consequences can be devastating. Reducing skin contamination should logically reduce risk of infectious complications. This prospective, randomized, controlled trial was designed to compare efficacy of skin asepsis using povidone-iodine with chlorhexidine in the parturient population.

METHODS

A convenience sample of accessible patients meeting inclusion criteria was used. Eligible participants were parturients over age 18 presenting as outpatients requesting LEA. Exclusion criteria were known allergy to either solution, antibiotic administration prior to placement of LEA, and immunosuppression of the patient. Sample size calculation was performed. A 30% positive culture rate using povidone-iodine has been reported in the literature[3]. A 50% reduction in positive culture rate[2] can be detected with 80% power at a one-tailed significance of 5%. A total of 300 parturients will be enrolled.

Following IRB approval and informed consent, patients were randomized via computer-generated random tables to receive skin preparation with 2% chlorhexidine or 10% povidone-iodine. Following standardized skin preparation with one of the two solutions, and prior to LEA placement, a skin swab was collected from the proposed LEA site. Data collection included parturient's age, level of operator (resident vs. attending) and compliance with protocol.

RESULTS

To date, culture analysis has been reported on 248 of a planned 300 samples. Only 3 positive cultures have been reported; the study remains blinded.

DISCUSSION

It is likely no difference will be found between the two solutions. The significant difference between rates reported in the literature and our observed rate at a Canadian Teaching Hospital needs to be examined.

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EFFECT OF DEXTROSE ON PREOPERATIVE GASTRIC CONTENT AND SERUM GASTRIN

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INTRODUCTION The aim of the study was to analyze the effect of preoperative dextrose infusion to prevent hypoglycemia on serum gastrin concentration, gastric acidity, and volume in pregnant patients.

METHODS The study protocol was approved by the Hospital Ethics Committee and informed consent was obtained from all patients. Forty pregnant women undergoing elective cesarean section were included in the study. After eight hours of fasting, patients were randomly assigned to one of two groups to receive either 120 mL/h of 5% dextrose fluid (Dextrose group, n = 20) or same rate of normal saline (Control group) until the induction of anesthesia. Preoperative serum concentrations of gastrin and glucose were analyzed by radioimmunoassay. Acidity and volume of gastric contents were determined by direct gastric aspiration method using 14 F multiorifice nasogastric tube in a double-blind manner.

RESULTS Aspirated gastric pH (2.7 vs. 2.9) and volumes (28.5 vs. 26.5 mL) were similar in the two groups. However, more patients (40%) were found to be at risk of aspiration syndrome in the control group than in the dextrose group (20%), the values were statistically significant ($P < 0.05$). The serum gastrin concentrations of the two groups were not significantly different (32.8 vs.27.1 pg/mL).

DISCUSSION In conclusion, prophylactic dextrose infusion preventing hypoglycemia in patients undergoing cesarean section can decrease the risk of pulmonary acid aspiration. A preanesthetic blood glucose determination and keeping normoglycemia by appropriate dose of dextrose infusion will facilitate maternal and fetal safety in over-fasting patients undergoing elective cesarean section.

EFFECT OF INTRAMUSCULAR OPIOIDS ON SUBSEQUENT EPIDURAL ANALGESIA

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INTRODUCTION: Morphine and nalbuphine have been used extensively as analgesics in early labour. In a retrospective review, Goodman demonstrated that patients who received *intravenous* nalbuphine required more supplementary epidural medications than controls. (1) The purpose of this pilot study was to determine whether intramuscular nalbuphine increases: 1) the need for return visits by the anesthesiologist for inadequate analgesia or 2) local anesthetic requirements in labor as determined by patient-controlled epidural (PCEA) bupivacaine consumption.

METHODS: This was a prospective, randomized double-blind study. After REB approval and informed consent, nulliparous women in early labour randomly received either 15-mg morphine or 20-mg nalbuphine intramuscularly. If the patient later requested epidural analgesia, divided doses of 12-ml bupivacaine 0.125% with 50 μg fentanyl or 10 μg sufentanil were given. Standardized rescue medications were used. A PCEA solution of 0.08% bupivacaine and 2 $\mu g.ml^{-1}$ fentanyl programmed to deliver 5-ml boluses of solution with a lockout period of 10 minutes and 5-ml background infusion was initiated. Total PCEA bupivacaine consumption was determined at delivery or decision for Cesarean section. Demographic data was collated. The primary outcome was number of return visits by the anesthesiologist for top ups. Secondary outcomes included total bupivacaine PCEA dosage. Mann-Whitney and t-tests were used to analyze data.

RESULTS: Thirty-nine women were recruited. Due to recruitment barriers, the study was terminated early. Sixteen patients were excluded due to protocol violations or withdrawals. Of the remaining patients, ten were assigned to the morphine group and thirteen were assigned to the nalbuphine group. There were no statistical differences in demographics, number of return visits or total PCEA used. (Table).

	Morphine n=10	Nalbuphine n=13	95% CI
# of return visits Median and range	0.00 (range 0-2)	1.00 (range 0-5)	-2.001,0.001 NS
Total PCEA mg bupivacaine Mean and SD	114.7 (SD 63.5)	98.6 (SD 45.3)	-35.0, 67.2 NS

DISCUSSION: This pilot study did not demonstrate a significant difference in the number of return visits or total PCEA usage in women receiving intramuscular nalbuphine or morphine in labour. Due to recruitment problems, the sample size was small, and a larger study is required.

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THE INCIDENCE AND ETIOLOGY OF POSTPARTUM HEADACHES

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INTRODUCTION

The incidence of headaches in the postpartum period may be as high as 39%[1]. The majority of these headaches are primary (e.g. tension-type, migraine), whereas some will be secondary (e.g. post-dural puncture, hypertension). Anesthesiologists are often called upon to assess post-partum headaches after patients have had regional anesthesia. It is not clear to what degree the more frequent primary headaches may confound the diagnosis of secondary headaches. We surveyed our postpartum population to establish the incidence and etiology of headaches in this group.

METHODS

After ethics approval, women who delivered a fetus greater than 20 weeks gestation from June to August 2003 were eligible to participate in this prospective cohort study. Those who consented underwent a structured interview and chart review. The primary outcome of interest was headache and/or neck/shoulder pain. Participants were reassessed at one week postpartum and given a contact number to inform the interviewer of any subsequent occurrences. Headaches were diagnosed by an anesthesiologist and a neurologist independently and then by consensus, using an algorithm based on the diagnostic criteria of the international headache society[2].

RESULTS

We interviewed 985 patients out of a total of 1606 deliveries. Participants reported 381 (38.7%) headaches and/or neck/shoulder pain. The etiologies and incidence are displayed in the table. Of these, 80 (21%) reported relief when supine, 8 (2.1%) were bed-ridden and 7 (1.8%) were unable to take care of their baby. The average and median durations were 20.7 and 4 hours respectively.

Headache Type	Number (percent of headaches)
Tension-type	146 (38.3%)
Migrainous	102 (26.8%)
Musculoskeletal	43 (11.3%)
Undetermined	31 (8.1%)
Migraine without aura	25 (6.6%)
Post-dural puncture	17 (4.5%)
Cervicogenic	14 (3.7%)
Migraine with aura	4 (1%)
Cluster, Secondary	0

DISCUSSION

Primary headaches were 20 times more frequent than secondary headaches. Post-dural puncture headaches made up only 21% of all headaches with reported postural symptoms, however these were difficult to diagnose due to a lack of published criteria. It appears that the high incidence of primary headaches may confound the diagnosis of post-dural puncture headaches and that the incidence of these might be under-estimated.

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PREVENTION OF PRURITUS FOLLOWING NEURAXIAL MORPHINE ANALGESIA FOR CAESAREAN SECTION - A SYSTEMATIC REVIEW

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INTRODUCTION

Neuraxial morphine is widely used to provide pain relief following Caesarean section (CS) but it can cause pruritus, which may limit its beneficial effects. The purpose of this systematic review was to investigate the prevention of pruritus in this clinical setting.

METHODS

We searched for articles reporting the pharmacological prophylaxis of pruritus among women receiving neuraxial morphine for post-CS analgesia. A decrease in the incidence or severity of pruritus was used to measure a successful outcome. The search strategy included the use of electronic databases [Medline 1966-2003, Embase 1980-2003, Cochrane Register and DARE (including the following key words: pruritus, itch, morphine, spinal and epidural)] and a hand search of major anesthetic journals from the last five years. Abstracts from major scientific meetings including ASA, IARS, SOAP and CAS (1998-2003) and the reference lists of retrieved articles were searched. Review articles and letters were not included for analysis. Only randomized trials and abstracts of randomized trials meeting relevance and quality ($\geq$ 3 points on the Jedad scale [1]) criteria were analyzed.

RESULTS

We retrieved 17 RCTs and 2 abstracts that met the criteria for relevance and quality. Drugs reported to be effective, compared with placebo in preventing pruritus attributed to neuraxial morphine included; oral naltrexone 6-12.5 mg (4 articles), iv ondansetron 4-8 mg (2 articles), iv alzipride 50 mg (1 article) and IV hydroxyzine 50 mg (1 article). Drugs reported to be ineffective, compared with placebo included; IV propofol 10 mg (1 article) and IV nalmefene 0.25-0.5mcg/kg (2 articles). Drugs reported in separate studies to be both effective and ineffective compared with placebo included; IV nalbuphine 4-20 mg (3 articles), IV naloxone infusion (4 articles) and both IV (2.5 mg) and epidural (1.25-5 mg) droperidol (4 articles).

DISCUSSION

This review highlights the wide variety of pharmacological agents that may be used to minimize post-CS pruritus following neuraxial morphine administration. No one agent can reliably claim to abolish this symptom completely. This fact must be considered when contemplating the use of opioid antagonists that may potentially reverse the beneficial effects of opioid analgesia.

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IN VITRO VALIDATION OF 23G EPIDURAL CATHETER PERFORMANCE USING STANDARD INFUSION PUMP APPARATUS

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INTRODUCTION

Postdural puncture headache (PDPH) is a common complication of dural puncture in parturients but cadaver studies suggest that the volume of CSF leakage and hence the incidence and severity of PDPH may be reduced by using smaller epidural needles (> 18g). Recently, a 23g catheter designed for use with a 19g epidural needle has become available for use. This study compared the *in vitro* performance of a 23g catheter with a standard 20g catheter using PCEA.

METHODS

Ten 23g (Pajunk, Germany) and 20g (Portex, Keene NH) closed end triple-port epidural catheters were connected to a syringe containing 50-ml of N saline, primed, then seated in a Graseby (Watford, UK) 3300 PCEA pump. Each catheter tip was pressurized to 20 cm H2O and the pump configured to deliver a 5-ml bolus of solution. The duration of time over which the bolus could be administered without pump occlusion was determined. A second 5-ml bolus was actuated with the catheter tip sitting in the barrel of a 10-ml syringe and the volume of solution recorded. The above procedures were then repeated using a 9-ml bolus of solution.

RESULTS

The differences between programmed and delivered boluses ranged from 0.5-1.0 ml for both types of catheters for each programmed bolus. 2-way RANOVA examining the differences in volume of delivery between 23g and 20g catheters did not reach statistical significance for 5-ml ($p=0.10$) or 9-ml ($p=0.55$). The minimum median (range) duration of time over which the 5-ml and 9-ml boluses could be administered without pump occlusion via the 23g catheter were 2(1.5-4.0) and 3(1.5-5.0) minutes respectively. All boluses administered via the 20g catheter were completed without pump occlusion in 1.5 minutes.

DISCUSSION

This experiment demonstrates the suitability of a 23g epidural catheter for use in one type of commonly used PCEA pump. Although the time taken to deliver a programmed bolus was longer with the 23g catheter, the actual volume of solution delivered by each catheter upon demand was similar. Further studies *in vivo* are required to determine whether this delay has a clinically significant impact upon the quality of labour analgesia provided.

IDENTIFYING MAJOR COMPONENTS OF QUALITY NEURAXIAL ANALGESIA

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INTRODUCTION: Labour analgesia research is limited by a fragmented approach to outcome measurement which does not permit meaningful discrimination between modern drug regimens/techniques. A global quality measure of analgesia is likely to provide this level of discrimination. Valid instrument development must be guided by knowledge of parturient perceptions of "quality neuraxial analgesia" (QNA). We report preliminary research examining these issues as part of development of the Quality of Labor Analgesia (QLA) Index, a multi-attribute health index designed to measure neuraxial labor analgesia in research. This work provides the first crucial step in developing the QLA.

METHODS: Qualitative descriptive methods were used to explore parturient experiences of neuraxial analgesia. After REB approval, a purposeful sample of English-speaking parturients of mixed parity, racial, socioeconomic status and delivery mode who received neuraxial analgesia was recruited from 3 urban (1 teaching, 2 community) hospitals with a combined delivery rate of >10,000/year and a range of neuraxial analgesia practice including PCEA. Focus groups/in-depth interviews were held in hospital $\leq$72 hours of delivery using semi-structured interviews. Parturients were asked key questions with further iterative exploration until response saturation was achieved. Transcripts were independently coded by 2 researchers and inter-rater reliability was established. Thematic content analysis was performed to identify emergent themes related to QNA.

RESULTS: 27 parturients were interviewed. Emergent themes related to pain, control and fear. Labour pain decreased perceptions of control which was restored when "QNA" was achieved. Women feared both pain, factors associated with epidural insertion and analgesia side-effects. Ideal QNA was defined as safe, complete continuous pain relief, rapid in onset, with complete absence of side-effects. Dissatisfaction was associated with breakthrough pain (most highly ranked source of dissatisfaction), loss of control associated with motor block or numbness and inability to feel the urge to push or contractions. The latter led to fear related to loss of bodily indicators of labour progress and diminished participation in the birth. Dissatisfaction with other side-effects included pruritus and inability to urinate.

DISCUSSION: Preliminary work suggests that the major component scales required to measure QNA must include: pain/pain relief, control, movement, numbness, itching, and ability to urinate.

EXPLORING LABOUR PAIN MEASUREMENT

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INTRODUCTION: Labour pain (LP) measurement in neuraxial analgesia (NA) trials currently treats LP as if it were a single discrete pain form. Failure to account for the true nature of LP and variability in pain patterns leads to information loss. We report preliminary findings related to LP in parturients with and without NA. This information represents the first step in developing the Labour Pain Scale, the first major scale of the Quality of Labour Analgesia (QLA) Index.

METHODS: Qualitative descriptive methods were used to explore LP. After REB approval, a purposeful sample of native English speaking parturients of mixed parity, racial, socioeconomic status and delivery mode (with and without NA during labour) was recruited from 3 urban (1 teaching, 2 community) hospitals with a combined delivery rate of >10,000/year. Indepth interviews were held in hospital using semi-structured interviews. Women without any form of analgesia were interviewed $\leq$ 24hrs after delivery. Partients receiving NA were interviewed $\leq$ 24hrs postpartum or (when possible)using a 2 stage interview process (during labour after NA followed by a second interview $\leq$12 hours postpartum). Parturients were asked to colour pain patterns on 4 anatomic diagrams(depicting relevant anatomy) for each of 4 labour stages and to designate relevant pain descriptors (provided on the pain picture) for each pain type. Pain was ranked (least to worst intense) by location for each stage.

RESULTS: 31 parturients were recruited (10 had no analgesia of any form, 21 had NA.). Pain was most easily described by location (uterine; backpain; vaginal, rectal pressure $\pm$ nerve pains) rather than pain descriptors. Common qualitative pain descriptors for each location were identified. Locations varied over time and were variably present between parturients. Patients were readily able to rank pain severity by location at each. Some pain forms were constantly present (eg back pain; rectal pressure) in some parturients. Prominent patterns varied with eventual mode of delivery.

DISCUSSION: "Labour pain" consists of multiple pain forms which are variably present in location and severity over time, vary in occurrence between parturients and are readily characterized by location. Meaningful labour pain measurement must address these findings.

FACTORS INFLUENCING USE OF NEURAXIAL LABOUR ANALGESIA

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INTRODUCTION: Little is known about parturient decision-making related to use of neuraxial analgesia (NA) for labour. We report preliminary research examining sources of information and concerns experienced related to NA prior to its use. Information was gathered during development of the Quality of Labour Analgesia Index.

METHODS: Qualitative descriptive methods were used to explore sources of information used related to NA and concerns at the time of epidural placement. After REB approval, a purposeful sample of English speaking parturients (mixed parity, racial, socioeconomic status, delivery mode) was recruited from 1 teaching and 2 community urban hospitals with a combined delivery rate of >10,000/year. All women received NA (readily available in all hospitals). Focus groups and in-depth interviews were held during hospitalization ≤72 hours of delivery. A semi-structured interview guide was used to explore information sources and concerns related to NA with further iterative exploration until response saturation was achieved. Thematic content analysis was performed. Emergent themes related to factors influencing women's decisions to use NA.

RESULTS: 27 parturients were interviewed (5 focus groups;14 in-depth interviews). Preliminary results suggest a complex dynamic interaction between major themes influencing the decision to use NA. Themes included: pain, past experience, self-image, fear (related to pain and/or NA side-effects/complications); information provided (past and present) by women's key informants (lay and professional), and personal labour support. Key concerns included: paralysis, nerve damage, long term back pain, effects on labour progress, participation in the birth experience, sitting still for the procedure, drug side-effects; safety (neonatal and maternal) and fear of having to wait for pain relief. Primiparous women were usually concerned over the risk of paralysis, nerve injury and backpain. Multiparous women with a history of uneventful NA were more likely to have few concerns and voiced fear of having to wait for analgesia. Dissatisfaction/frustration was voiced over the lack of accurate information (usually negative) available in communities and from some health care providers relating to NA.

DISCUSSION: Research findings suggest a complex dynamic process involved in parturients'decision making related to use of NA for labour and post-analgesia frustration related to the lack of accurate information provided by key informants.

IS NITROUS OXIDE AN EFFECTIVE ANALGESIC FOR LABOUR? A SYSTEMATIC REVIEW

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INTRODUCTION:

A qualitative systematic review was conducted to assess the efficacy of nitrous oxide for labour analgesia. While 50 % nitrous oxide is cheap, easy to administer, and well tolerated by mothers with minimal effect on uterine tone and fetus, detractors argue that that it provides little analgesic benefit over inhaled oxygen/air. However, it remains in widespread use where neuraxial analgesic techniques are not available or affordable or where minimal intervention for analgesia in labour is desired.

METHODS:

Randomized controlled trials of nitrous oxide for labour pain relief was sought. Electronic search strategies were used to identify eligible studies in MEDLINE (1966-2003), EMBASE, (1980 - 2003), and the Cochrane Library. Language was not restricted. Hand searches were conducted of major textbooks of anesthesia-published prior to 1985, and published abstracts from January 1998 to September 2003 of meetings of the ASA, IARS and SOAP. Included were full journal publications of any randomized controlled trial evaluating nitrous oxide analgesia for labour. Each study was assigned a quality score using the Jadad scale[1]. Two prospective studies and one observation study were included for discussion but were not scored. Excluded were review articles, letter and abstracts.

RESULTS:

Fifteen randomized controlled trials were identified to determine efficacy. Four trials compared nitrous oxide to either oxygen or air. Two trials compared different concentrations of nitrous oxide. Nine trials compared nitrous oxide to other inhalational agents. Quality scores ranged from one to five with the majority of trials receiving a score of either one or two. Two prospective studies and two observational studies comparing nitrous oxide with narcotics were included for discussion but were not assigned quality scores. The design of randomized controlled trials differed in mode and timing of administration, duration of use and stage of labour, as well as measurement of analgesic efficacy, and numbers of subjects enrolled.

DISCUSSION:

A review of this literature suggests that 50 % nitrous oxide has analgesic efficacy, and is safe. Quality and validity of these studies is such that further research is necessary to define factors that can optimize efficacy.

1. Control Clin Trials. 17:1-12

PROPOFOL ENHANCES INSULIN SECRETION IN INS-1 CELLS

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INTRODUCTION: Effects of anesthesia on plasma concentrations of insulin and glucose remains controversial. Insulin secretion is controlled by ion channel activities in β-cells. Propofol is a commonly used anesthetic. The aim of this study was to examine the effect of propofol on insulin secretion and relevant ion channel functions.

METHODS: Insulin secretion assay and whole-cell patch-clamp recordings were performed in cultured INS-1 cells in saline containing low (2.8mM) and high (16.8mM) concentrations of glucose ([G]), respectively.

RESULTS: Incubation of INS-1 cells with propofol (10μM) for two hours enhanced insulin secretion (low [G]: basal, 0.46 ± 0.05 ng/μg, propofol, 0.72 ± 0.12 ng/μg, $P<0.05$; high [G]: basal, 1.27 ± 0.20 ng/μg, propofol, 1.98 ± 0.18 ng/μg, $P<0.05$). Current-clamp recordings revealed that INS-1 cells exhibited more depolarized membrane potential (V_M) in high [G] than in low [G] (high [G]: -34 ± 4 mV; low [G]: -58 ± 3 mV, $P<0.05$). Propofol dose-dependently depolarized cells from their endogenous V_M with a larger amplitude in high [G] than in low [G] (high [G]: 8.4 ± 1.3 mV; low [G]: 2.8 ± 0.9 mV, $P<0.05$). The propofol effect reversed when the V_M was held below -65 mV. The nature of the propofol effect remained when intracellular K-gluconate was replaced with KCl, suggesting an action on K^+-, but not Cl^--conductance. Voltage-clamp recordings disclosed a delayed outward current that was sensitive to the Ca^{2+}-channel blocker nifedipine (12μM) and the K^+-channel antagonist TEA (5mM), indicating a Ca^{2+}-activated K^+-conductance (IK_{Ca}). Propofol suppressed the delayed K^+-conductance (high [G]: 0.35 ± 0.04; low [G]: 0.21 ± 0.03). Omitting ATP from the patch-electrode gradually activated an ATP-sensitive K^+ (K_{ATP})-conductance, on which, however, propofol exhibited no effect. Furthermore, TEA, but not the K_{ATP} blocker glybenclamide (100μM), depolarized cells and occluded the propofol-induced depolarization.

DISCUSSION: This study demonstrates for the first time that propofol enhances insulin secretion by suppressing an IK_{Ca} in β-Cells. When applied intravenously, propofol is rapidly redistributed into central and peripheral tissues[1]. Thus the action of propofol on insulin secretion should be taken into account when selecting anesthetics.

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AMBULATORY SURGICAL PATIENTS WITH NO ESCORTS

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INTRODUCTION

Over 70% of surgery is now being done on an ambulatory basis in North America[1]. Patients scheduled for ambulatory surgery must have a responsible adult to escort them home and to stay with them overnight. This is an essential requirement stipulated by the American Society of Anesthesiologists' Guidelines on Post-Anesthetic Care.[2] Ambulatory surgical patients without escorts is not reported in literature. The purpose of this study is to determine the incidence of unavailable escort, incidence of adverse outcomes and ways to limit the problem

METHOD

Following Institutional Research Board approval, all consecutive ambulatory surgical patients who had no escort were studied from September 2000- August 2003. Patients known to have no escort before surgery, were cancelled. Following surgery and recovery, should a patient not have an escort, efforts to find an inpatient bed is made. Patients who have no escort were discharged after signing against medical advice. The chart is examined and information such as ASA, type of anesthesia given and type of operation done is collected. All patients with no escort were contacted by phone 24 hours later and information such as mode of transport home was ascertained, whether an adult stayed with the patient overnight, and if any other complications occurred. A month after the date of surgery, the patients'charts were checked for re-admission or return hospital visits.

RESULTS

The total number of patients treated in the ambulatory surgery center was 27,775 in 36 months. The overall incidence of ambulatory surgical patients without an escort was 0.2%. The total number of patients with no escort was 58, 53 were operated and 5 patients were cancelled. Most (96%) of the patients knew they should have an escort and 11% looked after minors that night.

Table

DISCUSSION

In this study, the incidence of ambulatory patients without escort was 0.2%.The highest incidence was among patients scheduled for termination of pregnancy, 1.3%. Pain and bleeding were the only complications. Unanticipated admission and re-admission were 6.5% and 4.3% respectively.

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Table . Summary of Findings

	Number	Incidence
Knowledge of need for escort	56/58	96%
No. of patients cancelled	5/58	8.6%
Unanticipated admission	4/53	7.5%
Re-admitted within 1 month of surgery	2/53	3.8%
No. of patients contacted	27/53	50.9%
Responsible adult at home with patient	21/27	77%
Sole responsibility for minors on night of surgery	3/27	11%
Traveled a long distance to get home	4/27	15%
Complication-severe pain/ bleeding	7/27	26%

CARDIOVASCULAR SAFETY PROFILE OF AV430A IN HUMAN VOLUNTEERS

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INTRODUCTION: AV430A is a new nondepolarizing neuromuscular blocking drug with a rapid onset and short duration of action. The ED95 is 0.125mg/kg[1]. The cardiovascular safety profile was studied in four groups from a larger phase 1 study.

METHODS: After IRB approval, 20 ASA class 1 male and female volunteers aged 18-48 yr were studied in 4 dose groups of five. Anesthesia was induced with midazolam, fentanyl, and propofol, and the tracheae were intubated without paralysis. Anesthesia was maintained with propofol, N2O 70%/O2 30%, and fentanyl as needed. BP(via intra-arterial radial line), HR, ETCO2, ECG, and Temp were monitored. Each subject received their first bolus dose of AV430A at least 20 minutes after intubation. The groups received 2, 3, 5, or 7X ED95 doses of AV430A (0.25, 0.375, 0.625, and 0.875 mg/kg respectively). Data were analyzed for maximum HR and BP changes in the first five minutes after the first drug bolus.

RESULTS: 15 of the 20 volunteers had less than 20% change in HR and/or MAP. One volunteer receiving 0.625mg/kg had a 30% decrease in MAP. At 7XED95 (0.875mg/kg), three had changes of 20-29% in HR and MAP and one had a 41% increase in HR. Table 1 summarizes the mean maximum changes. All maximum hemodynamic changes occurred within 1.8 min. and were transient.

Table 1:

AV430 (mg/kg)	0.25	0.375	0.625	0.875
ED95 multiple	2	3	5	7
Mean max HR ↑	3 (0-8)	2 (0-6)	6 (0-16)	21 (7-41)
Mean max MAP↓	3 (0-5)	1 (0-6)	12 (2-30)	13 (2-22)

DISCUSSION: All dose levels were well tolerated. Administration of AV430A in doses through 3XED95 were completely free of significant cardiovascular side effects. The 5XED95 dose caused significant side effects in one of the five volunteers in that group, and the 7XED95 group experienced significant, yet transient, changes. Since the onset at 5XED95 is approximately one minute[1], higher doses are not likely to be recommended for clinical use.

REFERENCE:

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PHARMACOKINETIC PROFILE OF AV430A IN HUMAN VOLUNTEERS

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INTRODUCTION: AV430A is a new nondepolarizing alpha-chlorofumarate neuromuscular blocking drug with a rapid onset and short duration of action. This study was conducted to evaluate the pharmacokinetic profile of this drug in volunteers.

METHODS: After IRB approval, ten ASA 1 male and female volunteers aged 22-45 yrs were studied in 2 groups of five as part of a larger volunteer study of AV430A. Anesthesia was induced with midazolam, fentanyl, and propofol and maintained with N_2O/O_2 70%/30%, propofol and fentanyl as needed. BP, HR, ECG, $ETCO_2$, and temperature were monitored in the standard manner. The ulnar nerve was stimulated at the wrist with train-of-four every 10s and MMG responses of the adductor pollicis were recorded. The first group of five volunteers received 0.19mg/kg AV430A (1.5XED95) followed by a 30-minute infusion upon evidence of return of the twitch. The infusions were maintained to provide 95±4% twitch suppression. Arterial blood samples were collected prior to the bolus, 30s and 60s after the bolus, immediately prior to starting infusion, and 30s, 1, 2, 3, 4, 5, 15, 30, 31, 31.5, 32, 33, 34, 36, 38, 42, 50, and 60 min after start of the infusion. The second group of five volunteers received a single bolus of 0.625mg/kg AV430A (5XED95) and had 12 arterial blood samples collected prior to the bolus, 30s, 1, 1.5, 2, 4, 6, 8, 10, 12, 16, and 20 min after. Analysis of concentration-time data was conducted by non-compartmental analysis using WinNonlin. AV430A concentrations at 15 and 30 minutes during infusion were assumed to represent steady-state. Blood clearance (CL_B) was estimated from average steady state concentration ($C_{ss,avg}$) as follows: CL_B=infusion rate/$C_{ss,avg}$.

RESULTS: The average rate of infusion ranged from 58-62mcg/kg/min. The terminal elimination half-life of AV430A at the termination of infusion was 3.09±0.21 min and the $C_{ss,avg}$ was 3126±923 ng/ml. CL_B was 20.2±4.7 ml/min/kg. After the single bolus dose the elimination half-life was 2.41±0.17 min with an average CL_B=22.1±5.9 ml/min/kg. The estimated volumes of distribution at steady state and terminal phase averaged 0.057±0.024 L/kg and 0.077±0.021 L/kg.

DISCUSSION: The elimination half-life and blood clearance of AV430A are very similar when the agent is administered either as a bolus of 5XED95 or an infusion that maintained 95% block. AV430A is not widely distributed. The pharmacokinetic parameters are consistent with *in situ* rapid inactivation by plasma cysteine with a resultant short acting pharmacodynamic profile.

IS THERE DELAYED COGNITIVE FAILURE AFTER AMBULATORY ANESTHESIA?

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INTRODUCTION: Although patients are warned not to drive or operate machinery for 24 hours after general anesthesia, the duration and magnitude of impairment of cognitive function are poorly defined. This study was designed to determine the magnitude of subjective cognitive failure in the three days following general anesthesia for ambulatory surgery.

METHODS: Approval was gained from the hospital research ethics board prior to enrolling patients. Following written informed consent, 258 patients undergoing general anesthesia and 250 patients scheduled for local anesthesia were recruited from the ambulatory unit. Following the method of Tzabar et. al.[1] the Cognitive Failures Questionnaire[2] (CFQ) was used to study impaired cognitive function. High CFQ scores represent increasingly poor cognitive function. Patients were asked to complete the questionnaire before their procedures (with respect to the previous three days) and on their third postoperative day (with respect to their recovery period).

RESULTS: No differences were present between patients who received general anesthesia (GA) and those who did not (LA) in terms of age, gender or body mass index. There were significantly more patients of American Society of Anesthesia (ASA) status 1 in the LA group (65%) than in the GA group (53%) ($P<0.01$, chi-square).

		Pre-operative Score	Post-operative Score
LA Group	Mean (s.d.)	25.8 (12.8)	26.2 (13.3)
	Median (IQR)	26 (18)	25 (20)
GA Group	Mean (s.d.)	24.8 (12.7)	25.8* (14.3)
	Median (IQR)	26 (18)	28* (22)

IQR - Interquartile range, * = Significant difference from pre-operative score at $P<0.05$ level.

There was no significant difference in pre-operative CFQ score between the LA and GA groups (Mann-Whitney U). When pre- and post-operative CFQ scores were compared, a small but significant increase was seen in the GA group ($P<0.05$, Wilcoxon).

DISCUSSION: We found a statistically significant increase in cognitive failures in the three days following general, but not local anesthesia. However, the magnitude of this increase was very small, and is unlikely to be clinically significant. Ambulatory general anesthesia may have less effect on the subjective impairment of cognitive function than was previously thought.

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DRIVING IMPAIRMENT FOLLOWING AMBULATORY SURGERY

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INTRODUCTION: The objective of this study was to determine whether driving skills have returned to baseline levels within 2 to 24-hours after receiving a balanced general anesthesia for ambulatory surgery.

METHODS: After Institutional board approval 14 patients (pts) (ASA I & II) with valid driver's licenses (8 males and 6 females, aged 43.5±11.6) undergoing left knee arthroscopy were studied. Standardized anesthetic was given. Pts performed 30 min driving stimulations before surgery (baseline), 2 h & 24 h after using the York Driving stimulator. During each session, individuals were monitored for occurrence of micro sleep (MS) episodes and attention lapses (AL). Measured driving performance variables included: mean lane accuracy/road position (RP), mean speed deviation, mean reaction time (RT) to "virtual'' wind gusts and off-road events ("crashes'').

RESULTS: Patients demonstrated poor lane accuracy both at base line and 2 h after surgery. Reaction time (RT) 2 h after surgery was significantly longer vs values at 24 h and at baseline. Attention lapses (AL) episodes were found to occur more often 2 h after surgery vs baseline and 24 h after surgery.

Measure	Mean	SD	p(vs. baseline[a])	p(vs. 2 hours[a])	F[b]	p[a]
Road Position						
24 hours after	24.1	8.3	<.05	>.05	3.6	**.04**
2 hours after	29.0	2.8	>.05			
Baseline	30.7	7.4				
Reaction Time						
24 hours after	0.906	0.351	>.05	<.05	7.0	**.01**
2 hours after	1.340	0.474	<.05			
Baseline	0.985	0.344				
Attention Lapses						
24 hours after	1.0	1.2	<.05	<.05	13.4	**.0001**
2 hours after	3.3	2.0	<.05			
Baseline	1.9	1.3				

[a] p values for Tukey post hoc analysis.
[b] Overall test for differences

DISCUSSION: Both driving stimulation parameters and EEG-verified attention lapses showed that psychomotor performance was impaired 2 h after an anesthetic. All patients achieved relative normalization by 24 h post-anesthetic.

SIMULTANEOUS DETERMINATION OF NMB AT FOUR MUSCLES USING PHONOMYOGRAPHY

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INTRODUCTION: Phonomyography (PMG) consists of recording low frequency sounds created during muscle contraction and has been validated to show good agreement with mechanomyography (1,2). In this study, phonomyography was used to measure neuromuscular block (NMB) simultaneously at four muscles.

METHODS: After obtaining approval of the local ethics committee and informed consent, 15 patients were included in the study. PMG was recorded via small condenser microphones taped over the thenar mass (adductor pollicis - AP), over the eyebrow (corrugator supercilii - CS), at the paravertebral region at T12/L1 (diaphragm) and beside the vocal cords (adducting laryngeal muscles). After induction of anesthesia, the corresponding motor nerves were stimulated supramaximally using train-of-four (TOF) stimulation every 12 seconds. Onset, peak effect and offset of NMB after mivacurium 0.1 mg/kg were measured and compared using ANOVA, followed by *t*-test and the Bland-Altman method to determine agreement and bias between diaphragm, larynx and the corrugator supercilii muscle.

RESULTS: Onset and offset of NMB was significantly longest at the AP muscle; the significantly lowest peak effect was reached at the CS muscle. Peak effect was not significantly different between the adductor pollicis muscle and either the adducting laryngeal muscles or the diaphragm (Figure 1). Whereas there was a significantly shorter onset of NMB at the diaphragm than at the CS muscle, recovery of NMB was not significantly different between the CS muscle and either the adducting laryngeal muscles or the diaphragm. The peak effect of the CS muscle was significantly less pronounced than at the adducting laryngeal muscles. Using the Bland Altman method, there was a considerable bias of –0.2 min and –1.3 min with wide limits of agreement of 2.6 min and 10.2 min for onset and recovery to TOF 0.8, respectively (CS-Larynx).

DISCUSSION: We present the first study where simultaneous monitoring of NMB at the CS muscle, AP muscle, laryngeal adducting muscles and diaphragm was performed using the same method, phonomyography. Recent enthusiasm about the good correlation of the CS muscle with the adducting laryngeal muscles (3) cannot be supported by our study.

REFERENCES: 1.Anesth. 2003 Feb;98(2):359-63; 2.BJA. 2002 Mar;88(3):389-93; 3.Anesth. 2001 Jul;95(1):96-101

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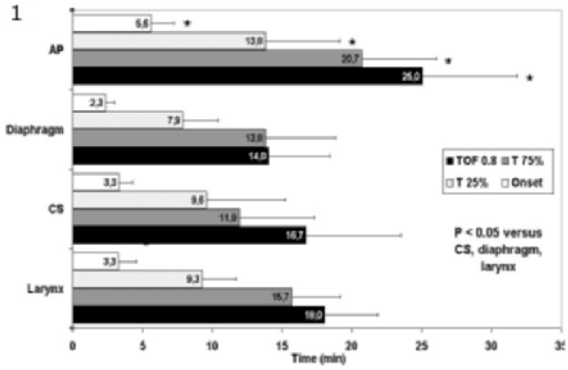
AP
5,6
13,8
20,7
26,0
Diaphragm
2,3
7,9
13,8
14,0
CS
3,3
9,6
11,9
16,7
Larynx
3,3
9,3
15,7
19,0
TOF 0.8
T 75%
T 25%
Onset
P < 0.05 versus CS, diaphragm, larynx
0
5
10
15
20
25
30
Time (min)

INTUBATING CONDITIONS AND NEUROMUSCULAR BLOCKADE USING PHONOMYOGRAPHY

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INTRODUCTION: The goals of this study is to compare intubating conditions when time to intubate is determined according to onset time at the corrugator supercilii (CS) muscle, larynx or at a fixed time of 3 min and to compare onset of neuromuscular blockade (NMB) at the CS muscle to the larynx.

METHODS: After obtaining approval of the local ethics committee and informed consent, 60 patients were included in the study. Neuromuscular monitoring consisted of phonomyography (1). One microphone was attached to the medial eyebrow to record NMB at the CS muscle (1). Another microphone was attached just lateral to the larynx in order to record NMB at the larynx. Supramaximal TOF stimulation of the facial and recurrent laryngeal nerves was performed every 12 sec. Anaesthesia consisted of remifentanil 0.35 µg/kg/min and propofol 2.5 mg/kg. Rocuronium 0.6 mg/kg was given. Patients were assigned to one of the following groups: Group CS (intubation was attempted at peak effect of the CS muscle), Group Larynx (intubation was attempted at peak effect of the larynx) or Group Control (after 3 min). Intubation conditions were rated as: 8-9=excellent, 6-7=good, 3-5=fair, 0-2=poor. Onset and peak effect of NMB at the CS muscle and the larynx were determined. Comparison of intubating conditions was performed using the Chi-square test. Onset and peak effect of NMB were compared using *t*-test. Agreement of onset time and peak effect was determined using the Bland-Altman test.

RESULTS: Table 1 shows intubation scores, onset time and peak effect. There was no significant differences between the groups. There was a significant bias and wide limits of agreement of onset time and peak effect between CS and larynx; for onset time, the mean bias was 12s (–31 to +55) and for peak effect, the mean bias was –7 % (–44 to 30).

DISCUSSION: Phonomyographic monitoring of either CS or larynx can be used to determine an early time to obtain excellent intubating conditions. These are not different from intubating conditions obtained 3 min after rocuronium 0.6 mg/kg. However, onset time and peak effect determined at the CS or the larynx cannot be used interchangeably.

REFERENCE: 1. BJA, 2002 Mar;88(3):389-93.

Table 1

Group	Age (y)	Height (cm)	Weight (kg)	Intubation score	Onset (s)	Peak (%)
3 min (N=20)	54 (14)	165 (11)	67 (13)	9		
CS (N=20)	49 (16)	168 911)	75 (11)	8.3 (0.9)	76 (24)	69 (12)
Larynx (N=20)	51 (14)	164 (12)	69 (16)	8.7 (0.5)	70 (27)	73 (18)

AN EVALUATION OF PRE-OPERATIVE CORONARY ANGIOGRAPHY IN NON-CARDIAC SURGERY

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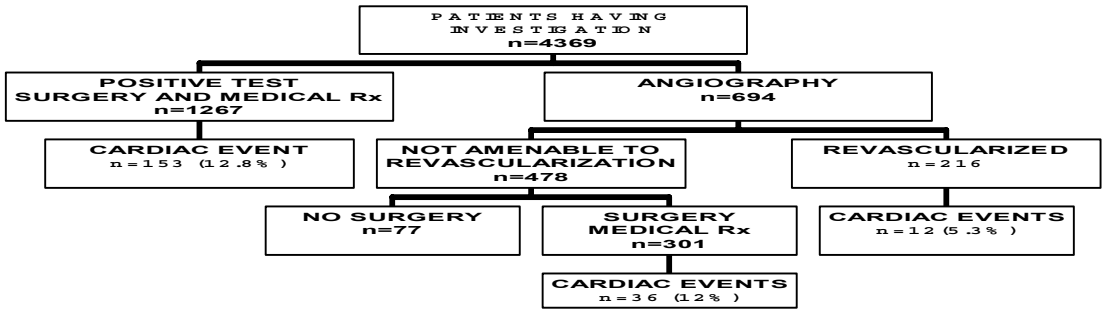
INTRODUCTION: The prevailing consensus among experts is that moderate to high risk patients with positive non-invasive testing should have angiography and re-vascularized, if possible, prior to elective non-cardiac surgery[1]. This belief is held even though there are no clinical trials to support it. The present study was conducted to assess if preoperative angiography, conducted in patients at moderate risk AND with positive pre-operative stress tests, leads to reduced morbidity.

METHODS: The meta-analysis used publications assessing the utility of nuclear scintigraphy and stress echocardiography. We searched the electronic databases, computerized bibliographies; hand searched of relevant journals, and corresponded with authors. In the MEDLINE search we used the MeSH headings: dipyridamole, thallium, sestamibi, dobutamine, stress echocardiography. Articles were reviewed for selection criteria, angiography, myocardial infarction and death. Analysis used Revman 4.2

RESULTS: Our search identified 46 studies encompassing 7376 patients. 30 studies (4369 patients) employed selection criteria, which allowed for coronary angiography. The test results and management of the results are seen in figure 1. 29% of patients had a positive stress test. 694 (15%) of patients underwent angiography. 216 (5%) had revascularization; 478 patients were not amenable to re-vascularization. Cardiac events in patients who had a positive stress and no angiography were 12.1% and angiography 6.7%; RR (0.55, 95% CI 0.41,.75). Re-vascularized patients had 12 cardiac events (5%) RR (.48, 95% CI .28, .78) most events occurred during investigation or revascularization.

EFFECT OF CORONARY ANGIOGRAPHY ON OUTCOME



CONCLUSION: The practice of angiography in patients with a positive stress test led to a management strategy that reduced the cardiac event rate. This practice should be evaluated in a well-designed clinical trial.

REFERENCE: Goldman L., Evidence Based Perioperative Risk Reduction Am. J. Med 2003; 114: 763

TRANSFUSION PRACTICE PATTERNS IN CRITICALLY ILL PATIENTS

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INTRODUCTION: RBC transfusion practices are often a response to low serum hemoglobin (Hb) levels indicative of anemic states or blood loss. Previously, Hb of 100g/L was recognized as the transfusion trigger, a value based primarily on nonrandomized studies.[1] This threshold was re-evaluated for critically ill patients after the publication of a large RCT that recommended a restrictive Hb trigger of 70g/L and a target range of 70 to 90g/L.[2] Our objectives were to evaluate the implementation of this restrictive transfusion protocol into clinical use (generalizability), to assess long-term compliance and the impact of evidence-based medicine.

METHODS: Following REB approval, consecutively admitted patients into a quaternary hospital's medical surgical ICU were reviewed in 2000 and 2002 starting in January of each year. Eligibility was based on criteria set forth by the source RCT.[2] Inclusions were Hb concentration of at least 90g/L within 72hrs of admission and length of ICU stay greater than 24hrs. Exclusions were age <16 years, refusal of blood products, pregnancy, cardiac or transplant surgical patients and active blood loss. Medical charts and electronic hospital records were used to gather pertinent patient information. Cohorts were compared using the χ^2- and *t*-tests.

RESULTS: Of a total of 146 study patients, 90 represented the cohort year of 2000 and 56 the cohort year of 2002. In 2000, 53.3% (n=48) of the patients received RBC transfusions totaling 141 individual transfusion episodes with mean pre- and post-transfusion Hb of 66.5±11.9g/L (67.7±6.9g/L without outliers) and 81.8±16.6g/L (82.9±10.1g/L without outliers), respectively. In 2002, 51.8% (n=29) received RBC transfusions totaling 129 transfusion episodes with mean pre- and post-transfusion Hb of 73.0±18.9g/L (73.9±10.3g/L without outliers) and 84.7±22.5g/L (88.0±11.2g/L without outliers), respectively. The mean pre-transfusion Hb was higher in the second cohort (P=0.001).

DISCUSSION: Transfusion practice was compliant to recommended guidelines in both time periods. Early results show a strict implementation of the protocol while two years later the transfusion trigger, although still compliant to guidelines, is trending toward a slightly higher benchmark. These results illustrate the successful impact of research-developed guidelines on routine clinical practice.

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PERIOPERATIVE MYOCARDIAL ISCHEMIA & METOPROLOL TITRATION PROTOCOL

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INTRODUCTION

A protocol was used to identify to patients at risk for perioperative myocardial ischemia or infarction (PMI/I) and provide prophylaxis.

METHODS

Patients with ≥2 risk criteria (Lee's Revised Cardiac Risk Index[1] modified to include age), were eligible for the protocol: IHD/CHF/CVD/RF/DM/ high-intermediate risk surgery /age >70 years. PAU patients took metoprolol 25-50mg bid orally for 1-4 weeks before surgery. Perioperatively, heart rate was controlled with intravenous metoprolol and with titrated oral metoprolol postoperatively until hospital discharge plus one month after discharge. With REB approval, we compared the incidence of ICU admissions with PMI/I before and after protocol introduction.

RESULTS

Surgeries included major general, orthopedic, thoracic, and gynecological, but no vascular, trauma, or neurosurgery. Risk criteria in surgical patients during a random month, extrapolated to the first six months of the protocol, suggest >400 patients should have been eligible; 60 patients were actually enrolled. One enrolled patient had PMI/I, but the protocol was violated. Four had metoprolol doses held post-operatively for minor adverse events. ICU admissions with PMI/I were unchanged (2.67 /month).

	Incidence of risk factors %					Incidence of BB therapy %			Mortality %
	0	1	2	3	≥4	Pre-op	Intra-op	Post-op pre-MI	
September 2003 surgical population (n=640)	39	36	16	6	3	14	19	NA	NA
ICU PMI/I admissions Jan 2002-Dec 2003 (n=56)	0	11	34	32	23	28	19	19	30

DISCUSSION

89% of ICU PMI/I admissions in 2002-3 had >2 risk factors, but most had not received beta blockers (BB) perioperatively. Prescriptions for metoprolol in the hospital increased during the period under review, but not in these high-risk patients. PMI/I risk factors are common in the surgical population at the General Campus, especially in those admitted to the ICU. Early experience suggests this protocol is safe but it is underutilized and has not yet reduced ICU admissions with PMI/I. Implementation strategies need to be revised to increase awareness and emphasize the potential impact of perioperative BB[2].

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VALIDITY OF TEE IN THE DIAGNOSIS OF POST-OPERATIVE CARDIAC TAMPONADE

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INTRODUCTION: Cardiac tamponade is a life-threatening complication following cardiac surgery that requires accurate diagnosis to prevent adverse outcomes. The clinical diagnosis of tamponade in the ICU is based on indirect evidence and can be challenging. Transesophageal echocardiography (TEE) has more recently been employed in the diagnosis of tamponade and although particular echocardiographic signs may indicate tamponade, few studies compare TEE findings with intraoperative findings. We evaluated the accuracy of TEE in making the diagnosis of tamponade in the ICU by comparing TEE findings with surgical findings.

METHODS: Retrospectively we identified all patients having a TEE in the ICU for suspected tamponade in a consecutive series of cardiac surgery cases from June 1997 to July 2003. A TEE diagnosis of tamponade was made when blood or clot was found around the heart, with chamber collapse or compression judged to impair filling. Among patients who underwent re-exploration, a surgical diagnosis of tamponade was made when mediastinal blood and or clot was found with hemodynamic improvement upon its removal.

RESULTS: Eighty-eight patients had a TEE in the ICU for suspected tamponade following cardiac surgery. Tamponade was identified by TEE in 30 (34%) patients. Of those, 25 (83%) returned to the OR where tamponade was confirmed in 18 (72%) patients. Tamponade was ruled out by TEE in 58 (66%) patients who had TEE in the ICU; of these, 13 (22%) returned to the OR and tamponade was found in 2 (15%) patients. In-hospital mortality for all patients who had TEE for suspected tamponade was 28% (25/88).

CONCLUSION: Among the 38 patients for whom surgical confirmation of TEE findings was available, TEE was accurate in 76% (29/38) of cases. Thus, TEE is a valuable adjunct in the diagnosis of tamponade. However, of the patients with negative TEE who were re-explored, there was an appreciable rate of tamponade. TEE alone cannot reliably rule out this diagnosis.

PRE-OPERATIVE MODERATE TO SEVERE LEFT AND RIGHT VENTRICULAR DIASTOLIC DYSFUNCTION ARE PREDICTIVE OF DIFFICULT SEPARATION FROM BYPASS

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Introduction: We have previously demonstrated that left ventricular diastolic dysfunction (DD) is a predictor of difficult separation from bypass (DSB) (1, 2). However, right ventricular DD can also be present before cardiac surgery and its relationship with DSB is unclear.
Method: 179 consecutive patients undergoing cardiac surgery were studied. Patients with pacemaker, atrial fibrillation, non-sinus rhythm, moderate to severe mitral or tricuspid regurgitation were excluded. Patients undergoing mitral valve surgery or with aortic insufficiency were excluded for the evaluation of left ventricular diastolic dysfunction. DSB was defined as as systolic blood pressure below 80 mm Hg confirmed with central measurement (femoral or aortic), diastolic pulmonary artery pressure or pulmonary artery capillary wedge pressure > 15 mm Hg during progressive weaning from CPB and the use of inotropic or vasopressive support (norepinephrine > 4 $\mu g.min^{-1}$, epinephrine > 2 $\mu g.min^{-1}$, dobutamine > 2 $\mu g.kg^{-1}.min^{-1}$) or the use of amrinone, milrinone, mechanical support or IABP to be weaned from bypass or to leave the operating room. The use of dopamine from 0.5-3.0 ug/kg/min was excluded from the definition. Left ventricular diastolic dysfunction was classified according to published guidelines (3) and newer modalities such as tissue Doppler and color M Mode (2). Normal or relaxation abnormalities were classified as mild DD, pseudonormal and restrictive were classified as moderate to severe left DD. Right ventricular DD was classified as moderate to severe right DD if the Doppler systolic hepatic venous flow was inferior to the diastolic waveform or if the systolic waveform was reversed. Groups were compared using descriptive statistics. A $p < 0.05$ was considered significant.Results: A total of 179 patients were studied (57 women, 122 man). Evaluation of left and right ventricular diastolic function was obtained before CPB in 144 (80%) and 162(91%) patients respectively. In patients with pre-CPB severe left ventricular DD (n = 29), DSB occurred in 66% (p = 0.0173). In patients with pre-CPB right ventricular DD (n=18), DSB occurred in 72% (p = 0.0455). DSB was also more common in complex surgeries (p=0.0024) and aortic surgeries (p = 0.0455).

Left ventricular diastolic dysfunction before CPB

	Normal or Mild	**Moderate or Severe**	**Total number**
No DSB	68 (60%)	10 (34%)	78
DSB	47(40%)	19 (66%)	66
Total	115	29	144

Right ventricular diastolic dysfunction before CPB

	Normal or Mild	**Moderate or Severe**	**Total number**
No DSB	76 (53%)	5(28%)	81
DSB	68 (47%)	13 (72%)	81
Total	144	18	162

Conclusion: Both moderate to severe left and right ventricular diastolic dysfunction are associated with DSB. Further studies will be required to determine the impact of pre-operative DD on other outcome variables.

1-Bernard et al Anesth Anal 2001;92:291-8
2-Garcia et al JACC 1998;32 :865-875
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IMMEDIATE EXTUBATION AFTER CARDIAC SURGERY AS A ROUTINE METHOD: FIRST EXPERIENCE AFTER 275 PATIENTS

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INTRODUCTION

This study presents the results of routine immediate extubation after cardiac surgery in 275 patients. Analgesia was provided either with high thoracic epidural (TEA), PCA morphine alone or in association with paravertebral blocs.

METHODOLOGY

275 patients undergoing cardiac surgery with an ejection fraction of at least 25 % were included in this prospective, non-randomized audit. Patients received one of the three sorts of analgesia: A)analgesia based on TEA (bupivacaine 0.125 % 4-16 ml/h), B)analgesia based on fentanyl bolus (< 15 µg/kg total) + remifentanil during surgery and po. PCA using morphine or C)analgesia based on bilateral paravertebral blocks (single shot technique) + fentanyl (< 15 µg/kg total) bolus + remifentanil infusion during surgery followed by patient controlled analgesia with PCA morphine. Primary analgesic regimen was TEA. If patients refused TEA or were on anticoagulative therapy, postop. analgesia was PCA morphine (bolus: 1 mg; lockout: 6 min) alone or with paravertebral blocks performed before surgery. Anesthesia was induced using fentanyl 2-3 µg/kg, propofol 1-2 mg/kg, and maintained using sevoflurane titrated to a BIS of 40-50.

RESULTS

The anthropometric data and surgery-related parameters (concomitant diseases, ejection fraction, number of grafts, ischemic time, time of surgery, extubation time, patients temperature) and postoperative pain scores immediately and up to 48 h were recorded and compared. 275 consecutive patients were successfully extubated after cardiac surgery. 212 had coronary artery bypass (13 on-pump and 199 off-pump). 63 patients had simple or combined aortic(55) or mitral(8) valve replacement. 196 patients had an high thoracic epidural, 64 had PCA-morphine and 15 had paravertebral blocks + PCA-morphine. Immediate post-operative pain scores in these groups were 1.14(1.88), 4.26(2,59), 3.93(2.36) respectively, in favor of the TEA group. Mean extubation time after surgery was 10 min without significant differences between groups. There was no complication related to epidural catheter. Only two patients needed reintubation.

DISCUSSION

This audit shows the feasibility of immediate extubation after cardiac surgery with either high thoracic epidural or a conventional low dose fentanyl + remifentanil balanced anesthesia. Significantly better postoperative pain scores were achieved with TEA.

EVALUATION OF VASCULAR ANASTOMOSES WITH TEE IN LUNG TRANSPLANTATION

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INTRODUCTION: Thrombus or stenosis of pulmonary vein (PV) anastomosis may result in catastrophic complications such as graft failure [1][2]. There is no literature comparing intraoperative assessment of PV anastomoses with Transesophageal echocardiography (TEE) and postoperative course in double-lung transplant (DLT) patients.

METHODS: Following REB approval, we retrospectively reviewed intraoperative TEE findings of the PV blood flow in 15 DLT patients operated at our institute between July 2002 and July 2003. All patients received sequential double-lung transplant. Six patients showed turbulent flow across the PV anastomosis and were assigned to Group A. Nine patients showed no abnormal flow and were assigned to Group B. One patient in Group A developed myocardial infarction and died from multiple organ failure. This patient was excluded from further comparison between groups. Average cold ischemic time, total ischemic time, and PaO2/FiO2 ratio on arrival at the ICU were compared between two groups.

RESULTS: In Group A, turbulent blood flow was always detected in the left PV anastomosis (6/6). Pressure gradient across the anastomosis ranged from 8 to 22mmHg. One patient developed left PV thrombosis and received left pneumonectomy. Five of 6 (83%) patients failed to be extubated and required long-term ventilatory support. In Group B, Six (64%) patients were extubated within 24 hours. Mean PaO2/FiO2 ratio on arrival at the ICU was lower in Group A than Group B but not statistically significant (196 vs.349, p=0.0693#). Mean cold ischemic time of left donor lung was significantly longer in Group A than Group B (352min vs. 242min, p= 0.0276#). Average hospital stay was significantly longer in Group A than Group B (103.8 days vs. 20.3 days). (#Unpaired t-test)

DISCUSSION: Group A patients required longer postoperative ventilatory support and hospital stay. Even though the mean ischemic time of the left donor lung was significantly longer in that group, we consider abnormal blood flow across the anastomosis may have had significant impact on the clinical outcome. Intraoperative TEE may have an important role in evaluating the vascular anastomosis in lung transplantation. Further prospective investigation is indicated.

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FVIIa FOR REFRACTORY BLEEDING AFTER CV SURGERY: A PROPENSITY ANALYSIS

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BACKGROUND: Cardiac surgery is sometimes complicated by excessive blood loss that is refractory to standard hemostatic interventions. Several case series have described the successful use of recombinant factor VIIa (FVIIa) in such cases. Questions remain about safety of this off-label use; the primary concern is risk for thrombotic complications. This concern was heightened by the high incidence of adverse events and death in the case series. Lacking control patients, these reports could not determine if FVIIa increased or decreased the risk of adverse events in this inherently high-risk patient population. The primary objective of this case-control study was to assess safety of this off-label use of FVIIa by comparing the outcomes of CV surgery patients treated with FVIIa to matching control patients.

METHODS: With REB approval, the perioperative course of 45 consecutive CV surgery patients who received FVIIa for excessive, refractory blood loss during 2003 at a single quaternary-care institution. To measure the effectiveness of FVIIa, we compared the difference in blood loss during the hour before and the hour after rF-VIIa therapy in patients treated after chest closure (Wilcoxon-signed rank test). To assess the safety of rF-VIIa, we compared (chi-squared test) the incidence of serious adverse events in treated patients to matched control patients. Each case was matched to one control based on the propensity for receiving >5 units of RBC. Logistic regression was used to calculate the propensity scores. Controls were identified from a prospective database that contains information on 9215 CV surgery patients from 1999 to 2003.

RESULTS: In the 29 patients treated after chest closure, blood loss decreased from 336 ± 266 ml during the hour before FVIIa administration to 90 ± 55 ml during the following hour (mean difference = 245 ± 49 ml; P<0.0001). Cases and controls were comparable in all assessed perioperative variables. The incidences of serious adverse events were similar between cases and controls (Table).

Adverse Event	Case/Control group 1 (N=45/45)	P
Death	7/6	0.8
Death or thrombotic complications	14/14	1.0

CONCLUSIONS: In this case-control study, FVIIa reduced refractory blood loss after CV surgery without increasing the risk of serious adverse events.

HORMONE REPLACEMENT THERAPY AND NEUROLOGICAL OUTCOME IN WOMEN IN CARDIAC SURGERY

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INTRODUCTION: Recent studies have demonstrated that women are at higher risk from neurological complications after cardiac surgery. There are conflicting results with respect to estrogen therapy reducing the risk of stroke in this patient population. Although an association between higher serum concentration of estradiol and decreased risk of cognitive decline has been established, the recent randomized trials suggest that hormone replacement therapy (HRT) increases the risk of ischemic stroke in generally healthy postmenopausal women. We sought to determine the relationship between preoperative HRT and neurological outcomes in women undergoing cardiac surgery.

METHODS: Following REB approval, we examined data collected prospectively on 2425 female patients undergoing cardiac surgery between October '99 and September '03. Based on preoperative HRT status patients were categorized into two groups; postmenopausal women who received HRT were included in the HRT group and women who did not receive HRT in control group. Patients were followed for development of postoperative neurological complications including stroke, TIA's, and seizures. Numerical and categorical data were analyzed with Chi-square test, T-test and ANOVA as appropriate. A p value of less than 0.05 was considered statistically significant. Data is expressed as mean ± SD.

RESULTS: A total of 1650 women > 50 yrs of age were assessed. 234 (14%) received HRT prior to surgery. Women who received HRT were on average 3 years younger (66 ± 7 vs. (69 ± 8.0, $p<0.0001$), had larger Body Surface Area (1.82 ± 0.3 vs. 1.75 ± 0.3, $p=0.0091$), were more likely smokers (50% vs. 41%, $p=0.009$) and were less likely to suffer from diabetes mellitus (21% vs. 30.0%, $p=0.0035$). Neurological outcome data is compared in the Table. Mortality rate was 2.9% in both groups.

Neurological sequelae	HRT group (n = 234)	Control group (n = 1416)	P value
Total	5 (2.1%)	42 (2.9%)	0.48
Stroke	2	25	0.30
Seizures	3	13	0.59
TIA's	0	4	0.62

CONCLUSIONS: There appears to be no association between preoperative HRT therapy and neurological outcomes in postmenopausal women undergoing cardiac surgery.

THE EFFECT OF PREVENTIVE INHALED NITRIC OXIDE ON CEREBRAL INFLAMMATION AFTER CARDIO-PULMONARY BYPASS IN RATS

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INTRODUCTION

Despite the improvement in the perfusion techniques, still 42% of the patients suffer from short and long term neuro-cognitive disorders (NCD) after cardio-pulmonary bypass (CPB). Inhaled Nitric Oxide (INO) used as a preventive medication can significantly decrease the pulmonary inflammation (acute lung injury) induced by CPB in pigs and has also extra-pulmonary effects. The objective of our research was to determine if INO can modify NCD induced by general anesthesia (if there are any) and by CPB in rats.

METHODS

We used an animal model developped in our laboratory (CPB in rats) to observe if preventive INO administration is able to modify the neuro-cognitive disorder observed after CPB in rats. We used that model because the neuro-cognitive behavioral evaluation tests are well described in rats and because the costs of the experiments are small.

The animals were randomly divided into 6 groups.

Lot	MWMT 1st day	CPB 2nd day	MWMT 10th day	4% formalin fixation and histo investig	CSF
1. Sham	Yes	No	Yes	Y	Y
2. Sham+INO (box)	Yes	No	Yes	Y	Y
3. Anesthesia	Yes	No	Yes	Y	Y
4. Anesthesia and INO	Yes	No	Yes	Y	Y
5. CPB	Yes	Yes	Yes	Y	Y
6. CPB + INO	Yes	Yes	Yes	Y	Y

RESULTS

Preventive INO administration reduce the local inflammatory reaction associated with the reperfusion injuries induced by CPB. INO increase NOx (NO2 and NO3; NO metabolites) level in the CSF.

DISCUSSION

We evaluated the effect of preventive INO on behaviour of rats that underwent to CPB in order to observe if the gas is able to influence the inflammatory response. Our research is at the beginning because NO associated with other gasotransmitters like carbon monoxide and hydrogen sulfide are considered as important neuro-modulators, able to deeply influence the cerebral function.

THE EFFECT OF PREVENTIVE INHALED NITRIC OXIDE ON PULMONARY REPERFUSION INJURY IN PIGS

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INTRODUCTION

The beneficial effect of inhaled nitric oxide (INO) on pulmonary hypertension is well known but its anti-inflammatory effect is not well established. Cardiopulmonary bypass (CPB) is associated with a systemic and local (pulmonary) inflammatory response induced as a reperfussion injury. We evaluated the effect of different strategies of preventive INO administration on the pulmonary inflammatory reperfusion injury induced by CPB.

METHODS

We used an animal model developped in our laboratory (pigs) to observe the weaning strategies associated with the 24 h continous INO administration.
The animals were randomly divided into 4 groups.

Group	Operation	Ventilation	Hemodynamics	Specimen
Sham	Sham	24h	+	3 BAL (bronchoalveolar lavage)
CPB without INO	CPB	24 h	+	3 BAL
CPB with INO	CPB+INO (preventive)	24 h	+	3 BAL
CPB with INO gradually weaned	CPB+ WINO (preventive)	24h	+	3 BAL

RESULTS

Preventive INO reduce the local inflammatory reaction associated with the reperfusion injuries induced by CPB, influencing the cell population observed in BAL. The progressive weaning of INO after CPB is not followed by rebound of the inflammation.

DISCUSSION

We evaluated the effect of preventive INO on pulmonary hemodynamics, function and inflammation. Preventive INO is able to modulate the inflammatory response. Its short action impose further association of INO with various drugs that are able to further influence the pulmonary inflamation. We consider INO as a pivotal drug with an important role in the future.

EFFECT OF CARDIOPULMONARY BYPASS ON ERYTHROPOIETIN PHARMACOKINETICS

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INTRODUCTION: Recent studies have demonstrated improved neurological outcome in patients suffering ischemic stroke treated with exogenous erythropoietin (r-huEPO). This observation raises the possibility that r-huEPO may have neuro-protectant properties that could be exploited in patients undergoing coronary artery bypass. It is hypothesized that the PK profile of r-huEPO may be altered during cardiopulmonary bypass (CPB) due to the increase in circulatory volume, blood loss, and adsorption onto the CPB circuit resulting in reduced bioavailability of r-huEPO. The objective of this study was to examine the pharmacokinetics of r-huEPO in patients undergoing CPB.

METHODS: Following REB approval patients undergoing CPB were enrolled into one of 3 groups: Control (n=6), 250 units/kg r-huEPO (n=3), and 500 units/kg r-huEPO (n=3). The r-huEPO was administered immediately prior to the induction of anesthesia. Erythropoietin blood levels were measured at baseline, 5 min after dosing, after sternotomy, on bypass (5, 15, 30, 45, 60 min) and after separation from CPB (5, 15, 45, and 60 min, 6, 12 and 24 hour and daily until day 5). Serum erythropoietin concentrations were measured using a validated enzyme-linked immunosorbent assay. Model-independent pharmacokinetic analyses were conducted using WinNonlin software, Version 3.1A (Scientific Consulting Inc., North Carolina).

RESULTS: Endogenous erythropoietin levels increased within the first 24 hours of surgery and remained elevated at levels up to 120 mIU/mL for the duration of the study period. There was a 30-40% decrease in serum concentration of r-huEPO at the initiation of CPB. Despite this decrease, there were no apparent differences in volume of distribution of the central compartment (42.2 ± 9.9, 39.8 ± 6.3 mL/kg), clearance (4.63 ± 1.14, 3.44 ± 0.68 mL/h/kg) and $t_{1/2}$ (10.7 ± 2.7, 7.99 ± 2.51 h) between the treatment groups.

CONCLUSIONS: The PK of r-huEPO appeared to be unchanged during and after CPB such that we can predict the serum concentration of the drug based on the dose administered. Data from this work will be used to develop PK models to predict levels of r-huEPO in the cerebral spinal fluid and to guide in the development of a randomized control trial to test the neuroprotective properties of r-huEPO in cardiac surgery.

CYTOKINE RESPONSE TO ERYTHROPOIETIN IN CARDIAC SURGERY

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INTRODUCTION: Cardiac surgery is associated with a high risk of neurological sequelae that may be exacerbated by an inflammatory response. Evidence from models of experimental brain injury and ischemic stroke patients suggest that erythropoietin is neuroprotective. One mechanism for this neuroprotection proposes that alteration in the inflammatory response attenuates the secondary brain injury. The objective of this work was to determine if erythropoietin modifies the inflammatory response to cardiopulmonary bypass (CPB).

METHODS: Following REB approval 12 consecutive patients undergoing CPB were enrolled into one of 3 groups: Controls (n=6), 250 IU/kg EPREX (r-huEPO) (n=3), and 500 IU/kg r-huEPO (n=3). R-huEPO was given immediately before induction of anaesthesia. Samples for measurement of IL-6, IL-10 and TNF-α were drawn 10 min before induction of anesthesia, 5 min after sternotomy, 45 min after initiation of CPB, and 45 min, 6 hours and 18 hours after separation from CPB. The IL-6, IL-10 and TNF-α levels were measured from serum with an Enzyme Amplified Sensitivity Immunoassay (EASIA, Biosource, Nivelles, Belgium). An ANOVA and Duncan post hoc test was used to compare cytokine levels at each time point.

RESULTS: Levels of IL-6 (Table Below) and IL-10 were higher than control subjects while on CPB. There was no difference in the levels of TNF-α between treatment groups at any time point.

	Plasma IL-6		
	Control (pg/ml)	**EPO 250 IU/kg** (pg/ml)	**EPO 500 IU/kg** (pg/ml)
Pre CPB (After Sternotomy)	ND	93 ± 161	2.6 ± 4.6
On CPB (45 min on CPB)	283 ± 291	1388 ± 208*	1789 ± 1111*
Post CPB (45 min after CPB)	382 ± 589	304 ± 176	206 ± 37

ND = Not detectable * $P < 0.05$

DISCUSSION: The administration of r-huEPO in patients undergoing cardiac surgery results in an alteration of the inflammatory response to CPB. The consequence of these changes remains to be clarified.

PERIPHERAL VENOUS PRESSURE PREDICTS CENTRAL VENOUS PRESSURE POORLY IN PEDIATRIC PATIENTS

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INTRODUCTION: Central venous pressure (CVP) is commonly used to assess and monitor intravascular volume status. Peripheral venous pressure (PVP) reliably predicted CVP in animal and adult surgical studies(2, 3, 4). The use of PVP in lieu of CVP as a perioperative volume monitor may decrease risks and costs and prove convenient. The objective of this study is to determine if pressure measured from a peripherally placed upper limb intravenous catheter (PVP) reliably predicts the CVP in pediatric patients.

METHODS: With ethics approval and informed consent, 15 pediatric patients aged neonate to twelve years requiring a peripheral intravenous and a central venous line were studied prospectively. With patients in the supine position both transducers were zeroed at the phlebostatic axis. The central line and upper extremity peripheral intravenous was simultaneously transduced. Two simultaneous 20s digitized recordings of CVP and PVP were made five minutes apart to allow both statistical analysis and transfer function analysis to be performed(6,7). Correlation (PVP vs. CVP) and Bland and Altman analysis (CVP-PVP vs. mean of CVP and PVP) of measurements were performed on the 30 recordings obtained to date. 30 patients (60 recordings) will be studied in total.

RESULTS: Mean (standard deviation: SD) of CVP (torr) was 6.74 (3.78); of PVP 10.75 (5.37). R, the correlation of PVP on CVP = 0.71, $P<0.0001$. In the Bland-Altman analysis, three data points lay outside 2 SD of the CVP – PVP differences. In 2 recordings, CVP exceeded PVP. Transfer function analysis awaits completion of the study.

DISCUSSION: Peripheral venous pressure appears to predict central venous pressure in adults much more reliably than in pediatric patients. Transfer function analysis may provide an explanation.

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AN EVALUATION OF PALS INTERVENTIONS USING THE ULSTEIN GUIDELINES.

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PURPOSE: Evaluate the efficacy of advanced life support interventions using the pediatric Ulstein guidelines [1].

METHODS: Charts from all patients for whom a cardiorespiratory arrest code was called during a six years period in a university affiliated center were review. Data were recorded according to the pediatric Ulstein guidelines and a $P < 0.05$ was considered significant.

RESULTS: Of the 234 calls, 203 were retained for analysis. The overall survival rate at 1 year was 26.9% of which 10 % had deterioration of their neurologic status compared to the precardiorespiratory arrest evaluation. Time to achieve sustained ROSC ($P<0.0001$) and sustained measurable blood pressure ($P=0.002$), to perform endotracheal intubation ($P=0.04$) and the dose of sodium bicarbonate ($P<0.0001$) were indicators of longterm survival. Two patients were alive at one year with unchanged neurologic status despite a time to achieve sustained ROSC longer than 30 minutes (38 and 44 minutes). The mean first epinephrine dose of patients for whom ROSC was achieved but unsustained was higher than those for whom ROSC was achieved and sustained (0.038 ± 0.069 mg.kg^{-1} vs. 0.011 ± 0.006 mg.kg^{-1}; $P=0.004$). Survival rate and mean first epinephrine dose of patients who received their first epinephrine dose intratracheally (13.3%; 0.011 ± 0.004 mg.kg^{-1}) were comparable to those of patients who received their first epinephrine dose intravenously (7%; 0.015 ± 0.027 mg.kg^{-1}).

CONCLUSION: For intravenously administered epinephrine, a dose of 0.01 mg.kg^{-1} seems appropriate as the first dose. The intratracheal route is a valuable alternative for epinephrine administration and, for infants, the dose does not need to be increased. A minimal resuscitation duration time of 30 minutes can be misleading if ROSC is used as the indicator

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EFFECTS OF PROPOFOL AND KETAMINE ON BODY TEMPERATURE DURING INDUCTION OF GENERAL ANESTHESIA IN CHILDREN

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INTRODUCTION:

The aim of study is to evaluate core temperature and skin-surface temperature gradients in use of ketamine for anesthetic induction compared with propofol in children(1).

METHODS:

After institutional ethics committee approval and informed consent, 40 children undergoing elective surgery were randomly assigned to anesthetic induction with either 2.0 mg/kg ketamine(n=20) or 2.0 mg/kg propofol(n=20). Anesthesia in both groups was maintained with sevoflurane and 50% nitrous oxide in oxygen. Core temperature, forearm skin temperature, fingertip skin temperature and forearm minus fingertip skin-temperature gradients were recorded before induction of anesthesia, 3 min(just before endotracheal intubation), 5 min, and at 5 min intervals until 30 minute after induction of anesthesia**.**

RESULTS:

Core temperature was decreased, but results did not differ significantly between two groups. Forearm skin temperature was increased , results did not differ significantly between two groups. Finger tip skin temperature was increased significantly after 3 min of anesthesia in the propofol group and 10 min in the ketamine group. Forearm minus finger skin surface temperature gradients was decreased significantly at 3 min of anesthesia in the propofol group and 10 min in the ketamine group. Gradients of 5 min of anesthesia was presented only significant between two groups.

DISCUSSION:

These data suggest that propofol produced vasodilatation, and ketamine maintained vasoconstriction during induction of general anesthesia in children. Peripheral vasodilation is likely to facilitate core-to-peripheral redistribution of heat.

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ULTRASOUND-GUIDED INTERNAL JUGULAR ACCESS IN INFANTS AND CHILDREN

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Introduction:
In infants and children, percutaneous access of the right internal jugular vein (IJV) based on anatomical landmarks is not always easy. Therefore, ultrasound-guided techniques for cannulation of the IJV have been described, and their use has been shown to increase the success rate and decrease the incidence of complication in infants and children [1)2)]. We compared the use of a small-caliber audio-Doppler probe with an ultrasound scanner when cannulating the right IJV in infants and children.

Methods:
The protocol was approved by the institutional Ethical Committee and written parental consent was obtained. Sixty-two infants and children undergoing cardiac surgery were randomized into two groups (ultrasound scanner group: US, and audio-Doppler group: AD). Under endotracheal general anaesthesia, the patient was positioned in the 15-20 degree Trendelenburg position with a shoulder roll inserted to allow extension of the head. The head was placed in the midline position. In the ultrasound scanner group, cannulation was guided using an ultrasound scanner image (Site-Rite II, Dymax Corporation, Pittsburgh, USA). In the audio-Doppler group, the pathway of the right IJV was located with the small-caliber probe (2mm in diameter, Bidirectional Velocity Meter, HD-307, HAYASHI Electronic, Tokyo, Japan) and marked on the skin, then the vessele was punctured using sterile technique. Success rate on the first attempt, cannulation time within 5min, ultimate success rate, and incidence of complications were recorded.

Results:

	US	AD	
success rate on the first attempt	65.5% (19/29)	39.4% (13/33)	P<0.05
cannulation time within 5min	75.9% (22/29)	60.6% (20/33)	N.S.
ultimate success rate	89.7% (26/29)	78.8% (26/33)	N.S.
Complications : hematoma	1	3	
: arterial puncture	0	2	

Discussion:
Both devices were helpful in cannulation of the IJV in infants and children. The success rate on the first attempt was higher with an ultrasound scanner.

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PEDIATRIC RENAL TRANSPLANTATION

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INTRODUCTION

Renal transplantation is the treatment of choice for children with end stage renal failure. The results of pediatric renal transplantation are inferior to those in adults due to the higher incidence of acute tubular necrosis and graft loss from vascular thrombosis and primary nonfunction. Infants are at highest risk for graft loss and mortality of any group undergoing renal transplantation[1, 2.] The aim of this study was to assess the incidence and predisposing factors of graft failure and to define optimal anesthetic management for pediatric renal transplantation.

METHODS

After Institutional Review Board approval, 34 patients who underwent renal transplantation at our institution between January 2001 and August 2003 were reviewed retrospectively.

RESULTS

The mean age and weight of the 34 patients at transplantation were 11 years and 36 kg respectively. The etiology of renal failure was obstructive uropathy (13), glomerulonephritis (10), renal dysplasia (4) and others (7). Live-donor grafts were used in 56% of patients, 35% received a cadaveric adult kidney and 9% received a cadaveric pediatric kidney. Crystalloids, 5 % Albumin or packed red cells were given at 22-55 mls/kg (mean= 53 mls/kg) to maintain intravascular volume and achieve a CVP of 11-19 mmHg (mean= 14 mmHg) prior to release of aortic and caval cross clamps. Mannitol (0.5 - 1.0g/kg) and furosemide (1mg/kg) were also given intravenously prior to release of cross-clamps to ensure a brisk diuresis. Venous thromboses occurred in two living related recipients (weight < 20 kg) resulting in early graft loss.

DISCUSSION

Anesthetic, surgical, and immunological advancements have contributed to improved pediatric renal transplantation graft survival. The 2 cases of early graft loss were both the result of venous thrombosis, a known risk factor in smaller renal transplant recipients[2]. Recent studies have suggested a correlation between perioperative donor kidney ischemia and increased graft immunogenic activation, making donor grafts with prolonged ischemia more vulnerable to host immune attack [3]. Our results demonstrate a trend towards attaining supraphysiologic intravascular volume at time of donor kidney revascularization and successfully minimizing graft ischemia. Aggressive perioperative fluid administration to attain supraphysiologic vascular volume is recommended to improve graft survival in pediatric renal transplantation patients.

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INCREASED TIDAL VOLUME VARIABILITY AS A MARKER OF OPIOID-INDUCED RESPIRATORY DEPRESSION IN CHILDREN

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Introduction. During opioid administration, decreasing respiratory rate is typically used as a predictor of respiratory depression. Prior to opioid-induced apnea, progressively irregular breathing patterns have been noticed. We hypothesize that opioid administration to children will increase tidal volume variability (TV_{var}) and that this will be a better predictor of respiratory depression than a decrease in respiratory rate.

Methods. We recruited 32 children aged 2 to 8 years scheduled to undergo surgery. During spontaneous ventilation, flow rates and respiratory rates were continuously recorded while remifentanil was infused at stepwise increasing doses each lasting 10 minutes. The infusion was continued until the patient showed signs of respiratory depression. Flow data from each dose was used to calculate tidal volumes, from which TV_{var} was calculated. The respiratory rate and TV_{var} during the last (D_{last}), second to last (D_{-2}) and third to last (D_{-3}), administered doses were compared to those during baseline (fourth to last dose). We chose a threshold of TV_{var} increase and compared it to a decrease in respiratory rate below 10 breaths/minute as predictors of respiratory depression.

Results. Compared to baseline, the TV_{var} increased by 336% and 668% during D_{-2} and D_{last} respectively, whereas respiratory rate decreased by 14.3%, 31.7% and 55.5% during D_{-3}, D_{-2} and D_{last} respectively. A threshold increase in TV_{var} of 150%over baseline correctly predicted respiratory depression in 41% of patients, compared to a drop in respiratory rate correctly predicting 22% of patients.

Conclusions. TV_{var} increases as children approach opioid-induced respiratory depression. This is a more useful predictor of respiratory depression than a fall in respiratory rate because the TV_{var} increase is 10 times the drop in respiratory rate, a TV_{var} increase correctly predicts respiratory depression twice as often as decreased respiratory rate, and TV_{var} is independent of age related alterations in physiologic respiratory rates.

EPIDURAL ANALGESIA VS. INTRAVENOUS OPIOIDS AFTER PECTUS EXCAVATUM REPAIR

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INTRODUCTION

The pain management techniques for the Ravitch repair of pectus excavatum are intravenous opioid analgesia (IOA), including patient-controlled analgesia (PCA) and continuous opioid infusion (COI), and thoracic epidural analgesia (TEA) using opioid and local anesthetic combination[1]. The benefits of IOA versus TEA are unproven in adolescents[2]. A retrospective chart review was performed to compare the pain outcome between these two pain management techniques.

METHODS

After approval by the University Research Ethics Board, medical charts of 27 patients who underwent pectus excavatum repair between 1999 and 2002 were reviewed. Data on demographic and pain-related variables were collected. Student's t-test was used to analyze continuous data while Mann-Whitney test was used for categorical data.

RESULTS

The age of all patients was 13.6 ± 2.7 years with a weight of 50.1 ± 16.5 kg. Thoracic epidural insertion was attempted on 92.6% of patients (25/27), and was effective (used for ≥12 hours postoperatively) in 80% (20/25). Epidural failure was caused by insertion failure (80%; 4/5) or by downstream occlusion (20%; 1/5). These patients were managed with either PCA (80%; 4/5) or COI (20%; 1/5). Two patients received PCA (7.4%; 2/27) due to epidural refusal. There was no difference between IOA and TEA groups with respect to demographics and pain-related variables (see table).

Variables	IOA (N=7)	TEA (N=20)
Maximum pain score (0-10, first 8 hours post-op)‡*	6 [2-8] (7)	4 [2-8] (20)
Time to ambulation (hours)†*	52.1 ± 16.2 (7)	58.9 ± 31.5 (19)
Length of hospital stay (days)†*	4.5 ± 1.3 (7)	4.6 ± 1.3 (20)
Satisfaction score at discharge (0-10)‡	8.5 [7-10] (6)	8 [3-10] (15)
Oxygen therapy: a) Received oxygen*	100% (7)	90% (19)
b) Duration (hours)†*	24.1 ± 12.5 (7)	25.4 ± 15.9 (17)
Duration of opioid administration (hours)†*	48.4 ± 14.9 (7)	52.5 ± 20.6 (20)
Side effects: a) Pruritus	14% (7)	35% (20)
b) Vomiting	71% (7)	45% (20)
c) Respiratory depression#	0% (7)	15% (20)
d) Post-op. urinary retention	50% (4)	86% (7)

† = mean ± standard deviation (number of subjects); ‡ = median [range] (number of subjects)
* = after discharge from Post-Anesthetic Care Unit
# = respiratory rate <12 BPM for age >10 years, or <14 BPM for age 2-10 years

DISCUSSION

In this small retrospective series, IOA and TEA were equally effective in relieving pain in patients who had undergone the Ravitch technique for repair of pectus excavatum. A trend to better pain outcome was observed in the TEA group. The high initial failure rate of TEA in this group was concerning. A larger prospective study evaluating optimal pain management after pectus repair is required.

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POSTOPERATIVE OPIOID CONSUMPTION IN SICKLE CELL DISEASE

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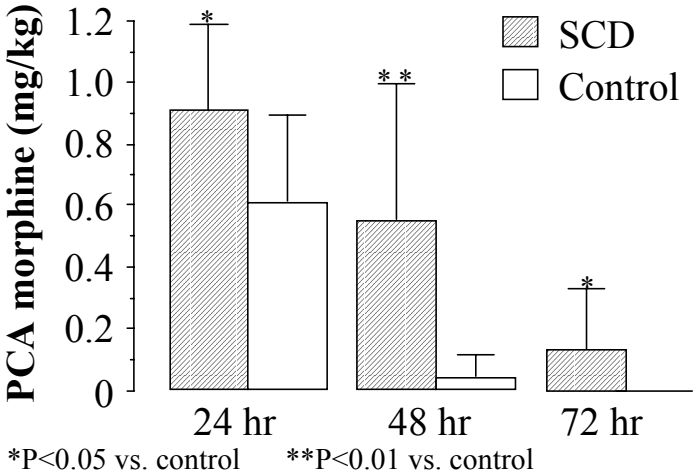
INTRODUCTION: Perioperative pain management is a primary goal in patients with sickle cell disease (SCD). Patient controlled analgesia (PCA) using morphine is frequently used to achieve this goal. The aim of the study was to compare postoperative PCA opioid consumption in SCD children and in a control group of non-SCD children undergoing laparoscopic cholecystectomy.

METHODS: After Research Ethics Board approval we searched the Acute Pain Service (APS) database to identify all patients referred for PCA after laparoscopic cholecystectomy from 1997 to 2003. After reviewing the pain service records, the medical records were reviewed retrospectively. Specific data collected included PCA morphine consumption, pain scores, use of adjuvant non-opioid analgesics and outcome. Statistical significance ($P<0.05$) was determined using Student's *t*-test and chi-square analysis.

RESULTS: Of 23 patients referred for PCA, 13 had SCD. The mean age of SCD and control patients was 13.4 ± 2.4 yrs and 12.9 ± 1.8 yrs, respectively. Postoperative PCA morphine consumption was significantly greater in SCD patients than in controls at 24 and 48 hrs (figure). The proportion of patients remaining on PCA at 72 hrs was greater among SCD patients ($P<0.05$) (figure). Duration of PCA use in SCD patients (51 ± 25 hours) was greater than in controls (21 ± 11 hours) ($P<0.01$). Postoperative pain scores in the first 24 hrs were greater in SCD patients (5.3 ± 1.5) than in controls (3.9 ± 1.5) ($P< 0.05$). The use of adjuvant analgesics was greater among SCD patients ($P<0.05$). Time to discharge from hospital was greater among SCD patients (4.0 ± 2.7 days) than controls (1.5 ± 0.5) ($P < 0.01$). One SCD patient who developed acute chest syndrome while on PCA was excluded from the analysis.

DISCUSSION: In SCD patients, overall PCA morphine consumption was approximately threefold greater and the duration of PCA use was approximately twice that for controls. SCD patients had significantly higher pain scores and used more adjuvant analgesics. These findings, which likely have a multifactorial origin, could be attributed in part to differences between the groups in pain perception, tolerance to analgesics, morphine pharmacokinetics, surgical trauma, and attitudes of health care professionals.



*P<0.05 vs. control **P<0.01 vs. control

CLINICIAN-RELEVANT QUALITY MEASUREMENT FOR PEDIATRIC DAY SURGERY PROGRAMS

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INTRODUCTION

The optimal allocation of squeezed health care budgets cannot be accomplished without ongoing measurement of the quality of health care provision. More patients than ever are serviced in day case surgery. Other institutions have broadened the scope of their quality management practices to include client-assessed outcomes (1); however, a formal validated and reliable questionnaire for measuring the quality of pediatric day surgery programs has not been developed (2).

This is the item generation phase for a larger project of developing a valid and reliable quality measurement tool. This exploratory study aims to uncover the main quality indicators from the perspective of clinicians; hence, a qualitative approach was considered appropriate.

METHODS

Written informed consent was obtained from four anesthesiologists, four surgeons and six nurses. Each semi-structured in-person interview lasted approximately 45 minutes and was audio taped for full transcription. The transcripts, together with the interviewees' rankings of the top ten quality indicators, formed the raw data. The data was analyzed for themes using ATLAS/ti qualitative data analysis software. All stages of coding and interpretation were performed independently by an experienced qualitative researcher. This analysis was externally validated by a clinician to compare the perspective of the researcher with that of the subjects.

RESULTS

Thirteen interviews were included. The need for after-discharge data on PONV and pain were themes in the majority of interviews and among the top ten quality indicators for 69% and 77% respectively. The need for measuring the extent to which parents' were informed about the process flow on the day of surgery was prioritized by 60%.

DISCUSSION

Objective measures of the patient's recovery that remain paramount to clinicians are currently discontinued at discharge. Clinicians' sense of duty extends beyond a successful surgery and comfortable recovery period for the patient to their supportive role to parents. As with objective post-discharge measures, clinicians are operating in the dark about the progress of their clinical practice. Satisfaction-related measures showed less potential in helping clinicians improve their practice. While the need for a quality measurement tool is clear, the inclusion of clinician-relevant metrics is requisite to its adoption and sustained use.

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MAGNESIUM PRETREATMENT DOES NOT ENHANCE ANALGESIA FOR TONSILLECTOMY

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INTRODUCTION

Magnesium, a N-methyl-D-aspartate (NMDA) receptor antagonist, has been demonstrated to prevent laryngospasm after tonsillectomy.[1] Previous studies have suggested a role for magnesium in decreasing postoperative pain and analgesic requirements in adults, but this has not been confirmed in children.[2] This randomized, double-blind study evaluated the ability of magnesium to prevent laryngospasm and provide enhanced analgesia in children undergoing tonsillectomy.

METHODS

After IRB approval, pediatric patients scheduled for tonsillectomy with or without adenoidectomy were randomly assigned to receive magnesium sulphate 40 mg/kg or saline intravenously 5 minutes before the end of surgery. Intraoperative analgesia was standardized. Patients were extubated upon eye opening using a no-touch technique.[3] This technique required patients to be turned to the recovery position at the end of surgery before discontinuing the volatile anesthetic agents. No further stimulation, besides continuous oximetry monitoring, was allowed until the patients spontaneously woke up. A blinded, independent observer assessed pain and postoperative morphine was administered at the discretion of the blinded postanesthetic recovery room nursing staff.

RESULTS

There were no statistically significant differences in gender, age, weight, or ASA physical status between the two treatment groups in the 24 patients studied. Laryngospasm did not occur in either group and there was no difference in pain scores. Compared with placebo, the treatment group tended to require more morphine in the postanesthesia recovery room (0.04 mg/kg versus 0.02 mg/kg) although this did not reach statistical significance.

DISCUSSION

Laryngospasm did not occur in either treatment group. This can be attributed to a no-touch extubation technique.[3] In addition, this pilot study did not demonstrate a decrease in pain or analgesic consumption in children undergoing tonsillectomy when intraoperative magnesium was administered.

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COMBINED PROPOFOL AND REMIFENTANIL TIVA FOR MRI IN CHILDREN

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INTRODUCTION

We performed an observational study of propofol total intravenous anesthesia (TIVA) versus propofol and remifentanil TIVA for magnetic resonance imaging (MRI) in children. Oxygen was provided via nasal prongs with patients breathing spontaneously. The purpose of our study was to compare the efficacy of sedation and recovery times.

METHODS

After IRB approval and informed consent, we observed 100 consecutive children receiving TIVA for MRI. Patients received either Propofol TIVA or Prop/Remi TIVA (Propofol 10 mg/ml / Remifentanil 10mcg/ml) depending on the anesthesiologist's standard practice. Initial recovery time was from scan completion until discharge from the initial recovery area. Total recovery time was from scan completion to discharge home. Data was collected by an independent observer.

RESULTS

The results are summarized in the following table. There were no respiratory or cardiovascular complications in either group. 24-hour follow-up revealed 1 patient from the Prop/Remi group and 2 from the Propofol group experienced post-procedural nausea and/or vomiting.

	Propofol (n=44)	**Prop/Remi (n=56)**
Age (yrs)	3.5 (2.9)	3.0 (2.6)
ASA (I:II:III)	(15:24:5)	(24:22:9)
Average Induction Dose (mg/kg)	3.8 (2.4-5.4)	4.2 (1.8-6.6)
Average Propofol Bolus (mg/kg)	0.7 (0-5.3)	1.1 (0-4.4)
Average Infusion Rate (mcg/kg/min)	200	60 / 0.06
Respiratory Rate (Initial/Final)	26(7) / 22(6)	27(9) / 16(7)*
Oxygen Saturation (%)	98(2) / 98(2)	97(2) / 97(2)
Repeat Scan due to Movement	2	6
Initial Recovery Time (min)	18	8.9*
Total Recovery Time (min)	42.4	28.2*

*p<0.05

DISCUSSION

Although there was a significant decrease in respiratory rate in the Prop/Remi group, this did not result in adverse sequelae. Repeat scans due to movement were not significantly

different between the two groups. Compared to propofol alone, the combination of remifentanil and propofol for TIVA results in significantly shorter recovery times without complications in children after MRI.

TRACHEAL INTUBATION AFTER PROPOFOL-REMIFENTANIL IN INFANTS

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INTRODUCTION Co-administration of propofol and an ultra-short acting narcotic has been used to facilitate tracheal intubation in adults and children undergoing elective surgery[1]. We tested the hypothesis that the dose response of remifentanil for tracheal intubation is similar in infants and children. We then compared the duration of apnea, tracheal intubating conditions, and hemodynamic changes after propofol-remifentanil with those after propofol-succinylcholine in a double blind randomized study in infants.

METHODS Institutional ethics board approval was obtained to study 88 infants and children undergoing elective surgery requiring tracheal intubation. The study was divided into two parts. *Part 1.* To determine the dose response of remifentanil, 32 infants and 32 children were anesthetized with glycopyrolate 10 µg/kg, propofol 4 mg/kg, and one of four doses of remifentanil 1.25, 1.50, 1.75, or 2.00 µg/kg in random fashion. At 90 seconds, the trachea was intubated and intubating conditions were graded. *Part 2.* Using data from Part 1, we conducted a randomized double blind study. Twenty-four infants received glycopyrolate, propofol, and either remifentanil 3.0 µg/kg or succinylcholine 2 mg/kg to fadilitate tratcheal intubation. Intubating conditions were graded, and the duration of apnea and hemodynamic variables were recorded.

RESULTS *Part 1.* ED_{50} and ED_{98} values determined by logistic regression were 1.70 ± 0.1 µg/kg and 2.88 ± 0.5 µg/kg, respectively. The logistic regression curve for infants did not differ significantly from that for children ($P = 0.38$). *Part 2.* Intubating conditions were good to excellent in all infants. Duration of apnea after remifentanil (4.3 ± 1.1 s) did not differ from that after succinylcholine (4.4 ± 0.7 s) (95% CI = –0.7 to 0.8 s). Mean arterial pressure did not differ significantly between groups. Heart rate was significantly greater at 3, 4, and 5 minutes after intubation with succinylcholine than with remifentanil (figure).

DISCUSSION The dose response of remifentanil for tracheal intubation is similar in infants and children. In infants, co-administration of propofol and remifentanil provides good to excellent intubating conditions, stable hemodynamics, and a duration of apnea comparable to that with propofol and succinylcholine.

REFERENCE 1. Anesth Analg. 75: 788-93.