MIDAZOLAM DECREASES THE INCIDENCE OF AWARENESS WITH RECALL DURING PROPOFOL/ALFENTANIL TOTAL INTRAVENOUS ANAESTHESIA

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INTRODUCTION: Midazolam has been shown to interact synergistically with propofol during "co-induction" of anaesthesia.[1] However, it is uncertain whether midazolam affects propofol requirements during, and recovery times following, total intravenous anaesthesia (TIVA) in Day Care patients. A double-blind study was therefore designed to determine these effects. Here, we describe unexpected cases of awareness with recall in our study population.

METHODS: Ninety unpremedicated ASA Class I and II adult Day Care patients, scheduled to undergo either knee arthroscopy or laparoscopic procedures, gave written consent to the protocol approved by the hospital REB. Patients received, in a random fashion, either placebo (Group PLAC) or midazolam at a dose of 0.015 $mg \cdot kg^{-1}$ (Group MID-15), 0.030 $mg \cdot kg^{-1}$ (Group MID-30) or 0.045 $mg \cdot kg^{-1}$ (Group MID-45) prior to induction of anaesthesia. Anaesthesia was then induced with propofol 0.8-1.5 $mg \cdot kg^{-1}$ and alfentanil 20 $\mu g \cdot kg^{-1}$, and atracurium 0.5 $mg.kg^{-1}$ to facilitate tracheal intubation. Anaesthesia was maintained with a continuous infusion of propofol beginning at 100 $\mu g \cdot kg^{-1} \cdot min^{-1}$, titrated as required to maintain HR and SBP within ±20% of the patient's normal values, or in response to patient movement, while alfentanil was infused at 0.5 $\mu g \cdot kg^{-1} \cdot min^{-1}$ (constant). Times to awakening were compared postoperatively. In addition, a follow-up questionnaire, designed to evaluate the overall quality of the anaesthetic experience, was completed for each patient on the first post-operative day. Data were analyzed using the Chi-square statistic and Fischer's Exact test where appropriate, with significance assumed when $P<0.05$

RESULTS: Propofol infusion requirements varied significantly from one patient to another (range 80-280 $ug \cdot kg^{-1} \cdot min^{-1}$), but cumulative requirements were not different between groups. Rapid awakening was observed in all four groups (5±3, 4±2, 6±3 and 6±3 min for groups PLAC, M-15, M-30 and M-45, respectively). Unexpectedly, however, six patients experienced awareness with recall using this technique (4 of 23 patients in the PLAC group compared with 2 of 67 patients in the midazolam treatment groups, $P<0.02$, Table). Five of the 6 patients experienced mild or moderate pain with their recall, but no patient described any psychological distress or anxiety. In fact, despite their experience of awareness, 3 of the 6 patients related the quality of this anaesthetic to have been superior to their last anaesthetic. For ethical reasons, the study was stopped.

DISCUSSION: Despite the high quality of recovery, TIVA was associated with an unacceptably high incidence of awareness with recall in this study. This may have been due, in part, to the relatively low initial infusion rate of propofol. We unexpectedly found that low dose midazolam (0.015-0.045 $mg.kg^{-1}$) reduces the likelihood of intra-operative awareness, without prolonging recovery times.

REFERENCE: Br J Anaesth 1991; 67:539-45.

TABLE: RECALL CHARACTERISTICS

GROUP/EVENT	PLAC (n=21)	M-15 (n=24)	M-30 (n=23)	M-45 (n=22)
Recall (n)	4*	1	0	1
Pain with recall (n)	4/4	0/1	0	1/1
↑ HR>20% (n)	3/4	0/1	0	0/1
Movement(n)	3/4	1/1	0	1/1

* $P<0.02$, different from M-15, M-30, and M-45, Fisher's exact test

EFFECTS OF EPINEPHRINE ON THE CONTINUOUS INFUSION OF EPIDURAL FENTANYL FOR POSTOPERATIVE ANALGESIA FOLLOWING THORACOTOMY

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INTRODUCTION: Epidural fentanyl infusions provide effective postop analgesia following thoracotomy. This prospective randomized double blind study compares epidural fentanyl vs epidural fentanyl and epinephrine by infusion for postop analgesia.

METHODS: Institutional approval and informed consent were obtained on 38 patients for elective thoracotomy. Preoperatively, baseline vital signs and spirometry were measured and patients were instructed in the use of the VAS pain scale. Patients had a thoracic epidural inserted preop and placement confirmed with local anesthetic. Patients received a standardized combined epidural and general anesthetic.

Postop, the patients were randomized to receive either epidural fentanyl and epinephrine 1:300,000 (EPI group) or epidural fentanyl (NO EPI group). The fentanyl concentration in both groups was 5 μg/ml. The epinephrine concentration in the EPI group was 3.33 μg/ml for both the bolus and infusion solutions. Upon arrival in the recovery room, all patients received a bolus of study drug containing fentanyl 0.5 μg/kg and an infusion initiated at 0.5 μg/kg/hr. Following this, their analgesic requirements were titrated by the VAS to obtain a score <4 using a standardized protocol.

Serum fentanyl levels were measured by radioimmunoassay. Other parameters compared included pain scores at rest (VAS-R) and with mobilization and coughing (VAS-M), fentanyl requirements, spirometry, mean blood pressure (MBP), heart rate (HR), side effects and satisfaction scores. Data were analyzed using t-tests for demographics, MANOVA for fentanyl plasma levels, fentanyl requirements, spirometry and vital signs, and Wilcoxon rank sum scores for pain scores and side effects with $p<.05$ significant.

RESULTS: There were 18 patients in the EPI group and 16 patients in the NO EPI group. There were no significant differences in demographics between the two groups except for patient weight. There was good pain control in both groups with no difference in VAS pain scores. There was a highly significant difference in fentanyl requirements ($p=.007$ MANOVA) and plasma fentanyl levels ($p=.007$ MANOVA) being reduced in the EPI group (Fig. 1). There was no difference in spirometry, side effects, satisfaction scores, MBP or HR.

DISCUSSION: This study demonstrates that epinephrine reduces requirements and plasma levels for continuous epidural fentanyl infusions. Epinephrine may reduce vascular uptake resulting in higher and prolonged CSF fentanyl levels. Another potential mechanism is that epinephrine may act as an alpha 2 agonist resulting in synergy with opioids. The design of this study does not allow us to conclude which mechanism is responsible for the reduction in fentanyl requirements and plasma levels with the addition of epinephrine.

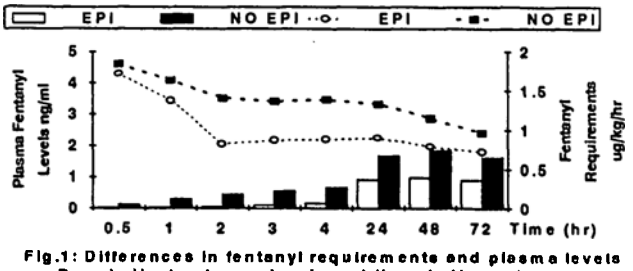

Fig.1: Differences in fentanyl requirements and plasma levels
Bars indicate plasma levels and lines indicate dosages

CEREBRAL MICROEMBOLIZATION DURING CORONARY ARTERY BYPASS SURGERY

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INTRODUCTION: Neurological dysfunction after cardiac surgery is an important clinical problem. Cerebral microembolization is believed to be a major cause. We studied transcranial doppler (TCD) evidence of microembolization in the right middle cerebral artery (R-MCA) in patients undergoing coronary artery bypass surgery (CABG) with various cardioplegia techniques.

METHODS: Twenty-seven patients scheduled for first time CABG surgery who had no known neurological dysfunction were studied. The R-MCA was monitored continuously from before aortic cannulation until 5 min after decannulation using 2 MHz TCD probe. For comparison, the data were divided into the following stages: aortic cannulation (ACan), initiation of cardiopulmonary bypass (iCPB), application of aortic crossclamp (Xon), release of crossclamp (Xoff), and aortic decannulation (ADec). For each period, the number of immediate emboli (within 60s of onset of a stage), total emboli, and emboli rate (emboli/min) were calculated. Three different blood cardioplegia techniques were employed: cold antegrade (CA n=10), warm antegrade (WA n=10), and warm retrograde (WR n=7). All patients were examined neurologically before and 4-6 days after surgery. Data was analyzed using 2-way ANOVA or t test with $p < 0.05$ considered statistically significant.

RESULTS: There was no demographic difference between groups. Regardless of the cardioplegia technique, the highest total number of microemboli was during Xon ($p<0.001$) and the highest rate was during iCPB and Xon ($p<0.001$). The immediate number of emboli was higher in the WR compared to CA and WA ($p<0.01$) at Xoff. Two patients had stroke (1 in AC and 1 in RW) and had total emboli counts of 371 and 934, (the range for those without stroke was 22-949).

Numbers and Rate of Microemboli During CABG

		A Can	iCPB	X On	X Off	A Dec
Total	WA	2.6±3.5	3.0±2.8	194.7±202.5*	63.9±67.0	0.4±0.7
	CA	2.3±2.3	9.3±14.2	318.9±259.5*	28.0±40.3	0.2±0.6
	WR	3.4±2.9	21.4±17.0	331.3±305.6*	62.4±113.7	0.0±0.0
Rate	WA	0.5±0.7	2.3±1.6*	4.0±4.5*	1.2±1.3	0.1±0.1
(emboli.min)	CA	0.3±0.3	5.5±7.5*	4.3±3.6 *	0.7±0.9	0.0±0.1
	WR	0.6±0.5	6.0±4.8*	3.9±3.7 *	1.5±1.5	0.0±0.0
Immediate	WA	2.3±3.4	2.5±1.8	3.6±5.2	1.4±2.3	0.3±0.7
	CA	2.3±2.3	6.2±7.4	7.4±10.5	1.7±1.8	0.2±0.6
	WR	2.7±1.6	10.7±9.7	2.0±3.3	8.1±9.6†	0.0±0.0

Value=Mean±SD * P<0.001 vs other time periods † P<0.01 vs WA,CA

DISCUSSION: This study has demonstrated that the incidence of microemboli during CABG surgery as detected by TCD is high, especially during CPB and the period of aortic crossclamp. Although total embolic load was not different between groups, WR had a higher incidence of microemboli immediately after release of cross clamp. This could be due to increased deposit of atheromatous material in the aortic root from retrograde flow in diseased coronary arteries. The relationship between the microemboli detected and postoperative neuropsychiatric dysfunction remains to be determined.

A

Edrophonium Requirements for Reversal of Neuromuscular Block Following Infusion of Mivacurium

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Introduction

Mivacurium is a new, short-acting, non-depolarizing muscle relaxant metabolized by plasma cholinesterase. Routine reversal of neuromuscular block (NMB) induced by mivacurium has been questioned because of its rapid spontaneous recovery.[1] The purpose of this study was to determine whether reversal of a mivacurium-induced NMB is advantageous, and if so, the optimal dose of edrophonium required.

Methods

Forty ASA Class I-II patients undergoing elective, outpatient, surgery of 30-90 minutes duration were recruited. Anaesthesia was induced with midazolam, propofol, alfentanil and mivacurium 0.15 $mg \cdot kg^{-1}$. The T_1 EMG response to TOF stimulation was maintained at 10% of control by adjusting a continuous infusion of mivacurium. At the completion of surgery NMB was reversed in a blinded fashion (0.1 $mL \cdot kg^{-1}$) using one of four preparations:

Grp 1 Normal Saline(Placebo)
Grp 2 Edrophonium 0.125 $mg \cdot kg^{-1}$ and Atropine 0.002 $mg \cdot kg^{-1}$
Grp 3 Edrophonium 0.250 $mg \cdot kg^{-1}$ and Atropine 0.004 $mg \cdot kg^{-1}$
Grp 4 Edrophonium 0.500 $mg \cdot kg^{-1}$ and Atropine 0.008 $mg \cdot kg^{-1}$

Time to train-of-four ratio ≥70% following administration of the reversal agent was recorded. Patients not achieving TOF ≥70% 20 min following reversal were rescued with edrophonium 0.5 $mg \cdot kg^{-1}$. Data was analyzed using ANOVA. A p value <0.05 was considered significant.

Results

Results are shown in the table. There were no significant demographic differences between groups. One patient in Group 1 required rescue and was later found to be heterozygous for plasma cholinesterase deficiency. This patient was rapidly reversed and excluded from analysis.

Group	n	Duration of Infusion (min)	% T_1 of Control at Reversal	Time to TOF ≥ 70% (min)
1	9	53.9 ± 22.2	5.6 ± 3.5	14.3 ± 2.6
2	10	36.1 ± 9.0	5.6 ± 2.5	9.8 ± 2.3 *
3	10	55.1 ± 24.6	6.0 ± 3.3	9.9 ± 1.9 *
4	10	43.3 ± 19.5	7.9 ± 2.8	8.7 ± 3.6 *

All values expressed as mean ± standard deviation.
* $p < 0.001$ compared to Group 1 by ANOVA.

Discussion

Reversal of mivacurium-induced neuromuscular block by edrophonium decreased the time to recovery by approximately 4 minutes. Doses of edrophonium greater than 0.125 $mg \cdot kg^{-1}$ provided no additional benefit. Patients with atypical plasma cholinesterase levels are at risk for prolonged NMB but appear to be easily reversed with edrophonium.

References

1. Savarese JJ, et al. Anesthesiology 1988; 68: 723-732.

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B

TEACHING EFFECTIVE CRICOID PRESSURE APPLICATION USING A FORCE MEASURING DEVICE

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INTRODUCTION

Cricoid Force (pressure) is a technique of occluding the esophagus between the cricoid cartilage and cervical spine to prevent passive regurgitation of gastric contents and insufflation of air into the stomach. It has been determined that a force of 44N (Newtons) applied to the cricoid cartilage prevented passive regurgitation in 50% of patients at high risk.[1] We designed a model to measure adequacy of applied cricoid force and to determine if improvement in force application could be obtained with teaching.

METHODS

An ACLS "Intubation Teaching Head" was modified so that externally applied cricoid force could be measured. The head was fixed and a load cell to measure the vertical force applied to the cricoid was installed. A digital scale displayed the force in Newtons. These modifications minimally changed its appearance thereby providing an anatomically realistic model.

Operating room staff were asked to apply their perceived correct force without feedback. Participants then repeated the procedure using the force display to learn the force of 44N. The same participants repeated the cricoid force measurement one month later.

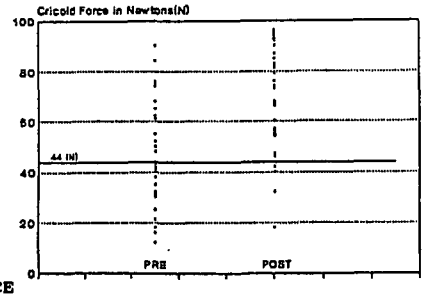
RESULTS

Anesthesia staff and residents comprised 16 of the 40 participants, the remainder were nurses, surgeons and other housestaff. On the first measurement, 62% failed to apply a force of 44N. Post-teaching, 94% of these applied 44N or greater. 38% exceeded 44N on the first measurement and 67% of these repeated this performance post-teaching (see figure). A t-test for paired results with 44N or greater considered optimal showed an overall improvement in performance ($p<0.05$).

DISCUSSION

A realistic model for measuring externally applied cricoid force has not been described and no model has previously been used to teach correct cricoid force application. The results show that the cricoid force technique improves with teaching on our model. Patients may be better protected from the risk of aspiration with appropriate application of cricoid force.

Comparison of Cricoid Force Measurements
Pre and Post Cricoid Force Teaching



REFERENCE

1. Wraight WJ, Chamney AR, Howells TH. The Determination of an Effective Cricoid Pressure. Anesthesia 1983; 38:461-6.

CHOICE OF ANAESTHETIC AFFECTS THE HEMODYNAMIC RESPONSE TO FAT EMBOLISM

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INTRODUCTION

Fat embolism (FE) during cemented arthroplasty (CA) occasionally causes sudden hypotension. The influence of anaesthesia on these hemodynamic changes has not been studied. We examined the effects of two anaesthetics on hemodynamics in a dog model of FE. We compared an opioid-based technique (which might promote stability through lack of negative inotropy, but could also blunt stress response) with a volatile anaesthetic.

METHODS

Anaesthesia was induced with sodium thiopental. The 22 dogs were intubated, ventilated with 50% nitrous oxide in oxygen, and paralyzed with pancuronium 0.25 mg/kg. NS was infused at 5 mL/kg/hr. Eight dogs (FENT) received 300 µg/kg diazepam and 100 µg/kg fentanyl. Eight dogs (ISOF) received isoflurane (0.62±0.27%) titrated to maintain stable hemodynamics prior to CA. A third group of six dogs (FENT/AVP) was identical to FENT with a demand epicardial AV pacemaker set at 130 bpm (to simulate ISOF group's resting HR). After thoracotomy, continuous invasive monitoring of MAP, PAP, RAP and LAP was established. An ultrasonic flowmeter was placed around the ascending aorta for continuous CO monitoring. Simultaneous bilateral CAs were performed; hemodynamics pre- and post- reaming, and 30, 60, 180 and 300 seconds after femoral prosthesis impaction were analyzed. Quantitative morphometry was performed to establish the degree of pulmonary FE in each dog. Multivariate analysis was performed with the SAS general linear model.

RESULTS

There was no difference between groups in the proportion of lung vasculature occluded by FE. The foramen ovale was not probe-patent in any dog. There was no change in any parameter from pre-ream to post-ream (prior to CA). After CA, all groups demonstrated increases in PAP, but decreases in SV and MAP. ISOF's decrease in MAP was more prolonged and severe than the other two groups'. In addition, decreased CO and SVR were noted in ISOF, but not FENT or FENT/AVP (see Table). Two ISOF dogs (but no FENT or FENT/AVP dogs) died within 3 minutes of CA.

DISCUSSION

Morphometric analysis and PAPs imply equivalence of the groups' embolic loads. ISOF's decrease in CO and SVR contributed to severe hypotension. FENT and FENT/AVP were more hemodynamically stable. This suggests that 1) choice of anaesthetic can substantially influence response to intraoperative fat embolism, and 2) hypotension during CA in ISOF is accompanied by decreased CO and SVR, and is not solely due to increased HR.

Table (Mean ± SD)		Baseline	1 min	5 min
MAP (mmHg)	FENT	118 ± 20	102 ± 24*	116 ± 24
	ISOF	111 ± 17	55 ± 27*	114 ± 14
	FENT/AVP	115 ± 22	96 ± 35*	111 ± 21
PAP (mmHg)	FENT	19 ± 4	38 ± 13*	36 ± 14*
	ISOF	15 ± 2	32 ± 7*	31 ± 4*
	FENT/AVP	16 ± 3	36 ± 5*	34 ± 3*
SVR (dynes/ sec/cm-5)	FENT	5950 ± 2150	5250 ± 1680	5760 ± 2060
	ISOF	4090 ± 1100	2590 ± 1270*	4530 ± 1040
	FENT/AVP	5700 ± 1510	5800 ± 2140	5960 ± 1690
CO (L/min)	FENT	1.6 ± 0.3	1.5 ± 0.4	1.6 ± 0.3
	ISOF	2.1 ± 0.5	1.4 ± 0.5*	1.9 ± 0.4
	FENT/AVP	1.6 ± 0.3	1.3 ± 0.5	1.5 ± 0.3

* denotes significant change vs. (pre CA) baseline ($p<0.05$)

PROPOFOL SELECTIVELY INHIBITS THE NMDA SUB-TYPE OF GLUTAMATE RECEPTOR

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Introduction: Glutamate, the major excitatory neurotransmitter in the central nervous system activates several ligand-activated ion channels including NMDA and kainate/AMPA receptors. Previous studies suggest that propofol inhibits glutamate-mediated neurotransmission[1,2]. The purpose of these studies was to investigate the effects of propofol on NMDA and kainate receptors using patch clamp techniques.

Methods: Whole-cell and single-channel currents were recorded from murine hippocampal neurons. Electrodes were filled with CsF 140 mM. The bath contained NaCl 140 mM, glycine 3 μM and TTX 0.3 μM. Whole-cell currents evoked by NMDA (50 μM) were recorded in the presence and absence of propofol (1μM-1mM). Outside-out patches were used to examine propofol's (100 μM) effect on NMDA (10 μM) activated single channel events. Propofol was prepared from Diprivan^R (Zeneca Pharma.).

Results: Propofol caused a concentration-dependent, reversible inhibition of NMDA currents Fig. 1.

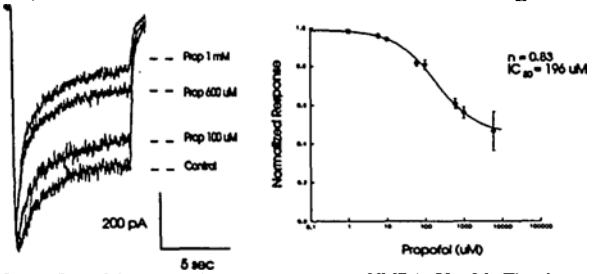

Fig 1. Propofol depressed curent response to NMDA 50 μM. The dose-response curve for propofol inhibition of steady-state NMDA responses is shown. The IC_{50} and Hill coefficient are indicated.

The onset and recovery from propofol inhibition did not require the presence of agonist. Propofol (100 μM) reduced the probability of channel opening (control = 0.17 ± 0.06, prop = 0.031 ± 0.01 n=5, p=0.03, one-tailed Student's *t*-test) without altering channel open time or conductance. The intralipid vehicle contained in Diprivan had minimal effect on NMDA-evoked responses. Kainate-evoked currents were not affected by propofol.

Discussion: Our results suggest that propofol selectively inhibits NMDA currents by allosterically modulating the NMDA receptor/channel complex. Inhibition of excitatory neurotransmission may contribute to propofol's neurodepressive properties.

References: 1.Neurochem Res 16 (4):443-446 2. Br. J. Anaesth 56:1143-1150 5.

A

CAN PARTURIENTS RELIABLY DISTINGUISH BETWEEN EPIDURAL AND INTRAVENOUS FENTANYL ?

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INTRODUCTION: It is generally accepted that a test dose should precede the administration of epidural anaesthetics. There is debate regarding which test dose will allow safe and reliable detection of an epidural catheter placed intravascularly[1,2]. We tested the hypothesis that the subjective effects of intravenous fentanyl would distinguish intravenous from epidural administration.

METHODS: Following institutional ethics approval and written informed consent, 100 ASA I and II laboring parturients were randomized in a double-blind fashion into 2 groups. Each patient received 100 ug of fentanyl citrate either intravenously or via an epidural catheter; the position of which had been confirmed by a standard lidocaine/epinephrine test dose. An anaesthetist blinded to the route of administration questioned each patient with regard to changes in analgesia, level of sedation, dizziness, or euphoria. He or she then guessed as to whether this patient had received intravenous fentanyl. Patients who had not delivered 2 hours later were crossed over to the alternate group. Continuous data was analyzed using a paired *t*-test; categorical data using a χ^2 test, with $p<0.05$ set as the level of significance for all tests.

RESULTS: 100 patients were enrolled, and 41 of these were crossed-over. Nineteen anaesthesiologists (8 staff and 11 residents) participated and correctly guessed the route of administration of the fentanyl in 61/66 intravenous doses and 69/75 epidural doses. In this population, fentanyl as a marker of intravascular injection demonstrated a sensitivity of 92.4 %, a specificity of 92.0 %, a positive predictive value of 91.0 %, and a negative predictive value of 93.2 %. Of those patients that were crossed-over, 38/41 patients (92.7 %) were able to detect a difference between the routes of administration. There were no clinically significant differences in fetal heart rate patterns or in maternal desaturation seen between the groups.

DISCUSSION: Most patients experienced prompt, short-lived symptoms with intravenous fentanyl. This study suggests that the subjective symptoms associated with intravenous administration of fentanyl citrate will accurately distinguish intravenous from epidural administration in laboring parturients ($p<0.001$). Absence of clinically significant maternal desaturation, fetal heart changes, or maternal dysphoria in the intravenous group, as compared to the epidural group, would suggest that fentanyl citrate should serve as a safe and reliable intravenous test dose for epidural anaesthesia in the obstetric population.

REFERENCES:

1. Can J Anaesth 34:601-605, 1987.
2. Can J Anaesth 34:545-548, 1987.

B

LUMBAR EPIDURAL SPACE COMPLIANCE IN A PORCINE MODEL OF ACUTE RAISED INTRACRANIAL PRESSURE

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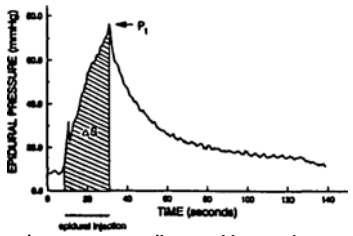
INTRODUCTION: The relationship between raised intracranial pressure (ICP) and lumbar epidural space pressure and compliance has not been well delineated. We studied the hydrodynamics of the lumbar epidural space and the effects of raised ICP on lumbar epidural space compliance hypothesizing that an increase in ICP would be associated with a reduction in epidural space compliance.

METHODS: Twelve pigs (21 ± 2 kg; mean ± SD), anesthetized (1.0 MAC ET isoflurane) and mechanically ventilated (pCO_2 38.2 ±1.7 mmHg), were studied. Temperature was maintained at 36.3 ± 0.8°C. All pigs had intracranial, lumbar epidural, arterial (MAP) and central venous pressures (CVP), and heart rate (HR) monitored. In addition, an 8.5Fr Fogarty catheter was placed in the cranial epidural space via a parietal burr hole. Six pigs had no intervention to alter ICP (10.4 ± 1.9 mmHg), and 6 had ICP elevated (24.2 ± 2.0 mmHg) by inflation of the Fogarty catheter. Each pig had 0.34 ± 0.02 ml•kg^{-1} of 2.0% CO_2 lidocaine injected over 20 seconds (rate = 0.34 ± 0.01 ml•sec^{-1}) via a 16 gauge Tuohy epidural needle at L3-4. Epidural pressure (monitored via a second Tuohy needle) and ICP were monitored continuously for 30 minutes after the injection. The lumbar epidural space compliance was calculated using a derivation of the Windkessel theory[1]:

$$C = \frac{V}{P_1 + (T^{-1} \bullet \Delta S)}$$



where C = lumbar epidural space compliance, V = volume of local anesthetic injected, P_1 = peak epidural pressure, T = time constant for epidural space pressure decay, and ΔS = area under the pressure-time curve from start until finish of injection. Pressure-time data were fit to traditional compartmental models.

RESULTS: The animals did not differ with respect to CVP, MAP, or HR. The pressure-time curve for the lumbar epidural space best fit a 2 compartment model such that epidural pressure = $41.4e^{-t/145} + 13.2e^{-t/5078}$ for pigs with no intervention to alter ICP; and $68.7e^{-t/155} + 13.9e^{-t/2790}$ for pigs with raised ICP. The compliance of the lumbar epidural space in the pigs with no intervention to alter ICP was 0.1424 ± 0.0608 ml•mmHg^{-1}; and 0.0770 ± 0.0169 ml•mmHg^{-1} in pigs with raised ICP, representing a significant reduction in compliance (P=0.043, unpaired t-test).

DISCUSSION: Our results indicate that the compliance of the lumbar epidural space is markedly reduced by elevations in ICP. A previous report[2] suggested a one compartment model for the pressure-time curve of the lumbar epidural space. In contrast, we have demonstrated a two compartment model.

REFERENCES: 1. *McDonald's Blood Flow in Arteries*, Lea & Febiger pp 125-252, 1990.
2. Br J Anaesth 65:508-513, 1990.

MYOCARDIAL ISCHEMIA DURING CAROTID ENDARTERECTOMY: PROPOFOL *versus* ISOFLURANE

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INTRODUCTION: For carotid endarterectomy (CEA), the risk of significant perioperative myocardial ischemia (MI) is twice as common as cerebral ischemia (CI)[1]. Thus, attempts to decrease the incidence of perioperative MI may improve outcome. In this study we compared the incidence of CI and MI using two anesthetic protocols. One group received propofol/alfentanil (Group P) and the other group isoflurane/alfentanil (Group I). We assessed MI in the perioperative period by Holter monitoring.

METHODS: Twenty-seven (27) patients scheduled for CEA were studied. Fourteen (14) patients were randomly allocated to Group P and 13 to Group I. Holter monitoring commenced the evening before surgery and ceased the morning following surgery. During the procedure, hemodynamic and end-tidal gas concentrations were captured each minute to a computer digital acquisition system. In Group P, patients were induced with alfentanil (A) 30 μg/kg IV, propofol (P) 0.5-1.5 mg/kg and vecuronium (V) 0.15 mg/kg. Maintenance anesthesia was a continuous infusion of P at 3-12 mg/kg/hr and A at 30 μg/kg/hr. In Group I, anesthesia was induced with A and V as above, thiopental 1-4 mg/kg and maintenance anesthesia was isoflurane (I) with a continuous infusion of A. Both groups received a phenylephrine infusion to support mean arterial pressure (MAP) during cross-clamp of the internal carotid artery (ICA). Emergence hypertension was treated promptly with labetalol or diazoxide if MAP exceeded 120% of ward values. Holter monitor tapes were examined without knowledge of treatment group. MI was defined as ST-segment depression of ≥1 mm (80 msec past the J-point) persisting for longer than 1 minute.

RESULTS: The two groups were identical demographically (similar age, incidence of hypertension, angina, myocardial infarction, diabetes, β-blocker and calcium channel blocker therapy). Cross-clamp duration was identical in the two groups. On emergence from anesthesia significantly more patients required vasodilator therapy in Group I (10/13 vs 5/14; P = 0.038 Fisher's exact test). No patient demonstrated MI during the cross-clamp period despite a 100% requirement for phenylephrine. On emergence, 6/13 patients in Group I demonstrated MI and only 1/14 in Group P (P = 0.029). The time to extubation tended to be longer for patients in Group P (P = 0.052). No patient awoke with evidence of CI.

DISCUSSION: ICA cross-clamp time has been identified as a risk period for MI during CEA if the blood pressure is supported with phenylephrine[2]. We demonstrated a 0% incidence of MI during this period. Emergence from anesthesia was the time of greatest risk for MI. Despite aggressive management of emergence hypertension MI was significantly more frequent in Group I. Therefore, propofol may be superior to isoflurane for CEA. Support of the blood pressure with phenylephrine during the period of ICA cross-clamping appears safe.

REFERENCES: 1. Roizen MF in *Anesthesia for Vascular Surgery*, Churchill Livingstone 1990, pp103-122
2. Smith JS, *et al.*: Anesthesiology 69:846-853, 1988

CAN MULTIFACTORIAL CLASSIFICATIONS PREDICT OUTCOME AFTER CARDIAC SURGERY IN PATIENTS WITH PREOPERATIVE RENAL DYSFUNCTION?

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Cardiac surgical patients presenting with preoperative renal dysfunction have increased perioperative mortality and morbidity as compared to patients with normal renal function.[1] In this retrospective study, a cohort of patients with increased preoperative plasma creatinine levels was used to compare the performance of four multifactorial risk classifications for cardiac surgery in the prediction of perioperative mortality and length of postoperative stay in the intensive care unit (ICU).

METHODS: The charts of 100 consecutive patients who presented for cardiac surgery with a plasma creatinine level ≥ 130 μmol/L between January 1, 1991 and December 31, 1992 were reviewed. Preoperative, intraoperative and postoperative data were collected by a single person (CM). Preoperative risk was assessed according to four risk classifications developed and evaluated elsewhere. Risk was scored by the following systems: 1) the Montreal Heart Institute (MHI) classification first developed by Paiement et al;[2] then revised by Tremblay et al;[3] 2) the Cleveland Clinic Clinic risk classification developed by Higgins et al;[4] 3) the risk classification developed by Tuman et al;[5] 4) the Parsonnet risk classification.[6] Mortality and length of ICU stay ≥ 7 days were the measured outcome parameters. The accuracy of each classification in the prediction of these outcomes was analyzed by building 4 receiver operating characteristic (ROC) curves for each outcome. The measured areas under the ROC curves were used for comparisons between the various classifications. Area greater than 0.70 suggests a useful diagnostic test. Analysis of the data was performed with Fisher's exact test or Chi-square test when appropriate. Statistical significance was established at $P < 0.05$.

RESULTS: Mortality in those patients with preoperative creatinine levels ≥ 130 μmol/L was 16% vs. 6.2% in those with normal renal function (relative risk of 3.2, P = 0.005). Mean ICU stay was 9 ± 12 days with 34% of our patients spending ≥ 7 days. The area measured under each ROC curve (AUC) is presented in the table.

Risk classification	AUC for Mortality	AUC for ICU≥7days
Tremblay et al [3]	0.61	0.63
Higgins et al[4]	0.61	0.66
Tuman et al[5]	0.58	0.61
Parsonnet et al[6]	0.61	0.68

DISCUSSION: When compared to patients with normal renal function, patients with preoperative creatinine levels ≥ 130 μmol/L represent a high-risk subset for cardiac surgery demonstrating both increased morbidity and mortality. Despite identification of preoperative renal dysfunction as a risk factor in each of the risk scoring systems evaluated none were successful in predicting morbidity or mortality in our series. This lack of predictive ability suggests the difficulty in applying these risk scoring systems outside the institution in which they were developed and in a preselected group of high risk patients.

REFERENCES
1) Circulation 1990;82:IV-380.
2) PCan J Anaesth 1983;30:61-8.
3) Can J Anaesth 1993;40:103-11.
4) JAMA 1992;267:2344-2348.
5) Chest 1992;102:36:44)
6) Circulation 1989;79:I-3-12.

PHARMACODYNAMICS AND HAEMODYNAMICS OF DOXACURIUM HYDROCHLORIDE IN PATIENTS UNDERGOING ELECTIVE CARDIAC SURGERY

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Doxacurium (DOX) is a long acting neuromuscular blocking agent with an ED95 of 0.025 mg/kg. In healthy patients dose dependent reductions in onset time and increases in duration of action have been reported when administered at up to 3x ED95 [1,2] The purpose of this study was to compare the onset time, clinical duration and haemodynamic effects of DOX 0.05 mg/kg (2x ED95) and DOX 0.075 mg/kg (3x ED95) given during induction of anaesthesia for coronary artery bypass graft (CABG) surgery with hypothermic cardiopulmonary bypass (CPB).

METHODS:

Following ethics committee approval 20 patients undergoing CABG surgery gave informed written consent to participate in this open non-randomized study. Patients were premedicated with lorazepam 0.03mg/kg p.o. and morphine 0.1 mg/kg i.m. Standard invasive and non-invasive monitoring for cardiac surgery was used. The response of the adductor pollicis after supramaximal train-of-four stimulation of the ulnar nerve was measured with a mechanomyogragh. Induction of anaesthesia was with sufentanil 1.5 to 2.5 μg /kg and midazolam 0.03 to 0.04 mg/kg. The first ten patients received DOX 0.075 mg/kg and the next ten 0.05 mg/kg. Onset time (from DOX injection to complete depression of twitch T1) and clinical duration (from 0% T1 to 25% T1 recovery) were measured. Heart rate, cardiac index (C.I.), mean arterial pressure (MAP), pulmonary capillary and central venous pressures were recorded before induction of anaesthesia (t-0), pre-intubation (t-1), one (t-2) and ten minutes (t-3) post-intubation. Data were analysed using Student's t-test, ANOVA for repeated measures and Dunnett's t-test with $P < 0.05$ being considered significant.

PHARMACODYNAMIC RESULTS: (Mean ± SD)

DOX Doses mg/kg	Onset time (sec)	Clinical duration (min)	Range of clinical duration (min)
0.05	312 ± 129	165 ± 90	43 - 296
0.075	370 ± 74	258 ± 86	116 - 380
	$P = 0.24$	$P = 0.03$	

HAEMODYNAMIC RESULTS: (Mean ± SD)

	t-0	t-1	t-2	t-3
HR .05 mg/kg	59 ± 8	50 ± 6	55 ± 13	47 ± 4 *
.075 mg/kg	60 ± 11	48 ± 11	53 ± 9	48 ± 9 *
MAP .05 mg/kg	97 ± 24	76 ± 6 *	86 ± 13	82 ± 9
.075 mg/kg	85 ± 11	67 ± 11 *	83 ± 10	77 ± 9
C.I. .05 mg/kg	2.5 ± 0.4	2.3 ± 0.4	2.3 ± 0.6	2.0 ± 0.5 *
.075 mg/kg	2.5 ± 0.3	2.3 ± 0.5	2.3 ± 0.4	2.0 ± 0.4 *

No significant differences between groups. * $P < 0.025$ versus t-0

CONCLUSION:

Increasing the dose of DOX greater than 0.05mg/kg for induction of anaesthesia did not produce a more rapid onset of action. This contrasts with results found when DOX was given after induction.[2] The clinical durations of action were between 50 to 100 % longer than reported in non cardiac surgery. The effects of hypothermic CPB may account for this. In a population where prolonged neuromuscular blockade is desirable, such as in cardiac surgical patients, a single induction dose of DOX of 0.075 mg/kg is more reliable than a dose of 0.05 mg/kg and results in similar haemodynamic stability.

REFERENCES.

1. Anesthesiology 1989;70:422-36
2. Anesth Analg 1989;68:255-60

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A

IS THERE A RELATIONSHIP BETWEEN OXYGEN CONSUMPTION AND NEUROMUSCULAR BLOCKADE AFTER CARDIAC SURGERY?

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Neuromuscular blockade (NMB) has been proposed to suppress shivering, decrease total body oxygen consumption (VO_2) and improve haemodynamics after cardiac surgery.[1] In this study, cardiac surgical patients with intense NMB on arrival to intensive care unit (ICU) were compared to patients whose NMB was antagonized on arrival to ICU. We sought to determine: 1) the level of NMB required to inhibit shivering; 2) the relationship between VO_2, haemodynamics and residual NMB after cardiac surgery.

METHODS

After Ethics Committee approval, 20 adult patients undergoing coronary artery surgery with hypothermic cardiopulmonary bypass gave informed consent to participate in this open non-randomized study. Standard premedication, monitoring and anaesthesia (sufentanil and midazolam) were used in all cases. The response of the adductor pollicis after supramaximal train-of-four stimulation of the ulnar nerve was measured with a mechanomyogragh. The first 10 patients (group 1) received doxacurium (DOX) 0.075 mg/kg on induction of anaesthesia and repeat doses of DOX to keep twitch (T1) < 25% of its control value until arrival in ICU, without postoperative NMB reversal. Ten other patients (group 2) received DOX 0.05 mg/kg on induction of anaesthesia and repeat doses of DOX when clinically indicated; on arrival to ICU they received atropine (1.2-2 mg) and neostigmine (2.5-5 mg) to achieve 100% T1 recovery and T4/T1 ≥ 0.7. Heart rate (HR), mean arterial pressure (MAP), rate pressure product (RPP), cardiac output, %T1 recovery, arterial and mixed venous O_2 saturation (Co-Oximeter), and VO_2 (derived from the Fick equation) were measured repeatedly for 4 hours in ICU. Shivering patients from both groups were given DOX 0.025 mg/kg and analysed separately thereafter. ANOVA for repeated measures and Fisher's exact probability test were used for data analysis. The relationship between VO_2 and %T1 recovery was assessed by simple linear regression analysis. $P \leq 0.05$ was significant.

RESULTS

The lowest %T1 recorded during shivering was 10% (2 patients). Haemodynamics and VO_2 were comparable between the groups at all times. No relationship was found between VO_2 and %T1 values at any time. Shivering occurred in 7 patients of group 1 and 4 of group 2. VO_2 increases were comparable between shivering patients of both groups. DOX 0.025 mg/kg inhibited shivering and abolished T1 in all but one case who required more DOX. Treatment of shivering with DOX decreased VO_2 by 40% ($P = 0.004$), with no significant effect on HR, MAP and RPP.

CONCLUSIONS

Intense NMB (T1 recovery as low as 10%) does not inhibit shivering. No correlation was found between the level of NMB and VO_2 in presence of ≥ 10% T1. However, treatment of shivering with a dose of muscle relaxant (MR) causing 100%T1 depression decreases VO_2. These results suggest that during recovery from anaesthesia after cardiac surgery: 1) only profound NMB may affect VO_2 ; 2) muscles more resistant to the effect of MR, such as the respiratory muscles, contribute the most to VO_2 increases. The VO_2 reduction induced by treatment of shivering is not accompanied by a significant reduction of HR, MAP and RPP, suggesting that the haemodynamic disturbances accompanying shivering are not the results of VO_2 increase, but probably the signs of increased sympathetic tone related to awakening or pain.

REFERENCES:1) Ann Thorac Surg 1987;43:428-31.

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B

CAUDAL MORPHINE AND EARLY EXTUBATION OF THE TRACHEA POST CARDIAC SURGERY IN CHILDREN

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INTRODUCTION

Caudal morphine (CM) injected at the end of surgery is a safe and effective method of providing postoperative pain relief in children following open heart surgery[1]. CM injected before surgery may reduce the amount of intravenous opioid and inhalational agent required intraoperatively, facilitating early tracheal extubation whilst providing postoperative pain relief. We determine the ease of extubation, postoperative analgesia and side-effects of CM compared with intravenous morphine (ivM).

METHODS

In a prospective, randomised, on-going, double-blind study, 9 children undergoing elective open heart surgery were enrolled following IRB approval and informed parental consent. Children were premedicated with oral midazolam 0.75mg/kg. Anaesthesia was induced with thiopentone/halothane, fentanyl 5μg/kg, and diazepam 0.2mg/kg. The trachea was intubated using pancuronium. Isoflurane was used for maintenance. Children were then randomly assigned to receive CM 50, 100, or 150μg/kg, or an ivM infusion (40μg/kg/hr) stopped 30 mins before the end of surgery. Extubation occurred when the children were stable after cardiopulmonary bypass and after reversal of neuromuscular blockade . Pain, sedation, time and requirements for supplementary ivM, and any side-effects were assessed hourly for 24 hours after surgery. Data were analysed with Student t-test and Mann-Whitney rank-sum test. $P<0.05$ was considered statistically significant.

RESULTS

Children received CM 50μg/kg (n=2), CM 100μg/kg (n=1), CM 150μg/kg (n=3) and ivM (n=3). All children were haemodynamically stable during anaesthesia and no additional analgesia was required. Tracheal extubation occurred at the end of surgery in 8 children; one child was extubated in the ICU 4 hours later when bleeding had diminished. None of the children developed respiratory depression or haemoglobin desaturation.

All doses of CM required supplementation with ivM in the first 24 hours postoperatively, but a smaller total dose of ivM (M^t) was needed compared with children in the ivM group ($p<0.001$). Objective pain scores[2] in the CM groups were significantly less than in the ivM group in the first two hours postoperatively ($p<0.05$). Three children who received CM were completely alert postoperatively and required sedation. Vomiting occurred in three children in CM and ivM groups. Two children developed mild pruritus, one had received ivM and one CM. No other side-effects occurred.

	CM (n=6)	iv M (n=3)
Age (months)	47.7 ± 29.6	47.3 ± 25.6
Weight (kg)	16.2 ± 7.4	14.3 ± 6.5
'GA stop- start iv morph' time (mins)	223.7± 178	39.33 ± 9.3
M^t (mg/kg/24 hrs)	0.4 ± 0.12	0.8 ± 0.1
Objective Pain Score:median (range)	0 (0-5)	1 (0-6)
no. patients vomiting	3	3

DISCUSSION

Preliminary studies have demonstrated that CM given before the start of surgery is a safe and effective method of providing analgesia intraoperatively and postoperatively in children undergoing open-heart surgery, whilst allowing early extubation of the trachea. All doses of CM reduced the ivM requirements in the first 24 hours postoperatively. Further data will confirm which dose of CM provides the best analgesia with the fewest side-effects.

REFERENCES: 1 Anesthesiology 70: 418-421, 1989.
2 Anesthesiology 69: 3A: A770, 1988.

DETERMINANTS OF POST-OPERATIVE HYPOTHERMIA FOLLOWING NORMOTHERMIC CARDIOPULMONARY BYPASS

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INTRODUCTION: Inadvertent post-operative hypothermia in the cardiac surgical patient can have various adverse physiologic effects including myocardial ischemia and worse mortality rates. Previous studies have investigated the relationship of patient, surgical and anaesthetic factors with post-operative hypothermia in patients undergoing **non**-cardiac surgery. This study was designed to assess factors which contribute to post-operative hypothermia after normothermic cardiopulmonary bypass (CPB) for cardiac surgery.

METHODS: After obtaining ethics approval, 56 patients receiving daytime elective or urgent cardiac surgery with warm (37°C) CPB were studied. Patient-related variables included: age, weight, height, sex, history of previous cardiac surgery, and pre-operative temperature. Treatment-related factors recorded were: type of surgery, type and dose of anaesthetic, use of airway humidifier, use of an iv fluid warmer, total volume of iv fluid (both crystalloid and blood products) given during surgery, net fluid volume given via CPB machine (pump balance), total time spent on CPB, use of nitroglycerine, use of α-agonists during surgery and elapsed time from end of CPB to end of surgery. Core temperature readings, as measured by a Swan-Ganz catheter thermistor were noted i) on insertion of the Swan-Ganz catheter, ii) after the patient was weaned from CPB, iii) within 30 minutes of ICU arrival, iv) 3-5 hrs after ICU arrival, v) 7-9 hrs after ICU arrival, and vi) 11-13 hrs after ICU arrival. Additionally, the lowest temperature attained during CPB was recorded. Multiple linear regression and logistic regression for categorical variables, with backward elimination (SAS, NC) was employed to determine the impact of all variables upon lowest post-operative temperature. A p value of less than 0.05 was considered significant.

RESULTS: The lowest mean temperature occurred during CPB. Older age, shorter CPB time, smaller fluid balance on CPB and weight less than 60kg were associated with lower post-operative temperatures.

Determinants of Postop Hypothermia

Parameter	Coeff.	p
Age	-.027	.003
CPB time	.009	.004
CPB fluid balance	.2	.01
Weight > 60kg	.643	.01

DISCUSSION: In contrast to the generally held belief that longer CPB time carries greater patient risk in general, this study demonstrated that longer CPB time is associated with less risk of postoperative hypothermia. This is likely due to a greater amount and better distribution of heat transfer during CPB at 37°C. Whether this reduced risk of postoperative hypothermia is responsible for improved patient outcome remains to be determined.

A PROSPECTIVE RANDOMIZED, CONTROLLED CLINICAL TRIAL OF EARLY VERSUS CONVENTIONAL TRACHEAL EXTUBATION FOLLOWING CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY: POSTOPERATIVE VENTILATORY DYNAMICS.

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INTRODUCTION: To lower the escalating cost of cardiac surgery, we propose earlier postoperative tracheal extubation and discharge of these patients from the ICU and hospital. However, is early extubation safe for the cardiac surgical population in the 1990s?

METHODS: Following Institutional approval, 29 elective CABG patients < 75 yrs old with left ventricular function I-IV were randomized into Early (n=14) or Conventional (Conv) (n=15) extubation group. Premedication was 1-2 mg lorazepam S.L. Early group patients were induced with 15 µg/kg fentanyl ± thiopentone 50-75 mg and pancuronium 0.15 mg/kg. Anaesthesia was maintained with isoflurane prior to cardiopulmonary bypass (CPB). After initiation of CPB, propofol infusion (2-4 mg/kg/hr) was commenced and continued until 1-4 hrs prior to tracheal extubation in the ICU. In Conv group, patients were induced with 50 µg/kg fentanyl and pancuronium 0.15 mg/kg. Anaesthesia was maintained with isoflurane and midazolam 0.1 mg/kg. Morphine and midazolam were titrated for sedation in the ICU. Tracheal extubation was attempted within 12-20 hrs. Serial arterial and mixed venous blood samples were drawn at baseline; 30, 90 & 240 min post-extubation. A respiratory inductive plethysmograph recorded all breaths continuously for 4 hrs after extubation following calibration. Apnea was defined by expiratory time > 10 sec or V_T < 100 ml. Data is expressed as mean ± SD and analyzed by ANOVA.

RESULTS: Demographic data were comparable. Four and 3 patients in Early and Conv groups respectively did not meet the extubation criteria. Post-extubation alveolar-arterial O_2 gradient and pulmonary shunt fraction were significantly lower in Early vs Conv group; whereas, O_2 consumption was significantly higher in Conv group vs baseline (Table I).

Table I	Baseline		30 min		90 min		240 min	
	Early	Conv	Early	Conv	Early	Conv	Early	Conv
pH	7.41 ± .03	7.41 ± .04	7.35 ± .03	7.40 ± .02	7.36 ± .03	7.40 ± .02	7.36 ± .03	7.41 ± .03
$PaCO_2$	38.9 ± 4.7	39.0 ± 4.8	41.4 ± 4.9	38.8 ± 3.6	41.1 ± 5.6	38.8 ± 3.9	39.4 ± 5.7	37.1 ± 3.5
PaO_2	157.0 ± 73.1	119.3 ± 49.7	156.5 ± 397	120.3 ± 46.	164.3 ± 38.7	128. 8 ±47.1	179.8 ±27.2	145.9 ±87
$P(A-a)O_2$	88.6 ±122	81.7 ±103	148.1 ±53.7	209.5 ±84.1	148.7 ±67.6	217.5 ±106	137.5 ±62*	236.4 ±127
VO_2 mL/min	168.3 ±44.8	173.3 ±79.1	211.8 ±53.2	260.8 ±58#	-	-	189.7 ±51.2	255.9 ±77#
Qs/Qt (%)	20.6 ±4.5	20.1 ±9.3	11.6 ±4.4*	22.9 ±8.5	-	-	13.9 ±5.2*	22.9 ±7.5

*P < 0.05 between groups, #P < 0.05 vs Baseline.

Post-extubation O_2 saturation, respiratory rate, labored breath index (thoraco-abdominal coordination), and apnea characteristics (Table II) were similar between both groups. Tidal volume and central respiratory drive significantly improved over time in both groups. Early group had consistently lower minute ventilation and predominantly abdominal breathing post-extubation.

Table II Apnea		Early	Conv
	Incidence	22.2% (2/9)	30% (3/10)
	Duration (sec)	17.8 ± 1.2	10.7 ± 1.3
	Index (rate/hr) 1 h	7	6
	2 h	0	0
	3 h	0	1
	4 h	0	5

DISCUSSION: Our preliminary data indicates that early tracheal extubation in patients following CABG surgery seems to be safe and provide better postoperative ventilatory dynamics than the conventional extubation.

A

A PROSPECTIVE RANDOMIZED, CONTROLLED CLINICAL TRIAL OF EARLY VERSUS CONVENTIONAL TRACHEAL EXTUBATION FOLLOWING CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY: PERIOPERATIVE HEMODYNAMICS AND STRESS RESPONSES

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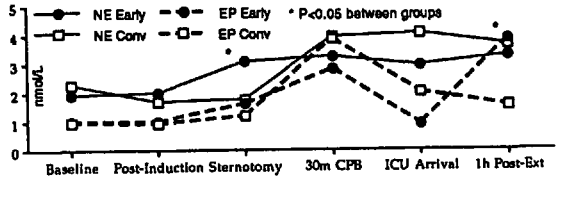
METHODS: Following Institutional approval, 29 elective CABG patients < 75 yrs old with left ventricular function I-IV were randomized into Early (n=14) or Conventional (Conv) (n=15) extubation groups. Premedication was 1-2 mg lorazepam S.L. In Early group, patients were induced with 15 µg/kg fentanyl ± thiopentone 50-75 mg and pancuronium 0.15 mg/kg. Anaesthesia was maintained with isoflurane prior to cardiopulmonary bypass (CPB). After initiation of CPB, propofol infusion (2-4 mg/kg/hr) was commenced and continued until 1-4 hrs prior to tracheal extubation in the ICU. In Conv group, patients were induced with 50 µg/kg fentanyl and pancuronium 0.15 mg/kg. Anaesthesia was maintained with isoflurane and midazolam 0.1 mg/kg. Morphine and midazolam were titrated for sedation in the ICU. Tracheal extubation was attempted within 12-20 hrs. Hemodynamic (HR, BP, PA, PCWP, CI, SVR, PVR), catecholamine (norepinephrine: NE, epinephrine: EP) and cortisol levels were measured at baseline, post-induction, sternotomy, pre-CPB, post-CPB, and at timed intervals before and after extubation. Intraoperative, postoperative and post-extubation medication requirements were compared. Data is expressed as mean ± SD and analyzed by ANOVA with repeated measures, Fisher exact test and t-test.

RESULTS: There was no significant difference in age, wt., preop cardiac status, surgical duration, CPB, and cross clamp time between the two groups. NE and EP levels were significantly higher in Early than Conv groups at sternotomy and 1 hr post-extubation respectively (figure I). Cortisol levels were not significantly different between groups. There was no significant difference in perioperative hemodynamics as well as in perioperative number of patients requiring vasodilators, inotropes, or β-blocker drugs between the two groups (Table I).

Table I:	Medications	Early	Conv
Intraop	Vasodilators	13	11
	Inotropes	1	3
	β-blocker	2	0
ICU (Intubated)	Vasodilator	9	13
	Inotropes	1	4
ICU (Extubated)	Vasodilator	7	6
	Inotropes	0	1



DISCUSSION: Our preliminary data suggests that early tracheal extubated patients following CABG surgery have elevated catecholamine response at sternotomy and 1 hr post-extubation when compared to conventional extubation.

B

INTERACTIONS OF PROPOFOL WITH METOPROLOL OR NIFEDIPINE ON HEMODYNAMIC, MYOCARDIAL BLOOD FLOW AND METABOLISM IN A SWINE MODEL OF CHRONIC CORONARY OCCLUSION

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INTRODUCTION: Patients with coronary artery disease are usually on beta-blocker and/or calcium channel blocker. This study investigated the effects of propofol with metoprolol (MET) or nifedipine (NIF) on hemodynamics, myocardial blood flow and metabolism in a swine model of chronic coronary occlusion.

METHODS: After institutional approval, 12 piglets underwent banding of the left anterior descending (LAD) coronary artery to induce collateral vessels(1). 10 weeks later, each animal was anaesthetized with isoflurane (ISO)/O_2 for instrumentation. MET (10μg/kg/min) or NIF (5μg/kg/min) was infused for 30 min. Anaesthesia was lightened to a near awake state for baseline measurements under similar preload conditions. Baseline hemodynamic and regional myocardial metabolism were measured from LAD (collateral-dependent area) and circumflex (Cx) (normal area) veins. was acquired using Radiolabelled microspheres were used for epicardial (Epi) and endocardial (Endo) blood flow measurements. A propofol bolus dose of 2.5 mg/kg was administered. Hemodynamic measurements were repeated at 1, 3, and 5 min with regional metabolism and blood flow measurements repeated at 5 min. Data (mean ± SD) were analyzed by ANOVA and t-tests.

RESULTS: Table I: Hemodynamic parameters: pre & post 1,3,5 min propofol.

	Metoprolol (n = 6)				Nifedipine (n = 6)			
	PRE	1 min	3 min	5 min	PRE	1 min	3 min	5 min
HR	91 ± 7	90 ± 10	88 ± 10	86 ± 13	133 ± 20*	140 ± 30	137 ± 24	134 ± 30
SBP	97 ± 17	82 ± 3	92 ± 11	96 ± 13	95 ± 11	86 ± 10	93 ± 9	94 ± 15
CO	3.9 ± 1	3.5 ± 1	-	3.3 ± 1*$	3.8 ± 1	3.9 ± 1	-	4.1 ± 1
SVR	1485± 686	1433± 302	-	1770± 567$	1340± 358	1086± 344$	-	1236±2 50
CPP	55 ± 19	44 ± 5	55 ± 12	58 ± 11	49 ± 13	38 ± 13$	51 ± 22	53 ± 15

*P < 0.05 MET and NIF; $P < 0.05 vs PRE; CPP = coronary perfusion pressure (mmHg)

Table II: Myocardial Blood Flow

Table II	Metoprolol (n = 5)		Nifedipine (n = 6)	
	Baseline	Propofol	Baseline	Propofol
LAD Endo	94.1 ± 16.3	111.5 ± 28.7	123.2 ± 45.3	117.9 ± 25.9
LAD Epi	113.5 ± 35.9	123.7 ± 33.1	172.8 ± 74.1	163.6 ± 54.4
CX Endo	84.8 ± 18.1	91.7 ± 24.2	119.5 ± 39.3	127.3 ± 50.6
CX Epi	99.1 ± 21.5	111.6 ± 24.3	144.2 ± 19.3	158.87 ± 61.9

Table III: Myocardial Metabolism

Table III	Metoprolol (n=6)		Nifedipine (n=6)	
	Baseline	Propofol	Baseline	Propofol
LE.LAD	0.32 ± 0.2	0.34 ± 0.1	0.34 ± 0.1	0.22 ± 0.1
LE.CX	0.36 ± 0.2	0.28 ± 0.1	0.29 ± 0.1	0.19 ± 0.1
MVO_2.LAD	6.9 ± 1.8	7.0 ± 2.2	10.6 ± 4.5	9.3 ± 0.2
MVO_2.CX	6.7 ± 0.9	6.7 ± 1.9	7.5 ± 1.9	7.5 ± 1.2

LE=Lactate Extraction(%); MVO_2=Myocardial oxygen consumption (ml/min/100 gm)

DISCUSSION: 1. NIF induced a higher HR, myocardial blood flow, MVO_2 and lower coronary vascular resistance (CVR), in baseline comparison to MET group.
2. Propofol bolus caused a transient decrease in arterial BP and CVR but no regional myocardial lactate production in both groups. With NIF, propofol caused a transient and significant decrease in CPP (22%) and SVR (19%). With MET, propofol caused a significant decrease in CO (15%) and increase in SVR (19%) at 5 min.

REFERENCE: 1. *Anesthesiology* 76:113-122,1992

Supported in part by Heart and Stroke Foundation of Ontario, Canada.

A

PROPOFOL FOR CONTINUOUS INTRAVENOUS SEDATION AFTER AORTOCORONARY BYPASS GRAFT SURGERY. DOSE FINDING STUDY.

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Introduction: Sixty percent of patients after aortocoronary bypass graft surgery (CABG) will develop hypertension in the postoperative period. Continuous infusion of propofol (Diprivan) may improve cardiovascular stability and speed up recovery and extubation. The optimal dose of propofol for sedation after CABG is not known.

Methods: We have studied 60 consenting CABG patients (20 patients per group) in a double-blinded, randomized, comparative dose-ranging study using for the postoperative sedation three fixed IV infusion rates of propofol: group I, 12.5 mcg/kg/min, group II, 25.0 mcg/kg/min and group III, 50.0 mcg/kg/min. Patients were premedicated with intramuscular morphine 0.15 mg/kg and perphenazine 2.5-5 mg and sublingual lorazepam 2 mg. Anaesthesia was induced with fentanyl 40 mcg/kg, pancuronium 0.15 mg/kg. and midazolam 0.1 mg/kg. Halothane or isoflurane were used. Propofol infusion was started within 60 min. of the patient transfer to the intensive care unit and continued for 6 hours. Patients who were undersedated during the infusion period (1-2 on the 6 point Ramsay Scale) received boluses of 10-50 mg of propofol intravenously. If hypotension occurred (systolic blood pressure < 90 mmHg) the infusion was stopped and restarted when blood pressure recovered. We collected hemodynamic data during sedation and recovery, sedation scores, and extra narcotic and propofol bolus doses.

Results: Data on patients is presented as mean ± SEM. Basic demographic data did not differ among groups. Patients were sedated with propofol infusion for mean 350 ± 9 minutes. Three patients in group III had three consecutive episodes of hypotension and were treatment failures.

Dose mcg/kg/min	Extubation© time minutes	Propofol total boluses mg	No. pts. on morphine during sedation
12.5	*46±38	*130±18	5
25.0	78±34	76±16	2
50.0	*194±37	*43±16	2
p value	*0.02	*0.003	NS

© Extubation time: from the time propofol infusion was discontinued.

Hemodynamics in group I and II were well controlled. Ten patients in group III had 18 episodes of hypotension where the propofol had to be temporarily stopped.

Conclusions: Continuous infusion of propofol in the dose of 25 mcg/kg/min in the post CABG patients provided optimal sedation, stable hemodynamics and minimal narcotic requirements. Patients receiving propofol, 12.5 mcg/kg/min were undersedated and required multiple propofol boluses. Patients receiving propofol, 50 mcg/kg/min were oversedated and propofol had to be temporarily stopped.

Supported by: ZENECA-PHARMA CANADA.

B

THE INFLUENCE OF SEROTONIN AND NORADRENALINE DEPLETION ON THIOPENTAL-INDUCED HYPERALGESIA IN RATS.

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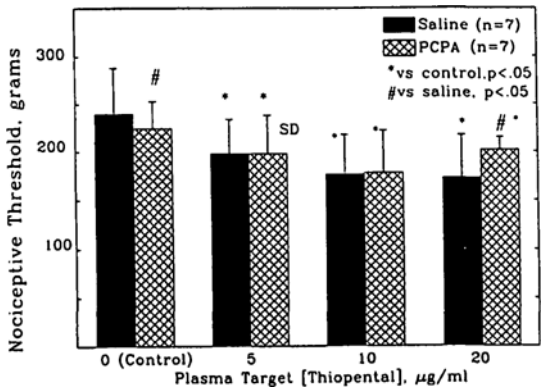
Introduction: Serotonergic and noradrenergic mechanisms in the spinal cord are believed to mediate hyperalgesia following low-dose barbiturate administration.[1] In recent studies[2] we have developed a model in which the hyperalgesic effects of thiopental can be quantified. In the present study we sought to determine whether the hyperalgesic effects of thiopental administration would be observed in animals depleted of 5-HT and NA.
Methods: Following approval by the Animal Care Committee, 14 male Sprague-Dawley rats were used in this study. Each animal was randomly allocated to receive an intraperitoneal injection (1 ml) of either saline or the tyrosine hydroxylase inhibitor, p-chlorophenylalanine, (PCPA, 200 mg/kg in saline). The nociception experiments were performed four days after injection under conditions of partial restraint commonly used for radioautographic studies[3]. Cannulation of femoral vessels provided access for blood sampling and thiopental administration. For this study the outcome measure was the first motor response to tail pressure measured with an Analgesy-Meter (Ugo Basile, Milan, Italy). Nociceptive threshold(NT) was calculated as the mean of three determinations. Thiopental was administered by a computer-controlled infusion pump capable of producing pseudo-steady state plasma concentrations at predetermined targets (5, 10, 20 µg/ml), and the NT measurements reported were made at 6 minutes after predicted equilibration between the effect site and the plasma. Data were analyzed using two-way repeated measures ANOVA.
Results: NT values in both groups at each of the three plasma thiopental concentrations. NT values in the PCPA treated animals differed from the saline treated group under control conditions (NT value in PCPA group less) and at [Thiopental] of 20 µg/ml (NT value in PCPA group greater).
Conclusions: Decreases in NT observed during a pseudo-steady state thiopental infusion strategy in 5-HT and NA-depleted animals were similar to the decreases seen in the saline-treated controls. This study thus fails to support the hypothesis that thiopental-induced hyperalgesia is mediated by serotonin or noradrenaline.

1. Kitihata LM, Saberski L. Anesthesiology 1992;77:1059-61
2. Archer DP, Ewen A, Samanani N, Roth SH. Anesthesiology, 1994; 80, 1 in press
3. Soncrant TT et al. J Cereb Blood Flow Metabol 1988;8:720-6



A

INTRAOPERATIVE NEUROLOGICAL INJURY - DOES IT AFFECT MAC?

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INTRODUCTION: The role that intraoperative neurological injury may play in altering anaesthetic requirements was examined by determining the relationship between changes in enflurane MAC and the occurrence of neurological sequelae following a minor neurosurgical procedure i.e. insertion of a CSF drainage catheter.
METHODS: Mongrel dogs (n=10) weighing 20.6±2.6 kg (mean±SD) were anesthetized with enflurane. MAC was determined prior to the surgical procedure(MAC1), immediately postop(MAC2), and again at 1 hour postop(MAC3). Surgery consisted of placement of a CSF drainage catheter by Seldinger technique (lateral ventricle, n=7; basal cistern, n=3). The animals were examined postop by a veterinary surgeon for neurological deficits. Data were analyzed by a repeated measures ANOVA. Linear regression analysis determined the correlation between neurological injury and changes in MAC pre- vs post-catheter insertion.
RESULTS: MAC reduction did not differ with respect to catheter insertion site and the data were therefore pooled. No differences in MAC pre- vs post-catheter insertion were observed (MAC1:2.09±0.30%; MAC2:1.98±0.36%; MAC3:2.01±0.29%). However 8 of 10 animals developed gross neurological impairment (Table) and the model was abandoned.
DISCUSSION: Data presented in the present study suggest that significant neurological injury can occur intraoperatively without altering volatile anaesthetic requirements i.e. MAC.

TABLE 1. CHANGE IN MAC REDUCTION PRE- VS POST-CATHETER INSERTION AND NEUROLOGICAL OUTCOME.

DOG No.	PRE-OP MAC	POST-OP MAC*	INJURIES INCURRED**
H097	1.9	1.9	1
H098	2.5	2.1	1,4,6
H099	1.8	1.5	9
H100	2.4	2.3	None
H101	1.6	1.4	1
H102	2.4	2.4	3,5,7,8
H103	2.0	1.6	1,2,5,8
H110	2.1	2.1	None
H113	1.9	2.1	4
H117	2.3	2.3	2

*Post-Op MAC = MAC determination at the second interval following placement of the CSF drainage catheter; **Injuries Incurred = Nature of the injury observed following recovery from anaesthesia.
1 = general loss of coordination; 2 = proprioceptive deficits, left front and hind limbs; 3 = proprioceptive deficits, left hind limb; 4 = proprioceptive deficits, right hind limb; 5 = no menace response (blind) left side; 6 = no menace response (blind), right side; 7 = circling to the right; 8 = head tilt; 9 = death within 24 hours post-recovery.

B

GASTRIC INTRAMUCOSAL pH MONITORING - A STUDY IN PATIENTS UNDERGOING MAJOR ELECTIVE SURGERY.

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INTRODUCTION: Monitoring of gastric intramucosal pH via tonometry (pHi) is a new technology capable of detecting early organ (gut) ischemia.[1,2] We hypothesized that following major surgery, gut ischemia detected by pHi might occur and that dopamine (5 $\mu g.kg^{-1}.min^{-1}$) might restore gut perfusion.

METHODS: Following institutional approval and informed consent, 11 patients (8M/3F) undergoing elective surgery and scheduled for postoperative observation in the ICU were studied. During surgery, a tonometric nasogastric sump (Tonometrics^{R}) was inserted. Upon arrival in ICU, an abdominal x-ray was performed to verify correct catheter location. Thirty minutes later (control), the intramucosal pH, arterial and mixed venous blood gases, and hemodynamic profile were measured. Following this, dopamine 5 $\mu g.kg^{-1}.min^{-1}$ infusion was initiated. Following a 30 min observation period, measurements were repeated (treated). Gastric ischemia was defined as an intramucosal pH <7.35.[1] Paired t-tests determined differences between control and treated values with $p<0.05$ considered a significant difference.

RESULTS: Adverse outcomes occurred in 4 patients (atrial fibrillation in 3, delayed line sepsis in 1). pHi was >7.35 on admission to ICU in all 4 patients. Ischemia was not felt clinically to be the underlying etiology for any of the adverse outcomes. Overall oxygen delivery (DO_2) increased from 809±241 to 988±269 ml/min ($p<0.05$) and oxygen consumption (VO_2) increased from 255±146 to 313±192 ml/min (p=NSD). pHi did not change (control=7.47±0.16; treated=7.46±0.16). pHi was <7.35 in 3 patients and following institution of the dopamine infusion it increased to >7.35 in 2 of 3 patients. In the non responder, DO_2 increased from 489 to 1245 ml/min following dopamine and VO_2 increased from 157 to 477 ml/min.

CONCLUSION: Eight of 11 patients in this study had DO_2 above the critical level for organ ischemia on arrival in ICU as detected by pHi. While they demonstrated ability to increase their DO_2 following dopamine infusion, VO_2 remained unchanged suggesting adequate tissue oxygenation. Of the remaining 3 patients, gut ischemia resolved following an increase in DO_2 by dopamine in 2/3 patients as detected by the use of pHi. Use of pHi may detect patients at risk for organ ischemia postoperatively. The cost-benefit ratio requires further study.

REFERENCES:

1. Gutierrez G, et al. Lancet 1992;339:195-99.
2. Fiddian-Green R: Intensive Care World 1992;9:60-5.

A

PENTOBARBITAL AND METHOHEXITAL REDUCE NOCICEPTIVE THRESHOLD IN THE RAT

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INTRODUCTION

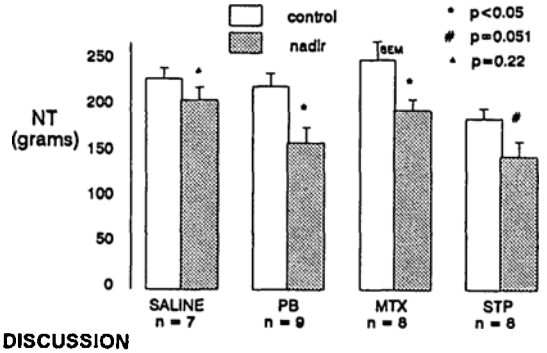
In a recent study [1] we demonstrated that sub-hypnotic plasma concentrations of thiopental are associated with a reduction in nociceptive threshold in the rat. The aim of this study was to determine whether this property is shared by other anaesthetic agents known to activate $GABA_A$ receptors.

METHODS

Institutionally approved studies were performed in 32 male Sprague-Dawley rats. Under general anaesthesia with halothane in oxygen, catheters were placed in a femoral artery and vein of each animal which was then allowed to recover for at least two hours before tesing. Each animal was then randomly allocated to receive an intravenous infusion of one of the following solutions: normal saline(NS), pentobarbital(PB) 0.75mg.ml^{-1}, methohexital(MTX) 0.67mg.ml^{-1} or thiopental(STP) 1.3 mg.ml^{-1}. Each solution was infused at a rate of 0.15 ml.min^{-1}. The observer was blinded to the group allocation for each animal. Nociceptive threshold (NT) was measured using an Analgesy-Meter (Ugo Basile, Milan, Italy) which applied a linearly increasing force to the distal part of the tail from zero up to 750g. NT was defined as the mean of three consecutive measurements (first motor response) and was determined at 0(control),2,4,6,8,12,16 and 20 min during the infusion. Arterial blood was sampled at the corresponding times for [STP],[MTX] or $[PB]_{plasma}$. Data are presented as means (SEM). Data were analyzed by two way repeated measures ANOVA and unpaired t-test as appropriate.

RESULTS

During PB and MTX infusions, we observed significant reductions in NT compared with control values. In the PB group, NT declined by 28% of control after 8 min ($[PB]_{plasma}$= 5.97(0.21)μg.ml^{-1}).In the MTX group, NT declined by 22% of control after 6 min ($[MTX]_{plasma}$= 2.97(0.47)μg.ml^{-1}). In most animals this coincided with a behavioral state characterized by drowsiness. No significant changes in NT were found in either the NS or the STP groups.



DISCUSSION

The results support the hypothesis that the phenomenon of hyperalgesia is an effect shared by different $GABA_A$ receptor agonists at sub-hypnotic concentrations. Further studies of these agents under steady state conditions are warranted.

REFERENCES

1. Ewen A, Samanani N, Roth SD, Archer DP. Anesthesiology. 1993;79:A702.

B

MAC-Amnesia for Isoflurane

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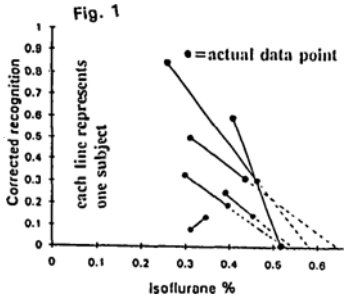
Introduction:
Awareness during general anesthesia is a continuing problem of uncertain etiology. The authors have attempted to determine MAC-Amnesia for isoflurane (ISO).
Methods:
With Human Investigation Committee approval paid ASA 1 fasted volunteers (university students) aged 19+ years giving written informed consent were studied. Subjects breathed 100% oxygen from a circle system and form-fitting plastic anesthesia mask modified to incorporate a small microphone and teflon tubing for gas sampling close to one nostril. ISO was introduced in increments to attain equilibrium of inspired and expired concentrations. ISO was measured at mass 51 using a mass spectrometer. Calibration was performed prior to each experiment. Forty different items comprising 10 photos, 10 visual words, 10 auditory words and 10 sound effects were presented for five seconds each on video with four repetitions of each item using a modified random order. Drowsy subjects were aroused as necessary by shaking a shoulder. After completion of the video ISO was discontinued. Subjects were permitted to recover for one hour. Free recall and explicit recognition testing was performed using an equal number of matched distractors. The experiment was then repeated using a different concentration of ISO. Tests for implicit auditory and visual word memory were administered after completion of the entire study. Corrected recognition (CR) scores ((hits-false alarms)/(1-false alarms)) for each subject were plotted against measured ISO concentration for each stimulus type. Explicit amnesia was defined as mean ISO concentration where these lines crossed zero on the corrected score axis.

Results:
Mass spectrometer response was linear ± 5%. Composite CR scores (all four stimuli types) were used as data were available for only six of 24 scheduled subjects. These were plotted against measured ISO (Fig. 1).

Fig. 1



MAC-Amnesia (mean of intercepts with CR=0) and S.D. were 0.58 ± .05. MAC-implicit-amnesia was not calculated due to limited data at this time.
Discussion:
Our value for MAC-Amnesia must be considered tentative since more data are needed at higher and lower concentrations.

A

THE ACTION OF NEOSTIGMINE AND EDROPHONIUM ON THE NEUROMUSCULAR JUNCTION OF THE MOUSE OMOHYOID MUSCLE IN THE PRESENCE OF D-TUBOCURARINE.

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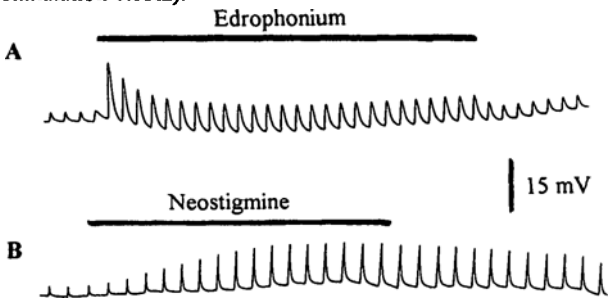
INTRODUCTION: It has been reported that neostigmine and edrophonium increase the amplitude and duration of the endplate potentials (EPP) at the neuromuscular junction (NMJ)[1,2]. Neostigmine is believed to produce long-lasting inhibition of junctional cholinesterase, in contrast to edrophonium[3,4]. There is no information concerning the effects or time-course of either agent on EPP at the NMJ in the presence of curare-like agents.

METHODS: Neostigmine or edrophonium were applied by iontophoresis from a microelectrode in the presence of continuously-iontophoresed d-tubocurarine (dTc) at the mouse omohyoid NMJ. EPP were produced by iontophoresed acetylcholine and recorded with an intracellular microelectrode.

RESULTS: Edrophonium produced a dose dependent increase in the duration and amplitude of the EPP. Maximum effect was seen in 3-5 seconds (n=5). With large doses the peak effect was not maintained. Following cessation of the application of edrophonium the EPP rapidly returned to control levels (trace A, stimulation 0.67Hz) Neostigmine produced increases in EPP amplitude and duration which were slower in onset (20-23 seconds (n=3)) but well maintained following cessation of the application of neostigmine (trace B, stimulation 0.5Hz).



DISCUSSION: The results of these experiments are in keeping with the view that neostigmine produces a prolonged effect on cholinesterase, in contrast to edrophonium, and that the anticholinesterase effect of these agents is an important factor in the reversal of non-depolarising neuromuscular blockade.

1. Journal of Neurophysiology1942; 5: 211-230
2. Journal of Physiology 1971; 213: 533-544
3. Acta Anaesthesiol Scand 1964; 8: 197-218
4. Arch Int Pharmacodyn Ther 1955; 54: 204-213

B

MECHANISM OF THE BRADYCARDIA PRODUCED BY ESERINE AND PYRIDOSTIGMINE

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INTRODUCTION: Neostigmine produces bradycardia in cats even when autonomic efferent activity is blocked[1]. This may be caused by direct activation by neostigmine of cholinergic receptors on cardiac ganglion cells, which results in release of acetylcholine from their terminals and subsequent activation of inhibitory cardiac receptors[1]. The aim of this investigation was to determine if eserine and pyridostigmine can produce a bradycardia when efferent input to the heart is blocked.

METHODS: Cats were anaesthetized (sodium pentobarbitone) and artificially ventilated. Parasympathetic input to the heart was interrupted by bilateral vagotomy. Sympathetic input to the heart was blocked with propranolol (3 mg/kg, i.v.). Arterial pressure, heart rate and EKG were continuously recorded. The distal end of the sectioned vagus nerve (right) was electrically stimulated to activate parasympathetic preganglionic axons. The anticholinesterases studied were eserine and pyridostigmine. Other drugs used were the nicotinic antagonist hexamethonium bromide (C6), the non-selective muscarinic antagonists atropine and glycopyrrolate, and the muscarinic (M2) antagonist pancuronium.

RESULTS: Mean heart rate was 164 $\pm$ 4 beats/min (SEM, n=39). Eserine and pyridostigmine evoked a dose-dependent reduction in heart rate (50% reduction with 2.0 $\pm$ 0.3 mg/kg for eserine, n=5; 50% reduction with 8.8 $\pm$ 3.8 mg/kg for pyridostigmine, n=5). The eserine-evoked bradycardia was blocked by the nicotinic antagonist C6 (ED50 13.3 $\pm$ 2.9 mg/kg, n=5), the non-selective muscarinic antagonists atropine (ED50 0.004 $\pm$ 0.001 mg/kg, n=5) and glycopyrrolate (ED50 0.008 $\pm$ 0.002 mg/kg, n=5), and the muscarinic (M2) antagonist pancuronium (ED50 0.03 $\pm$ 0.01 mg/kg, n=4). The pyridostigmine-induced bradycardia was blocked by the nicotinic antagonist C6 (ED50 8.4 $\pm$ 0.2 mg/kg, n=3), the non-selective muscarinic antagonists atropine (ED50 0.006 $\pm$ 0.002 mg/kg, n=4) and glycopyrrolate (ED50 0.008 $\pm$ 0.001 mg/kg, n=5), and the muscarinic (M2) antagonist pancuronium (ED50 0.02 $\pm$ 0.004 mg/kg, n=2). In comparison, the bradycardia produced by stimulation of the vagus nerve was blocked by lower doses of C6 (ED50 0.59 $\pm$ 0.15 mg/kg, n= 3), and by similar doses of glycopyrrolate (ED50 0.007 $\pm$ 0.001 mg/kg, n=5). The doses of atropine and pancuronium which blocked the eserine- and pyridostigmine-induced bradycardia are within the range that block cardiac muscarinic M2 receptors[2,3].

DISCUSSION: These results show that eserine and pyridostigmine, like neostigmine, produce a dose-dependent reduction in heart rate even in the absence of tonic autonomic input to the heart. The sensitivities of the eserine- and pyridostigmine-induced bradycardia to nicotinic and muscarinic antagonists are very similar to that observed for the bradycardia produced by neostigmine[1]. By analogy, then, this suggests that eserine and pyridostigmine may evoke bradycardia by direct activation of the cardiac parasympathetic pathway.

REFERENCES:

1. J Pharm Exp Ther 265: 194-200, 1993.
2. J Pharm Exp Ther 251: 797-802, 1989.
3. Eur J Pharm 11: 332-341, 1970.

A

MIVACURIUM DOSE-RESPONSE RELATIONSHIPS AND REVERSAL WITH EDROPHONIUM IN YOUNG AND ELDERLY ADULTS

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Mivacurium is a short duration non-depolarizing neuromuscular blocking drug. Its ED50 has been reported to be approximately 40 μg/kg[1-3]. Because spontaneous recovery is rapid, the use of reversal agents after mivacurium is controversial. Elderly patients often have a prolonged response to neuromuscular relaxants. This study was designed to compare dose-response and duration data for mivacurium in young and elderly adults, and to measure the effect of edrophonium, 0-0.4 mg/kg.

Methods. In 48 ASA physical status I or II patients of both sexes, aged 18-40 yr (young, n=24) or 70-85 yr (elderly, n=24), anaesthesia was induced with fentanyl (1-5 ug/kg) and thiopentone (3-7 mg/kg), and maintained initially with nitrous oxide in oxygen. Force of contraction of the adductor pollicis muscle was measured following stimulation of the ulnar nerve at 0.1 Hz. Mivacurium, 30, 40, 50, or 70 μg/kg (random allocation), was injected 2-3 min after induction. At maximum blockade, another mivacurium dose, for a total of 150 μg/kg was given. Isoflurane, 0.5 %, was then added. When recovery started, an infusion was given to keep 90% blockade. At the end of the surgery, train-of-four stimulation was used and edrophonium, 0, 0.1, 0.2 or 0.4 mg/kg (random allocation) was administered at 25% first twitch height recovery. Additional edrophonium was given after 10 min if required.

Results. Potency was similar in both groups. However, in the elderly, onset time and duration were prolonged. Maintenance doses were lower. Spontaneous recovery, but not edrophonium-assisted recovery, was slower in the elderly.

TABLE

	Young	Elderly	P
ED50(μg/kg)	78 $\pm$ 6	86 $\pm$ 11	N.S.
Time to max(min)	4.8 $\pm$ 0.2	6.1 $\pm$ 0.2	0.001
2nd dose effect(%)	91 $\pm$ 3	96 $\pm$ 1	NS
Duration(min)	7.5 $\pm$ 0.5	10.4 $\pm$ 1.0	0.002
Infusion (μg/kg/min)	4.05 $\pm$ 0.47	6.88 $\pm$ 0.74	0.001
T4/T1 at 10 min after 25% T1 recovery:			
edro: 0 mg/kg	0.70 $\pm$ 0.06	0.50 $\pm$ 0.06	0.05
edro: 0.1 mg/kg	0.67 $\pm$ 0.03	0.69 $\pm$ 0.03	NS
edro: 0.2 mg/kg	0.77 $\pm$ 0.03	0.77 $\pm$ 0.03	NS
edro: 0.4 mg/kg	0.80 $\pm$ 0.02	0.76 $\pm$ 0.03	NS

Discussion. The ED50 values were twice as large as those reported previously (40 μg/kg) [1-3]. The ED95 fell outside the dose range tested, but can be estimated at 150 μg/kg. One difference with previous studies [1-3] is that here mivacurium was given immediately after induction of anaesthesia. The effect of edrophonium was marginal, especially in the young.

[1] Savarese JJ et al. Anesthesiology 1988; 68: 723-732
[2] Caldwell JE et al. Anesthesiology 1989; 70: 31-35
[3] Maddineni VR, et al. Br J Anaesth 1993; 70: 694-695

Supported by Burroughs Wellcome

B

THE MAINTENANCE OF COMPETENCE (MOCOMP) PILOT PROJECT - ANAESTHETISTS' CONTINUING MEDICAL EDUCATION PRACTICES.

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INTRODUCTION

Continuing medical education (CME) has traditionally relied on passive methods of learning which are of limited value in changing and improving the performance of physicians. (1,2) The purpose of this study was to examine the types of CME activities anaesthetists were utilizing in 1992.

METHODS

All anaesthetists registered with the MOCOMP program were asked to submit their CME activities for at least 12 months up to December 1992. The type of CME activity and the amount of time spent were recorded in three categories: Type I - Self-directed CME (reading journals, literature searches, video/audio tapes, traineeships), Type II - Group CME (meetings, conferences, rounds) and Type III - Scholarly Activities (teaching, research, publishing). From the MOCOMP database the location of practice, the practice setting, university affiliation and the profile of other specialties participating in the pilot project, over the same time frame, were obtained.

RESULTS

377 anaesthetists had enrolled in the pilot project, 98 submitted CME forms (26%)

I. Sociodemographic Data

University Affiliation	
None	42(43%)
Full-time	21(21%)
Part-time	9(9%)
Other	26(27%)
Practice Setting	
Solo	36(37%)
Group	57(58%)
Missing	5(5%)
Community Size	
<100,000	24(24%)
100,000-500,000	25(26%)
>500,000	49(50%)

II. CME Activities

	Anaes.	Surg.	Paeds.	Obs/Gyn.
# hours	116	156	140	87
Type I	22%	25%	21%	13%
Type II	27%	25%	24%	30%
Type III	51%	50%	55%	57%

DISCUSSION

The reporting forms used in 1992 were impractical and the CME framework was too complex, thus a poor response rate. Different specialties reported similar amounts and types of CME activity. A very limited amount of time (13-25%) was devoted to self-directed learning activities. A key objective of MOCOMP is to encourage self-directed learning.

REFERENCES

JAMA 268:1111
JAMA 258:1352

A COST-UTILITY EVALUATION OF POST-OPERATIVE ANALGESIA IN THE ELDERLY IN A COMMUNITY HOSPITAL USING DECISION ANALYSIS

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PURPOSE: A Cost-Utility economic evaluation of three modalities for post-operative pain management for the elderly patient (alert and confused) was conducted in a community hospital in British Columbia, Canada.

METHODOLOGY: The three modalities subjected to analysis were intravenous patient controlled analgesia (I.V. PCA), epidural morphine (Epimorph), and standard therapy or intramuscular (I.M.) injections. The cost components of the analysis were derived from nursing consensus in regard to nursing labour; including the tasks involved in monitoring the two new modalities. Equipment costs were included for all modalities. The cost of the I.V. PCA pumps was subjected to sensitivity analysis with regard to pump lifetime and discount rates as well as maintenance.[1] Professional fees for physicians were included. Patient preference or utilities assigned were based on previous values in randomized controlled trials of the three therapies. Decision trees were developed for the elderly alert or confused patient using computer software in accordance with Expected Utility Theory. Outcome Probabilities were derived from the literature.

RESULTS: The cost of administering Epimorph, I.V. PCA, and I.M. injections for 48 hours were respectively $249, $179, and $97. For the elderly alert patient, the dominant strategy for marginal cost effectiveness is I.V. PCA provided the cost does not exceed $200. For the elderly confused patient, the dominant strategy is Epimorph provided the cost does not exceed $250.

DISCUSSION: I.V. PCA as a dominant strategy for the elderly alert patient is stable. The major component of cost in the I.V. PCA modality is the pump itself which may decrease in cost in the future as technology improves and marketplace competition increases. The tension in decision-making for the elderly confused patient is small. However, the major component of cost in the I.M. injection modality (the second choice) is nursing labour which is likely to increase in cost in the future.

REFERENCES:

1. Drummond MF, Stoddart GL, Torrance GW. Methods for Economic Evaluation of Health Care Programs. Oxford, England: Oxford Medical Publications, 1987.

A META-ANALYSIS OF PUBLISHED STUDIES PROVIDES PRECISE ESTIMATES OF THE EFFECTIVENESS OF ONDANSETRON (O) FOR THE PREVENTION OF POSTOPERATIVE NAUSEA/VOMITING (PONV).

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Introduction: Cost-containment considerations in North America have brought surgical procedures performed on an ambulatory basis to nearly 10 million each year in the US. PONV in that patient population constitutes one of the most frequent and worrisome complications with relevant cost-implications, if left untreated (1). Thus, prevention of PONV is crucial for patients at risk. O a serotonin antagonist and antiemetic mostly used for nausea/vomiting induced by cancer chemotherapy has been recently evaluated for the prevention of PONV. We are reporting summary measures of its effectiveness obtained through a meta-analysis of published randomized controlled trials (RCTs).

Methods: A MEDLINE search of the English literature from 1980 through 1993 was performed using the following key words: Ondansetron, nausea, vomiting and surgery. The bibliographies of peer-reviewed articles and of major anesthesia textbooks were thoroughly searched for eligible studies (n=69). Eligibility criteria consist of RCTs comparing O with placebos (P) or other alternative antiemetics in the prevention of PONV. Effectiveness was defined as no PONV over 24 hrs. Articles were further graded according to a methodological quality score (MQS) which consisted of five methodological items previously described (2). Each article was reviewed twice or more by each author for accuracy. Pooled data was analyzed with two softwares: Meta-1 uses frequential statistics, "Fast-Pro" uses the confidence profile method; both include homogeneity tests.

Results: Six articles and two abstracts were selected that met our eligibility criteria. The Breslow-Day test indicated homogeneity of the data in support of statistical pooling; p= 0.54 (POV), p=0.39 (PON). The summary odds ratio (OR) for the six articles indicated that, over 24 hrs, the O treated patients were 3.0 and 2.5 times more likely to be free from POV and PON respectively than P. The O group was 0.45 times less likely to require rescue antiemetic treatment than the P group. The absolute difference in probability of vomiting was 28%: 95% CI (21%-33%) favoring the O treated group. Sensitivity analysis was performed by pooling data from the two abstracts together with the six articles. The results (OR) did not change significantly for POV and PON (see table).

Discussion: By pooling data from rigorously designed studies (ie, minimized bias), meta-analysis affords more precise summary estimates of effectiveness of new drugs. With regard to this patient population, we can conclude that: 1) O is substantially more effective than P in preventing POV or PON, and decreases the requirement for rescue treatment; 2) the benefits extend to the first 24 post-operative hours. Owing to O higher cost, further studies comparing O to less costly alternatives (eg, Droperidol, Metoclopramide) are warranted (3). All outcomes including unanticipated hospitalization or reduced activity at home should be measured in the process of evaluating new drugs, to enable an accurate derivation of their cost-effectiveness. Such data would better inform a rational and cost-oriented decision process.

EFFICACY OF ONDANSETRON VS PLACEBO PREVENTION NAUSEA/VOMITING FOR 24 HOURS

Summary Estimates	Total No Patient	V/ 24hr	ΔV %	N/ 24hr	Rescue RX
OR 95% CI Six Studies	1246	3.0 2.4-3.8	28% 21%-33%	2.7 2.0-3.6	0.45 0.3-0.7
OR * 95% CI Eight Studies	1739	2.8 2.3-3.5	25% 20%-30%	2.2 1.7-2.7	NA

* Sensitivity Analysis; ΔV% - absolute difference in % vomiting between Odansetron & placebo.

References. 1. JAMA, 1989;262;3008-10. 2. Anesthesiology, 1993; 79;A1049.
3. Anesth Analg 1992;75;561-5.

COST-EFFECTIVENESS ANALYSIS (CEA) OF THE PREVENTION OF POST-OPERATIVE NAUSEA/VOMITING (PONV) WITH ONDANSETRON (OND).

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Introduction: Limited health resources may soon force anaesthetists to be more selective in adopting new drugs by requiring proof of superior effectiveness and efficiency (cost) compared to existing alternatives. This CEA of the prophylaxis of PONV with Ond. (a serotonin antagonist/antiemetic) compared with placebo (P) uses precise estimates of effectiveness afforded by meta-analysis.

Methods: The steps for CEA have been previously described [1]. Two viewpoints are considered: the patient/insurer and the hospital administration, using drugs acquisition cost for the latter and patient charges for the former (table). The economic model compares two programs with cohorts of 1000 patients each applying results from a meta-analysis of the efficacy of Ond. vs P pooling data from 8 randomized control trials of gynecological surgical patients. Summary estimates comprise the difference between Ond. and P in the incidence of 1) "no vomiting" over 24 hrs (28% : 95% CI 21%-33%); 2) rescue antiemetic (RA) required over 24 hrs (14% : 95%CI 10%-24%), 3) vomiting at home (10%), used to derive wages lost. Program A consists of preoperative prophylaxis for PONV with Ond. 4mg IV to one cohort. Program B uses no antiemetic prophylaxis ie. "do nothing" or P. Postoperative RA ie, Droperidol (Dro) 20mcg/Kg is used as needed. Following identification of all direct and indirect costs, an incremental cost-comparison is performed, excluding cost of resources common to both programs. The cost of prog. A comprises either the acquisition cost or the patient charges for Ond. 4mg injectable. Prog. B includes the following: the cost or charges for RA with Dro., the cost of extra-stay in PACU, the cost of unanticipated 23 hrs admission, the wages lost due to symptoms at home delaying return to work or to normal activities. The total cost of B is subtracted from the cost of A yielding a cost differential ΔC. Efficacy is defined as the number of patients with PONV and RA avoided by program A (eg, for a 28% efficacy, ΔE =280 patients). The CE ratio ΔC/ΔE is calculated.

Results: The CE ratio from the patient/insurer viewpoint is $204.00 per patient with PONV avoided (ΔE:28%, RA:14%). The CE ratios from the Hospital viewpoint and sensitivity analyses (SA) derived with the 95% limits of the need for RA (10 and 24%), with the limits of efficacy (ΔE 21% and 33%) and for both viewpoints are reported in the table.

Conclusion: Assuming equivalent efficacy in such patients, the CE ratio of Ond. is 15 times greater than that of Dro (1) although Ond. is only six times as costly as Dro. This underscores the significance of a CEA in the evaluative paradigm which provides the true cost of a new drug/practice for its level of effectiveness. Thus, all cost-producing outcomes should be measured consistently in the evaluation of new drugs. As important, comparing new drugs to effective but less costly alternatives would better inform the decision process with regard to cost-containment. This may indicate the sub-groups where the drug offers unique benefits.

Reference: Can J of Anaes: 39, A112, 1992

CEA - TWO COHORTS OF 1000 PATIENTS - $ VALUES - PROGRAM A-B

Viewpoint	Rescue Rx %	Diff. Cost (ΔC) $ Progr. A-B	C/E Ratio $ ΔE=280	C/E Ratio $ ΔE=210 **	C/E Ratio $ ΔE=300 **
Hosp.Admin.	10% *	13,097	47	62	40
Ond. = $ 20.76/dose	14%	11,760	42	56	36
	24% *	8,097	28	38	24
Patient/Insur.	10% *	58,576	209	279	177
Ond. = $ 66.44/dose	14%	57,159	204	272	173
	24% *	53,295	190	253	161

* SA with the 95% CI of RA needs ** SA with the limits of efficacy (21% & 33%)

A B

CARBON DIOXIDE EMBOLISM: DETECTION BY CAPNOGRAPHY, TRANSESOPHAGEAL ECHOCARDIOGRAPHY, PULMONARY ARTERY PRESSURE AND PRECORDIAL AUSCULTATION.

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Venous gas embolism (CO_2) is recognized as a complication during laparoscopic surgery[1]. No study has evaluated the utility of end-tidal CO_2 ($ETCO_2$) to detect CO_2 embolism. We studied the effect of different CO_2 infusion rate on $ETCO_2$ value and compared its sensitivity to other methods of detection that were mean pulmonary artery pressure (MPAP), transesophageal echocardiography (TEE) and precordial auscultation.

METHODS: 7 pigs (20-30 kg) were induced with ketamine and anesthesia was maintained with I.V. pentobarbital and pancuronium. Monitoring included $ETCO_2$ and MPAP, TEE to obtain an image of the right cardiac chamber and precordial auscultation (AUSC.). Positive response to CO_2 embolism was defined as a change of 3 mmHg in $ETCO_2$, 3 mm Hg in MPAP, visualisation of bubbles (TEE) or an obvious change in heart sounds (AUSC.). After stabilization, at 20 minutes intervals, we infused CO_2 using a Harvard pump at 0.01, 0.05, 0.1, 0.2, and 0.4 $ml \cdot kg^{-1} \cdot min^{-1}$ for 6 minutes period via the jugular vein. The frequency (%) of positive responses was noted for each method and for each infusion rate. A McNemar test was used for comparison. $P < 0.05$ was considered statistically significant.

RESULTS: Positive response to CO_2 infusion during $ETCO_2$ monitoring was always represented by a decrease in $ETCO_2$. For infusion rate as low as 0.05 $ml \cdot kg^{-1} \cdot min^{-1}$, TEE was the most sensitive method. No differences was found between MPAP, $ETCO_2$, and precordial auscultation. For infusion rate of 0.4 $ml \cdot kg^{-1} \cdot min^{-1}$ all methods were positive in 100 % of the pigs.

TABLE 1: Frequency (%) of positive responses

CO_2 ¶ infusion	0.01	0.05	0.1	0.2	0.4
$ETCO_2$	0	14	43	100	100
MPAP	0	29	57	100	100
TEE	43	86*	100**	100	100
AUSC	14	29	71	86	100

¶: Infusion rate ($ml \cdot kg^{-1} \cdot min^{-1}$)
* $P < 0.05$ when compared with the other methods.
** $P < 0.05$ when compared with $ETCO_2$

DISCUSSION: In this model, positive response to CO_2 embolism was represented by a decrease in $ETCO_2$. TEE was the most sensitive method while $ETCO_2$, MPAP and precordial auscultation were equally sensitive.

REFERENCE: 1- Anesth Analg 56:650-652, 1977.

A

POSTOPERATIVE NIGHTMARES RELATE TO PERI-OPERATIVE OPIOID THERAPY

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Introduction: Patients often experience vivid nightmares in the nights after operation - a complication often attributed to "the anaesthetic". In addition to causing distress, these nightmares mark a physiologically intense form of REM sleep that may account for cases of delirium and/or myocardial infarction in the nights after operation.[1] Our purpose was to document the frequency of these "bad dreams" and to assess their relation to anaesthesia and other potential determinants.

Methods: Adult inpatients (ASA I or II) undergoing elective non-cardiac surgery were questioned about nighttime dreams before and up to 5 days after operation. The bizarreness and distress of dreams were graded on an ordinal scale. Using a multivariate regression analysis, reports of postop nightmares were considered in relation to patient age; gender; type of anaesthesia, (general, regional); type of surgery (abdominal, thoracic, orthopaedic, superficial); intensity of postop pain, (visual analogue scale); and intraop & daily postop doses of opioid (expressed as morphine mg equivalents).

Results: Of 150 patients (61 ± 15 yrs; M=91, F=59), 40 reported terrifying nightmares after operation, primarily on postop nights 1 (n=9), 2 (n=18), 3 (n=10) and/or 4 (n=8). The incidence showed a biphasic relationship to increasing age, with the rate decreasing to 65 yrs and increasing thereafter. In patients ≤ 65 yrs, the incidence increased in relation to the total periop dose of opioid ($P < .02$). In those >65 yrs, this linkage was not detected. Timing of nightmares also related to opioid; the earlier the night of nightmares, the greater the rate of increase in the cumulative opioid dose ($P < 0.01$, see Figure). No other covariates were found.

Conclusion: Vivid nightmares are common after operation. They appear unrelated to the type of anaesthesia, the type of surgery or postop pain - but closely linked to the periop administration of opioid. This linkage to opioid may result from the marked suppressant effect of opioid on REM sleep [2] leading to intense postop "pressure" to replenish this state.

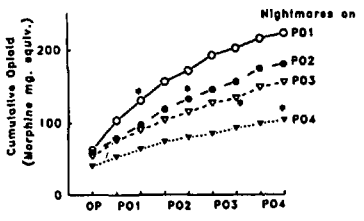

Figure: Mean 12 hr cumulative doses of opioid in patients reporting nightmares on various postop nights. (* indicates night of nightmares)

1. Anesthesiology 73: 52, 1990. 2. Anesth Analg 68: S200, 1989.

B

ARE PATIENTS SATISFIED WITH DAY BED SURGERY?

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In North America, 60-70% of surgery is done on a day bed basis. This provides significant savings for the health care system. However, adverse outcomes after anaesthesia and surgery still exist. Therefore, we studied whether patients were satisfied with day surgery.

METHODS After institutional approval, consent was obtained from 2098 day surgery patients. Demographic information, medical history, anaesthesia & surgery data were collected. Patients were discharged home after day surgery when their Post-Anaesthesia Discharge Scoring System score was ≥ 9.[1] Phone interviews were done 24 hours postop by trained nurses. A standardized questionnaire was used to document any adverse outcomes: nausea/vomiting, pain, dizziness, drowsiness, headache, fever and bleeding. Day surgery satisfaction was evaluated by asking whether patients would consider day surgery for a similar operation. When there was dissatisfaction with day surgery, patients were interviewed for the specific reasons. Any unexpected visit to their physician, emergency room or readmission was also recorded. Data were stored in a database specially designed for this purpose. Data analysis was by Fisher's Exact test or t-test where appropriate; $P<0.05$ was considered statistically significant.

RESULTS 2,098 patients were studied. Interviews were done on 1,027 patients (48.9%). Phone interviews were unsuccessful due to patient refusal (29.1%), language barrier (13.9%), unable to contact (7.1%), missing data (1%). Patient satisfaction with day surgery was 98.4% and dissatisfaction was 1.6% Demographic data are shown in table. The dissatisfied patients were significantly older than satisfied patients ($p<0.05$), In the dissatisfied group, more patients had conscious sedation than general anaesthesia ($p<0.05$) as compared to the satisfied group. 16 patients were dissatisfied with day surgery. 13 patients had ophthalmology procedures with conscious sedation (CS). All patients that were dissatisfied with day surgery were satisfied with anaesthesia with one exception. 12 patients preferred to be inpatients. Reasons were: living alone; additional home responsibility; & inconvenience. 4 patients had other reasons: long preop waiting period; no preop ECG; fever; & resident doing surgery.

CONCLUSION Day surgery satisfaction was high (98.4%). Patients that were dissatisfied with day surgery process had high anaesthesia satisfaction. More elderly ophthalmology patients were dissatisfied with day surgery. Further home care support of selected day patients may be needed.

REFERENCE 1. J of Clin Anesth 5:64S-68S, 1993

Table

	Satisfaction			Dissatisfaction		
Sex M:F (%)	36:64			50:50		
Age (yrs)	47.3 ± 20			58.8 ± 19*		
ASA (%)	I	II	III	I	II	III
	54.6	41.6	3.8	50	50	0
Anaes. dur. (m)	89.2 ± 65			95.3 ± 28		
Anaes. type (%)	GA	CS		GA	CS*	
	59.9	40.1		18.7	81.3	

* $p < 0.05$
mean ± SD

A

DOES ANAESTHETIC MANAGEMENT CONTRIBUTE TO HYPERTENSION AND TACHYCARDIA IN THE POST ANAESTHETIC CARE UNIT?

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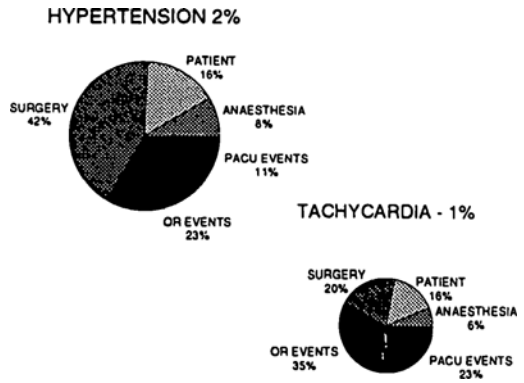
INTRODUCTION: Risk factors (grouped as patient, surgical, anaesthetic management and O.R. and PACU problems) for hypertension (>20% preop systolic >15 min.) and tachycardia (>120 bpm >15 min.) in the PACU were prospectively recorded, to identify the contribution of each factor group to outcome.

METHODS: After Ethics approval, data were collected from O.R. and PACU records. PACU events were documented by nurses. Rates of hypertension and tachycardia were determined for multiple variables and with a logistic regression model those which were independent predictors of PACU hypertension and tachycardia (GA only, $p<.05$) were identified. To determine the relative contributions of each factor group the multivariate chi square value for each group was calculated. This value was expressed as a percentage of the total for each outcome. The higher the percentage, the greater the contribution to outcome.

RESULTS: For GA patients (n=18,380) the rate of PACU hypertension was 2.0% and tachycardia 1.0%. Significant risk factors for hypertension were: older age, male gender, smoking, creatinine >140, O.R. duration and intracranial surgery; patients with angina were at lower risk. The only anaesthetic factor increasing risk was opioid choice (alfentanil/morphine). Intraoperative hypertension and tachycardia increased risk of PACU hypertension. PACU associated events were inadequate ventilation, agitation, and excessive pain.

Risk factors for tachycardia included younger age and preoperative analgesics. Smokers were at lower risk. Surgical factors were emergency and O.R. duration. Opioid choice (morphine/fentanyl) was the only anaesthetic factor which increased risk. OR tachycardia or dysrhythmia and PACU inadequate ventilation, tracheal intubation, agitation, or shivering increased risk. The relative contributions of each of the 5 factor groups to the two adverse outcomes are seen in the figure.



CONCLUSION: Surgical factors and O.R. and PACU patient problems were associated with both hypertension and tachycardia. These 3 factor groups contributed over 75% of the risk associated with both hypertension and tachycardia in the PACU. The contributions of patient and present anaesthetic management were comparatively small for both outcomes.

B

DOES METERED DOSE INHALER AEROSOL SALBUTAMOL, DELIVERED PROXIMAL TO THE ENDOTRACHEAL TUBE, INDUCE TRACHEAL LESIONS IN RABBITS?

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Introduction: The delivery efficiency of salbutamol to the distal airways is greatly increased when the aerosol is delivered via a narrow gauge catheter passed through the endotracheal tube (1). It has been demonstrated that salbutamol administered in this way can induce tracheal epithelial sloughing in rabbits (2). The objective of this study was to determine if 5 or 20 actuations of a salbutamol-containing MDI aerosol attached at the right angle connector in the anaesthetic circuit (as is common clinical practice) induces epithelial injury in this model.

Methods: With the approval of the Institutional Animal Care Committee, 18 New Zealand white rabbits (3.3-6kg) were studied. After induction of anaesthesia with halothane and nitrous oxide (70%), the trachea was intubated with a 3.0 mm tube. Anaesthesia was maintained with halothane in oxygen. Ventilation was controlled mechanically, using humidified gases initiated to maintain normocarbia. Temperature was maintained between 37-39 degrees Centigrade. With the rabbits in the left lateral decubitus position, each rabbit received 5 or 20 puffs of MDI salbutamol or no intervention according to a random allocation. Before each actuation, the MDI aerosol was vigorously shaken, and attached in the vertical position at a right-angle connector of the anaesthetic circuit. Each rabbit's lungs were ventilated for three hours and the animals then killed by administering a barbiturate overdose. Histological specimens were examined with light microscopy and appearances graded (0-4; 0=normal) according to a modification of the system described by Ophoven et al (3). The most severe grade identified in any rabbit was used for data analysis. Data were analysed using Chi-squared test. $p<0.05$ was considered significant.

Results: Histological grade is expressed as mode (range)

Study group	Control n=6	5 doses n=6	20 doses n=6
Histogical grade	2 (1-3)	3 (1-3)	2 (2-3)

Conclusion: When administered proximal to the endotracheal tube, salbutamol administered by MDI aerosol does not cause epithelial injury in intubated rabbits.

References: 1. Taylor RT, Lerman J.. Chest 1993 (in press).
2. Spahr-Schopfer IA, Lerman J, Cutz E, et al. Am Rev Respir Dis 1992;145:A364.
3. Ophoven JP, Mammel MC, Godon MJ, et al Crit Care Med 1984;12:829-32.

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A

A RANDOMIZED, BLINDED COMPARISON OF 20 MG VERSUS 25 MG ISOBARIC BUPIVACAINE FOR SUBARACHNOID ANAESTHESIA

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INTRODUCTION: It has been suggested that longer duration of spinal anesthesia may be achieved with higher than conventional doses of isobaric bupivacaine but little data is available to assess the validity of this statement.[1] It was our hypothesis that 25 mg isobaric bupivacaine, injected into the subarachnoid space, would result in a subarachnoid block that was more prolonged in duration but not associated with increased haemodynamic instability or high level of block when compared to a 20 mg injection.

METHODS: Ten consenting ASA I-III patients, age 45-68 yrs, presenting for elective total knee arthroplasty, were randomly assigned to either Group 25 or Group 20. After a 500 ml crystalloid preload was given, the block was performed in the sitting position, at the L2,3 level with a 27 ga Quincke needle and either 20 (Group 20) or 25 (Group 25) mg of isobaric plain bupivacaine (0.5%) was injected. Systolic BP < 100 mg Hg was treated by ephedrine IV and HR < 45 bpm was treated by atropine IV. BP and HR were determined before the block, at 5 min intervals during the intraoperative period, every 5 min for the first 30 min in the PAR and then every 15 min thereafter until discharge from the PAR. The level of sensory anaesthesia was assessed using pinprick at 5 min intervals after performance of the block until 30 min, then at 10 min intervals until 60 min elapsed time. Upon admission to the PAR, sensory level was assessed by a nurse blinded to the treatment, using pinprick every 15 min until regression to L_1. Motor block was assessed using the modified Bromage scale at the same time intervals until the start of surgery and then in the PAR thereafter.

RESULTS: No patient in either group received either ephedrine or atropine in the first 90 minutes of the study. Two patients in Group 25 and one in Group 20 received ephedrine or atropine or both at the time of tourniquet deflation for transient hypotension or bradycardia.

	Group 20	Group 25
Age	57 ± 8	60 ± 6
Height (cm) Weight (kg)	165 ± 10 74 ± 23	165 ± 14 79 ± 17
Thoracic segments blocked	8 ± 2	9.6 ± 1.7
Time to peak level (min)	35 ± 7	41 ± 10
Regression to L_1 (min)	195 ± 33	249 ± 34**
Duration of motor block (min)	365 ± 114	377 ± 83
Crystalloid administered (ml)	1850 ± 311	1980 ± 295

**P<0.05

CONCLUSION: We conclude that 25 mg of isobaric subarachnoid bupivacaine produces significantly longer duration of sensory block above the L_1 level when compared with 20 mg without resulting in haemodynamic instability or high level of block. Motor block is prolonged after either dose.

REFERENCES: 1. Acta Anaesthesiol Scand 1991;35:1-10.

B

THE EFFECT OF EPIDURAL ANAESTHESIA FOR CAESAREAN SECTION ON THE PULSATILITY INDEX OF THE UTERINE AND UMBILICAL ARTERIES IN LOW AND HIGH RISK PARTURIENTS

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Introduction Epidural anaesthesia is commonly used for caesarean section. In previous studies, uterine and umbilical blood flow velocity ratios have been measured using Doppler ultrasound and no change has been found after anaesthesia[1,2]. However these studies did not report precision of the technique and may have used too few subjects. The purpose of this study was to determine, using Doppler ultrasound, whether epidural anaesthesia changes uterine or umbilical pulsatility index (PI).

Methods The study was approved by the hospital REB and informed consent was obtained. The Doppler technique was standardized. There was substantial or near perfect agreement between two trained observers as shown by an intraclass correlation coefficient[3] of $>.75$ for all vessels. The PI, as defined as the ((peak systolic flow velocity)-(end diastolic flow velocity))/(mean flow velocity) was used as a correlate of blood flow in 30 low risk (Group L) and 10 high risk (Group H) parturients who were not in labour before C/S. The l. and rt. uterine and umbilical arteries were insonnated at times control (T_0), post 1 litre fluid bolus (T_1), and after epidural anaesthesia using 2% CO_2 lidocaine with 1:200,000 epinephrine and 50 μg of fentanyl reached a T4 level (T_2). Anaesthesia was given incrementally in the supine position with 15° of left lateral tilt. The PIs were compared in each patient using a repeated measure ANOVA. A p value$<$ 0.05 was considered statistically significant.

Results PI was significantly increased in both uterine arteries in the Group L and the right uterine Group H. There was no change in the PI of the umbilical arteries.

Discussion PI increases in value when resistance to flow is increased[4]. When mean arterial pressure is constant, a reduction in blood flow can be assumed. This study suggests epidural anaesthesia with CO_2 lidocaine and 1:200,000 epinephrine may reduce uterine blood flow when used for caesarean section. This study confirms other studies[5] that suggest that epinephrine containing local anaesthetics may reduce uterine blood flow.

References 1) Can J Anaest 1989;36:519-22. 2) Br J Obstet Gynecol 1987;94:55-9. 3) Health measurement scales. Streiner, Norman 1989,pg 93. 4) Ultrasound in Med and Biol 1988;14:337-54. 5) Br J Anaesth 1993; 71:348-53.

PULSATILITY INDEX IN LOW AND HIGH RISK PARTURIENTS

N	RISK	SITE	T_0	T_1	T_2
20	LOW	L UTERINE	.72 (21)	.74 (.13)	.82 (.20)*
25	LOW	R UTERINE	.71 (.21)	.77 (.21)#	.85 (.24)*
28	LOW	UMBILICAL	.81 (.12)	.81 (.16)	.80 (.15)
5	HIGH	L UTERINE	.67 (.15)	.76 (16)	.85 (15)
8	HIGH	R UTERINE	.98 (.45)	1.01 (.53)	1.38 (.80)*
8	HIGH	UMBILICAL	1.08 (.56)	1.31 (1.06)	1.14 (.52)

Mean $\pm$(S.D)* $P<0.05$ compared to T_0 and T_1 # $P<0.05$ compared to T_0

A

THE EFFECT OF EPHEDRINE ON THE PULSATILITY INDEXES OF THE UTERINE AND UMBILICAL ARTERIES IN CAESAREAN SECTION PATIENTS

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Introduction Ephedrine is commonly used as a vasopressor when hypotension occurs during epidural anaesthesia for caesarean section. The purpose of this study was to determine, using Doppler ultrasound, whether ephedrine changes uterine or umbilical pulsatility indexes (PI) in patients who receive the drug because of hypotension.

Methods The study was approved by the hospital REB and informed consent was obtained. The Doppler technique was standardized. The PI, defined as the [(peak systolic flow velocity)-(end diastolic flow velocity)]/(mean flow velocity) was used as a correlate of blood flow in 30 low risk and 10 high risk parturients who were not in labour before C/S. Patients received ephedrine in 5 mg increments if the systolic blood pressure fell more that 20% from control or below 100 mm hg. The left and right uterine and the umbilical arteries were insonnated at times control (T_0), post 1 litre fluid bolus (T_1), and after epidural anaesthesia using 2% CO_2 lidocaine with 1:200,000 epinephrine and 50 μg of fentanyl reached a T4 level (T_2). Anaesthesia was given incrementally in the supine position with 15° of left lateral tilt. The PIs were compared in each patient using a repeated measure ANOVA. A p value$<$ 0.05 was considered statistically significant.

Results None of the patients was hypotensive when the final insonnation was performed. The PI increased significantly on the left in patients who received ephedrine and on the right in those who did not (Table). There was no change in the umbilical PI.

Discussion PI increases in value when resistance to flow is increased[1]. When mean arterial pressure is constant, a reduction in blood flow can be assumed. This study shows that there is some increase in the PI whether or not ephedrine is used to treat hypotension. The effect of epidural anaesthesia with epinephrine was more important than the effect of ephedrine at the times measured.

Reference 1) Ultrasound in Med and Biol 1988;14:337-54.

PULSATILITY INDEXES

	N PER SITE	SITE	T_0	T_1	T_2
EPHEDRINE N=17	9	LEFT UTERINE	.67 (.12)	.73 (.11)	.86* (.19)
	15	RIGHT UTERINE	.78 (.33)	.77 (.18)	.97 (.54)
	15	UMBILICAL	.84 (.24)	1.05 (.80)	.83 (.27)
NO EPHEDRINE N=22	16	LEFT UTERINE	.74 (.23)	.75 (.15)	.81 (.19)
	18	RIGHT UTERINE	.79 (.30)	.87 (.40)#	.99 (.47)**
	20	UMBILICAL	.90 (.35)	.85 (.28)	.91 (.32)

Mean $\pm$ (S.D.) # $P<0.05$ compared to T_0
* $P<0.05$ compared to T_0 and T_1, **$P<0.01$ compared to T_0 and T_1

B

DURAL PUNCTURE HEADACHE AND SPINAL NEEDLES– A META-ANALYSIS

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Introduction Dural puncture headache (DPH) is a common problem after spinal anaesthesia. Recently, Sprotte (S) and Whitacre (W) needles have been used in an attempt to reduce the incidence of headache, but trials have been small and inconclusive. The purpose of this meta-analysis is to synthesize the data available to determine whether S or W needles reduce the incidence of DPH compared to Quincke (Q) needles.

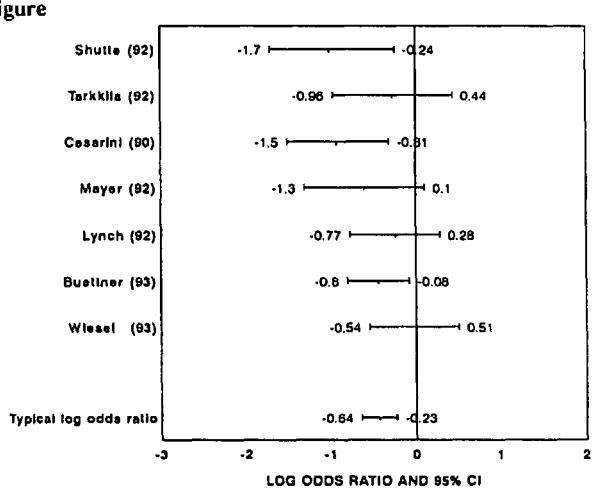
Methods MEDLINE, Exerpta Medica, Scientific Citation Index, Oxford Database of Perinatal trials, and abstracts of major anaesthesia meetings were searched by both authors independently for articles that met the following criteria: 1) randomized trial comparing S or W needles to Q needles 2) post dural puncture headache was an outcome 4) the definition of postdural puncture headache that would avoid contaminiation with other types of headache. The authors then rated the articles for quality using a previously published scale[1]. Articles with a score of less than 0.5 were disgarded. The incidence of headache, log odds ratio, and 95% confidence limits were computed and the studies combined after checking for heterogeneity, using the Mantel Hanzel method. The typical log odds ratio was computed with 95% confidence limits. When these limits excluded zero, the results were considered statisically significant.

Results The results are shown (figure). The incidence of headache is 1.7 to 4.4 times greater with a Q needle than a S or W needle.

Discussion S and W needles are associated with a lower incidence of DPH than Q needles. This effect is made more apparent by statisically combining randomized trials with DPH as an outcome. Caution must be exercized when interpreting these results since none of the trials were free from the possiblity of bias resulting from the randomization methodology used.

Reference 1) J. Clin Epidemiol 1992; 45:255-65.

Figure



A

QUALITY ASSSURANCE IN OBSTETRICAL ANAESTHESIA

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Introduction: Quality assurance (QA) is an important means of maintaining a high quality of care in anaesthesia. Using a validated tracking system[1], we have examined the incidence of anesthesia-related complications in the obstetrical suite. This abstract reports the incidence of these complications for a one year period from Nov 1 1992 to Oct 31 1993.

Methods: A QA transmittal form, designed to detect anaesthetic complications related to vaginal delivery and caesarean section was attached to the chart of each obstetrical patient. The nurse caring for the patient filled out the form following delivery. Anaesthetics were given by staff, fellows and senior residents. The information on the forms was entered into a computer data-base by the anaesthesia department secretary for further analysis.

Results: There were 3850 deliveries performed in the year. A total of 3417 transmittal forms were returned, giving an 89% return rate. The labour epidural rate was approximately 70%. The complication rate is noted in tables I and II. The dural puncture rate for epidurals initiated for caesarean section was 1.8% (95% CI 0.1-3.5%). The failure rate of epidural anaesthetics for caesarean section was 11% (95% CI 7-15%) for patients who did not have labour epidurals and 5% (95% CI 1.3-8.7%) for those who did. The failure rate for spinal anaesthesia for caesarean section was significantly lower than that of epidural anaesthesia ($p=0.02$).

Discussion: The use of a simple transmittal report form in the obstetric suite provides a means of assessing problem areas in the provision of anaethesia for obstetrical patients. We have found that, although labour epidurals provide a very successful form of analgesia, a significant number fail to provide pain relief and must be replaced. Spinal anaesthesia for cesarean section may have a lower failure rate than epidural anaesthesia for caesarean section.

References: 1) Can J Anaesth 1993; 40s:A53

Table I: LABOUR EPIDURALS (n=2096)

Events	n	%	95% CI
Uneventful	1890	90	88.7% , 91.3%
Initial failure	45	2	1.4% , 2.6%
Replaced	60	3	2.3% , 3.7%
Ephedrine given	41	2	1.4% , 2.6%
Spinal tap	13	0.6	0.3% , 0.9%
Other	115	5.5	4.5% , 6.5%

Table II CAESAREAN SECTIONS (n=575)

Technique	Total		Failed		
	n	%	n	%	95% CI
Epidural	368	64	33	9	6% , 12%
Spinal	154	27	5	3	0.2% , 5.8%
General	53	9	—	—	——

B

NITROGLYCERIN RELAXES UTERINE MUSCLE IN VITRO

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INTRODUCTION Intravenous nitroglycerin (GTN) has been reported to be effective in facilitating uterine relaxation at Caesarean delivery[1] and uterine exploration for retained placenta[2,3], but the dose-response relationship of GTN in these situations is unknown. Despite reports of clinical relaxation with GTN varying from 50 mcg to 500 mcg[4], we have observed cases where no apparent relaxation was achieved despite boluses of 1000 mcg. The objective of this study is to evaluate the potency and efficacy of GTN and sodium nitroprusside (SNP) in vitro as uterine relaxants.

METHODS Informed written consent is obtained from patients undergoing elective Caesarean section. A sample of uterine muscle is resected after delivery but prior to administration of vasoactive drugs. The uterine muscle is then suspended from a known resistance and submaximally contracted with oxytocin. After steady-state contraction is achieved, GTN or SNP is added to the tissue baths in progressively increasing concentrations. Relaxation is assessed according to the reduction in frequency and amplitude of contractions. Statistical analysis is performed by one-way ANOVA, with $p < 0.05$ considered significant.

RESULTS Steady-state contractions have been achieved from n=4 samples of uterus to 0.1 mM oxytocin. These have been challenged with 10^{-7} to 10^{-5} M GTN. The frequency of induced contractions was reduced from a mean of 1.8 Hz (range 1-3) to a mean of 0.5 Hz (range 0.4-0.8), at peak effect (10^{-5} M GTN). The amplitude of induced contractions was reduced from 1.9 units (range 1.5-2.5) to 1.6 units (range 0.2-3.5) at peak effect.

DISCUSSION Reductions in the frequency and amplitude of oxytocin-induced contractions of uterine muscle have been observed in association with incremental infusions of GTN. These results confirm that this in vitro model is useful in the evaluation of uterine relaxants. Further study with this model will be conducted to determine the efficacy and potency of GTN and SNP in uterine relaxation.

REFERENCES 1 CJA 39:2, 166-69
2 AJOG 166:4, 1237-38
3 Anesthesiology 71:1, 172-73
4 CJA 39:2, 168

ACUPRESSURE FOR INTRATHECAL NARCOTIC-INDUCED NAUSEA AND VOMITING POST-CAESAREAN SECTION

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INTRODUCTION: Acupressure (Seabands®), a treatment for motion sickness, has been shown to reduce the incidence of nausea and vomiting postoperatively[1] and during caesarean section under spinal anaesthesia[2]. This double-blind, randomized, placebo controlled study was designed to determine whether prophylactic acupressure reduces the incidence of intrathecal (IT) narcotic-induced nausea and vomiting post-caesarean section.

METHODS: Following Ethics committee approval and informed consent ASA I-II patients presenting for elective caesarean section under spinal anaesthesia were enroled. They were randomized to wear on their wrists either a pair of SeaBands® (Acupressure, Group A) or Placebo bands (Placebo, Group B) which were applied prior to their arrival in the operating room. All patients received spinal anaesthesia with hyperbaric 0.75% bupivacaine containing 10 μg fentanyl and 250 μg morphine. Severity of nausea (on a VAS scale) and frequency of vomiting, retching and dizziness were assessed at two hour intervals for 10 hours following IT injection. Intra and postoperative medications were recorded.

Data were analyzed using t-test, Mann Whitney, Chi square and Fisher's exact test with Bonferroni correction. $p<0.05$ was considered significant.

RESULTS: To date 40 patients (19 Grp A, 21 Grp B) have completed the study. There was no statistically significant difference between the groups with respect to demographics, block height, bupivacaine dose, intraoperative hypotension, narcotic supplementation or duration of surgery. Four patients in Grp A required antiemetics in the 10 hours following IT injection vs seven in Grp B (NS). Five patients had vomiting in Grp A vs six in Grp B (NS).

DISCUSSION: Spinal opiates are associated with a high incidence of nausea and vomiting (44% in the parturient) which is thought to share a common mechanism with motion sickness (seasickness). Prophylactic acupressure offers the possibility of a non-pharmacological method of preventing nausea and vomiting in women receiving IT narcotics for postcaesarean section analgesia. To show a statistically significant difference (power 80%) 122 patients per group are required. This study is ongoing.

REFERENCES
1. Br J Anaesth 1989;63:612-8
2. Anesthesiology 1993;79:A1020

SUPPLEMENTAL ANALGESIC REQUIREMENTS WITH CONTINUOUS EPIDURAL INFUSION: PATIENT PROFILES

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INTRODUCTION: Continuous epidural infusion (CEI) of local anaesthetics for labour may be associated with persistent discomfort necessitating supplemental bolus injections of the anaesthetics. We reviewed our obstetrical practice over the last 15 months to identify patient parameters that were associated with the increased requirement for supplemental boluses.

METHODS: Following approval from the Ethics committee we reviewed the records of all consecutive obstetrical patients who presented at our hospital between October 1, 1992 and October 31, 1993. Patients who received a continuous epidural infusion via pump system were selected and subdivided into 2 groups: those who required 1 or 2 boluses (n = 618) and those who required >2 supplemental boluses (n = 197). For these 2 groups we examined multiple factors including age, parity, gestational age and augmentation of labour with oxytocin. Choice of local anaesthetics administered via CEI was noted for each group. Outcome variables studied included the rate of Cesarean section (CS), APGAR scores at 1 and 5 min., and the combined rate of vacuum extraction and forceps delivery. Differences between groups were compared using chi-squared analysis with $P<0.05$ considered significant.

RESULTS: Maternal age, gestational age, use of epidural narcotics, APGARs, and rate of vacuum extraction/forceps extraction did not correlate with an increased need for supplemental epidural boluses. Patients who received CEI with bupivicaine 0.1%, 0.125% or 0.2% (± fentanyl) all had similar rates of supplemental bolus requirements. Patients receiving an oxytocin infusion and nulliparous women were more likely to require >2 bolus epidural injections (see table). Supplemental top-ups were required significantly more frequently in mothers requiring a replacement catheter or proceeding to a CS.

	n	% >2 Boluses
Nullip/Multip	608/207	26.7/14.7*
Oxytocin/No oxytocin infusion	427/388	31.4/16.2*
CS/vag delivery	158/657	34.8/21.6*
Cath. changed/Not changed	22/793	77.3/0.6*

*P<0.05

CONCLUSION: In our series, 24% of all patients with CEI had inadequate analgesia at some time in the course of labour. Both nulliparity and oxytocin-augmented labour can be associated with an increase of length or intensity of labour: this may explain the need for more top-ups in this group of patients. The increased need to change the catheter suggests an inherently poor epidural block that cannot be salvaged by any choice or combination of agents. The choice of anaesthetic agents for infusion in our series did not influence the need for further top-ups. Future studies which address the degree of pain control are needed to identify optimal anaesthetic techniques which may eliminate the requirement for supplemental bolus injections.

A

EFFECT OF PROSTAGLANDIN E1 FOR HYPERTENSION: FROM THE POINT OF VISCERAL MICROCIRCULATORY SYSTEM

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INTRODUCTION: Prostaglandin E1 (PGE1) is considered to be a useful vasopressor and regarded to dilate resistance vessels. To evaluate the effect of PGE1 for the hypertensive patients, we observed the microcirculatory dynamics of spontaneously hypertensive rats' mesenteries.

METHODS: We used female SH rats, about 180g, 10w. With tracheotomy under anesthesia, neck A-V lines were performed for monitoring means arterial pressure (MAP) and infusion. Mesentery of each rat was spread on the stage of microscopy with perfusion. Picture of the mesentery microcirculation was recorded on a high speed video system consecutively: blood cell velocity (BCV) of venules, internal diameters of arterioles (IDA), internal diameters of venules (IDV) were analyzed [1]. The rats were divided into two groups: each rat of the 10 group was given 10 μg of PGE1 as a bolus injection, and each of the 20 group was given 20 μg, respectively. At first, we measured all parameters for the control levels; each rat was given PGE1 and we measured these articles consecutively during the 30 min time course.

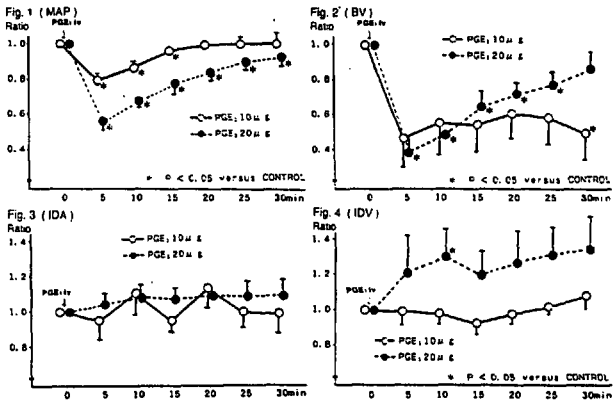
RESULTS: About the control data (Table), no significance was found. Time courses are shown in Figs.1 to 4 as rational changes. MAP and BV once decreased, soon recovered; some rats did not show enough impairment of BV. Both groups showed no significant change about IDA; 20 group rats showed significant dilatation of IDV (21.9 ± 1.7 → 28.4 ± 4.2 μm) at 10 min time course ($p < 0.05$, t-test).

CONCLUSIONS: It is reported that PGE1 mainly dilates resistance vessels. This report suggests the possibility that PGE1 dilates capacitance vessels. In case of hypertensive rats, vascular reaction caused by PGE1 may be different from normal rats; this phenomenon may be also applicable to hypertensive patients.

REFERENCE:
1. Circulatory Shock, 36 (4) 284-289, 1992.

TABLE:

	10 group	20 group	
MAP	136.1 ± 4.6	147.7 ± 7.9	mmHg
BCV	1.31 ± 0.17	1.01 ± 0.19	mm/sec
IDA	14.3 ± 2.3	13.4 ± 1.2	μm
IDV	21.1 ± 0.78	21.9 ± 1.7	μm



B

THE EFFECT OF GENERAL ANAESTHESIA ON THE PLASMA LEVELS OF ENDOTHELIN IN HUMANS

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INTRODUCTION

Endothelin (ET) is a newly discovered vasoconstrictor peptide secreted by the endothelial cells of the blood vessels. The pulmonary circulation plays an important role in the metabolism of ET. ET has profound vasoconstrictor effects on the pulmonary circulation and bronchial tissue, and its production is augmented in pulmonary hypertension, systemic hypertension[1], and after pulmonary surgery[2]. The aim of this study was to investigate the effects of general anaesthetics on the plasma levels of ET in ASA1 adults.

METHODS

Plasma samples were collected from 8 patients who underwent arthroscopic surgery or tendon repair. Samples were obtained at the following four intervals: before and after induction with standardized general anaesthesia, 10-15 minutes after the application of the tourniquet, and following recovery from anaesthesia. ET samples were extracted on Sep Pak C18 cartridges, and measured using a commercially available radioimmunoassay kit for human endothelin-1.

RESULTS

After induction of general anaesthesia, there was a significant decrease in the blood pressure, which went back to the pre-induction level following recovery. Heart rate was not affected by the anaesthesia. Plasma levels of ET ranged from 4.9 to 12.5 pg/ml of plasma, and there was no significant change in ET levels during any of the surgical periods. There was also no apparent difference based on sex, nor on age.

DISCUSSION

Previous studies have suggested that the circulating levels of ET may be altered under some pathological conditions, and also during surgery. General anaesthetics are known to be associated with cardiovascular depression, and as ET is the most potent vasoconstrictor peptide known to date, we hypothesized that the circulating levels of ET may be affected by anaesthesia. Our results showed that in patients with no underlying cardiovascular and pulmonary diseases, even though general anaesthesia caused a drop in blood pressure, this was not associated with any significant change in the circulating ET levels.

REFERENCES

1. *Am. Rev. Resp. Dis.* 1992; 146:S56-S60.
2. *J. Cardiovasc. Pharmacol.* 1991; 17:S402-S403.

IMPAIRED ACQUISITION OF THE MORRIS WATER TASK FOR 24 HR AFTER HALOTHANE, BUT NOT ISOFLURANE OR PENTOBARBITAL ANAESTHESIA IN RATS

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INTRODUCTION

In studies of brain injury in rats (1), after halothane anaesthesia sham-operated animals performed significantly worse in the Morris water maze test than normals. The effects of anaesthesia alone were therefore investigated.

METHODS

Two groups of rats were exposed to halothane or isoflurane, 2 vol% in oxygen for 10 min. In a third group rats were injected i.p. with 65 mg/kg pentobarbital. A fourth group were not anaesthetized. On days 1 to 3 post-anaesthesia, all rats were tested in Morris water maze task (2) i.e., finding a submerged platform in opaque water. Each test consisted of four timed trials to locate the platform.

RESULTS

On day 1 post-anaesthesia, on first trial there were no significant differences in latency to locate the platform between groups. On second trial, normal, isoflurane- and pentobarbital-treated rats showed a statistically significant decrease in latency, which persisted on trials 3 and 4. Halothane-treated rats showed no decrease in latency on trial 2, but some on trial 3. By trial 4 and on day 2 post-anaesthesia there were no significant differences between the groups.

TABLE - Latency, hundredths of min. Day 1

	Trial 1	Trial 2	Trial 3	Trial 4
halothane (12)	92±7	94±3*	71±10*	33±10
isoflurane (12)	93±4	43±12	35±10	32±7
pentobarb. (12)	76±8	49±11	39±8	35±9
no anaesth.(36)	82±5	40±5	26±4	24±4

AV ± SEM. *$p < 0.01$ from normal.

DISCUSSION

These data indicate that halothane, but not isoflurane or pentobarbital, delays acquisition of spatial memory in rats during the first 24 hr. The results are in agreement with clinical observations of short-term post-operative impairment of memory and learning for at least 24 hr after administration of halothane (3).

REFERENCES

(1) Neurochemical Research 16:941, 1991. (2) Nature 297:681, 1982. (3) Anesthesia and Analgesia 65:955, 1986.

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THE INITIAL DISTRIBUTION VOLUME OF GLUCOSE AND CARDIAC OUTPUT IN POST-SURGICAL PATIENTS

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INTRODUCTION

Recently our study(1) demonstrated that the initial distribution volume of glucose[IDVG] reflects thermodilution cardiac output[CO] rather than glucose metabolism in non-surgical critically ills without obvious congestive heart failure[CHF], which suggested that the IDVG might have the potential as an indicator of CO or dilution volumetry. Post-surgical patients may have some fluid accumulation as well as considerable changes in glucose metabolism. The purpose of the study was to calculate the IDVG and CO in post-surgical patients, and to test the hypothesis that the IDVG reflects CO rather than glucose metabolism in post-surgical patients with or without obvious CHF.

METHODS

Seventeen post-surgical patients were studied in the ICU. Five patients among the 17 patients had CHF including compensated CHF on the admission to the ICU. A total of 41 comparisons between the IDVG and CO were performed on the day of surgery, the first, second, and/or third post-operative days. There were some points when an infusion of a vasoactive drug or insulin was required. A bolus of 5 g glucose was given over 30 seconds, and serial blood samples were obtained through a radial artery line immediately before and 3, 5 and 7 minutes after the glucose injection. The IDVG was calculated using a one compartment model from the incremental plasma decay curve after the glucose challenge. CO was also calculated immediately before each glucose challenge.

RESULTS

Linear correlations were found between the IDVG and CO in patients without CHF (IDVG=0.7*CO+2.5: n=26, r=0.86, $p<0.001$), and in patients with CHF (IDVG=1.3*CO-1.5: n=15, r=0.63, $p<0.05$). The two regression lines with or without CHF were different ($p<0.05$). No difference was found between the IDVG with or without a continuous infusion of a vasoactive drug or insulin.

DISCUSSION

The linear correlation between the IDVG and CO in post-surgical patients without CHF was statistically identical with that of the non-surgical critically ill(1). Although only 5 patients had apparent CHF, and the regression line may change in response to the severity of CHF, the results indicate that the IDVG reflects CO rather than glucose metabolism even in post-surgical patients, and that the relationship is different with or without CHF.

REFERENCE

1.Canad J Anaesth 1993;40:28-31

ANXIETY, SEDATION, PATIENT SATISFACTION AND ARTERIAL OXYGEN SATURATION IN PREMEDICATED PATIENTS UNDERGOING CARDIAC CATHETERIZATION

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INTRODUCTION

Anxiety is common in patients undergoing cardiac catheterization (CC).[1] Premedication may induce respiratory depression and apnea[2]. The purpose of this prospective investigation was to assess anxiety (A), sedation (S), patient satisfaction (PS) and arterial oxygen saturation (SaO_2) in adult patients undergoing CC and receiving oral premedication prescribed by cardiologists.

METHODS

With Research Ethics approval, 62 consenting adults were randomly chosen. With the patients left undisturbed, heart rate (HR) and SaO_2 were monitored for at least 10 min by pulse oximetry. Immediately before (BCC) and after cardiac catheterization (ACC) a single trained observer assessed A (verbal analog scale; 0=nil; 10=maximal), S(0=agitated; 1=awake; 6=unconscious and unarousable) and PS (global satisfaction).

RESULTS

Age was 60±11 years, weight 83±13 kg, 48 males and 14 females. 51 patients received diazepam (5-10 mg) alone, 6 lorazepam (1 mg) alone, 4 diazepam (5-10 mg) and promethazine (25 mg), and 1 diazepam (10 mg) and diphenhydramine (25 mg). BCC and ACC evaluations were performed 29±16 min and 135±43 min after premedication, respectively. High levels of A (A score ≥ 6) were found in 13% of patients BCC and 16% ACC. No patient, at any time had an S score >3 (asleep, eyes open to name). One patient was agitated BCC. 74% and 94% had an S score of 1 BCC and ACC, respectively. BCC 23% were dissatisfied. Of those, 14% had A scores ≥6. ACC 10% were dissatisfied. Of those 20% had A scores ≥6. Mean SaO_2 for the group was 97±1% BCC and 96±2% ACC. The mean of the lowest SaO_2 was 95±2% BCC and 95±1% ACC. One patient had a BCC SaO_2 reading of 89% for 20 seconds and another patient had an ACC SaO_2 reading of 90% for 15 seconds. The remaining patients had all SaO_2 readings >90% BCC and ACC. Pearson product-moment correlation coefficients analysis showed no relationship between patient demographics, type or dose of premedication, A, S, PS scores and SaO_2 values.

DISCUSSION

Premedication prescribed by cardiologists did not cause excessive sedation or hypoxemia. However, it failed to achieve its goal of anxiolysis. Assessment of A, S, PS and SaO_2 before and during CC may be used to guide therapeutic interventions in this patient population. Our results suggest that higher doses of anxiolytics are needed to improve patient satisfaction. This could probably be done with little risk, especially if O_2 supplement is added.

REFERENCES

1. Heart & Lung 1991; 20:643-647
2. Anesthesia and Analgesia 1979; 58:52-53

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A RANDOMIZED COMPARISON OF THE EFFICACY OF HIGH OR LOW DOSE APROTININ, OR TRANEXAMIC ACID, TO DECREASE BLOOD LOSS AND TRANSFUSION REQUIREMENTS IN ASPIRIN-TREATED CARDIAC SURGICAL PATIENTS

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High dose aprotinin (HDA - 6 m KIU) decreases blood loss and transfusion requirements in cardiac surgical patients.[1-3] Low dose aprotinin (2 m KIU)[3] may be equally efficacious, and tranexamic acid (TA) may also decrease blood loss.[4] We compared the efficacy of these 3 different strategies to decrease blood loss and transfusion requirements in aspirin treated patients undergoing cardiac surgery, a group previously demonstrated to be at high risk for excessive blood loss.[2]

Methods: After Institutional Review Board approval and obtaining written patient consent, 34 patients undergoing elective cardiac surgery who had been chronically maintained on aspirin within 48 hr of surgery, were randomized to receive a blinded infusion of saline containing either HDA (2 m KIU load to patient and CPB circuit, and 0.5 m KIU/hr during surgery),[1-3] LDA (2 m KIU to CPB circuit only)[3] or TA (10 gm prior to incision).[4] Intraoperative blood loss (sponge weight plus suction volume), postoperative blood loss (chest tube drainage), and transfusion requirements, as well as complications including re-exploration for bleeding, myocardial infarction, intraaortic balloon pump usage, and death were recorded and compared between patients. For statistical comparisons, either Chi-square analysis or ANOVA were used and $p < 0.05$ was required for significance.

Results: There were no statistically or clinically significant differences in total, intraoperative, or postoperative blood loss ($p=0.778$), or in transfusion requirements, between LDA, HDA, or TA, for patients maintained on aspirin. The incidence of complications did not differ significantly between any of these groups.

Conclusions: Low dose aprotinin or TA are as effective as HDA[2] in decreasing blood loss and transfusion requirements in patients maintained on aspirin and undergoing cardiac surgery.

References: 1) Royston D. J Cardiothorac Vasc Anesth 6:76-100;1992. 2) Murkin JM, et al. J Cardiovasc Surg (in press),1994. 3) van Oeveren W, et al. J Thorac Cardiovasc Surg 99:788-97;1990. 4) Karski JM, et al. Can J Anaesth 40:A47;1993.

HIGH DOSE APROTININ REDUCES TRANSFUSION REQUIREMENTS OF BLOOD AND BLOOD PRODUCTS DURING ORTHOTOPIC LIVER TRANSPLANTATION

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Introduction:
The administration of Aprotinin (APR) during orthotopic liver transplantation (OLT) to decrease bleeding and transfusion requirements has been controversial.[1,2] We evaluated the efficiency of a high dose of APR in patients with the most advanced end-stage chronic liver disease stratified as a status 3 and 4 according to the United Network for Organ Sharing (UNOS) classification.

Methods:
Eighteen patients, six women and twelve men, (status 3 & 4 UNOS) for OLT without veno-venous bypass were given APR in the following manner: loading dose of 2,000,000 kallikrein inactivation units (KIU) before skin incision followed by continuous infusion of 500,000 KIU/h until the end of surgery. According to institutional protocol all patients had hemoglobin, haematocrit, platelets and coagulation tests recorded during preanhepatic, anhepatic and neohepatic stages. Red blood cells (RBC), fresh frozen plasma (FFP) and platelets intraoperative transfusions were recorded. This group of patients was compared to a similar group of eighteen patients having OLT without veno-venous bypass and without APR administration. Statistical analysis was done using t-test with $p<0.05$ considered as significant.

Results:
No significant differences were found regarding age, weight, preoperative and end of OLT values of hemoglobin. Significantly less RBC, FFP and platelet units were transfused in the APR group and a trend toward shorter operation time was observed in this group as well (table).

Discussion:
These results suggest that Aprotinin is effective in reducing transfusion requirements of blood and possibly blood products during OLT in patients with the most advanced end-stage chronic liver disease stratified as status 3 & 4 according to UNOS.

TABLE

	WITH APR	NO APR
age (years)	46±6	48±14
weight (kg)	68±12	62±8
Hb (g/dl)		
preoperative	9.3±1.6	9.1±0.8
end of OLT	9.8±1.2	9.6±1.4
TRANSFUSION (units)		
RBC	4.8±2.4	8.6±2.2*
FFP	5.2±1.4	10.2±3.4*
Platelets	4.4±1.8	9.2±1.6*
OPERATIVE TIME (mean-min)		
Total	418±136	472±122
Preanhepatic	174±42	182±56
Anhepatic	74±18	78±26

* $p<0.05$ ± SD

References:
1. Lancet, 336:886-887, 1990
2. Anesthesiology, 77:A225, 1992

A B

THE CEREBROVASCULAR RESPONSE TO CO_2 IN HEPATIC FAILURE: TRANSCRANIAL DOPPLER VELOCITY VS $PaCO_2$ DURING ANESTHESIA FOR ORTHOTOPIC LIVER TRANSPLANT

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INTRODUCTION

The study was designed to determine the cerebrovascular reactivity to carbon dioxide in man in end-stage hepatic failure in order to examine the relative contributions of vasodilators and/or CO_2 in the MCAV response to graft reperfusion previously reported (1).

METHODS

Following IRB approval and patient informed consent, 11 adult patients selected for transplantation were anesthetized using pentothal, fentanyl, and isoflurane. During the pre-anhepatic phase, minute ventilation was varied to produce 2 or 3 steady state levels of $PaCO_2$. MCAV was measured at each level using a EME Doppler (Nicolet, Inc.) secured to the head over the middle cerebral artery with an elastic strap.

RESULTS

MCAV slope was 5.82 ± 0.46 cm/sec/mmHg. End-tidal Isoflurane averaged 0.45 ± 0.05 %. Average $PaCO_2$ change was 11.3 ± 1.2 mmHg produced by hyperventilation.

DISCUSSION

The slope of the MCAV response to the CO_2 stimulus was 53% to 132% greater than that reported for normal man anesthetized with the same anesthetic agents (2,3). This increased sensitivity to CO_2 may place the transplant patient at increased risk for intracranial hypertension at reperfusion.

REFERENCES

1. Doblar et al. J Clin Anes (in press).
2. Markwalder et al. J Cereb Blood Flow and Metab 1984.
3 Kinnard et al. Anesthesiology Suppl 1992.

Patient	MCAV Slope	ET Forane (%)	CO2 change
Number	cm/sec/mmHg		mmHg
1	3.40	0.3	8
2	5.69	0.4	17
3	4.50	0.5	7
4	5.56	0.5	9
5	5.05	0.4	11
6	4.38	0.6	11
7	6.91	0.5	15
8	6.67	0.4	16
9	6.25	0.6	8
10	6.94	0.7	8
11	8.63	0.1	14
Average	5.82	0.45	11.3
SEM	0.46	0.05	1.2

A

COMPARISON OF TWO METHODS OF ADMINISTRATION OF INHALED NO (NITRIC OXIDE) ON NO_2 (NITRITE) PRODUCTION.

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INTRODUCTION

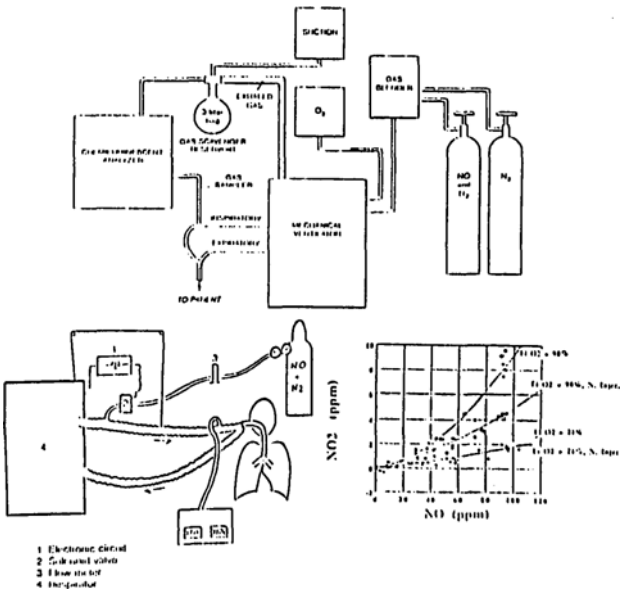
Inhaled NO, a selective pulmonary vasodilator, will improve oxygenation of the patient with a distress syndrome (ARDS).[1] NO is a very unstable molecule which reacts with O_2 to produce nitrite (NO_2)[2], a potent oxidant having a pulmunary effect similar to O_3. We compared two methods of NO administration on the rate of NO_2 production. The effect of a different FiO_2 and NO concentration on the NO_2 production was determined.

METHODS

NO and O_2 were mixed either before the gas mixture entered the respirator (fig 1) or the NO was injected directly in the inspiratory line between inspirator and endotracheal tube (fig 2). The concentration of NO and NO_2 were measured distal to the NO administration point (close to the endotracheal tube by chemiluminescence apparatus).

RESULTS

The injector device reduced the NO_2 production from 8.9 ± 0.72 to 4.4 ± 0.14 ppm ($P<0.05$, unpaired t-test, $n=6$) at FiO_2 of 90% and 90 ppm of NO (fig 3). At FiO_2 of 21%, the production of NO_2 by either method is not significantly different.



CONCLUSION

For patients requiring high FiO_2, the new injection system maintains a concentration of inhaled NO_2 less than 5 ppm which is considered as toxic.[3]

REFERENCES

1. New Engl J Med 1993; 328(6):399-405.
2. Circulation 1991; 83:2038-47.
3. MMWR August 26, 1988, vol. 37, No S-7(21).

B

Percutaneous 14 French, the Perfect Percutaneous Cannula for Establishing Venous Bypass Access in Orthotopic Liver Transplantation (OLT).

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Introduction: Partial veno-venous bypass (VVB) is used to minimize the physiologic alteration from cross clamping of the inferior vena cava (IVC) during OLT. VVB involves cannulating the femoral the portal veins and routing blood to a centrifugal pump which returns the blood to a tributary of the superior vena cava. Traditionally, a surgical cut-down is used to access an axillary vein (AxV)(1). Since 1989, we have been using different size percutaneous cannulae to establish VVB during OLT. We evaluated percutaneous techniques in an effort to avoid cutdown for venous access (2). Cut down is used when percutaneous access fails or is contraindicated (< 2.5 %).
This study compares pump flows (PF) and pump pressures (PP), recorded on the Bio-Medicus 11157 pump, in cases using different percutaneous cannulae during VVB. We recorded complications such as unexpected flow interruption with flows < 1 liter and other problems related to venous access. Low flow during VVB results in an emergency interruption of the VVB because of the hign incidence of fatal pulmonary emboli. High pressure with smaller cannullae during VVB may lead to damage of the red blood cells.
Methods:Return flow was via a 9 Fr cannula in the AxV in Group1; via a 9 Fr cannula in the Internal Jugular Vein (IJ) in Group 2; via a15 Fr cannula in the IJ in Group 3 and via a 14 Fr cannula in the IJ in Group 4
Results: The results are presented in the table below

Group	1	2	3	4
	AxV 9F (n=10)	IJ 9F (n=10)	IJ 15F (n=8)	IJ 14F n=10)
P F(L/min)	2.04 ± 0.07	2.09±0.19	*2.89±0.45	*2.55±0.45
P(mmHg)	309 ± 17	305 ± 20	*75±24	*85±25

Complication

A. Interruption(%)	40	40	13 (n=1)	*0
B. Access Compl (%)	10	10	13 (n=1)	*0
C. (A+ B) (%)	50	50	26	*0

*p< 0.05 IJ 15F and 14 F compared to AxV 9F and IJ 9F.
Statisticace analysis was performed using Anova with statistical significant at p< 0.05
Conclusion: Percutaneous placement of a 15 Fr and 14 Fr cannula in the IJ vein appears to offer the best pump flows with lower pressure. and fewer complications. Overall the 14 F represents the best catheter with adequate flow without complication. Originally this 14 F catheter was designed for femoral arterial access during pediatric cardiopulmonary bypass. The cannula is 14 French in diameter and 19 cm in length. To use this cathether during VVB, we found it necessery to add a customised extension to the distal end. Which includes, one stopcock to prime, perfuse and remove air bubbles from the cannula. A two one and half inch segment of 1/4 inch transparent polyvinyl placed before and after the high flow stopcock and one removable dead ender to seal the canula circuit before and after the by pass and finally one transparent connector 1/4 inch to 3/8 inch just before the dead ender.
Because of our excellent pump results with this 14 F catheter we are in contact with an manufacture to produce an improved version of this 14 F.
References: 1.Surg Gync Obst 1985: 160: 270-2
2.Sem. Liv.Disea.1985:344-348

A

HEMODYNAMIC EFFECTS OF DOXACURIUM AND VECURONIUM IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS SURGERY

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Introduction: The choice of neuromuscular blocking agent for patients with heart disease is determined by the likely circulatory effects that will be evoked by these drugs when combined with other anaesthetic agents. The purpose of this study was to evaluate the cardiovascular effects of doxacurium and vecuronium in patients anaesthetized with fentanyl and diazepam, after succinylcholine assisted tracheal intubation.
Methods: Nine patients undergoing elective coronary artery bypass graft were studied in a double blinded randomized prospective fashion. Monitors included blood pressure, ECG, automated ST segment analysis of leads II and V5, blood gases, ventricular filling pressures, cardiac output, mixed venous oxygen (O2) saturation. Myocardial contractility was estimated using esophageal accelerometry. Preoperative medications were morphine and scopolamine. Anaesthesia was induced with fentanyl, diazepam and succinylcholine. Five min after tracheal intubation, doxacurium 0.08 mg/kg or vecuronium 0.15 mg/kg was infused over 30 seconds. Data were recorded before intubation, 5 min after intubation and every min for 5 min after the nondepolarizing agent. Data were analyzed using t test with Bonferroni correction. Results are reported as mean ± SEM. $P < 0.05$ was considered significant.
Results: Patient groups were similar with respect to age, weight, height, preop medications, medical history, and number of stenotic coronary arteries. There were no differences between groups at the time intervals studied, nor were there any differences within groups following injection of the drug. Induction of anaesthesia prior to injection of nondepolarizing muscle relaxant accounted for the major differences observed (decrease in O2 consumption, extraction ratio, mean arterial pressure, cardiac index; increase in mixed venous O2 saturation).
Discussion: Preliminary results indicate that administration of both doxacurium and vecuronium resulted in stable hemodynamics with no adverse effects on cardiac function O2 metabolism, or myocardial ischemia.

	Base line	After intubation	5 min after drug infusion
MAP 1)vec	95.8±5	76.2±5	70±4
2)dox	96.2±6	85.5±9	74.7±4
HR 1)vec	83.4±4	76.4±4	70.6±11
2)dox	82.2±5	79.2±4	66.7±3
CI 1)vec	3.1±0.4	2.4±0.3	2.3±0.3
2)dox	2.8±0.2	2.5±0.2	2.2±0.2
PCWP 1)vec	18.4±6	11.9±1	11.5±0.5
2)dox	15±3	11.5±1	11.5±1
SVR 1)vec	1406±220	1265±195	1219±213
2)dox	1485±87	1340±95	1396±190
PVR 1)vec	87±21	184±22	158±21
2)dox	95±18	180±13	180±32
DO2 1)vec	914±117	788±103	727±113
2)dox	737±67	666±57	464±111
VO2 1)vec	276±26	130±24	108±28
2)dox	213±17	114±19	72±21
AIn 1)vec		0.14±0.16	0.16±0.02
2)dox		0.34±0.31	0.34±0.07
AIy 1)vec		0.4±0.12	0.36±0.1
2)dox		0.68±0.16	0.49±0.16

*p < 0.05 vs base line within group

B

Clinical Comparison of Blood Warmer Performance At Maximum Flow Rates

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Introduction. Rapid transfusion of large volumes of cold crystalloid solutions and blood components may result in hypothermia, abnormal hemostasis and cardiac arrhythmias. The purpose of the study was to evaluate the fluid warming ability of 4 blood warmers at maximum infusion rates.
Methods. The blood warmers tested were the Astotherm, Flotem IIE, Level 1 and Rapid Infuser. The warmers were operated in accordance with manufacturers' guidelines using standard blood tubing, filters and connections. Fluids tested were packed red blood cells (pRBC), pRBC diluted with saline 200 mL, and crystalloid (saline or ringers lactate, 1L bags). All pRBC were obtained from outdated standard blood bank supply, had been collected in Adsol and were kept refrigerated until use. Outlet temperature was measured with a rapid-acting in-line thermistor probe inserted at the end of the tubing (point where tubing would be attached to patient). Volume of fluid and temperatures were measured every 10 -20 seconds for each fluid during rapid infusion (constant pressure, 300 mmHg) until each bag was empty. Flow rate (mL/min) and outlet temperature were compared between warmers for each fluid type using the GLM procedure, with Tukey's Test for multiple comparisons. A p value < 0.05 was considered significant.
Results. For all fluids, flow rates were fastest with the Rapid Infuser (Table 1, $p < 0.05$ vs other warmers), and warmest with the Rapid Infuser and Level 1 (Table 2, $p < 0.05$ vs other warmers).
Discussion. Only the Level 1 and Rapid Infuser warmers, which use countercurrent heat exchange mechanisms where a heater warms water to 38 - 39°C and circulates it via a pump, were effective in warming cold solutions of crystalloid and pRBC at rapid infusion rates. The Flotem and Astotherm warmers, which use plastic tubing sandwiched in grooves between dry heat (36 - 38°C), were not effective in warming fluids.

Table 1. Flow Rate (mL/min), 300 mmHg constant pressure.

	Astotherm	Flotemp	Level 1	Rapid Infuser
pRBC	44 (14)[a]	86 (7)[b]	161 (60)[c]	234 (53)[d]
diluted pRBC	145 (33)[a]	140 (54)[a]	203 (98)[a]	418 (108)[b]
crystalloid	259 (36)[a]	268 (49)[a]	613 (52)[b]	740 (192)[c]

Means (SD). Means with the same letter are not significantly different between warmers.

Table 2. Outlet Temperature (°C)

	Astotherm	Flotemp	Level 1	Rapid Infuser
pRBC	30.6 (2.4)	23.4 (2.2)	34.0 (0.8)*	32.4 (3.2)*
diluted pRBC	25.8 (2.3)	23.4 (3.8)	32.6 (1.9)*	32.8 (1.4)*
crystalloid	24.7 (0.5)	23.7 (1.0)	32.7 (0.7)*	34.7 (2.2)*

Means (SD), *P< 0.05 vs other warmers

A

Lingual-Pulse Oximetry

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Introduction: Pulse oximetry has become an essential and integral part of critical care monitoring. The failure rate of pulse oximetry in the operating room ranges from 1-2% to more than 10%, depending on the location of the probe application, the design of the probe and most importantly, the perfusion at the sampling site [1]. The excessive failure incidence in hypotensive patients is especially disturbing because hypotensive patients with cardiopulmonary decompensation can potentially gain the most from this monitoring modality. A location with high vascularity and therefore with perfusion less susceptible to blood pressure variation would serve as a better sampling site for the pulse oximeter.
Pulse oximeters report the hemoglobin oxygen saturation at the site of sampling. The circulatory delay between the left ventricle and the site of sampling causes the latency of the response. Early intervention may be of crucial importancein the welfare of a marginally compensated patient.
The tongue is a highly vascular organ. Perfusion of the tongue is derived mainly from the lingual artery, which is the second branch of the external carotid artery. The circulatory delay for the lingual artery would be comparable to the average cerebral circulation. Theoretically, the tongue is a superb location for sampling of the arterial oxygen saturation. To further explore our hypothesis we designed and constructed a series of reflective pulse oximeter integrated into the oropharyngeal airway. Their clinical performance were studied.

Methods: In 10 consecutive surgical patients scheduled for general anesthesia, a reflective pulse oximeter probe integrated oropharyngeal airway is used. The reported O_2 saturation failure rate, the incidence of interference caused by electric cautery, the response time of arterial blood saturation change when FiO_2 was changed were recorded and compared.

Results:

	SO_2	Failure Rate	Electrocautery Interference	Response time increased FiO_2
Finger Probe	99±1	1/10	3/10	30 sec
Airway Probe	98± 0.7	0/10	1/10	7 sec

Conclusion: The oropharyngeal integrated pulse oximeter may be a significant improvement in pulse oximetry. This new probe seems to have a reduced failure rate, reduced incidence of electrocautery interference and significant reduction in response time in detecting decreased O_2 saturation. Additionally, the integration of pulse oximeter probe to the airway provides us with a device of both measurement diagnostic and therapeutic intervention.

Reference:
Anesth Analg 74: S15, 1992

B

REGIONAL VS GENERAL ANAESTHESIA FOR CAROTID ENDARTERECTOMY SURGERY

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INTRODUCTION
We reviewed the incidence of perioperative cardiac, neurologic, and respiratory events as well as the use of shunt placement, in patients having regional anaesthesia (RA) and general anaesthesia (GA) for carotid endarterectomy (CEA).

METHODS
Fifty eight consecutive patients who received GA (29 patients), and RA with deep and superficial cervical plexus block (29 patients) for CEA by the same surgeon were reviewed during 06/89 and 12/93.

RESULTS
There were no significant differences between groups in the age, gender, current smoking history, remote smoking history, prior history of myocardial infarction, preoperative hypertension, COPD, diabetes, angina, congestive failure, peripheral vascular disease, incidence of ulcerative plaque or number of extracranial vessels involved. There were no significant differences between groups in the preoperative use of bronchodilators, ECASA, beta blockers, calcium channel blockers, ACE inhibitors, nitrates, diuretics, or digoxin. There were no significant differences intraoperatively between groups in the use of beta blockers or the incidence of tachycardia or hypertension requiring treatment. There were no significant postoperative differences between groups in the number of critical care days, days in hospital, incidence of tachycardia or hypotension requiring treatment, or use of phenylephrine postoperatively.

	Regional	General
Intraop Hypotension requiring Rx (p<0.001)	13% (4/29 pts)	76% (22/29 pts)
Intraop Bradycardia requiring Rx (p<0.03)	3% (1/29 pts)	37% (11/29 pts)
Intraop Phenylephrine use (p<0.006)	17% (5/29 pts)	52% (15/29 pts)
Shunt use (p<0.05)	3% (1/29 pts)	48% (14/29 pts)
Postop Bradycardia requiring Rx (p<0.03)	3% (1/29 pts)	24% (7/29 pts)
Postop Depressed LOC requiring M.D.	0	38% (11/29 pts)
Postop Narcan used	0	17% (5/29 pts)

No patient who received RA required conversion to a GA or intubation in the perioperative period. There was one death in each group secondary to severe postoperative cerebrovascular accidents. Four patients in the GA group required postoperative ventilation, and two GA patients required re-intubation in the immediate postoperative period. One GA patient required re-intubation and brief chest compressions for a respiratory arrest in the recovery room. This patient subsequently demonstrated a mild but persistent neurologic deficit felt to be secondary to an anoxic insult.

DISCUSSION
Patients having GA for CEA compared to RA (in this review) were found to have a significant increase in the use of shunt placement, perioperative need for intervention due to abnormal hemodynamic parameters, and significantly more respiratory and neurologic events requiring intervention in the immediate postoperative period.

INTRALIPID ALTERS LD50 OF STAPHYLOCOCCUS AUREUS

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INTRODUCTION
Only 6 months after propofol gained U.S. Federal Drug Administration approval, the U.S. Centers for Disease Control connected the drug with increased staphylococcal and fungal infections in otherwise healthy patients.[1] Since it is insoluble in water, propofol is administered in a 10% emulsion of intralipid as a vehicle. Many critical care studies demonstrate that intralipid parenteral nutrition is also associated with an increased incidence of staphylococcal and fungal infections. Propofol or intralipid may serve as a growth medium that, when contaminated, results in overwhelming numbers of microorganisms and subsequent infections. New, unpublished data from our laboratory, however, show propofol and intralipid to be poor growth media for *Staphylococcus*, especially at room temperature or cooler. Thus, a mechanism other than simple bacterial multiplication may be responsible for the increased incidence and severity of infection.

METHODS
The LD50s for *Staphylococcus aureus* in intralipid and in saline were determined in 2.0-kg NZWM rabbits inoculated intravenously with 1 ml of intralipid or saline containing 1 x 10^6, 1 x 10^7, or 1 x 10^8 CFU of *S. aureus* (n = 3 each). Animals were then returned to their cages and given free access to food and water and were observed every 12 hours. Survival curves were established for each of the 6 groups.

RESULTS
With *S. aureus* in intralipid, animals became ill sooner and died earlier than with saline. The LD50 for *S. aureus* in intralipid was shifted to the left.

DISCUSSION
Animals in the saline and intralipid groups received equal numbers of organisms, therefore, replication of bacteria in intralipid cannot explain the increased incidence and severity of infections. Our results are inconsistent with those suggesting that trace contamination of propofol produces enough bacterial replication to result in the growth of overwhelming numbers of organisms. Intralipid may potentiate the virility of the organism, and bacterial growth may not be the mechanism increasing the incidence and severity of staphylococcal and fungal infections.

REFERENCES
1. MMWR 39:426-27, 433, 1990.

HIGHER DEATH RATES IN MEDICAL COMPARED TO SURGICAL ICU PATIENTS WITH IDENTICAL APACHE II SCORES

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APACHE II (**AP2**) scores has been used extensively to measure severity of illness in ICU patients. When comparing different ICU populations, groups of patients with comparable AP2 scores are assumed to have the same risks of death. Yet, the patients' risks of death are heavily influenced by their diagnoses. Our hypothesis is that for patients with similar AP2 scores, medical patients have a higher Hospital Death Rate (**HDR**) than surgical patients.

METHODS

After institutional approval, data was collected prospectively from consecutive admissions to two tertiary hospital medical-surgical ICUs from June 91 to June 93. Data collected included demographics, admission category: Medical (**MED**), Emergency Surgical (**EMS**), Elective Surgical (**ELS**); AP2 score and survival at hospital discharge. The Predicted Risk of Death (**PROD**) for each patient was calculated from the AP2 equation using the patients' AP2 score, diagnoses and surgical status.

RESULTS

There was a total of 1724 patients. The HDR was higher in MED than surgical patients ($p<0.01$). Among surgical patients, HDR was higher in EMS than ELS patients ($p=0.03$). To control for severity of illness, patients were stratified by 10 point AP2 ranges. For AP2 ranges 0-9 and 10-19, MED patients still had a significantly higher HDR than surgical patients. For AP2 ranges above 20, there were no significant differences in HDR between MED and surgical patients. The PRODs correlated closely with the observed HDRs for MED, EMS and ELS groups.

	MEDICAL	SURGICAL		
		TOTAL	EMS	ELS
n	856	868	255	613
AP2	19.3	13.8	14.5	13.5
HDR	34.2 *	15.4	20.0 ■	13.7
PROD	31.3	18.1	24.3	15.6

* $p < 0.01$ (MEDICAL vs SURGICAL TOTAL)
■ $p = 0.03$ (EMS vs ELS)

DISCUSSION

Medical patients have a higher overall HDR than surgical patients. After stratifying for severity of illness by comparable AP2 ranges, medical patients still have a higher HDR compared to surgical patients. The PRODs correlate closely with the observed HDRs for medical and surgical patients.

To compare mortality risks of ICU patients from different populations, the patients' PRODs which take into account the diagnoses should be used in place of AP2 scores alone.

A

AIRWAY OBSTRUCTION POST CAROTID ENDARTERECTOMY

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Introduction: In patients with symptomatic high grade carotid stenosis (70-99%), carotid endarterectomy (CEA) has been shown to decrease the incidence of strokes and death compared to medically managed patients.[1] Upper airway obstruction (UAO) following carotid endarterectomy is an infrequent but life threatening complication.[2] It is unknown whether the obstruction primarily involves the supraglottic area, larynx, or trachea. Suggested etiologies include hematoma formation and soft tissue edema. This study was designed to document prospectively the etiology and site of UAO in CEA patients.

Methods: Following institutional approval and informed consent, patients undergoing elective CEA were studied. A neck CT scan was performed pre-operatively and repeated the day following CEA. Transverse and anterior-posterior airway diameters were measured at the hyoid, arytenoid and cricoid levels. The upper airway was examined by direct laryngoscopy at induction and by fiberoptic laryngoscopy 4 hour postoperatively. Chi-squared and the unpaired t-test were used to analyze categorical and continuous data respectively.

Results: Eleven patients ages 58 to 82 years (male/female,8/3) were studied. Patient demographics and surgical duration was similar in both groups. Four patients(36%) were intubated (INT) within 16 hours postoperatively for clinical UAO and respiratory distress. Two patients showed moderate to severe upper airway edema at the time of intubation. All 4 INT patients had severe bilateral neck edema, pharyngeal edema and unilateral neck hematomas >10 mm^3 on the postoperative CT scan vs 1/7 in the nonintubated (NONINT) group ($P<0.05$). These patients also demonstrated mean tracheal deviation of 11.8 mm away from the midline compared to 4.9 mm in the NONINT group ($P<0.05$). The airway diameter of the INT group was significantly reduced in size at the cricoid level (table). There was also a trend towards smaller airway diameter at the hyoid and arytenoid levels.

Table: **Airway diameter reduction postop vs preop**

	Intubated	non Intubated
Hyoid-trans	62.7 %	35.6 %
Hyoid-AP	41.7 %	21.2 %
Arytenoid-trans	10.3 %	25.3 %
Arytenoid-AP	44.2 %	19.0 %
Cricoid-trans	37.1 %*	12.5 %
Cricoid-AP	29.6 %*	1.6 %

* ($P<0.05$) compared to non intubated group

Discussion: This data shows that all CEA patients have some degree of reduction of airway diameter. Those who require reintubation postoperatively have significant bilateral pharyngeal and neck edema in the presence of wound hematomas causing tracheal deviation. The INT patients all had surgical drains in place and none received reversal for heparin. Emergency airway management is complicated by the reduced laryngeal lumen both for translaryngeal intubation as well as for cricothyroidotomy. These UAO complications may be prevented by use of protamine, larger surgical drains, prophylactic steroids to prevent swelling or changes in surgical technique.

Reference:
(1) NEJM 1991; 325: 445 (2) Am J Surg 1984; 48: 844

B

PREOPERATIVE MULTI-MODEL ANALGESIA REDUCES POSTOP PAIN IN OUTPATIENT LAPAROSCOPIC CHOLECYSTECTOMY – A RANDOMIZED DOUBLE BLIND PLACEBO-CONTROLLED STUDY

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Laparoscopic technique has shortened recovery in cholecystectomy but pain and nausea remain. Since surgical incision may induce CNS sensitization that enhances postop pain,[1] we hypothesized that preop multi-model nociceptive blockade with bupivacaine, ketorolac and pethidine would quicken recovery and facilitate same day discharge.

METHODS After institutional approval, 49 pts were randomized to either Rx group (Gp T) or control group (Gp C) in a prospective double-blind design. Gp T (n=24) received demerol 0.6 mg/kg + ketorolac 0.5 mg/kg IM, 45 m preop, & 2 mg/kg 0.5% bupivacaine 10 m pre-incisional local infiltration in the 4 punctures. Gp C (n=25) received placebo injections & infiltration. Anaesthesia was induced with propofol, N_2O/O_2, atracurium, droperidol, and fentanyl 1.5 ug/kg. Supplemental fentanyl 25 ug was given when BP & HR > 20% preop.In PACU, demerol 10-20 mg iv was given every ten minutes per request & in DBU, ketorolac 10 mg po for pain & IM as required. A visual analogue score (VAS) assessed pain, nausea, anxiety & verbal score for pain and sedation preop preinduction at 0, 1/2, 1, 2, 3, 4 h postop at discharge, and 10, 24, 48 h.postop follow up. Patients were discharged by PADS.[2] Data analysis was repeated measures of variance, t-test & Wilcoxon rank sum test where appropriate.

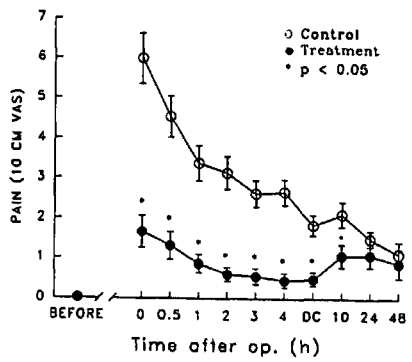
RESULTS Demographic data and baseline assessments were similar. Gp C required more fentanyl than Gp T ($P<0.05$). Pain was 6 fold higher in Gp C on arrival to PACU. In Gp T & Gp C 28% vs 91% of pts required demerol respectively. Gp C had more pain by VAS and VSP at all times postop (Fig. 1) except 24 & 48 h. Demerol & Ketorolac requirements were higher in Gp C .

CONCLUSION Premedication with preop multi-model long-acting analgesia reduces the need for narcotic post-op and its effect exists beyond the duration of the drugs.

Reference 1) Pain 33:289-90, 1988 2) Anest/gy 75:A1105, 1991

	Control (n=24)	Treatment (n=21)
Pts requiring Demerol	22 (91.7%)*	6 (28.6%)
Demerol dose (mg)	32.5 ± 3.6*	5.2 ± 2.0
Pts requiring Ketorol DBU	18 (75%)*	5 (23.8%)
DBU Ketorolac (mg)	17.9 ± 3.7*	2.5 ± 1
Total Ketorolac 48 h (mg)	65.0 ± 8.9*	37.8 ± 6.3
Time to first analgesic (min)	24.2 ± 9.1*	187.0 ± 37.9
Time to solid food (min)	543.8 ± 52*	373.0 ± 29
Functional activity (48 h)	46.2 ± 5*	60.2 ± 4

Values are mean ± SE. * $p < 0.05$



A

CAN ANAESTHETISTS CHANGE THEIR PRACTICE TO REDUCE POSTOPERATIVE PAIN?

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INTRODUCTION: Two interventions-enhanced education and individualized feedback-were evaluated at two hospitals (A and B) to determine if anaesthetists' practice patterns changed (increased use of methods to relieve pain) and patient outcome improved (decreased rate of excessive pain-EP).[1]

METHODS: After Ethics approval, anaesthetists at Hospital A received enhanced education and personalized feedback and Hospital B served as control (usual practice). Following a 6 month baseline period, enhanced education included seminars, literature reviews, handouts, and summaries which promoted the use of 4 methods; PCA, nonsteroidals, regional blocks and epidural opioids. For the final 6 months each anaesthetist at Hospital A received personalized confidential forms detailing the use of his/her methods and the rate of EP. During 3 six-month periods (baseline, education, and feedback) consecutive high-risk patients at both hospitals (inpatients for gynaecological, joint and abdominal procedures) were studied. EP was recorded in the PACU if nursing care was dominated by pain control or if the patient was moaning or writhing with pain, and in the 6 hour period after PACU discharge by a pain score ≥8 out of 10. Only data on EP was collected at Hospital B. The rates and use of the 4 methods during the different time periods were determined (chi square $p<0.05$) as well as the rate of EP adjusted for case mix differences using multiple logistic regression ($p<0.05$).

RESULTS: There were 1606 patients at Hospital A, and 1451 patients at Hospital B. PCA use at both hospitals was significantly increased over the three time periods ($p<.05$). For Hospital A the rate of PCA use during baseline was 0%, education 2.1%, and feedback 25.7%; and at Hospital B 4.5%, 9.7%, and 13.2%. Hospital A showed an increased use of nonsteroidals, 0.0% for baseline, 7.1% for education, and 13.8% for feedback ($p<.05$); at Hospital B this rate was unchanged, 0.3%, 1.6%, and 0.75%. Use of nerve blocks and epidural opioids were uncommon at both hospitals and did not change throughout the study. During the feedback period 38.8% of patients at Hospital A received at least one of the 4 methods compared to 20.3% at Hospital B ($p<0.01$). The rate of EP at Hospital A declined during each period: 62.3% during baseline, 55.8% after education, and 48.1% after feedback ($p<0.01$). Corresponding rates for Hospital B were 62.9%, 61.2%, and 52.3% ($p<0.01$ only for the final period).

DISCUSSION: Changes in anaesthetists' practice patterns were demonstrated at both hospitals. Although the rate of EP dropped throughout the study at both hospitals, during the latter period this rate was similar at Hospitals A and B (48.1% and 52.3%). We conclude that enhanced education and personal feedback were successful in increasing the use of methods for pain relief at Hospital A. However, the still limited overall rate of use of these treatments may explain why we were unable to show a difference in the rate of excessive postoperative pain between Hospitals A and B.

REFERENCE: N Engl J Med 1993;329:1271-74.

B

RECOVERY TIME FOLLOWING SHORT TERM SEDATION WITH PROPOFOL AFTER CARDIAC SURGERY.

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Introduction: Prolonged postoperative sedation and ventilation after cardiac surgery are the result of high dose narcotic anaesthetic technique and the use of long acting sedating agents in the postoperative period. New studies indicate that faster postoperative recovery from anaesthetic and earlier extubation follows when reduced intraoperative doses of fentanyl and midazolam are given with intra and postoperative use of propofol for sedation. In this study we aimed to evaluate the recovery time after postoperative sedation with propofol in patients anaesthetized with moderate dose narcotic technique..

Methods: We studied 59 consenting patients undergoing coronary artery bypass graft surgery (CABG). All patients had normal ventricular function. Patients were premedicated with IM morphine 0.15 mg/kg, perphenazine 2.5-5 mg and lorazepam 2 mg sublingually. Anaesthesia was induced with fentanyl 40 mcg/kg, pancuronium 0.15 mg/kg and midazolam 0.1 mg/kg. Ventilation was maintained with 100% oxygen and halothane or isoflurane. Routine pump and surgical technique were employed. Propofol infusion at rates of 12.5, 25.0,or 50.0 mcg/kg/min was started within 60 minutes of the patients transfer to the ICU and continued for 6 hours. Patients received Indomethacin 100 mg rectally 1 hour before sedation was discontinued. Sedation was stopped and patients were extubated when awake, responsive to command, a Vc >10 ml/kg and NIF >20 cmH2O. We collected demographic data, time to extubation and arterial blood gases after extubation.

Results: Nine patients (15%) were not extubated within 240 minutes from the time sedation was stopped and so were not included in analysis. Data is presented as mean±SD.

No.	age years	sedation minutes	extubation min.
50	56±7.7	354±70	56±46*

*min+max (10÷225)

Arterial blood gases measured after extubation:

Time	FiO_2	pH	pCO_2	pO_2
30 min	0.5±0.06	7.4±0.06	42±6	135±38
90 min	0.5±0.08	7.4±0.04	42±5	131±37

No patient required reintubation for respiratory failure. Four patients required naloxone infusion for a respiratory rate less than 10 breaths per minute and hypercapnia.

Multivariant analysis of all patients (n=59) indicated that age (p=0.02) and dose of the propofol infusion (p=0.001) are predictors for time to extubation.

Conclusions: Most of the patients anaesthetized with the above regime and sedated with a propofol infusion postoperatively can be extubated safety, within a short time following discontinuation of propofol sedation.

Supported by: ZENECA-PHARMA CANADA.

A

TITLE: A DOSE-RESPONSE STUDY OF THE HEMODYNAMIC EFFECTS OF DOXACURIUM CHLORIDE IN THE PITHED RAT.

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INTRODUCTION: Doxacurium chloride (DX) is recommended in patients with cardiovascular disease because of its hemodynamic stability.[1,2] However, there are reports of significant and rapid declines in blood pressure.[3] We investigated the dose response of DX on hemodynamics in the pithed rat. This model permits the study of the direct effects of DX on the cardiovascular system in the absence of central nervous system compensatory reflex mechanisms.

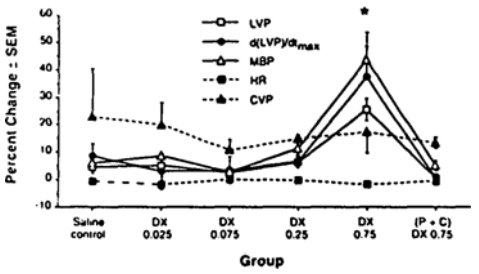
METHODS: After institutional animal care committee approval, 25 male Wistar rats were anesthestized with halothane in O_2. The carotid artery, left ventricle, and both internal jugular veins were cannulated. The rats were then pithed down to the sacral vertebrae. Mechanical ventilation was initiated via a tracheostomy tube. Bilateral vagotomy was performed at the cervical level. Mean blood pressure (MBP), left ventricular systolic pressure (LVP), $d/(LVP)dt_{max}$, heart rate (HR), and central venous pressure (CVP) were recorded. Rats in experiment 1 (n=4 per group) were randomly assigned to receive either normal saline or DX 0.025, 0.075, 0.25, 0.75 mg/kg. Rats in experiment 2 (n=5) were treated with promethazine (2.5 mg/kg), an H_1 antagonist, and cimetidine (30 mg/kg), an H_2 antagonist, prior to receiving DX 0.75 mg/kg ((P+C) DX 0.75). Body temperature and blood gases were maintained within normal limits. Data were analyzed by one-way independent samples ANOVA followed by Scheffe's procedure for post-hoc testing. $P < 0.05$ was considered statistically significant.

RESULTS: DX 0.75 resulted in a significant increase in LVP, MBP, and $d/(LVP)dt_{max}$ when compared with all other groups, including the group pre-treated with H_1 and H_2 antagonists. No significant changes were observed in HR or CVP (Figure).

DISCUSSION: DX is hemodynamically stable at ED_{95}, 3 x ED_{95}, and 10 x ED_{95}. At 30 ED_{95}, DX exerts a significant pressor effect in the pithed rat. The lack of changes in HR or CVP suggests the effect may be due to increased systemic vascular resistance apparently mediated through histamine receptors.

REFERENCES:

1. Stoops CM et al. Anesthesiology 69: 365-370, 1988
2. Emmott RS et al. Br. J. Anaesth. 65: 480-486, 1990
3. Reich DL. Anesthesiology 71: 783-785, 1989



Supported in part by Burroughs Wellcome Inc.

B

COMPARISON OF THE EFFECT OF 3 DIFFERENT DOSES OF TRANEXAMIC ACID ON POSTOPERATIVE BLEEDING IN CARDIAC SURGERY PERFORMED WITHOUT ACTIVE SYSTEMIC COOLING.

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Introduction: Patients undergoing cardiac surgery with cardiopulmonary bypass (CPB) are at risk of postoperative bleeding, which contributes to morbidity, mortality and re-operation (3-5%). Platelet dysfunction induced by fibrinolysis is thought to be responsible. We have been using the synthetic antifibrinolytic agent - tranexamic acid (TA) in a dose of 10 grams given as an intravenous infusion in the pre CPB to prevent fibrinolysis and postoperative bleeding. TA (10 grams) when compared to placebo reduces 6 hour blood loss by 50% and 24 hour blood loss by 35% in patients cooled systemically (mean temp.29.2°C) during CPB[1]. Recently we stopped actively cooling patients during CPB which may change the requirements for TA. In this study we aim to define the optimal dose of TA to be given before warm CPB to control postoperative blood loss.

Methods: We collected, in a double blinded, prospective, randomized fashion, data on 150 patients undergoing first time aorto-coronary bypass and valvular surgery. Fifty patients received 50 mg / kg of TA over 20 minutes prior to CPB, 50 received 100 mg / kg of TA and 50 received 150 mg/kg of TA prior to CPB. Routine surgery was performed with use of heparin and CPB (body temperature was permitted to drift to 32°C). Mediastinal and pleural drains were employed to collect blood which was autotransfused up to 6 hours post operatively. We collected and analyzed; blood loss over 6 and 24 hours and blood products transfused.

Results: Demographic data apart from preoperative hemoglobin level did not differ. Mean lowest temperature during CPB was 32.2°C±0.2. No patient in the study was reoperated on for bleeding. Five patients in group I required additional doses of antifibrinolytics vs. 2 in group II and III. Results are presented as mean±SEM, confidence intervals 0.95 are in brackets.

Group	Blood loss ml over 6 hours	Total Hb. loss grams	No. Patients transfused.
50 mg/kg	218 (184+256)*	20 (15+26)	7
100 mg/kg	161 (136+191)	15 (11+20)	4
150 mg/kg	158 (134+187)	12 (8+16)*	11
p value	*p=0.03	*p=0.04	NS

Conclusions: Results from this study indicate that 100 mg/kg of tranexamic acid is the optimal dose in preventing postoperative blood loss in patients undergoing primary CPB without systemic cooling. Total hemoglobin loss (as calculated by all chest tube losses multiplied by hematocrit x 3) is lowest in the group 150 mg/kg (p=0.04). However when autotransfused blood volume is removed from the calculation of hemoglobin loss, there is no statistical difference in hemoglobin loss between the three TA groups. Therefore autotransfusion prevents increased hemoglobin loss in TA 50 mg/kg group.

Preoperative hemoglobin level is the strongest predictor for the need of blood transfusion as calculated by univariant and multivariant analysis.

Reference: 1. Karski, J.M., Teasdale, S.J., Norman, P.H., et al. J Cardioth Vasc Anesth, 1993, 7:431-435.

Support: Heart & Stroke Foundation of Ontario and Pharmacia Inc.

SAFETY OF INDOMETHACIN IN THE EARLY POSTOPERATIVE PERIOD FOLLOWING AORTO-CORONARY BYPASS SURGERY

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Introduction. The administration of non-steroidal anti-inflammatory drugs (NSAIDs) following major thoracic surgery has been shown to cause a significant reduction in pain and to decrease cumulative opioid requirements.[1] Due to the potential risks of inducing impaired hemostasis and renal insufficiency, NSAIDs have not been used post coronary artery bypass graft (CABG) surgery. This is the first study to assess the safety of NSAIDs usage in this group of patients. Blood loss and renal function were monitored before and after postoperative rectal administration of indomethacin 100 mg.

Methods. Fifty seven consenting patients undergoing elective CABG surgery were included in a prospective study. These patients were age 40-70 years, with normal left ventricular function and normal renal function. Standard anaesthesia and surgery were performed. All patients received tranexamic acid 10g prior to cardio-pulmonary bypass. On transfer to the intensive care unit (ICU) after surgery, patients were sedated with a propofol infusion. Indomethacin suppository 100 mg was administered 6 hours after surgery and sedation was discontinued. Hourly blood loss from chest and mediastinal drains was recorded for 6 hours prior to, and for 2 periods of 6 hours following indomethacin. Serum creatinine was assayed preoperatively, 12 hours post indomethacin and on days 4 and 6 postoperatively. Results were analyzed using paired t test.

Results. Data are presented as mean ± SD. The mean age was 56±7 years. The mean time to indomethacin administration from admission to ICU was 5.6±0.7 hours. Furosemide dosage during the study period was 58±32 mg.

Blood loss in ml before and after indomethacin.

6 hours blood loss pre indomethacin	6 hour blood loss post indomethacin	Blood loss hours 12-18 post-op.	p
*157±80	*167±101	136±88	*NS

Creatinine (µmols/l) before and after indomethacin.(*,**p=0.6)

Creatinine pre-op.	Creatinine 12 hrs post-op	Creatinine 4 days post-op	Creatinine 6 days post-op
*112±14	103±18	*111±17	**111±16

Following indomethacin, there was no alteration in renal function or increase of blood loss in the subsequent 12 hours.

Conclusion. This study demonstrates the safe use of indomethacin in a single dose following CABG surgery in patients less than 70 years, with normal renal function and without excessive postoperative blood loss. Further studies are needed to evaluate NSAIDs in these patients as their use may facilitate earlier extubation by reducing opioid requirements.

References. 1. Pavy T, Medley C, Murphy DF.. British Journal of Anaesthesia 1990;65: 624-627.

CRITICAL CARDIORESPIRATORY EVENTS LEADING TO CARDIOPULMONARY BYPASS (CPB) DURING SEQUENTIAL SINGLE LUNG TRANSPLANT (SSLT) SURGERY

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INTRODUCTION: Early detection and management of critical intraop events may prevent the need for CPB in SSLT surgery. This prospective study was undertaken to compare the critical cardiorespiratory events in SSLT patients who required CPB with those who did not require CPB.
METHODS: Following Institutional approval, 8 patients who underwent SSLT were studied. Invasive monitors used were pulmonary artery (PA) catheter, continuous intra-arterial blood gas monitor (PB 3300) and an arterial blood pressure line in radial arteries. Anaesthetic induction was carried out using fentanyl (10-20 µg/kg)/ midazolam (1-3 mg)/ propofol (1-3 mg/kg)/ pancuronium (0.1 mg/kg) and was maintained on fentanyl/ midazolam/ pancuronium/ inhalational agents/ 100% oxygen.
RESULTS: The age, FEV_1, % lung perfusion, right ventricular ejection fraction, systolic pulmonary artery pressure (SPAP), systolic blood pressure (SBP) were not significantly different between CPB (n=4) and non-CPB group (n=4). Table 1 defines the indications for CPB.

Pt	Events and Indications for CPB
1	1st PA clamp: SPAP=73, SBP < 80 mmHg
2	Prior to 1-lung vent: pH=7.03, PCO_2= 100, PO_2= 73, SPAP= 64, SBP=65
3	Elective VSD, ASD repair before SSLT
4	Pul. edema (SPAP=59) in 1st transplant lung due to bleeding prior to 2nd PA clamp

Table 2: Critical intraop events in non-CPB group(mean ± SD)

Events	pH	pCO_2 (mmHg)	pO_2 (mmHg)	SPAP (mmHg)	SBP (mmHg)	K^+ (mmol/L)
Baseline	7.3± 0.1	58± 17	381 ± 131	37 ± 5	115 ± 6	4.3 ± 1.1
1st One-Lung Vent.	7.3± 0.2	58 ± 28	516 ± 114	39 ± 5.0	103± 5	4.8± 0.9
1st PA clamp	7.4± 0.1	45 ± 9	301 ± 216	-	85 ± 7	3.5 ± 0.0
1st Lung Reperfusion	7.3± 0.2	55 ± 30	418 ± 114	52 ± 10	90 ± 20	5.0 ± 0.5
2nd PA Clamp	7.3± 0.1	61 ± 34	382 ± 229	31 ± 22	83 ± 20	5.0 ± 1.4
2nd Lung Reperfusion	7.3± 0.1	49 ± 24	359 ± 180	45 ± 12	65 ± 17	4.5 ± 0.6

Transient ECG ST elevation > 2 mm occurred in two non-CPB patients without evidence of postoperative myocardial infarction. There was no significant difference in arterial blood gases, SPAP, SBP, K^+ at the time of reperfusion of the 2nd lung in the non-CPB group compared to the separation from CPB in the CPB group. Cold ischemic time (min) was significantly (*P<0.005) prolonged in both the 1st (256± 59*vs 82±41) and 2nd transplanted lung (338±52* vs 147± 61) in CPB group when compared to non-CPB group.
DISCUSSION: In SSLT surgery, the indication for CPB cannot be predicted by the above preoperative parameters, but is precipitated by intraoperative pulmonary hypertension, respiratory acidosis and systemic hypotension. Although, cold ischemic time is significantly longer in the CPB group, it appeared not to be an indicator for CPB. In non-CPB group, hypotension post transplanted lung reperfusion is unrelated to K^+ level.

STERNAL ACCELERATION BALLISTOCARDIOGRAPHY AND ARTERIAL PRESSURE WAVE ANALYSIS TO DETERMINE STROKE VOLUME

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INTRODUCTION

Ballistocardiography[1], the study of the body's motions imparted by the heartbeat and circulation, was eventually abandoned as a diagnostic device because of it was difficult to use. A practical new method to derive cardiac output (CO) has been developed using a 54 gram accelerometer taped on the chest[2]: the sternal acceleration ballistocardiograph (SAB). It is combined with information from the radial arterial pressure wave and demographic information in a probabilistic formula.

METHODS

30 intensive care unit patients (143 recordings) who had pulmonary artery thermodilution catheters and radial artery catheters in place provided the data to derive the formula. A further 8 subjects (20 recordings) formed the test group. One minute SAB and arterial line recordings were made at the time of thermodilution CO determinations for clinical indications. Measurements of time and amplitude coordinates of the acceleration wave peaks and radial artery pressure waves as well as subjects' weight were entered into a multiple regression programme with thermodilution stroke volume (SV) as the dependent variable to derive the formula.

RESULTS

A regression equation was generated which showed highly significant correlation with SV derived from thermodilution (R^2 = 0.85). This was used to derive the test-group SV, where the method of Bland and Altman[3] shows a clinically acceptable comparison with thermodilution.

DISCUSSION

The SAB combined with arterial line shows promise of providing a less invasive measure of CO than thermodilution.

REFERENCES

1 Starr I et al. Am J Physiol 1939; 127:1
2 Gregson PH, McKay WPS. Proc 17th Can Med and Biol Engineering Conf 1991; 17:77.
3 Bland JM, Altman DG. The Lancet 1986; Feb 8: 307 - 310.

NITROUS OXIDE HAS NO ELECTROPHYSIOLOGICAL EFFECTS ON THE FUNCTION OF SINUS NODE CONDUCTION, THE NORMAL ATRIOVENTRICULAR SYSTEM OR THE ACCESSORY PATHWAYS IN PATIENTS WITH WOLFF-PARKINSON-WHITE SYNDROME

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Introduction:
Patients with Wolff-Parkinson-White Syndrome (WPW) undergoing accessory pathway (AP) ablation via transcatheter may require general anaesthesia. However, any depression of AP refractoriness by anaesthetic agents[1,2] could compromise mapping and ablation. The purpose of this study was to investigate the effects of nitrous oxide on the electrophysiological (EP) properties of the sinus node (SN), normal atrioventricular (AV) conduction system and accessory pathways (AP) in WPW patients undergoing transcatheter ablation.

Methods:
With Ethics Committee approval 5 WPW patients (3 men and 2 women) aged 18-34 were investigated. During alfentanil, midazolam, vecuronium general anaesthesia, which has been previously shown to have no EP effects in humans[3], a baseline EP study was done as follows: 1) Right atrial effective refractory periods (RAERP), atrioventricular effective refractory period (AVERP) and AP effective refractory period (APERP) at cycle length 400-500msec with coupling intervals in steps of 20msec from 300-400msec, and 10msec below 300msec; 2) Right ventricular effective refractory period (RVERP); 3) Shortest cycle length (SCL) with 1:1 conduction for accessory pathway (SCL-AP) conduction; 4) Sinus node recovery time (SNRT) and corrected (CSNRT) were calculated to assess SN function. Then, nitrous oxide (60%) with oxygen was administered for 10 minutes and the EP study repeated. Paired Student's t-tests compared EP studies prior to and during nitrous oxide administration. $P<0.05$ was considered significant. Values are Mean ± SD.

Results:
See table:

SINUS NODE FUNCTION (msec)

	CONTROL	NITROUS OXIDE	P VALUE
SNRT	1486±124	1682±166	.54
CSNRT	494±22	536±34	.14

ANTEGRADE CONDUCTION (msec)

	CONTROL	NITROUS OXIDE	P VALUE
RAERP	226±14	212±18	.12
AVERP	278±24	286±20	.09
APERP	288±12	296±14	.42
SCL-AP	242±64	314±94	.26

RETROGRADE CONDUCTION (msec)

	CONTROL	NITROUS OXIDE	P VALUE
RVERP	222±26	248±14	1.0
APERP	286±32	272±54	.62
SCL-AP	290±26	322±18	.34

Discussion:
Nitrous oxide does not have significant electrophysiological effects on sinus node function, normal AV and accessory pathways conduction.

References:
1. MD Sharpe, WB Dobkowski, Anesthesia & Analgesia, 1990:70:S365
2. WB Dobkowski, MD Sharpe, Anesthesia & Analgesia, 1990:70:S86
3. MD Sharpe, WB Dobkowski, Canadian Journal of Anaesthesia, 1992:39:816-821

Combined General and Epidural Anaesthesia with Post-operative Epidural Analgesia: The Effect on Cardiac Ischemia.

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Introduction: Combined epidural and general anaesthesia with post-operative epidural analgesia has been shown in some studies to reduce the incidence of perl-operative cardiac events.[1] Recently, we have shown that there is a high incidence of ischemic events with this technique. We have also shown that the discontinuation of epidural analgesics 48 hours postop is associated with a significant increase in the incidence of ischemia.[2]

The purpose of this study was to determine whether prolonged analgesia via epimorph or reduced oxygen demand via ß-blockade with metoprolol, or a combination of the two, will prevent ischemia coincident with cessation of the epidural 48 hours postop.

Methods: After obtaining informed consent, a standardized light general anaesthetic technique was carried out using Fentanyl, pancuronium, and low dose isoflurane, with PA catheter controlled hemodynamics. All patients received an intraoperative epidural infusion of 2% CO2 lidocaine/demerol 2 mg/ml, and a post-operative infusion of 0.10% bupivacaine with demerol 2 mg/ml for 48 hours. Ischemia and infarction were detected by continuous Holter monitoring for 96 hours post-op; CK-MBs and 12 lead ECG q12h for 3 days. Each patient was randomized to receive either Epidural morphine 2-3 mg, Metoprolol 50 mg BID for 3 days, or the combination of both, to commence the second post-op day (48 hours post-op), coincident with the removal of the epidural catheter.

Results: 20 patients have been enroled and all were similar demographically. Only one patient in the ß-blocker group had an ischemic event after the epidural catheter was discontinued.

Discussion: Ischemia may occur coincident with the termination of epidural analgesia 48 hours postoperatively. This ischemia may be undetected because patients are transferred to an unmonitored ward setting at this time. This ischemia may be secondary to increased sympathetic tone, increased pain, or increased myocardial oxygen demand secondary to increased heart rate and blood pressure. We have attempted to prevent this ischemia by improving long term analgesia and/or reducing oxygen demand.

References:

1. Anaesthesiology 1987, 66(6); 729-736.
2. Can. J. Anaesthesia 1993, 40(5 suppl); A52

A

BLOOD LOSS IN PATIENTS UNDERGOING REPEAT MEDIAN STERNOTOMY RANDOMIZED TO EITHER HIGH OR LOW DOSE APROTININ, OR TRANEXAMIC ACID

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High dose aprotinin (HDA - 6 m KIU), low dose aprotinin (LDA-2 m KIU), and tranexamic acid (TA) have all been reported to decrease blood loss in cardiac surgical patients,1-4 but no direct comparison of all 3 has been reported. We compared these 3 different strategies in patients undergoing repeat median sternotomy for CABG and/or valve replacement surgery.

Methods: After Institutional Review Board approval and obtaining written patient consent, 39 patients undergoing elective repeat median sternotomy for cardiac surgery were randomized to receive a blinded infusion of saline containing either HDA (2 m KIU load to patient and CPB circuit, and 0.5 m KIU/hr during surgery),[1-3] LDA (2 m KIU to CPB circuit only)[3] or TA (10 gm prior to incision).[4] Intraoperative blood loss (sponge weight plus suction volume), postoperative blood loss (chest tube drainage), and transfusion requirements, as well as complications were recorded and compared between patients. For statistical comparisons, either Chi-square analysis or ANOVA with S-N-K, were used and $p < 0.05$ was required for significance.

Results: There were no statistically or clinically significant differences in total, intraoperative, or postoperative blood loss, or in transfusion requirements between HDA or TA. Both transfusion requirements ($p=0.047$) and blood loss ($p=0.013$) were significantly higher in LDA group in comparison to HDA or TA (see Table). The incidence of complications did not differ significantly between any of these groups. **Conclusions:** TA and HDA are equally efficacious in decreasing blood loss and transfusion requirements in patients undergoing repeat median sternotomy, whereas LDA did not prove to be beneficial. **References:** 1)Royston D, J Cardiothorac Vasc Anesth 6:76-100;1992. 2)Murkin JM, et al. Can J Anaes 1991. 3)van Oeveren W, et al. J Thorac Cardiovasc Surg 99:788-97;1990. 4)Karski JM, et al. Can J Anaesth 40:A47;1993.

	Blood Loss Total (ml)	PRBC Total (units)
HDA (n=10)	1404±833	3.6±2.8
LDA (n=16)	3185±2258*	3.4±3.6**
TA (n=11)	1667±605	1.0±1.8

Results are mean±S.D.; *p=0.013 vs TA, LDA; **p=0.047 vs TA

B

COMPARISON OF SUFENTANIL - PROPOFOL VS SUFENTANIL - MIDAZOLAM ANAESTHESIA FOR ELECTIVE MYOCARDIAL REVASCULARIZATION.

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Recently two new short acting intravenous anesthetic agents, with ideal pharmacokinetic properties for administration by continuous infusion have been suggested for supplementation during anesthesia for cardiac surgery. Therefore, we wished to compare sufentanil-propofol vs sufentanil -midazolam on hemodynamic stability, incidence of intraoperative myocardial ischemia, time to postoperatively awakening and incidence of recall in patients undergoing elective myocardial revascularization.

METHODS: Twenty patients scheduled for elective myocardial revascularization were studied. Cardiac medications were continued until surgery and patients received midazolam for premedication. After insertion of routine monitoring lines and a Holter monitor, anesthesia was induced with sufentanil with pancuronium/vecuronium for muscle relaxation. Five min post induction, patients received either propofol 3mg/kg/hr Gp(P) or midazolam 0.125mg/kg/hr Gp(M). This rate was reduced by 50% after sternotomy. Thereafter the infusion rate was altered to maintain hemodynamics within 20% control values. No volatile agent was given at any time. Full hemodynamic profiles were taken at: pre-induction(0), post-induction(1), and 1 min: post intubation(2), post skin incision(3), post sternotomy(4), at aortic dissection(5) and stable post CPB(6). Total dose of drug infused, infusion time, time to awakening were recorded. Incidence of ischemic episodes was recorded, as was the use of inotropes and, vasodilators. All patients were questioned about recall at 24 hr.

RESULTS: The groups were demographically similar. Mean infusion time was 224.6 $\pm$ 14 min, with total dose of 494.9 $\pm$ 29 mg for infusion rate of 1.8 mg/kg/hr in Gp(P) and 230.7 $\pm$ 11 min and 19.9 $\pm$ 1 mg for infusion rate of 0.07 mg/kg/hr in Gp(M). Four patients in each group needed a maximum of two adjustments. Time to awakening was significantly faster in Gp(P) compared to Gp(M)(30.2 $\pm$ 7 vs 127.3 $\pm$ 37 min respectively). Both methods produced well controlled hemodynamics (Fig). There was no difference between groups in use of inotropes or vasodilators to wean from CPB. One patient in Gp(P) developed preinduction ST depression associated with tachycardia. This resolved at induction. No other patient developed prebypass ischemia. Four patients (Gp(P) 2, Gp(M) 2,) developed transient postbypass ischemia, only detected by the Holter monitor. No patient had recall of events during surgery.

DISCUSSION: Both methods produced similar, easily controlled supplementation to sufentanil anesthesia for cardiac surgery, without recall. The rapid awakening associated with the sufentanil-propofol regimen may have some advantage when early extubation is anticipated.

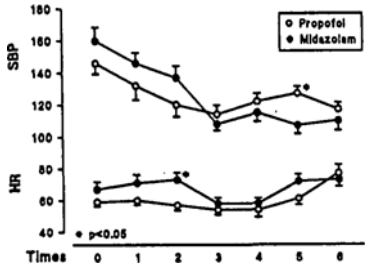

Figure 1: Mean SBP and HR during infusion

A

FATAL MYOCARDIAL INFARCTION IN THE POST-OPERATIVE PERIOD DIFFERS FROM FATAL MYOCARDIAL INFARCTION ELSEWHERE

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Introduction: Postoperative myocardial infarction is a leading cause of death after non-cardiac surgery but its specific nature has not been well defined. The purpose was to compare clinical and EKG characteristics of fatal postoperative myocardial infarction (PAMI) to those of fatal myocardial infarction in nonsurgical settings (AMI).

Methods: We identified all cases of fatal and autopsy proven PAMI that appeared within 7 days of otherwise uncomplicated non-cardiac surgery during the past decade at this institution. Each case was matched for age and gender to two cases of fatal AMI. From a review of records, we determined for each case (1) identifiable risk factors for ischaemic heart disease (IHD), i.e. $\uparrow$BP, diabetes, smoking and obesity; (2) prior indicators of IHD, i.e. angina, AMI; (3) the Q-wave/non Q-wave EKG characteristics of the MI; and (4) the onset time of MI, assigned to 1 of 4 six hr periods of the 24 hr day on the basis of chest pain and/or time of change in serum enzymes. Proportions were compared using Fisher's exact test.

Results: Ten cases of PAMI were matched to 20 of AMI (M/F ratios 6:4, ages 77 $\pm$ 7 and 75 $\pm$ 6 yrs respectively). Numbers of PAMI on postop days 1, 2, 3, 4, & 5 were 4, 2, 1, 2 & 1 respectively. There was no detectable difference in the frequency of any risk factor between PAMI & AMI groups. PAMI was more commonly associated with a history of prior AMI (8/10 vs 6/20, P=0.019) and less frequently with Q-waves when EKG's could be interpreted (3/10 vs 14/16, P=0.009). AMI's that could be timed (n=18) tended to be more common in the early morning hrs (i.e. 04-10 hrs), as reported previously,[1] whereas PAMI's (n=9) were most frequent in the nighttime (i.e. 22-04 hrs, P$\leq$0.05; see Fig).

Conclusion: Fatal PAMI and AMI differ with respect to history of prior AMI, EKG characteristics and the circadian variation of onset time. Accordingly, the pathology and precipitating mechanisms of each may not be the same. The ultimate triggers of PAMI arise most frequently in the night.

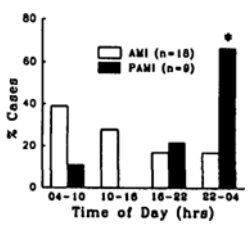

Figure: Onset times of fatal PAMI and AMI. (*proportion different from that of PAMI at 04-10 and 10-16 hrs and from AMI at 16-22 and 22-04 hrs, all P values $\leq$0.05)

1. New Engl J Med 313: 1315, 1985.

B

IS EPINEPHRINE OR NOREPINEPHRINE SUPERIOR TO PLACEBO DURING SEPARATION FROM CARDIOPULMONARY BYPASS?

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INTRODUCTION Successful termination of cardiopulmonary bypass (CPB) often requires the administration of cardiotonic agents to recruit myocardial contractile reserve, improve myocardial performance and maintain coronary perfusion pressure. [1] The study compared the hemodynamic effects of epinephrine, norepinephrine and placebo in cardiac surgery patients during and after separation from CPB.

METHODS Written consent was obtained from 21 patients with LV dysfunction (LVEDP ≥ 20, abnormal left ventriculogram) undergoing elective coronary artery surgery. Anesthetic technique, hemodynamic parameters, conduct of CPB and separation from CPB were standardized. Five min prior to separation from CPB, patients received an infusion of epinephrine, 0.05 ug/kg/min (epi, n=6), norepinephrine, 0.10 ug/kg/min (norepi, n=6), or placebo (D5W, n=9) in a randomized, double-blind fashion. The infusion was maintained for 30 min after cessation of CPB. Parameters were recorded before induction of anesthesia, during CPB, before infusion, 5 min after infusion and 15, 30 and 60 min following CPB. Between group data were analyzed with ANOVA, Tukeys test, and Chi Square. A p value < 0.05 was considered significant.

RESULTS There were no differences in age (mean ± SE: 62± 2 yrs), BSA (1.93±.05 m^2), CPB time (126±8 min), cross clamp time (60±4 min), degree of LV dysfunction, number of distals (3), quality of myocardial protection and quality of grafts between groups. Although hemodynamics were similar between groups (Table 1), controls were more likely to require inotropes 15 min after CPB (8/9 patients) compared with the epi (2/6) and norepi (2/6) groups ($p < 0.05$).

DISCUSSION The results of the study suggest that low doses of epi or norepi may be beneficial during separation from CPB in patients with preoperative LV dysfunction.

REFERENCE 1. J Cardiothor Vasc Anesth 6:528-534, 1992

Table 1. Hemodynamic variables 15 and 60 minutes after CPB

		HR beats/min	MAP mm/Hg	CI l/min/m^2	DO_2 ml/min/m^2	VO_2 ml/min/m^2	ER %
Epi	15 min	95 ± 5	81 ± 4	2.9 ± 0.2	417 ± 54	113 ± 6	29 ± 4
	60 min	94 ± 6	82 ± 4	2.5 ± 0.3	361 ± 55	91 ± 7	27 ± 3
Norepi	15 min	93 ± 5	92 ± 3	2.7 ± 0.2	419 ± 41	101 ± 12	25 ± 4
	60 min	96 ± 7	86 ± 4	2.4 ± 0.2	324 ± 47	90 ± 20	28 ± 3
D5W	15 min	91 ± 2	88 ± 3	2.9 ± 0.2	385 ± 37	87 ± 14	22 ± 3
	60 min	94 ± 12	97 ± 3	3.1 ± 0.3	407 ± 49	74 ± 9	19 ± 2

HR=heart rate, DO_2=O_2 delivery, VO_2=O_2 consumption, ER=extraction ratio (VO_2/DO_2*100)

A

A PROSPECTIVE RANDOMIZED, CONTROLLED CLINICAL TRIAL OF EARLY VERSUS CONVENTIONAL TRACHEAL EXTUBATION FOLLOWING CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY: POST-OPERATIVE MYOCARDIAL ISCHEMIA & INFARCTION.

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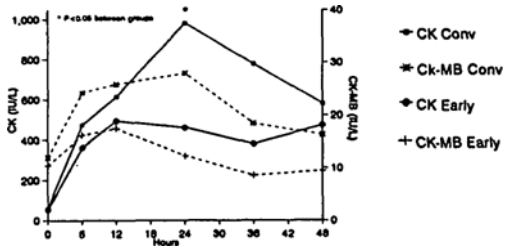
INTRODUCTION: To lower the escalating cost of cardiac surgery, we propose earlier postoperative tracheal extubation and discharge of these patients from the ICU and hospital. However, is early extubation safe for the cardiac surgical population in the 1990s?

METHODS: Following Institutional Ethics Committee approval, 29 elective CABG patients less than 75 yrs old with left ventricular function I-IV were randomized into Early (n=14) or Conventional (Conv) (n=15) extubation group. Premedication was 1-2 mg lorazepam S.L. Early group, patients were induced with 15 µg/kg fentanyl ± thiopentone 50-75 mg and pancuronium 0.15 mg/kg. Anaesthesia was maintained with isoflurane prior to cardiopulmonary bypass (CPB). After initiation of CPB, propofol infusion (2-4 mg/kg/hr) was commenced and continued until 1-4 hrs prior to tracheal extubation in the ICU. In Conv group, patients were induced with 50 µg/kg fentanyl and pancuronium 0.15 mg/kg. Anaesthesia was maintained with isoflurane and midazolam 0.1 mg/kg. Morphine and midazolam were titrated for sedation in the ICU. Tracheal extubation was attempted within 12-20 hrs. A 12 lead ECG continuous ST monitor (Mortara) was attached to all patients for 1 hr of preop baseline and 30 hrs postop monitoring. Serial CK, CK-MB activity and mass were collected at 6, 12, 24, 36 and 48 hrs post aortic cross-clamp release. Myocardial infarction (MI) was defined as CK-MB > 50 IU/L, > 8% total CK or new Q-wave. Data is expressed as mean ± SD and analyzed by ANOVA with repeated measures and t-test.

RESULTS: No significant difference in age, sex, wt., no. of grafts and perioperative variables was found between the two groups (Table I). In addition no significant difference was found between the 2 groups in myocardial ischemia incidence, episodes and duration for 30 hrs postop (Table II). Although no significant difference was found in the postop CK-MB level, CK total was significantly higher in Conv group at 24 hrs postop (Fig I). 2 patients in the Conv group had postop MI related to difficult surgical graft whereas no MI occurred in the Early group.

Table I	Age (yrs)	Wt. (kg)	LV Grade	No. Grafts	CPB time (min)	X-clamp time (min)
Early	58±7	77±13	2.0±1.0	3.7±0.8	77±24	54±19
Conv	58±12	87±16	1.9±0.8	3.5±0.8	92±33	69±26

Table II	Incidence	Episodes	Total Duration
Early	50.0 % (5/10)	6	258 min
Conv	38.5 % (5/13)	7	297 min



DISCUSSION: Our preliminary data suggests that early tracheal extubation in patients following CABG surgery does not increase the risk of postoperative myocardial ischemia or infarction when compared to conventional extubation.

B

A PROSPECTIVE RANDOMIZED, CONTROLLED CLINICAL TRIAL OF EARLY VERSUS CONVENTIONAL TRACHEAL EXTUBATION FOLLOWING CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY: POSTOPERATIVE COMPLICATIONS AND HOSPITAL DISCHARGE

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Department of Anaesthesia, Div. of Cardiovascular Surgery*, University of Toronto, The Toronto Hospital, Toronto, Ont.

INTRODUCTION: To lower the escalating cost of cardiac surgery, we propose earlier postoperative tracheal extubation and discharge of these patients from the ICU and hospital. However, is early extubation safe for the cardiac surgical population in the 1990s?
METHODS: Following Institutional approval, 29 elective CABG patients < 75 yrs old with left ventricular function I-IV were randomized into Early (n=14) or Conventional (Conv) (n=15) extubation groups. Premedication was 1-2 mg lorazepam S.L. Early group patients were induced with 15 µg/kg fentanyl ± thiopentone 50-75 mg and pancuronium 0.15 mg/kg. Anaesthesia was maintained with isoflurane prior to cardiopulmonary bypass (CPB). After initiation of CPB, propofol infusion (2-4 mg/kg/hr) was commenced and continued until 1-4 hrs prior to tracheal extubation in the ICU. In Conv group, patients were induced with 50 µg/kg fentanyl and pancuronium 0.15 mg/kg. Anaesthesia was maintained with isoflurane and midazolam 0.1 mg/kg. Morphine and midazolam were titrated for sedation in the ICU. Tracheal extubation was attempted within 12-20 hrs. Postoperative complications were documented. An ICU and hospital discharge criteria was formulated and the time at which the patients met the ICU and hospital discharge criteria was compared with the actual discharge time.
RESULTS: Demographic data was comparable between the 2 groups. 4 and 3 patients in Early and Conv groups respectively did not meet the extubation criteria. The incidence of postop complications are presented in Table I.

Table I: Complications Treated in ICU

	Early	Conv
Seizure and Stroke	0	2
Low Cardiac Output Syndrome	3	2
Myocardial Infarction	0	2
Arrhythmia	1	1
Re-intubation	0	1
Bleeding	1	1
Low Urine Output	1	1
Shivering	2	4
Mortality	0	1

The time at which the patients met the ICU and hospital discharge criteria and the actual discharge time was significantly shorter in the Early vs Conv group (Table II).

Table II: Postoperative Time (Mean ±SD)

	Early	Conv
Extubation Time (hrs)	3.4±1.0*	18.6±2.1
ICU Discharge Criteria (hrs)	15.3±4.9*	36.9±21
Actual ICU Discharge (hrs)	29.1±12*	49.1±19
Hospital Discharge Criteria (days)	5.3±1.2*	9.1±4.9
Actual Hospital Discharge (days)	6.5±1.6	9.2±4.6

* P<0.05 vs Conv

DISCUSSION: Our preliminary data indicates that early tracheal extubation in patients following CABG surgery decreases ICU time by 21.6 hrs and significantly shortens hospital stay by 3.8 days, when compared to conventional extubation practice.

A LOW FLOW MODIFICATION OF THE BAIN CIRCUIT FOR REMOTE ANAESTHESIA AND EVACUATION

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INTRODUCTION

In developing countries and the remote areas of affluent countries anaesthetic compressed gases, especially N_2O, are scarce and expensive to transport. Practical systems for anaesthesia and evacuation of patients should use O_2 and volatile anaesthetics sparingly and substitute air for N_2O. We have designed a non-rebreathing anaesthetic system which meets these requirements.

METHODS

An Ambu-E non-rebreathing anaesthetic valve and self inflating Ambu bag were connected to a Bain circuit to construct a non-rebreathing system which used ambient air to supplement a mixture of low flow O_2 ($\dot{V}O_2$ of 2 $L.min^{-1}$) and halothane. Compressed O_2 from a cylinder was metered by a rotameter flowmeter through a Fluotec Mark 2 halothane vaporizer to the inner co-axial tube of the circuit. Ventilation of the lungs was manually controlled by squeezing the Ambu bag.

Over 100 patients have been anaesthetized with a balanced anaesthetic technique. Measurements were: F_IO_2 by an Ohio Model 5100 O_2 analyzer, volume of liquid halothane vaporized, $P_{ET}CO_2$ by a NIHON-KHODEN CO_2 Monitor, and finger tip O_2 saturation by a Nelcor model 200 pulse oximeter.

RESULTS

With a $\dot{V}O_2$ of 2 $L.min^{-1}$ and a vaporizer setting of 1.5% the average liquid halothane consumption was 8 $ml.hr^{-1}$. During manual ventilation of the lungs of paralyzed patients average F_IO_2 was 0.34, $P_{ET}CO_2$ was 30 mmHg and the air:O_2 dilution was 5:1.

DISCUSSION

A graphical analysis of inspiratory gas flow[1] predicted that the system was almost 100% efficient, that is almost all of the O_2 and halothane would enter the alveoli. The alveolar F_IO_2 would be 1.0 when $\dot{V}O_2$ was equal to minute alveolar ventilation.

This is a safe, simple and economical system for emergency inhalation anaesthesia. With O_2 alone it is also suitable for transport of critically ill patients who are either breathing spontaneously or require manual assisted ventilation. The alveolar F_IO_2 can be varied from 0.21 to 1.0 by varying the $\dot{V}O_2$. It is efficient because almost all of the O_2 and anaesthetic vapour go to alveolar ventilation.

1. Anaesthesia 1989; 44: 300-2.

PHYSIOLOGIC CHANGE DURING TOURNIQUET USE IN CHILDREN

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INTRODUCTION: The use of a tourniquet in pediatric orthopedic extremity surgery is very common. Advantages of tourniquet use include facilitation of microsurgery by maintaining a bloodless surgical field as well as decreasing blood loss. Venous blood from an extremity made ischemic by tourniquet use shows progressive decrease in pH and paO_2 and an increase in $paCO_2$ and lactate as ischemic time increases. In children, where oxygen consumption and metabolic rate may be 2 to 3 folds higher than an adult, tourniquet homeostasis may result in greater accumulation of ischemic metabolites. When these ischemic products enter the circulation, systemic acidosis may cause sympathomimetic activity and elevation in temperature and pulse rate.

METHODS: After HIRB approval, and written informed consent from all parents, 30 healthy children (ASA 1-2) were selected for the study. Ages ranged from 8 months to 14 years. The patients had surgery for correction of club foot involving the use of tourniquets. Anesthesia was induced and maintained with halothane, N2O and narcotics. No premedication was given and no heating blanket or other warming devices were used. Patients were monitored with continuous ECG, an esophageal stethoscope, temperature probe, oxygen analyzer, BP, pulse oximeter and capnogram. Endtidal CO_2 was kept at 33-37 torr. All children had intravenous fluids given at maintenance rates with replacement of estimated fasting period and insensible loss. Intraoperative hyperthermia, tachycardia, endtidal CO_2 and lactic acid concentrations were measured before and after the inflation of the tourniquet.

RESULT: Maximum changes in temperature and pulse rate occurred in those patient who had tourniquet application time lasting more than 60 minutes. The level of lactate and endtidal CO_2 were also significantly increased in the same group of patients. Results were analyzed by a one way analysis of variance (ANOVA) and data was presented as mean +/- SD. Tourniquet inflation times were correlated with the maximum changes in blood chemistries (lactic acid and endtidal CO2) by linear regression analysis.

DISCUSSION: The duration of tourniquet inflation appears to be the main precipitating factor in the hyperthermia observed in our study group. The use of pneumatic tourniquets in children results in a progressive increase of temperature, endtidal CO2 and lactate level when the tourniquet is inflated for more than one hour. Such changes commence while the tourniquet still inflated. It has been reported, that the vascular bed of bone has alpha-adrenoceptors, muscarinic receptors and prostaglandin H2/thromboxane A2 receptors. Such receptors might be affected, both intra-osseous and extra-osseous, when metabolites progressively accumulate in the extremity while the tourniquet is inflated, leading to alteration in the bone of medullary vessels and thereby affecting intramedullary hemodynamics to " bypass " the tourniquet.

A

A NEW LIGHT-GUIDED INTUBATION TECHNIQUE FOR INEXPERIENCED INTUBATORS.

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INTRODUCTION: A new light-guided stylet (Trachlight™ Laerdal Med Corp., Stavanger, Norway) has been shown to be a simple, effective, and safe intubating device in the hands of experienced laryngoscopists.[1] This suggests that light-guided technique might be particularly valuable for "occasional" or "novice" intubators outside the setting of the operating theatre. The goal of the study is to compare the use of the Trachlight™ and laryngoscope by "novice" intubators in intubating surgical patients.

METHODS: Following institutional review board approval, 14 (7F/7M) respiratory therapy and medical students with no previous experience of intubation were recruited. After instruction and practise on manikins, each student intubated 20 surgical patients (10 with Trachlight™ and 10 with laryngoscope) in a randomized fashion using standardized anaesthetic technique. Failure to intubate was defined as an inability to place the endotracheal tube after 3 attempts or when significant alterations occurred in haemodynamic and respiratory parameters (blood pressure, O_2 saturation). The time-to-intubation, complications, and hemodynamic changes following the intubation were recorded. The data were analyzed using unpaired t-tests and chi-squares analysis where appropriate ($P < .05$).

RESULTS: 265 patients were intubated with 126 (88F/38M) in the Trachlight™ group and 139 (88F/51M) in the laryngoscopy group. There were no significant differences in age, weight, and height between the groups. The table summarizes the results of the study.

	Trachlight™	Laryngoscopy
Time-to-intubate	35.8 (±34.3) Sec	67.2 (±59.0)*
Failure	2	25*
Trauma/bleed	5	25*
Sore throat	21	44*
% MAP change after intubation	-0.2 (±25.9)	10.3 (±24.1)*
% Heart rate change after intubation	13.6 (± 19.9)	21.8 (± 26.2)*

* $p < .01$

DISCUSSION: In the hands of inexperienced ("novice") intubators, the Trachlight™ proved to be significantly quicker, and more successful than the laryngoscope. In addition, the Trachlight® has fewer complications with less trauma and fewer sore throats following intubation. The data have implications for medical and health care personnel who are "occasional" intubators and would support further study of the use of Trachlight™ in these environments.

REFERENCES: Can J Anaesth 39(5II):A147, 1993.

B

A QUANTITATIVE EVALUATION OF PRESSURE INCREASES DUE TO NITROUS OXIDE DIFFUSION INTO TRACHEAL TUBE CUFFS

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INTRODUCTION: It is well recognized that when used during anesthesia, nitrous oxide (N_2O) will diffuse into closed airfilled cavities such as tracheal tube cuffs. Such pressure increases may result in damage to the trachea. We undertook this quantitative study because we were not aware of a detailed evaluation of this phenomenon.

METHODS: The trachea of a model lung was intubated with a Mallinckrodt 7 mm ID PVC tracheal tube and ventilated with N_2O/O_2 2:1 $L \bullet min^{-1}$ after the cuff was inflated with air to an initial pressure of 30.0 mmHg. A pressure transducer was attached to the cuff inflation (pilot) valve of the tracheal tube after its calibration with a mercury manometer. The cuff pressure was then continuously recorded.

RESULTS: The cuff pressure doubled in 19 min. The rate of increase of pressure was greatest initially and declined to zero as the pressure reached a plateau value of 172 mmHg (see table). Employing a mathematic model for this curve, a plot of: Ln [$(P_F - P_O) / (P_F - P)$] vs. time, (where P_O is the initial cuff pressure, P_F is the final plateau pressure, and P is the pressure at a given time) revealed a straight line ($R = 0.995$) with a slope of $1/\tau$ where τ is the time constant or time required for P to reach 63% of the final pressure increase.

DISCUSSION: The diffusion of N_2O into closed air containing spaces such as tracheal tube cuffs, bowel loops, or pneumothoraces has long been recognized by anesthesiologists and is due to the more rapid diffusion of N_2O than nitrogen. Employing a test lung, we found that N_2O increased the tracheal tube's cuff pressure most rapidly initially. The pressure doubled in 19 min and doubled again by 55 min. The rate of pressure increase decreased to zero as the pressure approached an upper limit of 172 mmHg by 3 hours. Our experiment allowed a mathematic model to be formulated to account for the observed cuff pressure increases and to transform the curve of pressure vs. time into a straight line.

Table 1: Tracheal Tube Cuff Pressures

Time (min)	Pressure (mmHg)
0	30
20	62
40	96
60	125
120	160
180	172

A

THE 40 HZ AUDITORY STEADY STATE RESPONSE (40 HZ ASSR) DURING INDUCTION OF ANAESTHESIA WITH PROPOFOL

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INTRODUCTION: The 40 Hz ASSR is a sinusoidal electrical potential evoked by auditory stimuli presented at the rate of 40/sec. It is markedly attenuated during unconsciousness produced by various anaesthetic agents [1]. We now report the effects of propofol (1.5 mg/kg) on the 40 Hz ASSR.

METHODS: After institutional ethics approval, we obtained informed consent from nine unpremedicated elective surgical patients aged 18-50 years. The stimuli were 500 Hz tonebursts (10 ms; 84 dB peSPL) delivered binaurally *via* insert earphones at the rate of 40/sec. The EEG was recorded from Cz referenced to M2 (0.3-100 Hz; digitizing rate 298.978 Hz; epochs of 3.425 s; artifact rejection $\pm 100\ \mu V$). Epochs were averaged by groups of ten before computing the Fast Fourier Transform. A new waveform was recorded every minute. After placement of the ECG, NIBP and 0_2 saturation monitors baseline recordings were obtained while the patients were breathing oxygen before induction. Propofol (1.5 mg/kg) was then given over 15 sec. and the 40 Hz ASSR continued to be recorded at 1 minute intervals. Responsiveness to verbal command (open your eyes) was assessed every minute. At 8 minutes following induction or on the return of responsiveness to verbal command propofol 1 mg/kg was given along with isoflurane and the study was terminated.
The amplitude of the 40 Hz ASSR was compared with the amplitude at adjacent frequencies by computing the ratio (a-m)/s where a, m and s are respectively the 40 Hz ASSR amplitude, the mean and the standard deviation of the amplitude measures between 35 and 45 Hz (32 values). A ratio 2.5 or more indicates that the amplitude at 40 Hz is significantly larger ($P < 0.01$) than the amplitude at adjacent frequencies (one-tailed t distribution with 30 df) [2]. This approach avoids artifactual increase in the 40 Hz ASSR caused by increased background noise.

RESULTS: The ratio was consistently above 2.5 before induction. It was markedly attenuated following induction in all patients because of a decrease in the amplitude of the 40 Hz-ASSR. In four patients the ratio stayed below 2.5 throughout the period of unresponsiveness; in the other patients it increased above 2.5, at the end of period of unresponsiveness. Following the return of responsiveness to verbal command the ratio exceeded 2.5 except in one patient who showed a high level of residual noise.

DISCUSSION: The results indicate that the 40 Hz ASSR is markedly attenuated following loss of responsiveness to verbal command during induction with propofol. The 40 Hz ASSR regains amplitude either shortly before or concurrently with the return of responsiveness to verbal command.

REFERENCES:
1. Plourde G. Int Anesthesiol Clin 31 (4): 108-20; 1993
2. Picton TW et al Electroencephalogr Clin Neurophysiol 68: 119-31, 1987

Supported by the FRSQ.

B

Anesthetic concentrations in operating room air: The need for periodic quantitative measurement.

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Introduction:
Technological improvements have systems has led to an expectation of minimal occupational exposure to inhalational anesthetics. Many hospitals do not monitor OR contamination. The authors initiated a program to accurately measure inhaled anesthetics in OR air.

Methods:
OR air samples were collected in the vicinity of the anesthesia machine 30 minutes after induction and intubation. Samples were collected by opening a 125 ml evacuated glass gas bottle with teflon gas-tight stopcocks for three seconds. Volatile anesthetics were measured in the laboratory with a gas chromatograph equipped with a flame ionization detector. Nitrous oxide (N_2O) was measured at mass 30 by coupling a gas chromatograph column at room temperature to the inlet of a computer-controlled mass spectrometer. Calibration was performed using known concentrations of anesthetic vapours produced by injection of liquid or gaseous anesthetic into glass bottles of known volume. Bottle seals and all tubings were inert teflon shown not to adsorb anesthetics. Helium (high purity, Canadian Liquid Air) was used as the carrier gas. Samples were collected from four pediatric and seven adult operating rooms.

Results:
Detection limits were: halothane(HAL) 1 ppm; isoflurane (ISO) 1 ppm; N_2O 10 ppm. The coefficients of variation for calibration measurements at the occupational exposure limits were: 10% (HAL); 8% (ISO) and 8% for N_2O. Results (Table 1) are means of duplicate measurements for each OR.

Table 1: Anesthetic concentrations (ppm) in pediatric (P) and Adult (A) operating rooms, 25C, 760 mmHg.

	P1	P2	P3	P4	A1	A2	A3	A4	A5	A6	A7
N_2O	170	108	17	50	870	10	20	0	0	63	24
ISO	0	0	0	0	0	0	0	0	0	0	0
HAL	5.5	2.5	0	0	0	0	0	0	0	0	0

N.B. 0 = value < detection limit

Discussion:
Published guidelines (NIOSH) (1) for occupational exposure are: N2O 25 ppm; Halocarbons 2 ppm. These were exceeded in several operating rooms. The causes were traced to faulty hoses, connectors and scavenging systems. Room A1 results were due to nitrous oxide flow when the breathing system was not connected to a patient. Dosimeters and other semi-quantitative measurements may not have been so effective in determining these problems. Our results highlight the need for continued vigilance and quanitiative measurements.

References: 1. J.T. Purdham, Anaesthetic Gases and Vapours. Can. Cent. for Occ. Health and Safety Doc. P86-21E,1986. P13.

A

EVALUATION OF THE ACCURACY OF NON-INVASIVE BLOOD PRESSURE MONITORS

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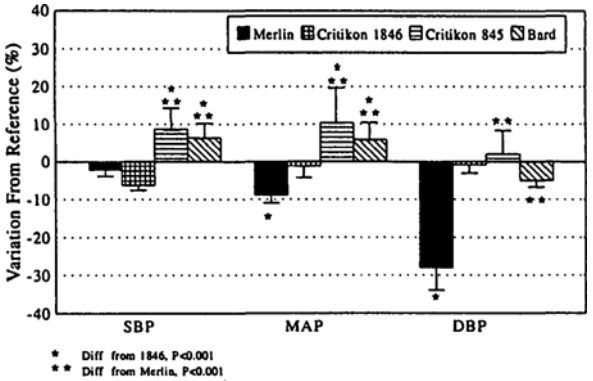
INTRODUCTION: There is a paucity of information regarding the performance of non-invasive blood pressure devices at extremes of physiologic values. A study was therefore undertaken to compare the accuracy and response times of four types of non-invasive blood pressure monitors in current use at a tertiary care hospital.

METHODS: The non-invasive blood pressure monitors in use in the Operating Rooms, Recovery Room, and Intensive Care Unit of the Ottawa General Hospital, were evaluated over a 1-month period using a Cufflink Non-invasive Blood Pressure Analyzer. This device provides an accurate and repeatable dynamic BP waveform (accuracy ±1%) for both semi- and fully automated NIBP devices, by a microprocessor-controlled simulation of the actual response of the patient's arm to the blood pressure (BP) cuff. The monitor was used to generate different dynamic pressure waveforms for a High Range (200/165/150 mmHg), Normal Range (120/90/80 mmHg) and Low Range (60/40/30) of simulated BP. Pressure measurements were recorded in duplicate for each monitor, and the mean pressure and response times at each of the three ranges was compared using analysis of variance, with statistical significance assumed when $P<0.05$.

RESULTS: The following monitors were evaluated: Merlin HP M1046A (n=11), Critikon 1846 (n=21), Critikon 845 (n=9) and Bard (n=7). Acquisition times were longer in the low range for all four types of monitors. However, the Critikon 1846 monitor had the most rapid acquisition time at all three pressure ranges (36±9 sec for Low, 22±4 sec for Medium and 33±5 sec for High, $P<0.01$ compared with Merlin, Critikon 845 and Bard). All monitors performed well in the High and Normal ranges of BP. However, in the Low Range, the Critikon 1846 monitor provided the greatest accuracy of MAP and DBP, whereas the Merlin monitor underestimated MAP by 9.2±3.2% ($P<0.001$) and underestimated DBP by 27±9% ($P<0.01$, Figure).

DISCUSSION: All monitors provided an acceptable degree of accuracy. However, of the monitors compared, the Critikon 1846 provided the most rapid response time, and the greatest degree of accuracy at the low range of blood pressure, whereas the Merlin monitor was least accurate at this range. Such information is clinically relevant, as absolute accuracy of blood pressure monitoring devices becomes more critical when systemic blood pressure is either very low or very high.

FIGURE MEASUREMENT ERROR
Low Range (60/40/30)



B

INFLUENCE OF TAPE TYPE AND OF MASTISOL AND BENZOIN ON THE FORCE REQUIRED TO DISLODGE ANGIOCATHETERS IN HUMANS

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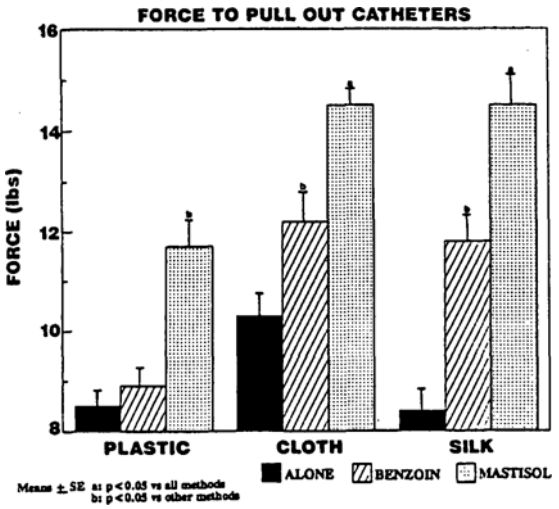
INTRODUCTION The purpose of the study was to determine the force required to dislodge IV catheters that were secured to skin with a standard taping method using 3 currently available tape types with and without the application of liquid adhesive agents. The study has clinical relevance because anaesthetists are required to securely tape IV catheters to patient skin in order to prevent accidental dislodgement.
METHODS A 14 gauge 2 inch angiocatheter attached to standard IV tubing was taped to human forearm using a standard taping method. A calibrated piezoelectric force transducer was attached to the IV tubing such that a force applied along the longitudinal axis to pull out the taped catheter could be measured and recorded on paper. Three tape types, plastic, adhesive cloth and hypoallergenic cloth, were evaluated alone, with benzoin skin pretreatment and with mastisol pretreatment. A randomized 3 x 3 block design with 20 replications per block was utilized, and a total of 180 pullout tests were performed on 2 adult volunteers. The method of dislodgement for each pull out test was also evaluated. Data was analyzed by ANOVA followed by Tukeys test. $P < 0.05$ was considered significant.
RESULTS The maximal force required to dislodge angiocatheters is shown in Figure 1. Compared with benzoin, pretreatment of skin with mastisol increased the dislodgement force for plastic, adhesive cloth and hypoallergenic cloth tape. Chi Square analysis of data on the dislodgement method revealed that the most frequent failure mode for plastic tape was by tape fracture, for adhesive cloth tape was by separation of tape and catheter as a single unit, and for hypoallergenic tape was by catheter separation without tape fracture ($p < 0.001$).
DISCUSSION The data suggest that the application of mastisol prior to taping IV catheters with adhesive cloth or hypoallergenic cloth tape helps to minimize the risk of accidental dislodgement.



A

CLINICAL COMPARISON OF TWO FLUID WARMERS IN ADULT PATIENTS

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Introduction. Fluid warmers that utilize dry heat or water bath technologies may not adequately warm fluids because of inefficient heat transfer, and because of heat loss along the tubing at low flow rates[1,2]. The study tested the hypothesis that warming IV fluids with the Hotline fluid warmer results in less accidental hypothermia (core temperature < 35.5°C), and less need for other warming methods compared with dry heat technology.
Methods. Thirty six adult patients scheduled for elective, major orthopaedic and gynaecologic surgery requiring general inhalational anaesthesia were studied in an open, randomized, prospective design. Intravenous fluids were given to maintain normovolaemia either via the Flotem IIE device (dry heat, n = 17 patients) or via the Hotline (n = 19 patients) device. Measured data included vital signs, fluid balance, lower esophageal (Eso), tympanic membrane (TM), operating room and skin temperatures. Calculated data were (TM initial-TM final) and (TM initial-TM minimum). Intervention for Eso T < 35.5°C consisted of the Bair Hugger convective warming device. Between group data were analyzed by t tests and Fishers's Exact test. $P < 0.05$ was considered significant.
Results. There was a greater fall in TM in the Flotemp compared with the Hotline group ($p < 0.05$, Table). Five patients in the Flotem group required the Bair Hugger for treatment of hypothermia vs none in the Hotline group ($p < 0.05$). The average time to develop hypothermia in these 5 patients was (mean ± SEM) 117 ± 10 minutes after infusion of 1620 ± 260 mL.
Discussion. The Hotline fluid warmer, which uses a 245 cm length of tubing between the warming unit and the patient to warm IV fluids, prevented accidental hypothermia in all patients. The ability of the Hotline warmer to prevent accidental intraoperative hypothermia is probably because of the high specific heat of water and the lack of heat loss along the IV tubing at flows between 1 and 75 mL/min. [2]

References

1. Anesthesiology 1992;77:1022-8
2. Anaesthesia 1992;47:869-71

	Hotline	Flotem
Age (years)	45±4	36±4
Male/Female	6/13	9/8
Weight (kg)	73±4	82±5
Duration (min)	232±25	214±20
Blood Loss (mL)	687±149*	268±78
IV Fluids (L)	3.9±0.6	2.6±0.3
TM initial (°C)	36.97±0.1	37.28±0.1
$TM_{initial}$-TM_{final}(°C)	0.36±0.12*	0.83±0.17
$TM_{initial}$-$TM_{minimum}$(°C)	0.90±0.15*	1.36±0.13

Means ± SEM. *P < 0.05 between groups.

B

SACRAL INTERVERTEBRAL APPROACH FOR EPIDURAL ANAESTHESIA IN INFANTS AND CHILDREN

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INTRODUCTION

Sacral intervertebral approach to the epidural space was introduced as an alternative to caudal approach in infants and children in 1987[1]. This is a report of our clinical experience using single-shot sacral intervertebral epidural anaesthesia.

METHODS

Infants and children undergoing surgical or oncological procedures below the diaphragm were prospectively studied. One staff anaesthetist and five anaesthesia residents participated in this study. After induction of general anaesthesia, the patients were placed in the left lateral position with the legs flexed. The bilateral posterior superior iliac spines were palpated and a line was drawn between them. This line crossed the second sacral vertebral arch. A 20G, 3.5cm Tuohy needle was inserted at S2/3 or S1/2. The needle was advanced perpendicular to the skin. The micro-drip infusion set, which was filled with saline, was connected to an extension tube. The extension tube was then attached to the needle. Identification of the epidural space was assisted by observing commencement of dripping in the chamber. The local anaesthetic solution with epinephrine was given via the injection port of the extension tube[2]. The epidural block was considered successful when no changes in heart rate or blood pressure were observed at incision under light general anaesthesia (sevoflurane 1% in 66%N_2O,34%O_2) or when analgesia level was above the incision site after the operation.

RESULTS

We have administered epidural anaesthesia by this approach in 73 infants (< 1 yr.) and 127 children (3.4 ± 2.2 yr., Mean ± SD). It was easy to identify the sacral intervertebral space in each patient. Overall success rate was 96% (Staff anaesthetist 100%, residents 94%). The success rate on the first attempt at the initial intervertebral space was 83%. The correlation of the body weight to the skin-dura distance was poor (Regression line equation was Y = 0.46X + 9.4, X = body weight in kg, Y = skin-dural distance in mm, $r^2 = 0.53$). Lateralization of analgesia was found in two patients. Two incidents of intravascular injection were detected by the change in heart rate. No inadvertent injection of local anaesthetic into the subarachnoid space occurred.

DISCUSSION

We found the sacral intervertebral approach to the epidural space in paediatric age group extremely practical. Technically, the puncture method is essentially identical to that of adult lumbar epidural anaesthesia. So, residents can apply their skills of adult lumbar epidural anaesthesia easily to this approach. The success rate by the residents was reasonably high. We recommend that this approach to be taught to residents before they are allowed to do lumbar or thoracic epidural anaesthesia in infants and children.

REFERENCES

1. Anesthesiology 67: 993-995.
2. Paediatric Anaesthesia 3: Accepted for publication.

A

A COMPARISON OF ISOFLURANE AND HALOTHANE ON DIASTOLIC AND SYSTOLIC VENTRICULAR FUNCTION IN THE NEWBORN PIG.

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INTRODUCTION: Volatile anesthetics have been shown to affect both systolic and diastolic function in the adult myocardium. Their effects on newborn diastolic function are not known. As the newborn heart has increased passive stiffness[1] and altered calcium handling[2] relative to the adult, we hypothesized that diastolic effects could contribute significantly to the known myocardial depressant effects of both halothane (H) and isoflurane (I) in the newborn.

METHODS: Sixteen newborn pigs were randomized for study at control (background fentanyl 100mcg/kg/hr) and 0.5, 1.0 and 1.5 MAC of I (n = 8) or H (n = 8). Left ventricular pressure (LVP) was monitored continuously with LV anterior-posterior dimension, determined by sonomicrometry crystals. Diastolic relaxation, given by peak negative (-) dP/dT and the time constant for ventricular relaxation (τ) were determined from analysis of the LVP trace. Left ventricular stiffness was calculated from the slope of the end-diastolic pressure-dimension (EDP-D) relationship. Systolic function was determined by peak positive (+) dP/dT and the slope of the end-systolic pressure-dimension (ESP-D) relationship. Temperature, arterial blood gases, LVEDP and CVP were controlled. Results at each MAC equivalent were compared within and between groups by a repeated measures ANOVA.

RESULTS:

	ISOFLURANE				HALOTHANE			
MAC	Control	.5	1	1.5	Control	.5	1	1.5
τ	18±6	22±5	24±5	30±7*	21±6	26±10	27±8	30±11*
EDP-D	.15±.2	.19±.2	.5±.4*	.4±.3*	.16±.1	.14±.1	.58±.4*	.57±.4*
ESP-D	51±31	24±13*	22±14*	17±10*	71±37	32±15*	35±19*	29±19*
+dP/dT (10^3)	2±.5	1±.3*	.9±.3*	.8±.3*	2±.5	1±.2*	.9±.1*	.7±.1*
-dP/dT (10^3)	2±.5	1±.4*	1±.3*	.8±.3*	2±.4	1±.2*	1±.2*	.8±.2*

* P < 0.05 vs Control. Values are Means ± SD.

At equiMAC concentrations, there were no significant differences between H or I for any parameter studied.
EDP-D slopes were not significantly different between 1 and 1.5 MAC. ESP-D slopes, +dP/dT and -dP/dT were not different between 0.5, 1.0 and 1.5 MAC anesthesia.

DISCUSSION: Systolic function was affected at every concen tration of anesthetic studied while diastolic effects were apparent at higher anesthetic levels only. One agent does not appear superior to the other but the combined effects of either agent on systole and diastole may be minimized by maintaining inspired anesthetic concentrations ≤ .5 MAC.

REFERENCES: 1.Friedman WF. Prog. in Cardiov. Disease, XV: 1,87-111, 1972
2. Kaufman TM, Am.J. Physiol.259:H309-19,1990

B

PERIOPERATIVE RESPIRATORY COMPLICATIONS AFTER GENERAL ANAESTHESIA IN CHILDREN WITH ASTHMA

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INTRODUCTION

Asthma is a common childhood disease. Recent studies suggest increasing morbidity and mortality despite greater therapeutic options.[1-3] The majority of children with asthma have mild disease exacerbated by intercurrent viral URIs and require episodic bronchodilator therapy. The consequences of general anaesthesia in this setting are not clearly defined in the literature.[4,5]

METHODS

A retrospective review of hospital records for the period 1984-1992 was conducted on charts cross-referenced for "asthma" and in whom an anaesthetic had been given. Exclusion criteria included airway foreign body, cardio-pulmonary structural defects, CHF, isolated acute pulmonary disease, or suspected perioperative anaphylaxis. A total of 206 cases have been examined in detail and compared with 44 control cases undergoing anaesthetics during the same period without a history of asthma. Chi-square analysis was used to detect statistical differences ($p<0.05$).

RESULTS

Of the 206 cases with a history of asthma, 62 (30%) had some perioperative respiratory event recorded. This compares to no events (0%) noted in the 44 non-asthmatic patients ($p<0.001$).

Only the following two symptoms or signs were found to be associated with complications: positive preoperative lung exam ($p<0.01$) and recent URI/Otitis ($p<0.04$). Complications not associated with a history of "severe" asthma, recent asthma exacerbation, or the frequency of asthma therapy, including preoperative bronchodilator therapy or steroids. Intraoperative airway management was also found to contribute to postoperative complications, with tracheal intubation being more common in asthmatic patients with complications ($p<0.05$). No other anaesthetic-related items achieved significance.

Major Complications (N=12)		Minor Complications (N=50)	
Severe Resp Acidosis	6	Bronchospasm	47
ICU Admission	5	SpO_2 Desaturation	28
Intraop Epi/Aminoph IV	5	Excess Cough/Stridor	15
Urgent Bronchoscopy	4	Prolong Hospital	13
Respiratory Failure	2	Laryngospasm	5
Pulmonary Edema	1	Surgery Canc. p Indxn	5
Pneumothorax	1	Readmit for Wheezing	1

Complications occurred at induction of anaesthesia in 8% of cases, during maintenance in 35%, at emergence in 10%, in the PACU in 44%, and on the ward postoperatively in 23%.

DISCUSSION

Pediatric patients with a history of "asthma" are extremely common. The complication rate we report here is alarmingly high and did not appear to be lessened by any therapeutic interventions immediately preoperatively. Major complications, though not frequent in (12 of 206), are largely unpredictable except in the presence of abnormal airway sounds or a recent upper respiratory illness.

REFERENCES

[1] J Pediatrics 115: 838, 1989
[2] NEJM 326: 1540, 1992
[3] Br J Anaesth 61: 263, 1988
[4] Anesthesiology 72: 828, 1990
[5] Acta Anaesthesiol Scand 31: 244, 1987

ANAESTHETIC AGREEMENT IN ASSESSMENT OF CHILDREN'S FITNESS FOR SURGERY WITH U.R.I.

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PURPOSE: Assessment of anaesthetists' observer variability in fitness of children with symptoms of Upper Respiratory Infection (URI) for elective paediatric surgery from two different practice settings was conducted. Comparison to criteria used in previously randomized clinical trials by DeSoto and Tait was also performed.[1,2]

METHODOLOGY: Twelve anaesthetists from tertiary and community hospitals assessed sixty case scenarios of children with various symptoms of URI. The cases were developed with criteria used in previous randomized clinical trials for URI diagnosis (Tait, DeSoto). The children were randomly assigned to three different elective surgeries (bilateral myringotomies and tubes, inguinal hernia repair, and tonsillectomy). Dichotomous decisions for the diagnosis of URI and the decision to proceed to surgery were obtained (yes or no).

RESULTS: Interobserver variability among the anaesthetists with previous randomized trial criteria for the diagnosis of URI indicated only fair agreement using the Kappa statistic (0.45). Likelihood ratios (LR) for each anaesthetist as a measure of their diagnostic ability, compared to the randomized trial criteria varied widely. The anaesthetists' were able to rule out disease slightly better than ruling in disease (mean LR+ = 2.6, mean LR- = 0.37). Multiple Logistic regression revealed that the anaesthetists from both practice settings used similar criteria to diagnose URI. However, the type of surgery influenced the decision to proceed to surgery. The children for tonsillectomy were cancelled more frequently with similar symptomatology.

DISCUSSION: This study illustrates the importance of developing criteria for diagnosis of URI in children using a combination of clinician consensus and outcome analysis in prospective randomized trials. Without diagnostic criteria that integrate the anaesthetists' intuitive clinical reasoning with established outcomes, the issue of guidelines for anaesthetizing the child with URI for elective surgery cannot be adequately addressed.

REFERENCES:

1. Anesthesiology 1988;68:276-279
2. Anesthesiology 1987;67:930-935

AN ANALYSIS OF THE DIMENSIONS AND FLOW CHARACTERISTICS OF PEDIATRIC LASER RESISTANT TRACHEAL TUBES

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INTRODUCTION: Laser-protected tracheal tubes should minimally restrict the flow of respiratory gases and should not interfere with the surgeon's exposure. In this investigation, we compared the dimensions and flow characteristics of two types of laser resistant pediatric tracheal tubes.

METHODS: Size 3, 3.5, and 4 mm ID corrugated Mallinckrodt (St. Louis, MO, USA) stainless steel Laser-Flex and size 2, 2.5, 3, 3.5, and 4 mm ID PVC tracheal tubes wrapped with Venture (Rockland, MA, USA) copper tape were studied. The tracheal tubes' lengths, ODs, and IDs were measured. Their flow characteristics were studied by measuring the gas head pressure while 8 $L \cdot min^{-1}$ of oxygen flowed through the tracheal tubes.

RESULTS: Table 1 lists the measured ODs for the copper foil wrapped PVC and Laser-Flex tracheal tubes. The Laser-Flex tubes had thicker walls. The head pressure and lengths for the stainless steel Laser-Flex tracheal tubes allowed their effective IDs to be calculated using Poiseuille's equation (see Table 1). They averaged 0.27 mm smaller than their nominal sizes.

DISCUSSION: The ideal tracheal tube for laser airway surgery should have thin, smooth walls to minimally obscure the surgeon's field and allow for the least airway resistance. This investigation demonstrates that copper foil wrapped PVC tracheal tubes have smaller ODs than corrugated stainless steel Laser-Flex tracheal tubes of the same nominal ID. Furthermore, the calculated IDs of the Laser-Flex tracheal tubes averaged 0.27 mm less than their nominal sizes. The reduced IDs may significantly restrict the flow of ventilatory gases through the corrugated stainless steel Laser-Flex tracheal tubes.

Table 1 - Characteristics of Laser Tracheal Tubes

Tracheal Tube Type	Nom. ID (mm)	ID* (mm)	Measured OD (mm)	Head Pressure (mmHg)
PVC+	2	2.01	3.34	32
Copper Tape	2.5	2.49	3.54	14
	3	3.05	4.54	7
	3.5	3.56	5.10	4
	4	4.04	5.71	3
Laser-Flex	3	2.69	5.24	15
Stainless	3.5	3.26	5.62	7
Steel	4	3.73	6.04	4

* Measured for PVC and calculated for Laser-Flex tubes

A

AMBULATORY SURGERY AND CHILDREN WITH SUSPECTED OR PROVEN MALIGNANT HYPERTHERMIA SUSCEPTIBILITY

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INTRODUCTION

A retrospective chart review[1] over a 10 year period of 406 anaesthetics in 285 children suspected by history or confirmed by muscle biopsy to be malignant hyperthermia susceptible (MHS) was performed in our institution. The MHS label was the sole reason for hospital admission following 58% of the procedures. There were no MH reactions or complications. It was concluded that same-day discharge for MHS susceptible children would be safe. The following is a prospective, on-going study of ambulatory surgery in MHS children.

METHODS

All children with suspected or confirmed MHS for ambulatory surgery were included. A detailed MH history was taken for each child. The parents were given an information sheet explaining our same-day discharge program including monitoring expectations, and the signs of MH to alert them to bring their child back in to hospital. All children received a trigger-free anaesthetic chosen by the individual anaesthetist. Vital signs were recorded perioperatively and rectal or axillary temperatures continuously and throughout the recovery period. Children were monitored for four hours in the recovery room and discharged home if there had been no evidence of a MH reaction. Parents were contacted the following day to document any problems overnight.

RESULTS

Seventy six MHS children (mean age 5.3 ± 4.1 years) received 103 anaesthetics on an ambulatory basis in the first 29 months of the study. The reasons for the MHS label are summarised in the following table.

Reason for MHS label	Children (n=76)
Biopsy positive	1
Previous MH reaction	1
First degree relative, biopsy positive	20
First degree relative, previous MH reaction	18
Other relative, biopsy positive	33
Other relative, MH reaction	35

The surgeries included dental (28), ENT(19), general (18) and ophthalmic (14). General anaesthetics lasted 64 ± 39 mins and the following drugs were commonly used:

Induction	Thiopentone	(n=51)	Propofol	(n=51)
Narcotic	Fentanyl	(n=54)	Morphine	(n=3)
Hypnotic	Midazolam	(n=15)	Diazepam	(n=31)
Muscle Relaxant	Atracurium	(n=28)	Vecuronium	(n= 25)

All MHS children were discharged home 4 hours after ambulatory surgery. No MH reactions occurred and no child required readmission to hospital. A 3 year old child discharged home developed a fever of 38.9°C which subsided following oral acetaminophen and he recovered completely.

DISCUSSION

Overnight admission solely because of MH susceptibility is unnecessary. Moreover it is often an inconvenience to parents and is costly. MHS children can be discharged home safely following ambulatory surgery providing clear guidelines regarding follow-up and management are given.

REFERENCES 1 Anesth Analg 1992; 75:345-50.

B

Perioperative Respiratory Complications in a Paediatric Anaesthesia Practice

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Introduction
How many of the children undergoing anaesthesia have respiratory complications during or after surgery? This prospective study was designed to give information on the frequency, nature, and timing of perioperative complications in all children presenting for surgery at the Winnipeg Children's Hospital in a 14 month period.
Methods
Information was collected on children presenting for 6765 consecutive anaesthetics in our hospital. A standard information sheet was completed by the individual anesthetist on pre-operative status and intra-operative respiratory events. The early or recovery room (RR) events were recorded by the RR nurse or by one of two designated follow up personnel. Most of the children were between 1 and 10 years of age (73%) and were elective (87%) day surgery procedures (73%). General anaesthesia was the norm (98%) with inhalational induction (77%) and intubation (66%). Of those intubated 60% were extubated deep in the Operating Room (OR), 27% awake in the OR and 6% awake in the RR. Four percent were transferred intubated to one of the critical care units. No heart, liver or lung transplant surgery was performed. The majority of cases (60%) were head and neck procedures .
Results
Twenty three percent of all the patients had complications. Eight percent (34% of the complication) occurred in the OR. Four percent (18% of the complications) resolved in the OR, another three percent (12% of the complications) resolved in the RR. Only one percent (4.5% of the complications) which developed in the OR were still present at six hours. Ten percent of patients developed their first complication (43% of the complications) in the RR. Eight percent (35% of the complications) resolved in the RR and 2% (8% of the complications) persisted to 6 hours post op. Five percent of patients (22% of the complications) had their first complications develop after 6 hours post-operatively. Nineteen percent of children *without* acute or a history of chronic respiratory tract infections (RTI) at the time of surgery developed a perioperative complication. Thirty four percent of those *with* an acute upper RTI, 48% of those with a lower RTI and 34% of those with chronic or recurrent respiratory infections had perioperative respiratory complications. The overall complication rate was 43% for children under one month and 20-25% thereafter.
Discussion
Perioperative respiratory complications in children are not rare (1). As previously reported neonates are most likely to have complications. A history of acute or chronic respiratory infections increases the likelihood of having a respiratory complication perioperatively. Most complications which develop intraoperatively, or in the RR, will resolve before the patient leaves the RR. A significant number of patients who had uncomplicated anaesthetics and RR stays will develop complications at 6 hours post op. Detailed data on demographics, predisposing factors and types of complications will be presented.
References
1) ANESTH ANALG Vol 70, page 10

A

THE EFFECTS OF PULMONARY ASPIRATION OF HUMAN BREAST MILK AND NORMAL SALINE IN THE INTUBATED RABBIT.

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Introduction: Pulmonary aspiration of gastric contents in the perioperative period may be responsible for up to 20% of anaesthesia-related deaths (1). The pH and volume of the aspirate are the major determinants of the degree of resulting lung injury (2). Very limited information exists on the effects of pulmonary aspiration of human breast milk (HBM). Using a live rabbit model, we compared the acute effects of pulmonary aspiration of HBM and normal saline.

Methods: Six adult New Zealand white rabbits (4-5.2 kg) were studied. After induction of anaesthesia with halothane and nitrous oxide (70%), the trachea was intubated with a 3.0 mm tube. Anaesthesia was maintained with halothane in oxygen. Ventilation was controlled mechanically, using humidified gases initiated to maintain arterial pCO2 in the normal range (35-45 mm Hg). Temperature was maintained between 37-39 degrees Centigrade. A peripheral arterial and a central venous catheter were inserted and the shunt fraction (Qs/Qt) calculated. After 20-30 minutes at room temperature, and with the rabbits in the supine position, HBM (0.4 ml/kg; pH=6.6-7.0) or normal saline (0.4 ml/kg) was instilled into the bronchi. Immediately before, and at five and sixty minutes after instillation, arterial and right atrial blood samples were analysed for pH, pCO_2, and pO_2. The rabbits were killed by administering a barbiturate overdose. Histological specimens were examined with light microscopy and appearances graded as normal (0), mild (1), moderate (2) or severe (3) injury.

Results: Data are expressed as means (range); histological grade is expressed as mode (range).

Group	Qs/Qt % pre	Qs/Qt % 5' post	Qs/Qt % 60' post	Histolog Grade
NS n=2	28 (17-38)	46 (24-69)	23 13-30	1 (0-2)
HBM n=4	36 (30-40)	31 (29-35)	41 (35-48)	0 (0-2)

Conclusion: In rabbits, the acute pulmonary injury resulting from aspiration of human breast milk (0.4 ml/kg) is mild and similar to that following aspiration of the same volume of normal saline. Further data are required to fully elucidate the risk of pneumonitis after aspiration of human breast milk.

References: 1.Boadlander FMS. Br J Anaesth 1975:47;36-40. 2.Manchikanti L, Colliver JA, Marrero TC, et al Anesth Analg 1984:63;903-10

B

CAUDAL MORPHINE ANALGESIA IN INFANTS UNDERGOING THORACOTOMY FOR EXTRACARDIAC SURGERY.

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INTRODUCTION
Infants may require thoracotomy for repair of coarctation, ligation of patent ductus arteriosus, or palliation of cardiac defects (e.g. systemic-to-pulmonary artery anastomosis, pulmonary artery banding). High dose narcotics used for these cases often necessitate a period of postoperative ventilation. Caudal administration of morphine(MS) is widely used for postoperative analgesia in children (1) and has a low incidence of respiratory depression (2). In an ongoing study, three doses of caudal morphine given at the beginning of surgery were evaluated for the ease of extubation, postoperative analgesia, and side-effects.

METHODS
After IRB approval and informed parental consent, suitable infants were randomly assigned to receive 25, 50, or 75 mcg/kg of caudal MS in a minimum of 5cc normal saline immediately after induction. Anaesthesia was induced with either halothane or sodium pentothal and the trachea was intubated using vecuronium. No intravenous narcotics were given. Anaesthesia was maintained with air, oxygen, isoflurane or halothane. After reversal of the muscle relaxant, the patient was extubated when awake and haemodynamically stable. Arterial oxygen saturation and cardiorespiratory tracings were continuously monitored for 24 hrs. An objective pain score (3) and sedation score were performed hourly to determine the time supplemental analgesia was required. For a pain score of 5 or greater, a morphine infusion of 10 mcg/kg/hour was started and increased until pain was adequately controlled. Data were analyzed using the Student's t-test. A p value < 0.05 was considered significant.

RESULTS
Seven patients age 3-8 months old are reported. All were extubated in the operating room. The average time from the end of anaesthesia to the commencement of parenteral narcotics was 9.4 hr. No patient had respiratory complications. Although the patients who received 75 mcg/kg of caudal MS had a longer duration of analgesia and less total narcotic requirement over the next 24 hours, this was not statistically significant.

No. of subjects	Age (mos)	weight (kg)	Caudal MS (mcg/kg)	Analgesia (hr)	Total MS mg/kg/24hr
3	7.0±1.7	5.5±0.3	25 or 50	8.6±4.7	0.31±0.13
4	5.4±2.2	4.3±0.6	75	11.4±5.9	0.26±0.17

DISCUSSION
Many studies have evaluated caudal epidural MS in children undergoing procedures below the diaphragm but none have examined its efficacy in infants undergoing thoracotomy. We evaluated three doses of caudal epidural morphine. All gave effective analgesia (mean duration 9.4hrs). All infants were successfully extubated in the operating room and no respiratory depression was noted. We conclude that caudal epidural morphine given as a single injection at the beginning of surgery is an effective method for postoperative analgesia in infants undergoing thoracotomy. The small number of patients thus far precludes a definitive conclusion of the optimal dose of caudal MS.

REFERENCES
1. Anesth Analg 1991;72:120-124.
2. Anesthesiology 1989 70:418-421.
3.Anesthesiology 1988;69:3A:A770.

A

PROPOFOL AS A TREATMENT OF POSTOPERATIVE EMESIS IN CHILDREN

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INTRODUCTION
Propofol has been shown to decrease the incidence of postoperative nausea and vomiting when used for induction and maintenance of anaesthesia (1). It has been used in oncology as a low-dose continuous infusion to successfully treat nausea and vomiting (2). Recently, Borgeat demonstrated the antiemetic effect of low-dose propofol in patients postoperativey (3). We evaluate the antiemetic effect of a low-dose propofol bolus, 0.2mg/kg, given to children to treat vomiting in the early postoperative period.

METHODS
In our ongoing, prospective, double-blind study, after IRB approval and written informed consent, 130 patients scheduled for tonsillectomy or adenoidectomy were enrolled. Anaesthesia was induced with thiopentone 5 mg/kg, atropine 0.01 mg/kg, succinylcholine 2 mg/kg and the trachea was intubated. Anaesthesia was maintained with oxygen, nitrous oxide, halothane or methoxyflurane. Children received codeine 1-2 mg/kg im and tylenol 15 mg/kg pr. Children who wretched or vomited postoperatively were randomly assigned to receive 0.2 mg/kg of propofol or an equivalent volume of placebo (intralipid 10 %). Treatment was evaluated after 60 seconds and repeated if symptoms had not improved. Side effects, drug administration and oral fluid intake were recorded. Emetic episodes and any rescue antiemetic (dimenhydrinate) were recorded. Data were analyzed using the Student's t-test, Chi-square analysis and Fisher's exact test. A p value < 0.05 was considered significant.

RESULTS
To date, 36 patients age 3-16 years have been treated for postoperative emesis.The two groups were similar in age and weight. Only the patients receiving propofol noted pain on injection ($p<0.001$). No increase in sedation was noted in any patients. None of the patients treated with propofol and only 3 of the patients treated with placebo vomited within an hour of treatment. The difference was not statistically significant ($p= 0.23$).

	No.	Age (yrs)	Weight (kg)	Pain on injection *	1 hr relapse *	4hr relapse *
Propofol	18	7.4 ±4.4	30 ±15	12	0	10
Placebo	18	5.7 ±2.3	24 ± 9	0	3	6

* number of patients

DISCUSSION
The preliminary data in our study suggest propofol may not be more effective than placebo in treating postoperative emesis after adenotonsillectomy in children. Emesis was our endpoint for treatment since small children seldom report nausea. Many children vomit only once or vomit several hours apart and the antiemetic effect of propofol may have dissipated by the time of the repeat episode. To establish an adequate power, this study will require enrollment of the planned 70 patients.

REFERENCES
1. Anesth Analg 1993;76:760-4.
2. Can J Anaesth 1992;39:170-2.
3. Anesth Analg 1992;74:539-41.

B

COMPARISON OF TWO METHODS OF ANAESTHESIA FOR TRANSOESOPHAGEAL ECHOCARDIOGRAPHY (TEE)

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INTRODUCTION

Approximately 1/3 of patients report TEE to be an unpleasant or very unpleasant experience[1]. Gagging and retching detract from test quality and may prevent placement of the TEE probe[2]. The aim of this study was to compare two techniques of topical anaesthesia for TEE.

METHODS

After institutional approval 19 patients scheduled for TEE were enrolled in a prospective, randomized, blinded study. The patients were randomized into 2 groups; Group A (Spray; n=10) received 60 mg of lidocaine 1 % spray to the oropharynx. Group B (Feeding Tube; n=9) received 60 mg lidocaine 1 % spray plus 160 mg of lidocaine 4 % administered incrementally via a # 8 Fr. feeding tube advanced from the base of the tongue until the 20 cm mark reached the lower incisors. Intravenous access was established, and all patients were monitored with non-invasive blood pressure, pulse oximetry and ECG. Gag counts were recorded for the first 15 minutes starting with TEE probe insertion. Patient discomfort was assessed employing a 100mm Visual Analogue Scale (VAS) by both a blinded cardiologist and blinded observer. Overall patient satisfaction was assessed on a 5 point scale (1=very satisfied, 5=very unsatisfied). Sedation was administered at the discretion of the blinded cardiologist performing the TEE. Statistical analysis was performed employing the student t test or Fisher exact test as appropriate with a P value < 0.05 considered significant.

RESULTS

No demographic differences between the two groups were demonstrated. Heart rate, blood pressure and oxygen saturation were similar in both groups. The feeding tube was easily placed and tolerated well by all who received it. The results of the gag count, sedation required, patient discomfort and patient satisfaction scores are recorded in the table below.

Table Spray vs Feeding Tube

	Gag Count/patient	Midazolam mg/patient	Discomfort VAS/patient	Patient Satisfaction
Spray	* 14.6 ± 11.9	* 1.2 ± 1.1	* 52 ± 21	* 1.2 ± 0.5
Feeding Tube	6.2 ± 3.4	0.3 ± 0.5	30 ± 20	1.9 ± 1.0

(mean ± standard deviation) * P < 0.05

DISCUSSION

We conclude that a combination of lidocaine spray and supplemental lidocaine administered via a feeding tube provides superior anaesthesia and reduces sedation requirements for the performance of TEE . This technique may be particularly useful where difficult TEE placement is anticipated or where sedation is contraindicated. The technique could easily be applied to other procedures where upper airway instrumentation is necessary. Although patient satisfaction scores were better in the Spray group this may have been confounded by greater use of I.V. midazolam in that group.

REFERENCES

1. JAm Soc Echocardiogr 1989;2:375-9
2. Anesthesiology 1990;72:746-7.

CARDIOPULMONARY EFFECTS OF ABDOMINAL INSUFFLATION IN PREGNANCY : FETAL AND MATERNAL PARAMETERS IN THE SHEEP MODEL

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INTRODUCTION

Laparoscopic cholecystectomy is safe and has advantages over the open surgical approach[1]. Pregnancy is considered by some experts to be a contraindication to the use of laparoscopic techniques[2]. Theoretical concerns, which have yet to be reported on in pregnancy, include: a) physiological changes which occur during abdominal CO_2 insufflation b) positional changes assumed during surgery c) trauma secondary to trochar placement[3]. The purpose of this pilot study was to evaluate physiological trends with abdominal CO_2 insufflation in the gravid ewe and to gather preliminary data for estimates of sample size for future studies.

METHODOLOGY

After approval by the Institutional Animal Care Committee, a pilot study on 10 healthy pregnant Suffolk ewes, divided into 3 groups, was performed. Fetuses were 120 -135 days gestation (third trimester). Group 1 (n=3) were controls and had no abdominal insufflation, Group 2 (n=4) and Group 3 (n=3) were insufflated to 15 and 25mmHg respectively. Prior to the study, epidural anaesthesia was established and hysterotomy was performed for placement of a fetal femoral arterial line. Carotid and jugular lines were placed in the ewe. Following a rest and feeding period of 48hrs, general anaesthesia was induced with thiamylal and continuous muscle relaxation was provided with vecuronium. Anaesthesia was maintained with halothane (1-1.5%) and 100% oxygen. End tidal CO_2 was controlled between 35 and 45mmHg. Haemodynamic and respiratory data were collected in the ewe and fetus. In all groups, baseline measurements were obtained after induction of anaesthesia and continued for 90mins. In groups 2 and 3, abdominal CO_2 insufflation was performed and maintained for 60mins and data collection continued for a further 30mins following desufflation. Mean values (+/-SEM) were plotted and examined for trends.

RESULTS

Several trends were observed in both insufflation groups including: a) Decreased arterial oxygen tension (PaO_2) and pH, and increased arterial to end tidal CO_2 gradient in the ewe and fetus, and b) Increased fetal blood pressure and heart rate.

CONCLUSION

The clinical significance of physiological changes observed in this study are yet to be determined. Fetal tachycardia and decreased pH may be an indication of fetal distress and might be a risk marker for adverse fetal outcome. Before laparoscopy becomes a generally accepted technique in pregnant patients, potentially deleterious observed trends will require confirmation in a larger cohort study.

REFERENCES

1. CJS 1992;35:291-296, 2. Anesth Analg 1993;76:1120-33, 3. Anesth Analg 1993;76:1067-71.

ACUTE INTRAVENOUS HYDRATION PRIOR TO EPIDURAL ANALGESIA FOR LABOUR : A COMPARISON OF TWO VOLUMES OF LACTATED RINGER'S SOLUTION

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INTRODUCTION: An intravenous (IV) fluid bolus of 0.5 to 1.5L has been recommended prior to induction of lumbar epidural anaesthesia (LEA) to prevent maternal hypotension at Caesarean section.[1,2] This has been extrapolated to include induction of LEA for labour. However, induction of LEA for labour may not require aggressive IV hydration because a lower sensory block is adequate for pain relief in labour. This study compares the efficacy of a 0.5L vs a 1.0L bolus of crystalloid solution in preventing maternal hypotension following induction of LEA for labour.

METHODS: After obtaining institutional approval and informed consent, 50 patients requesting LEA for labour were randomized to receive either a 0.5L or 1.0L IV bolus of lactated Ringer's solution during placement of the epidural catheter. The parturients were then positioned supine with left uterine displacement. LEA was induced to a T10 sensory level with 2% lidocaine with 1:200 000 epinephrine in increments of 3cc, 4cc and 3cc at 5 minute intervals. Hemodynamic data was recorded every 2 minutes for 30 minutes using an automatic blood pressure device. Significant hypotension was defined as a systolic blood pressure (SBP) <90 mmHg or a decrease of >20% from baseline. Fetal heart rate and frequency of uterine contractions were recorded during the study period. Neonatal APGAR scores were also recorded. The data were analyzed using ANOVA for hemodynamic variables, and chi-square analysis and student's t-test for demographic variables.

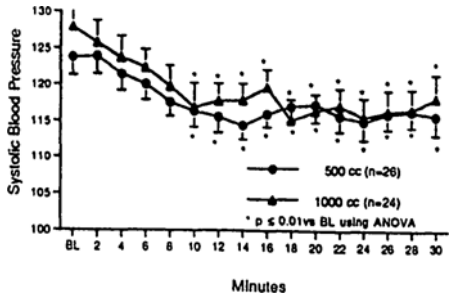
RESULTS: There were no differences in age, weight, height, gestational age or amount of lidocaine used between groups. There was a significant decrease ($p<0.01$) in SBP from baseline (BL) measurements in both groups 10 minutes after initial injection of local anaesthetic solution (Fig.). This decrease persisted for the remainder of the study period (Fig.). However, only 1 patient who received 0.5L and 2 patients who received 1.0L developed SBP<90 mmHg after induction of LEA for labour. These patients responded to IV ephedrine or increased IV fluid administration.

CONCLUSION: Our data indicates that there is no difference in the incidence of hypotension in parturients receiving a 0.5L or a 1.0L IV crystalloid bolus prior to induction of LEA for labour.

REFERENCES:

1) Anaesthesiology 1968;29:374-380
2) Anaesthesia 1983;38:250-253

Figure: SBP vs Time



A

INFORMED CONSENT IN EPIDURAL ANALGESIA FOR LABOUR AND DELIVERY

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INTRODUCTION: Many anaesthetists believe that informed consent for epidural analgesia during labour is inadequate.[1] Patients are perceived to be poorly informed and unable to cope with the information during labour. The goals of this survey were to: 1) define complications about which patients seek information, 2) assess the importance of prior patient education, the incidence and severity of each complication, and the influence of pain, anxiety and narcotic premedication on a patient's "need to know" and 3) assess whether satisfactory pain relief correlates with satisfaction with the consent process.

METHODS: Following ethics approval and consent, 26 patients were interviewed by a single observer 24-48 hours post vaginal delivery. Questions were either categorical (yes/no) or scored on a Visual Analogue Scale (VAS). All patients had received a standard explanation prior to their epidural. Results were analyzed using linear regression with a significance level of $p<.05$.

RESULTS: 85% of patients had not had a previous epidural. There was no correlation between education level (40% gr 13 or less, 40% college and 20% university) and the expressed desire for information. The epidural was successful in relieving pain (VAS improvement 5-10/10) in 92% of subjects. No correlation existed between successful pain relief and satisfaction with the consent process. There was no correlation of the rarity of a complication with the need for its understanding. VAS scores (1-10) of "need to know" per complication: Headache (6.7) Backache (7.5) Infection (8.3) Decreased BP (7.8) Inability to pass water (7.2) Local anaesthetic toxicity (7.8) Convulsions (8.9) Death/Paralysis (9.2) Effects on Baby (9.2) Effects on Labour (8.4) Inability to walk in labour (5.7). There was no difference in the information requested in the presence of severe pre consent pain or prior narcotic analgesia. 92% of patients wished they had received epidural information prior to labour.

CONCLUSION: Patients want to know of all possible complications of epidural analgesia, preferably before the onset of labour, and rank highest those with greatest morbidity. The presence of pain or narcotic premed do not appear to alter the perceived ability to comprehend the consent process. In addition, level of education cannot be used to identify those who desire greater explanation.

REFERENCES

1. Can Anaesth Soc J 1985; 32:681-5.

B

VENOUS EMBOLISM AFTER THIGH TOURNIQUET DEFLATION

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INTRODUCTION

Severe hypotension and sudden death upon thigh tourniquet deflation has been reported. [1,2] Limited evidence from animal experiments suggest that emboli released from the isolated limb may be a causative factor.[3] This study was designed to determine the incidence of venous emboli after thigh tourniquet deflation and to compare two surgical techniques on the basis of incidence, size and consequence of venous emboli.

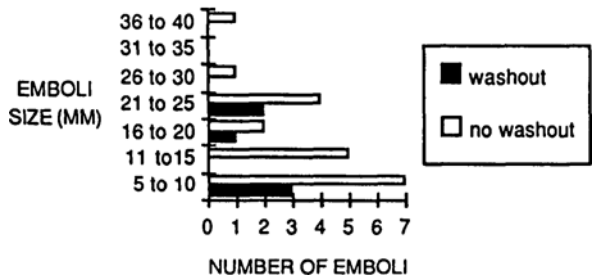
METHODS

Sixteen consenting adults requiring total knee arthroplasty (TKA) under general anaesthesia were studied. Each patient was assigned to a group according to the technique chosen by the surgeon (non-randomized). Difference in technique was based on whether the femoral intramedullary cavity was irrigated and drained prior to prostheses insertion (washout and no washout groups). Invasive arterial blood pressure monitoring and standard cardiac four chamber view via transesophageal echocardiography were recorded continuously prior to and for five minutes after tourniquet deflation. Emboli were categorized according to size and number by a blinded observer.

RESULTS

All patients had echocardiographically demonstrable venous emboli less than 5 mm in size after tourniquet deflation. No significant difference was found in the number of patients with emboli larger than 5 mm (washout 4/6, no washout 6/10). However, on average, the no washout group had twice as many large emboli per patient (figure 1). Decrease in mean arterial pressure 30 and 60 seconds after tourniquet deflation was similar in both groups. There was no difference in mean post-operative hospital stay.

FIGURE 1



DISCUSSION

Sixty-three percent of all patients had demonstrable large venous emboli. Washing and draining the femoral intramedullary space prior to knee prosthesis insertion does not decrease development of large emboli. The composition, fate and post-operative consequences of these emboli subsequent to tourniquet deflation remains to be determined.

REFERENCES

1. Anaesthesiology, 1989;71:A77
2. Anaesthesiology, 1991;74:618-20
3. Unfallchirurg, 1990;93:56-61

A

ANAESTHESIA PHARMACOECONOMICS: IMPACT OF COST-MINIMIZATION STRATEGIES IN A TERTIARY CARE HOSPITAL

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INTRODUCTION: In 1990, a collaborarative survey allowed us to determine that anaesthetic drug expenditures constitute a relatively small proportion of overall hospital drug costs.[1] The present survey was designed to compare anaesthetic drug expenditures over a three-year time period, to evaluate the impact of strategies introduced to curtail continuously-rising drug costs.

METHODS: Suggestions introduced to control rising expenditures of anaesthetic drugs were primarily based on education of anaesthesia personnel regarding drug costs, rational use of more expensive drugs, and increasing attempts to control drug wastage. To assess the impact of these measures, a review of annual hospital budgets, global pharmacy expenditures, and anaesthetic drug expenditures was conducted for the period 1991 to 1993. Both absolute and proportional costs of anaesthetic drugs were compared, by year, according to six major classes: opioid analgesics (OA), muscle relaxants (MR), inhalational anaesthetic drugs (INH), intravenous anaesthetic drugs (IV), local anaesthetic drugs (LA) and a category labelled other drugs (OTH). In addition, the utilization patterns and unit price changes for each drug were compared for the periods 1991-92, and 1992-93.

RESULTS: Total hospital drug costs increased from $7.1M to $8.5M from 1991 to 1993. During the same period, the cost of anaesthetic drugs actually decreased from $379K to $361K, despite an augmentation in annual case load from 12,507 to 13,076. For the entire survey period, the mean cumulative anaesthetic drug cost was only 4.6% of the pharmacy budget, or 0.24% of the hospital budget. The proportional costs of major classes of anaesthetic drugs are displayed in the Table. For the three-year time period, analysis by class revealed a $51K decrease in expenditures on OA, due to decreased utilization of alfentanil and fentanyl and a decrease in the price of fentanyl. The increased expenditure on INH drugs was primarily due to an increase in their acquisition costs. The introduction of new IV anaesthetic drugs ($34K increase) had minimal effect on overall drug expenditures.

DISCUSSION: The implementation of simple measures such as the education of anaesthesia personnel regarding drug costs and decreasing drug wastage can be an effective means of controlling drug expenditures, at a time when new drugs and techniques are being introduced. The pharmacoeconomic benefits of such efforts must consider overall cost-effectiveness, including the duration and quality of recovery. This will be the focus of considerable future research.

REFERENCES:

1. Can J Anaesth 1992; 39: A113.

ANNUAL DRUG EXPENDITURES

YEAR/CLASS	1991 ($379K)	1992 ($365K)	1993 ($361K)
OA (% of total)	31	18	19
MR (% of total)	22	24	21
INH (% of total)	19	21	24
IV (% of total)	5	12	15
LA (% of total)	8	9	9
OTH (% of total)	15	16	12

(For abbreviations see text)

B

DETERMINATION OF INTRINSIC PEEP AND PULMONARY COMPLIANCE DURING ONE LUNG VENTILATION AND ITS RELATIONSHIP WITH PREOPERATIVE FEV_1

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Introduction: The development of intrinsic positive end expiratory pressure (iPEEP) during one lung ventilation (OLV) for thoracic surgery has been documented.[1,2] Currently no one has determined pulmonary static compliance (CL) during OLV taking into consideration the effect of iPEEP. The purpose of the study was to determine the amount iPEEP under OLV and then to calculate CL under the same conditions. A relationship was sought between preoperative FEV_1 and calculated CL during OLV.

Methods: After approval from the hospital ethics committee, signed consent was obtained. Ten patients requiring OLV were studied. Preoperative FEV_1 were obtained. A standardized anaesthetic technique was employed. Patients were induced and intubated with a Mallinkrodt double lumen endobronchial tube (#37 - 41 Fr) and placed in the lateral decubitus position. Patients were ventilated at a tidal volume of 10ml/kg lean body weight. Respiratory rate was set to obtain $PaCO_2$ of 35 to 45 mm Hg. At end expiration the airway was occluded and iPEEP was measured using a Transpac II #42569-01 pressure transducer to a Marquette S-7010 monitor. Tidal volume, plateau pressure, and extrinsic PEEP were measured by a Datex Capnomac Ultima with side stream spirometry. Measurements were performed at the beginning and end of OLV. Statistical analysis was tested for significance by student's t-test for paired data and on the slope of the least squares regression line.

Results: This mode of ventilation produced an iPEEP of 5 (SD 3) (95% C.I. 3 - 7) cm H_2O. The CL during OLV was 27 (SD 10) (95% C.I. 20 - 35) ml/cm H_2O. There was no significant change in iPEEP or CL ($P>0.10$) during OLV. Preoperative FEV_1 displayed a linear relationship to CL ($P<0.05$) during OLV.

Discussion: iPEEP measurements during OLV were similar to those previously reported.[1] CL during OLV is decreased in comparison to two lung ventilation under anaesthesia (85 ml/cm H_2O)[3] and is similar to CL in respiratory failure[4].

References: 1. Anaesth. Analg. 68:5269
2. Br. J. Anaesth. 59:585
3. Am. Rev. Resp. Dis. 112:541
4. Crit. Care Med. 14:110

A

PRE-INDUCTION VOLUME LOADING MAINTAINS HAEMODYNAMIC STABILITY DURING RAPID SEQUENCE INTUBATION USING PROPOFOL AND SUCCINYLCHOLINE

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INTRODUCTION

Propofol provides better induction characteristics (1), greater attenuation of upper airway reflexes (2) and higher recovery scores (3) than other IV induction agents, but may be associated with hypotension (4). We report a study to evaluate the use of propofol as the induction agent during rapid sequence intubation (RSI), with two methods of prophylactic treatment of the anticipated propofol-induced hypotension.

METHODS

Twenty-four (21-60 yr-old, ASA I/II) patients were allocated randomly into 3 groups: control (Ctr.), pre-induction ephedrine 70 ug/kg (Eph.), and pre-induction volume loading 7 ml/kg Ringer's Lactate (Vol.). Patients were pre-oxygenated and induced with propofol 2.5 mg/kg (< 10 s bolus) immediately followed by cricoid pressure & succinylcholine 1 mg/kg. Oro-tracheal intubation & cuff inflation were carried out 30 s later. IPPV was started at this stage with isoflurane (0.5-0.75%) in N2O/O2 and vecuronium. The heart rate and BP were measured Q1min just before induction and for 10 min. Data were expressed as percentages of the base-line preoperative values and analyzed by the Mann-Whitney test and ANOVA.

RESULTS

The table below shows the mean percent changes in systolic blood pressure (SBP) from base-line in 24 patients (8/group).

	Post-induction	Post-intubation	10 min post-intubation
Ctr.(%)	- 4.2	+11.4	-32.4
Eph.(%)	+12.0*	+27.2*	-14.1*
Vol.(%)	- 2.3**	+ 6.6**	+ 1.3* **

(*:$p<0.05$ from Ctr., **: $p<0.05$ from Eph.; Surgical stimulation occurred after 10 min) The post-induction,the post-intubation & 10 min post-intubation heart rates were significantly different from control in the Eph. but not in the vol. group. The intubating conditions were graded as excellent in 87% of patients.

DISCUSSION

The present study has shown that RSI with propofol/ succinylcholine is not associated with immediate post-intubation hypotension. However, a delayed decrease in the BP was observed before surgical stimulation. This delayed onset hypotension was completely prevented by pre-induction volume loading.

REFERENCES

1. Can J Anaesth 1987; 34:110.
2. Anesthesiol 1988; 69:63.
3. Anaesthesia 1985; 40:735.

B

FEMORAL NERVE BLOCK: SINGLE INJECTION VS. CONTINUOUS INFUSION FOR TOTAL KNEE ARTHROPLASTY

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INTRODUCTION: Continuous femoral nerve conduction blockade has been shown to improve analgesia following total knee arthroplasty (TKA) when compared to conventional analgesic protocols[1]. This study was to ascertain whether there is any advantage of the continuous infusion (CI) technique over the single injection (SI) femoral nerve block (FNB) as assessed by pain scores, narcotic requirements, incidence of side-effects and overall patient satisfaction.

METHODOLOGY: After Ethics Committee approval, we did a prospective, randomised, double-blind study (patients and assessors) on ASA I - III patients undergoing TKA. It was determined that a sample size of at least 10 patients per group could detect a minimum treatment effect of 30% with a power of 0.8. Thirty-three patients were randomized into one of 3 groups. Group 1 received a SI FNB with 20mls 0.5% bupivacaine with 1:200 000 epinephrine (bup-e). In group 2, a FNB using 20mls 0.5% bup-e was established through an 18-G Portex catheter, threaded 10-15cm into the femoral nerve sheath. Post-operatively, a CI of 0.125% bupivacaine at 6mls/hr was commenced and continued for 48hrs. All FNB's were performed prior to induction of a standardized general anaesthetic using a nerve stimulator and insulated needles. Group 3 patients acted as controls and had a "mock" FNB. In groups 1 and 3 an infusion was simulated. All patients received a patient-controlled analgesia machine post-operatively. Patients were assessed at 2,6,12,18,24,48 and 72hrs. Pain was recorded on a 100mm visual analogue scale (VAS), at rest(r) and with motion(m) of the knee. Sensation was assessed using a sharp needle in the SI and CI groups and a dull needle in the control group prior to induction of anaesthesia and post-operatively. Narcotic consumption and side-effects related to both narcotic use and the FNB were recorded. At 72hrs, patients recorded overall satisfaction with pain management (on a scale of 1 to 5, where 1 was very satisfied and 5 was completely dissatisfied) and a guess as to group assignment. Group comparisons were evaluated using an ANCOVA, adjusting for weight and pre-operative pain scores. Alpha was set at < 0.05.

RESULTS: There were no demographic differences between the groups. All FNB's were successful. In the recovery room (RR) VAS-m scores were lower in the SI and CI groups ($p<0.05$). There were no significant differences between any of the groups regarding VAS scores, morphine requirements or complications beyond the RR. All SI FNB's, lasted at least 18hrs and all CI FNB's lasted beyond 48hrs. There were no differences between the groups regarding overall patient satisfaction with post-operative analgesia and 97% of patients were either satisfied or very satisfied. Only 2 of 11 patients in the control group felt they did not receive a FNB.

CONCLUSION: We were unable to confirm improvements in analgesia provided by CI FNB's for TKA's except in the RR. We suspect that this is largely due to sampling and study design differences. We conclude that isolated FNB's offer little advantage over narcotics alone for analgesia following TKA in this patient population.

REFERENCE: 1.Anesth Analg 1992;75:26-7.

MIDAZOLAM DOES NOT PROLONG RECOVERY FOLLOWING TOTAL INTRAVENOUS ANAESTHESIA WITH PROPOFOL/ALFENTANIL

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INTRODUCTION: Midazolam has been shown to interact synergistically with propofol, during "co-induction" of anaesthesia.[1] To evaluate the effects of midazolam on propofol requirements during total intravenous anaesthesia (TIVA) in Day Care patients, a placebo-controlled, double-blind study was designed. In addition, recovery and discharge times were compared for three different doses of midazolam given prior to induction of TIVA with propofol/alfentanil.

METHODS: Ninety unpremedicated ASA Class I and II adult Day Care patients, scheduled to undergo either knee arthroscopy or laparoscopic procedures, gave written consent to the protocol approved by the Hospital Research Ethics Board. Prior to induction of anaesthesia, patients received, in a random fashion, either placebo (Group PLAC), or midazolam at a dose of 0.015 $mg \cdot kg^{-1}$ (Group M-15), 0.030 $mg \cdot kg^{-1}$ (Group M-30) or 0.045 $mg \cdot kg^{-1}$ (Group M-45). Anaesthesia was induced with alfentanil 20 $\mu g \cdot kg^{-1}$ and propofol titrated to loss of consciousness, and was maintained with a continuous infusion of propofol beginning at 100 $\mu g \cdot kg^{-1} \cdot min^{-1}$. The propofol infusion was adjusted as required to maintain HR and SBP within ±20% of the patient's normal values, or in response to patient movement, while alfentanil was infused at 0.5 $\mu g \cdot kg^{-1} min^{-1}$ (constant). Muscle relaxation was provided with atracurium. Cumulative propofol requirements were compared, and tests of psychomotor function (Trieger Dot Test) and recovery scores were done post-operatively. Data were analyzed using analysis of variance and Fischer's Exact test, with significance assumed when $P<0.05$.

RESULTS: The mean induction dose of propofol was lower in the M-30 and M-45 groups when compared with PLAC ($P<0.05$), but average cumulative propofol requirements were not different between groups (Table). Importantly, times to awakening, Trieger scores, and discharge times from Recovery Room (RR) and the Day Care Unit (DCU), were not different in any midazolam group when compared to PLAC (Table).

DISCUSSION: Midazolam reduces the dose of propofol needed for induction of anaesthesia, but does not influence propofol infusion requirements during TIVA. Furthermore, midazolam doses which correspond to either 1, 2 or 3 mg for an average 70 kg patient, had no detectable effects on recovery profiles or discharge times from the Day Care Unit.

REFERENCE: Br J Anaesth 1991; 67:539-45.

Table: **PROPOFOL REQUIREMENTS AND RECOVERY CHARACTERISTICS**

	PLAC	M-15	M-30	M-45
Propofol Dose:				
Induction (mg)	109±42	90±47	81±34*	87±20*
Total (mg)	301±117	305±125	286±128	302±128
Awakening (min)	5.4±2.8	4.4±2.0	5.6±3.4	5.7±3.4
Trieger Score at t=30' (n)	12.1±6.6	12.8±9.6	10.5±7.1	14.0±8.8
Discharge time:				
RR (min)	57±21	59±18	60±23	64±15
DCU (min)	152±88	165±30	170±64	159±44

* Different from PLAC, $P<0.05$

A

B

HYPERGLYCEMIA DURING CARDIOPULMONARY BYPASS: THE ROLE OF THE KIDNEY

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INTRODUCTION: Hyperglycemia is frequently observed during cardiopulmonary bypass (CPB). This could be detrimental to organs, such as the brain, which may be rendered ischemic and then reperfused. Conventional textbooks of renal physiology suggest that a 10 mmol/L tubular threshold exists for glycosuria.[1] Serum glucose levels in excess of this threshold should cause the appearance of glucose in the urine. Whether this threshold exists during CPB is unknown. This prospective study was therefore designed to objectively evaluate the role of the kidney in elevated glucose levels during CPB.

METHODS: Following ethics approval and informed consent 8 patients who were free of renal disease and diabetes and who were undergoing CPB for elective coronary artery or valve surgery were studied. Anaesthesia consisted of fentanyl 50 µg/kg, midazolam 40 µg/kg and pancuronium 0.1 mg/kg for induction followed by increments of fentanyl, midazolam and enflurane as appropriate. The only intraoperative fluid administered which contained glucose was cardioplegia which is composed of 4 parts blood and 1 part Freme's solution (electrolytes in 5% dextrose). From the amount of cardioplegia given to each patient, the glucose load was determined. During CPB, systemic flows were maintained ≥2.5 L/m²/min using a nonpulsatile pump and body temperatures were kept between 33 and 38°C. Samples of blood and urine were taken at the following intervals: preCPB, on CPB x 15 min, on CPB x 30 min, end CPB, ICU arrival, and 2 hrs after ICU arrival. These samples were analyzed for: glucose, electrolytes, blood gases, substrate levels, hormones, albumin, hematocrit (Hct) and subsequently used to calculate GFR. The expected amount of glycosuria was calculated as: (serum glucose - 10 mmol/L) x GFR x time. Data analysis was performed by ANOVA or paired t tests and $p<0.05$ was considered statistically significant.

RESULTS: Glucose loads ranged from 16.2 to 65 grams. All patients became hyperglycemic during CPB (maximum value - 28.7 mmol/L). Data for preCPB and the time of maximum hyperglycemia (Maxglu) are shown in Table 1. Despite serum glucose levels in excess of 10 mmol/L, no patient excreted the expected amount of glucose in the urine. GFR did not decrease during CPB. Insulin levels rose significantly during CPB while urinary norepinephrine (NE) and epinephrine (E) did not change significantly.

Table 1

	Serum Glucose mmol/L	Expected glucose excretion mmol	Observed glucose excretion mmol	GFR ml/min	Insulin pmol/L	NE nmol/L	E nmol/L	Hct %	Alb g/L
PreCPB	6.5 ±1.1	0 ±0	0 ±0	102 ±27	45 ±21	167 ±123	26 ±15	39 ±5	34 ±3
Maxglu	18.1* ±4.7	35* ±32	1.9** ±2.8	94 ±69	187* ±82	107 ±94	25 ±21	24* ±3	22* ±4

* p<0.05 vs preCPB value. ** p<0.05 vs expected glucose excretion.

DISCUSSION: The concept of a renal threshold of 10 mmol/L for glycosuria does not appear to be valid during conditions of CPB as in this study. Since insulin levels rose appropriately and urinary catecholamines did not increase when serum glucose increased, the role of these glucose regulating hormones may be less important than that of the kidney. The mechanism for increased tubular reabsorption of glucose seen during CPB in this study is not known, but could be related to non-pulsatile flow, decreased serum Hct or decreased albumin. We conclude that the kidney plays an important and previously unrecognized role in the development of hyperglycemia during CPB.

REFERENCES: 1. The Kidney. Seldin DW, p 2873,1992.

A

MIDAZOLAM PROPOFOL CO-INDUCTION DOES NOT DELAY RECOVERY FROM ANAESTHESIA

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INTRODUCTION:

Midazolam has been shown to act synergistically with propofol during induction of anaesthesia in humans[1,2]. However, these studies did not examine the recovery phase. We tested the hypothesis that the combination of midazolam and propofol for a short procedure would not affect the recovery phase.

METHODS:

With ethics approval and informed consent, 64 outpatients scheduled for dilatation and curettage participated in a randomized double-blind study. During pre-oxygenation, patients received low-dose midazolam 0.03 mg/kg (group LM), high-dose midazolam 0.06 mg/kg (group HM) or placebo (group C) IV, followed one minute later by alfentanil 10 mcg/kg IV. Two minutes after the study drug, patients received lidocaine 20 mg IV, followed by propofol 30 mg IV every 10 sec until loss of lash reflex. Anaesthesia was maintained with 70% N_2O in O_2 by mask, with ventilation controlled as needed to maintain $ETCO_2$ 30-40mm Hg. Propofol 20-30 mg IV was given when movement occurred. Vital signs were recorded every 3 minutes, and N_2O was discontinued upon completion of surgery. Patients were observed in the OR until they opened their eyes to command. Postoperatively, they were observed every 15 minutes until a discharge score of 9 out of 10 was achieved[3]. Results, shown as mean (SD), were assessed by analysis of variance with p values for analysis of trend amongst means.

RESULTS:

Groups were similar in age, weight, and duration of surgery. Hemodynamic differences were clinically insignificant.

Group (N=64)	propofol induction dose(mg/kg)	propofol for maintenance (mg/kg/min)	eye-opening (min)	discharge -ready (min)
C (N=21)	2.22 (0.77)	0.12 (0.10)	2.7 (1.7)	115 (62)
LM(N=23)	1.61 (0.80)	0.14 (0.17)	4.5 (2.8)	126 (56)
HM(N=20)	0.96 (0.65)	0.082 (0.07)	5.0 (3.3)	109 (48)
ANOVA	p=0.0001	p=0.35	p=0.01	p=0.74

DISCUSSION:

The induction dose data are consistent with synergism of midazolam and propofol. The absence of differences in maintenance doses of propofol may reflect a) redistribution of midazolam and alfentanil, b) absence of synergism of midazolam and propofol for noxious stimulation, or c) an unsustained interaction at central GABA receptors. We conclude that in the dosage range used, midazolam-propofol co-induction delays eye-opening, but does not delay recovery from anaesthesia.

(1) Br J Anaesth 1991;67:539.
(2) Br J Anaesth. 1992;69:240.
(3) Anesth Analg 1991;72:S42.

B

THE COST IMPACT OF NEEDLE-FREE INTRAVENOUS SYSTEMS ON A PAEDIATRIC ANAESTHESIA DEPARTMENT.

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INTRODUCTION

Because of concerns over disease transmission via needlestick injury, we undertook a study to assess the cost impact of needle-free systems, for anaesthetists, in a Canadian children's hospital.

METHODS

This project was done in two stages. First, we quantitated existing consumption of intravenous supplies. The anaesthesia equipment carts in each operating theatre were inventoried daily for 5 consecutive working days. The results were extrapolated to 52 weeks. Second, we obtained retail price quotes from suppliers of alternative equipment. We then calculated the cost impact of each alternative, based on existing consumption and prices.

RESULTS

Over 5 days, in 5 operating theatres, 210 venous accesses were performed. This consumed 55 butterfly® sets, 372 indwelling IV catheters, 44 heplock caps, 166 dripsets, 150 T-connectors, 7 stopcocks, and 26 extensions. In addition, 708 needles were used for drug administration through IV ports.

The cost of existing iv cannulae was $21,632 per annum; Critikon ProtectIV® increased it by $44,536 [2X] and Landmark® by $222,612 [10X].

Alternatives to conventional dripset ports; supplied by Braun Safsite®, Quest , and Baxter Interlink®, are tabulated below. The first two are anti-reflux Luer ports, adaptable to existing dripsets. T-connectors are replaced by Y-extensions. Sharp needles are still required to fill syringes. The third is an integrated system of dripsets, ports, and blunt injection cannulae.

system	annual cost $	annual increment $ [%]
current	71,136.00	0 [00]
Burron safsite®	99,476.00	28,340 [40]
Quest	77,168.00	6,032 [08]
Baxter Interlink®	106,132.00	34,996 [49]

DISCUSSION

Intravenous catheter stylets carry the greatest risk for disease transmission, but the alternatives are cost prohibitive.

Dripset ports, and needles which broach them, must also be considered contaminated [1]. Quest offers the least expensive alternative. Problems of air entrainment through these ports have been reported with central venous lines, but never with peripheral lines.[2] Meticulous care can prevent bacterial contamination.[3]

In our institution, no needlesticks have been reported by anaesthetists, but this may simply be lack of reporting. The prevalence of HIV, HBV, and HCV seropositivity in Canadian children is unknown; in Alberta, only 2 cases of childhood AIDS have been reported, but seropositivity may be more prevalent in teenagers.[4] Only 1-2 cases of childhood HBV are reported annually in Alberta; however immigrants from high prevalence countries are not screened for carrier status.

We cannot quantitate benefit for these systems because the risk of disease transmission is unclear. We have, however, provided a cost framework on which decisions conceming needlefree alternatives can be made.

REFERENCES

1. CJA 37: 156-59
2. Anesthesiology 75: 1120-21
3. AnesthAnalg 58:141-142
4. Dr. J. Waters Director, Communicable Disease Control, Alberta Public Health: personal communication

B.U.R.P. IS MORE EFFECTIVE THAN BACKWARD PRESSURE ON THE THYROID CARTILAGE IN MANAGING DIFFICULT LARYNGOSCOPY

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Introduction: Difficult laryngoscopy that complicates tracheal intubation is an important problem. However, the relative effectiveness of various methods of management has not been systematically studied. We compared the efficacy of two simple maneuvers to improve the glottic view when laryngoscopy is difficult: (1) "B.P." (back pressure on the thyroid cartilage) and (2) "B.U.R.P." (backward, upward and rightward pressure on this cartilage). We also determined whether the benefits of these maneuvers could be predicted by characteristics of the upper airway assessed preoperatively.

Methods: Successive adults requiring general anaesthesia and routine tracheal intubation were studied by the investigators. Each was examined before anaesthesia for mouth opening, thyromental distance, dentition, neck mobility and Mallampati class. With the patient's head & neck in the sniffing position, general anaesthesia was induced intravenously, neuromuscular paralysis produced by succinylcholine and a MacIntosh #3 blade positioned in the usual way. Exposure of the glottis was graded using the Cormack scale (1 = full view, 2 = partial view and 3 = no view) in 3 conditions: (1) control, (2) with B.P. applied by an assistant, and (3) with B.U.R.P. performed by the assistant according to published criteria [1].

Results: Of 220 patients (45 $\pm$ 18 yrs, M=F), 15 (6.8%) presented in the control state with a grade 3 view. B.P. exposed the glottis in 6 of the 15 (prop .40; 95% confidence interval .16-.68) converting all to a grade 2 view; visualization in 9 was unaffected (Fig). B.U.R.P. exposed the glottis in all 15 grade 3 cases (prop 1.0; 95% CI .77-1.0), converting 8 to a grade 2 and 7 to a grade 1 view; no glottis was left unexposed (difference from B.P., $P<0.001$; Fisher's exact test). While grade 3 views in the control state related to the preop Mallampati class ($P=0.002$; multivariate regression) the variable benefit of B.P. on grade 3 views was not predictable.

Conclusion: Most cases of difficult laryngoscopy (at least 75% of grade 3 views) can be managed quickly and easily with B.U.R.P. When used as recommended [1], this technique is more consistently effective than back pressure alone.

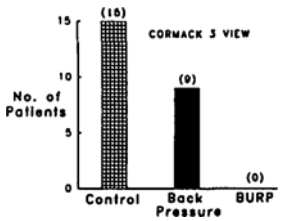

Figure: Number of cases with Cormack grade 3 laryngoscopic view in the control state and with B.P. and B.U.R.P.

1. Can J Anaesth 40: 279, 1992.

A B

COMPARISON OF PROPOFOL (P), DROPERIDOL (D) AND METOCLOPRAMIDE (M) FOR THE TREATMENT OF POSTOPERATIVE NAUSEA AND VOMITING.

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INTRODUCTION : Postoperative nausea and vomiting (PNV) are the most frequent complications of general anaesthesia. Despite the improvement of anaesthetic techniques, the incidence of PNV remains between 20 and 40%. The drawback of the antiemetic drugs presently used for the treatment of PNV is their high incidence of undesirable side effects (sedation, extrapyramidal rigidity, hypotension). Recently, Borgeat et al. reported the efficacy of P compared to placebo for the treatment of PNV(1). A subhypnotic dose of P was used and no side effect was observed. However, no study has yet compared P to M and D, the two most commonly used drugs for the treatment of PNV. The goal of this study was to compare the efficacy a subhypnotic dose of P(10mg IV) with M(10mg IV) and D(1.25mg IV) in the treatment of PNV. This was done in a prospective, controlled, randomized, double-blind study.

METHODS : All patients scheduled for elective surgery under general anaesthesia were recruited. Those who consented to the protocol received a standard anaesthetic including N_2O, O_2, a narcotic, isoflurane and a muscle relaxant when required. No patient received P as an anaesthetic or any prophylactic antiemetic drug. Patients requiring a naso-gastric tube postoperatively were excluded. In the recovery room, patients complaining of persistent nausea (lasting > 10 min) and/or experiencing at least two episodes of retching or vomiting were given one of the three study drugs according to a randomized double-blind table. The three drugs were mixed with Intralipid® to make them undistinguishable. Nausea was assessed on a visual analog scale just before injection (time 0) and 5, 10, 15, 20, 30, 45, 60 minutes after. Recurrence of retching and vomiting was also recorded during this period. Patients still having symptoms after 30 minutes were given dimenhydrinate 50mg IV as a rescue medication. Data on the incidence and severity of side effects and on the need of an antiemetic after discharge from the recovery room were also collected.

RESULTS : 781 patients gave consent to the study. Of these 75 met the inclusion criteria and received one of the study drugs. The three groups were comparable with respect to age, sex, weight, height and severity of PNV prior to injection (time 0). The three drugs decreased the severity of nausea. After 5 minutes, the efficacy of the three drugs was comparable. However after that, P was less effective ($p<0.05$). The recurrence of vomiting and retching was clearly higher with P (58%) than M (25%) and D (4%) ($p<0.001$). More patients who received P necessitated a rescue medication (54%) than those who received M (29%) or D (16%) ($p< 0.02$). There was no significant difference between M and D.

DISCUSSION : Subhypnotic dose of P possesses antiemetic properties that appear useful to treat PNV and chemotherapy-induced nausea and vomiting(2). Our results confirm its efficacy in the treatment of PNV. However, it is less effective than M and D that have been the usual choices for that purpose in the past. We conclude that conventionnal antiemetics (M and D) are superior to P for the treatment of PNV.

REFERENCES :
1. **Anesth Analg** 1992; **74** : 539-41.
2. **Can J Anaesth** 1992; **39** : 170-2.

A

THE EFFECTS OF REVERSAL OF NEUROMUSCULAR BLOCKADE ON BAROREFLEX FUNCTION AND HEART RATE VARIABILITY

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INTRODUCTION

Impaired parasympathetic control of heart rate is associated with an increased incidence of cardiac dysrhythmias and ischemia, and decreased survival after myocardial infarction[1]. Baroreflex sensitivity (BRS) and the high frequency component of heart rate variability (HRV) are sensitive indicators of parasympathetic activity [2]. Anticholinergic drugs, commonly administered during reversal of neuromuscular blockade, suppress BRS and HRV [3] and might therefore be detrimental in patients at risk of cardiovascular complications. In this double-blind randomized trial, we compared the effects of atropine, glycopyrrolate and placebo on BRS and HRV in the postoperative period.

METHODS

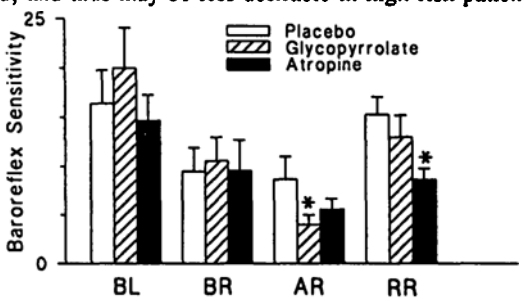
Thirty ASA I or II patients aged 17-51 were induced with propofol, fentanyl and succinylcholine and maintained with a propofol infusion, N_2O/O_2 and vecuronium. Neuromuscular blockade was allowed to wear off spontaneously. Patients then received either atropine 20μg/kg and neostigmine 50μg/kg (A), glycopyrrolate 8μg/kg and neostigmine 50μg/kg (G), or placebo (P). Muscle strength was tested prior to extubation. Four 15-20 minute recordings of continuous heart rate and blood pressure (Finapres, Ohmeda) were taken at baseline before induction (BL), before reversal (BR), 10 min after reversal while still anaesthetized (AR), and 90-120 min after reversal in the recovery room (RR). Spontaneous BRS and spectral analysis of HRV in the high frequency band (>0.15 Hz.) were calculated using dedicated software. Data were analyzed with ANOVA for repeated measures (significance $P<0.05$).

RESULTS

The 3 groups had similar BRS and HRV at baseline. BRS and HRV decreased significantly after reversal with A and G. At 90-120 min. postop, BRS had recovered to baseline values in the P and G groups but not the A group. HRV remained lower than placebo in both A and G groups postoperatively.

CONCLUSIONS

Atropine leads to more prolonged impairment of parasympathetic control than glycopyrrolate in the postop period, and thus may be less desirable in high-risk patients.



[1] Circ 78:967-979 [2] JANS 21:127-134 [3] Circ Res 19:400-411

B

DOSE-RESPONSE AND DURATION OF ACTION OF SUCCINYLCHOLINE AND VECURONIUM IN SEVEN MUSCLES IN THE GOAT

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INTRODUCTION: Animal[1] and human[2,3] studies have suggested that in some instances slow-twitch muscles are more sensitive to non-depolarizing relaxants and less so to depolarizing relaxants than fast-twitch muscles. It is not known whether this inverse relationship between depolarizing and non-depolarizing relaxants applies to other muscles or species. This study investigated (1) the relative responses of muscles of the limb, abdominal wall, diaphragm and larynx to vecuronium (VEC) and succinylcholine (SUX); and (2) whether there is inversion of the relative responses of these muscles to these drugs.

METHODS: Two groups each of seven adult female goats were used to study SUX and VEC after Institutional approval. Under thiopentone anaesthesia, evoked integrated EMG response to indirect supramaximal train-of-four stimulation every 12 sec was monitored at the rectus abdominis (ReAb), transversus abdominis (TrAb), gastrocnemius (GAS), soleus (SOL), diaphragm (DIA), cricoarytenoideus dorsalis (CAD) and thyroarytenoideus (TA) muscles. Cumulative doses of the drugs were given to depress the first response in the train (T1) by ≥ 90% of control in all muscles, and spontaneous recovery allowed to occur. Cumulative dose-response curves were constructed from the logit transformation of T1 blockade versus logarithm of the dose and the ED50 derived for each muscle. The duration for spontaneous recovery of T1 to 25% (T25) of maximum response was recorded for each muscle. The mean (± SEM) of the ED50s and duration to T25 were compared between muscles by Oneway ANOVA.

RESULTS: For both SUX and VEC, there were significant differences between the duration to T25 but not the ED50s at the seven muscles. Duration to T25 was longer ($P < 0.05$) at the abdominal than at the laryngeal muscles for SUX, or than at the diaphragm and laryngeal muscles for VEC (Table).

DISCUSSION: These results demonstrate that (1) in goats the duration of both SUX and VEC blockade is shorter at the laryngeal muscles and longer at abdominal muscles than at the diaphragm and limb muscles; and (2) the relative sensitivities of these muscles is not inverted between SUX and VEC.

Mean (± SEM) of the ED50s (μg kg^{-1}) and duration (min) to T25 in seven muscles after SUX and VEC

Muscle	SUX ED50	SUX T25	VEC ED50	VEC T25
1. TA	152.4 ± 20.2	5.2 ± 1.5	2.9 ± 0.3	34.7 ± 4.2
2. CAD	139.9 ± 25.8	6.3 ± 2.0	3.2 ± 0.4	27.4 ± 4.6
3. DIA	135.8 ± 9.8	17.3 ± 4.4	3.7 ± 0.8	34.0 ± 3.9
4. GAS	118.6 ± 11.4	19.6 ± 5.4	3.4 ± 0.4	38.8 ± 3.7
5. SOL	159.2 ± 19.6	15.9 ± 6.5	3.4 ± 0.3	39.4 ± 3.0
6. ReAb	135.8 ± 10.8	31.6 ± 3.9	2.8 ± 0.2	57.7 ± 9.2
7. TrAb	134.8 ± 9.3	31.1 ± 3.7	3.1 ± 0.2	62.4 ± 5.9
P	0.6953	0.0001	0.7884	0.0001

1. Journal of Physiology (London) 112: 311- 331.
2. Anesthesia and Analgesia 73: 278-282.
3. Anesthesiology 74: 833-837.

A

A SIMPLE SPREADSHEET TOOL FOR COST ACCOUNTING ANAESTHESIA CARE

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Introduction. In order to deliver cost-effective anaesthetic care without compromising patient safety, a cost accounting system utilizing a computer spreadsheet to monitor anaesthesia expenses was developed.
Methods: A spreadsheet tool listing 29 anaesthetic agents and several disposable equipment items was developed using Microsoft's Excel For Windows. The spreadsheet incorporated unit costs, enabling the agents and items to be tracked and their costs totalled per anaesthetic encounter. Cost estimates of volatile anaesthetics were obtained from repetitive calculations of vaporizer settings and fresh gas flow rates at specific time intervals.[1] The spreadsheet tool was used for two separate one-week periods in order to determine the cost of drug wastage (defined as opened, but unused drugs left on the carts at the close of each day). Educational efforts emphasizing awareness of drug wastage were made in the interim time span separating the two study periods. The spreadsheet tool was also used to calculate comparative costs of various anaesthetic agents.
Results. The use of the tool in combination with educational efforts reduced drug wastage by $1000 per week (from $1500 to $500). Comparative cost analysis using the tool showed that mivacurium was 18 times more expensive than pancuronium and 1.3 times more expensive than atracurium or vecuronium when used for induction and maintenance of neuromuscular blockade for a two hour case. Similarly, alfentanil was 30 times more expensive than fentanyl and 1.5 times more expensive than sufentanil for a 2 hour case. Reduction of fresh gas flows from 5 to 2 liters/minute resulted in a savings of $0.94, $15.85, and $20.26 for 2 hours of halothane, enflurane and isoflurane anaesthesia, respectively.
Discussion. The spreadsheet tool identified areas of high expenditure and permitted comparison of alternative anaesthetic plans from a cost standpoint. Careful attention to anaesthetic technique, choice of agent, drug wastage (drawn up, but not used and discarded) and fresh gas flow settings should reduce wastage of anaesthetic agents, without compromising patient care.
Reference. 1. Can J Anaesth 1992;39:633

B

EFFECT OF INTRACORONARY MIDAZOLAM ON SYSTOLIC FUNCTION IN THE DOG HEART

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INTRODUCTION: The unique pharmacologic profile of midazolam has resulted in its widespread clinical use both in and out of the operating room. Although hypotension has been reported, the direct effects on myocardial contractile function and metabolic indices have not been fully elucidated. This study evaluated the effect of intracoronary midazolam on regional contractility and metabolism in an in-situ canine model.

METHODS: Dogs (25-33 kg) were anaesthetized with sodium thiopentone 10 mg/kg iv, alpha-chloralose 100 mg/kg iv and morphine sulphate 3 mg/kg im. Following endotracheal intubation, ventilation was controlled and anaesthesia was continued with an infusion of alpha-chloralose 20 mg/kg/hr. Left ventricular and aortic blood pressures were continuously monitored. Regional systolic shortening (SS) in the areas supplied by the left anterior descending (LAD) and circumflex (CIRC) coronary arteries was measured using piezoelectric crystals implanted in the midmyocardium of each area. Catheters were inserted into two epicardial veins draining the LAD and CIRC perfusion beds for venous blood sampling and calculation of oxygen extraction. The LAD was cannulated with a 3 mm DLP flexible vessel catheter and perfused by an autoperfusion circuit from the left carotid artery. Midazolam was administered directly into the LAD cannula to achieve concentrations of 4 and 8 µg/ml. Data are presented as Mean ± SD and were analyzed using ANOVA. Differences were considered significant if $p < 0.05$.

RESULTS: As shown in Table 1, midazolam, at either concentration, did not alter MAP, HR, or oxygen extraction. There was however a dose dependent decrease in systolic shortening in both the LAD and CIRC areas.

	Ctrl n=8	Midaz (4µg/ml)	Recov	Midaz (8µg/ml)	Recov
SS LAD (%)	14.9±3.2 (100%)	14.3±4 (97%)	12.3±2.3 (87%)	11.6±3* (80%)	12.4±3.9 (85%)
SS CIRC (%)	9.7±3.0 (100%)	10.3±3.4 (106%)	9.0±4.0 (91%)	7.9±4.2* (78%)	8.1±4.8 (82%)
O_2 Extract. LAD (%)	39±11	34±6	36±7	35±9	39±9
O_2 Extract. CIRC (%)	47±6	42±1	44±7	44±8	45±11
MAP (mmHg)	99±25	97±20	104±31	96±27	93±24
HR (bpm)	94±30	90±24	86±19	89±22	88±24

DISCUSSION: The results of this study demonstrate that midazolam, at clinically relevant concentrations, has a significant effect on systolic function. Interestingly, systolic shortening in the CIRC area was affected by administration of the drug into the LAD region. The reason for this effect is not known. These depressant effects on LAD systolic function are similar to those produced by intracoronary thiopentone administration.

A

COMBINED ONDANSETRON AND DROPERIDOL IN OUT-PATIENT LAPAROSCOPY

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INTRODUCTION: Ondansetron (OND), a 5-hydroxytryptamine$_3$ receptor antagonist, has been shown to reduce but not eliminate post-operative nausea and/or vomiting (PONV)[1]. Droperidol (DRO), a dopaminergic antagonist, is also an effective anti-emetic. It was hypothesized that the co-administration of these two drugs prophylactically would result in better anti-emetic effects.

METHODS: Following Ethics Board approval and patient consent, 80 consecutive female out-patients scheduled for laparoscopy were randomly allotted in a double blind fashion to receive either: i) saline (placebo), ii) OND 4mg, iii) DRO 1.25mg, and iv) OND 4mg and DRO 1.25mg (COMB) on induction. Following a standardized general anæsthetic, patients were interviewed and assessed for PONV at 0.5, 1.5, 2.5, 3.5, and 24 hours post-surgery. Groups were compared by t-tests and χ^2 with a $p < 0.05$ considered significant.

RESULTS: There were no significant demographic differences between the four groups. During the 3.5 hours hospital stay, the incidence of PONV in the placebo group was 85%. This was reduced to 35% with DRO alone ($p < 0.002$), or to 30% with OND alone ($p < 0.001$). The COMB resulted in an incidence of 10% ($p < 0.001$). Although there were no statistically significant differences between COMB and the two separate drug treatments (OND and DRO) in this time interval, a decreasing trend in PONV was evident. At 24 hours (Fig. 1), although the incidence of PONV stayed the same in placebo, in DRO it increased to 50%, in OND to 35%, and in COMB to 15% (all p's < 0.01 vs. placebo). A statistically significant difference was observed between DRO and COMB during this time period ($p < 0.02$).

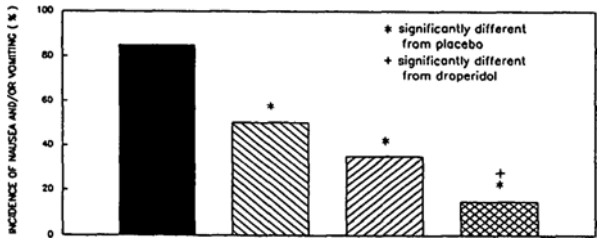

Figure 1:

DISCUSSION: The results of this study suggest that the combination of these two drugs is more efficacious as a prophylactic anti-emetic than either agent alone. This additive effect may be due to the different mechanisms of action of OND and DRO. Verification will require further studies with larger number of participants. Also, the apparent decrease in the efficacy of both DRO and OND with time suggests that a second prophylactic dose may be beneficial.

REFERENCES: 1. *Anesth Analg* 1991;73:250-254

B

HYPOMAGNESEMIA AND KETAMINE ANAETHESIA

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INTRODUCTION The NMDA subtype of glutamate receptor is blocked by Mg and ketamine. In vitro studies indicate that Mg ions inhibit blockade by ketamine[1,2]. Conversely, ketamine inhibits Mg blockade of NMDA receptors suggesting that these compounds are mutually exclusive in their binding. The purpose of this study was to determine if a reduction in magnesium levels in vivo influences the duration of ketamine anaesthesia.

METHODS Eleven Wistar weanling rats were randomly allocated to receive a control (n=6) or magnesium deficient diet (n=5). Animals were maintained on diets for 14 days then anaesthetized with ketamine (125 mg/kg IP). Time to loss of righting reflex, and latency to recovery of righting, corneal, tail flick, and crawl reflexes were noted by observers blinded to the treatment group. Animals were then sacrificed and serum Mg, Ca and protein concentrations determined. Power analysis of the pilot study suggested that 44 animal be enrolled in a subsequent study. Results from these animals are presented below.

RESULTS Serum concentrations of Ca and protein were within the normal range for both groups whereas Mg was less in depleted animals (1.07±0.15 vs 0.32±0.21 mmol/L P< 0.0001 Student's t-Test). Three of 22 low Mg rats died prior to ketamine with no deaths observed the control group (n=22). Four of 19 low Mg survivors subsequently died following ketamine. No deaths were observed in the control group 0/22 (P<0.038 Fishers Exact Test). The time to loss of righting reflex was shorter in low magnesium animals (1.95±1.11 vs 2.58±0.9 P<0.05, Mann-Whitney Test). Latency to toe pinch was longer in the low magnesium rats (25±20.2 vs 3.12±8.5, P<0.005 Mann-Whitney Test) with no difference in the time to recovery of corneal, righting and crawl reflexes observed between the two groups.

DISCUSSION More deaths were observed in the hypomagnesemic group following ketamine. Of the survivors, the time to loss of righting reflex was shorter and latency of toe pinch longer than control animals. The potency of ketamine may have increased due to enhanced access to its binding site. Alternatively, magnesium may influenced the bioavailablility and metabolism of ketamine. These results indicate that ketamine should be used with caution in hypomagnesemic patients.

References: 1. J.Pysiol 432,485-508, 2. Eur J Pharmacol 204, 29-34

The Pharmacodynamic Half-Life of Doxacurium

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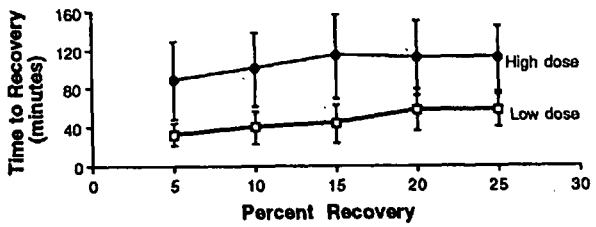
Introduction Ordinarily, the elimination half-life of a drug is determined by serial estimation of the drug concentration in plasma, a process which is generally cumbersome, invasive and expensive. Where a drug has a readily measured effect (eg, degree of neuromuscular blockade) drug half-life can sometimes be determined by pharmacodynamic methods. The concept of pharmacodynamic half-life is based on the premise that if the dose of a drug is doubled, its effect will be prolonged by one half-life since it takes one half-life for the drug plasma concentration to decrease by one half. Such a technique has been previously applied to succinylcholine [1] and to atracurium [2]. This technique is particularly well-suited to studying drugs which would otherwise be rapidly broken down following sampling of the drug (eg, by plasma cholinesterase).

Methods Following institutional approval, 40 ASA physical status I or II adults under age 70 and scheduled for elective surgery were entered into the study. All were free of hepatic, renal and neuromuscular disease Patients were randomized to receive either ED_{95} (0.03 mg/kg) or 2 x ED_{95} (0.06 mg/kg) of doxacurium following induction with propofol and obtaining a baseline thumb mechanomyogram in response to supramaximal stimulation of the ulnar nerve (repeated every 12 sec). Maintenance of anaesthesia was with propofol and nitrous oxide. In each case, the time to 5, 10, 15, 20 and 25% recovery of neuromuscular blockade was obtained from the graphic recordings. For each recovery point, the pharmacodynamic half-life was taken as the difference between the mean time to recovery for both groups.

Results and Discussion The figure below shows the mean and standard deviation of the time to recovery for each group and for each level of recovery. The difference between these curves is the estimate of pharmacodynamic half-life, as given in the table below. These results are consistent with classical estimates of the pharmacokinetically derived elimination half-life of doxacurium, which ranges from 70 to 99 minutes[3].

Percent Recovery	5%	10%	15%	20%	25%
Half-Life (min)	55.7	60.8	69.7	53.9	53.9



References
1. Cook DR, Wingard LB, Taylor FH. Pharmacokinetics of succinylcholine in infants, children and adults. Clin Pharmacol Ther 1976; 20:493-8.
2. Donati F, Bevan DR. The pharmacodynamic half-life of atracurium. Can Anaesth Soc J 1985; 32:S56-S57.
3. Faulds D, Clissold SP. Doxacurium. A review of its pharmacology and clinical potential in anaesthesia. Drugs 1991; 42:673-689.
This project was supported in part by Burroughs Wellcome Inc., Canada

A PROSPECTIVE RANDOMIZED STUDY OF INTRAOPERATIVE EFFICACY OF MIVACURIUM CHLORIDE WITH OR WITHOUT REVERSAL AGENTS IN COMPARISON TO SUCCINYLCHOLINE

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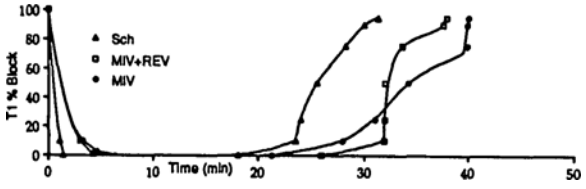
INTRODUCTION: A reversal agent may not be essential for a new short acting non-depolarizing muscle relaxant mivacurium chloride (MIV) as it is metabolized by plasma cholinesterase. We compared the time for recovery of neuromuscular (NM) function after infusion of MIV with or without a reversal agent to that of succinylcholine (Sch).
METHODS: After Institutional approval, 42 laparoscopic surgical patients were randomized into 3 groups. Group A(n=16):Sch (1.5mg/kg); Group B (n=13): MIV (0.15mg/kg) +Reversal agent (REV) (neostigmine & glycopyrrolate) and Group C(n=13):MIV(0.15mg/kg) only. Patients were induced with propofol (2.5mg/kg), fentanyl (1.5µg/kg) and the randomized muscle relaxant. Intubation was achieved at 60 sec for group A, 120 sec for group B and C. Anaesthesia was maintained with propofol infusion/N_2O/O_2. Intraoperative hemodynamics was noted and NM function was measured by EMG response to TOF stimulation using a relaxograph (Datex NMT-100) every 20 sec. When T_1 recovered to 5% of control an infusion of Sch (60µg/kg/min) for group A or MIV for groups B and C (10µg/kg/min) was commenced and titrated to maintain a T_1 of 5-10%. The infusion was stopped 5 min before end of surgery. Patients in group A and C were monitored until T_1 recovery reached a plateau and T_4/T_1 ratio≥ 70% before extubation. Group B patients received REV when T_1=10% and time to T_4/T_1 ratio≥ 70% was measured. Time to achieve recovery index (RI) was measured when T_1 increased from 25-75%.
RESULTS: There was no significant difference in demographic and hemodynamic parameters among the 3 groups.The table compares the recovery time among the 3 groups (mean ± SD)

Group	Rec TOF≥ 70% (min)	RI (min)
A: Sch	——	5.9 ± 3.0
B: MIV +REV	6.7 ± 1.8	6.2 ± 3.2
C: MIV	13.7 ± 4.2 *	8.9 ± 3.4 *

*P<0.05 vs group A and B.
The NM function patterns from the time the muscle relaxant was administered to recovery was compared in Fig I.



DISCUSSION: Time for spontaneous recovery of NM function after MIV without reversal agents was significantly more prolonged than MIV+REV and Sch. There was no difference in recovery of NM function when MIV+REV was compared to Sch.
Supported in part by Burroughs Wellcome Inc., Canada

A

POSTOPERATIVE MYALGIA OF MIVACURIUM WITH OR WITHOUT REVERSAL AGENTS IN COMPARISON TO SUCCINYLCHOLINE IN DAY SURGERY:A PROSPECTIVE RANDOMIZED STUDY.

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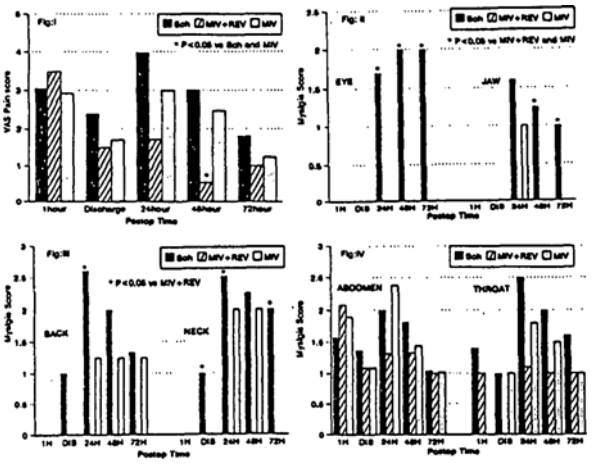
INTRODUCTION: This study was undertaken to compare postop myalgia of mivacurium chloride (MIV) with or without a reversal agent to succinylcholine (Sch).
METHODS: After Institutional approval, 42 laparoscopic surgical patients were randomized into 3 groups. Group A (n=16): Sch (1.5mg/kg) + d-tubocurarine (3mg); Group B (n=13): MIV (0.15mg/kg) + Reversal agent (REV) (neostigmine & glycopyrrolate) and Group C(n=13): MIV (0.15mg/kg) only. Patients were induced with propofol (2.5mg/kg), fentanyl (1.5µg/kg) and the randomized muscle relaxant. Intubation was achieved at 60 sec for group A and 120 sec for group B & C. Anaesthesia was maintained with propofol infusion/ N_2O/O_2. When T_1 recovered to 5% of control, as measured by EMG response to TOF stimulation, an infusion of Sch (60µg/kg/min) for group A or MIV (10µg/kg/min) for group B and C was commenced. 2 blood samples were drawn for creatinine kinase (CK) level - preop and 2 hrs postop. Patients were discharged from the hospital when the discharge score was ≥ 9 (PADS)[1]. Overall pain was assessed by a visual analog pain score (VAS) and myalgia were assessed using a scale of 0-5 (0= no pain, 5= excruciating) at preop and postop time intervals: 1h, at discharge, 24, 48 and 72h.
RESULTS: There was no significant difference in demographic and CK levels among the 3 groups. The postop VAS pain score was significantly lower in group B at 48 hrs than in groups A & C (Fig I). Group A had a significantly higher postop myalgia score in the eye, jaw, neck, back and arm than the patients in group B (Fig II, III), but not in abdomen or throat (Fig IV).



DISCUSSION: In patients undergoing ambulatory laparoscopic surgery, MIV+REV significantly decreases postop myalgia, when compared to Sch or MIV only.
REFERENCE:1. *J Clin Anesth* 5: 64-68S,1993.
Supported in part by Burroughs Wellcome Inc., Canada

B

Safety and Efficacy of PCA and Epidural Narcotic - Local Anesthetic Infusions on Regular Wards

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Introduction: A recent survey of university-affiliated acute care hospitals documented the existence and composition of acute pain services in Canada.[1] An estimation of complications was also made, however, the inaccuracy of their data was noted. Since our acute pain service has kept detailed records of all patients treated for the last two years we feel that our results would be indicative of the present standard of care.

Methods: We retrospectively reviewed our results for the time periods July '91-June '92 and July '92-June '93. Patients receiving patient controlled analgesia (PCA) had orders written by their attending anesthetist and treatment initiated in PACU. PCA therapy consisted of morphine 1-2 mg, fentanyl 10-20 μg or demerol 10-20 mg with lockout intervals of 5-10 minutes. Epidural catheters were usually inserted preoperatively and used intraoperatively as part of their anesthetic. Postoperatively, epidural analgesia consisted of fentanyl 5-10 μg/ml and/or bupivacaine 0.1-0.25% administered by syringe pump at 6-10 ml/hr. All patients routinely returned to the regular surgical ward where monitoring consisted of hourly assessments of respiratory rate and sedation. For PCA patients, doses attempted and given were recorded q4h while for epidural patients assessments of motor blockade were made q4h. Patients were also assessed twice daily by the acute pain service with analgesia (VAS), SaO_2 and side effects recorded during the morning visit. Comparisons were made using unpaired t-tests and ANOVA where appropriate.

Results: Table 1 shows the average analgesia and duration of use for both forms of therapy for the two time periods. Epidural analgesia produced significantly better analgesia during both time periods. Table 2 lists the incidence of side effects that resulted. Nausea was the only side effect that was significantly different. One epidural catheter migrated intrathecally, and one that became disconnected was inadvertently connected to the patient's nasogastric tube. Both were recognized quickly and removed.

	July '91-June '92		July '92-June '93	
	PCA	epidural	PCA	epidural
POD1AM	42.3±25.0	31.1±25.9*	43.8±26.1	27.5±26.3*
POD2AM	36.9±23.7	20.7±20.8*	37.1±23.2	26.0±21.7*

Table 1 VAS (0-100 mm), *p < 0.001

	July '91-June '92		July '92-June '93	
	PCA	epidural	PCA	epidural
number patients	664	122	1232	163
nausea	171(26%)	18(15%)*	388(31%)	32(20%)*
pruritis	92(14%)	17(14%)	179(15%)	19(12%)
sedation > 4/5	7(1.0%)	0(0%)	5(0.4%)	0(0%)
resp. depression				
-T_x changed	9(1.4%)	6(5%)	44(3.5%)	5(3%)
-narcan given	2(0.3%)	1(0.8%)	3(0.3%)	0(0%)

Table 2 side effects, *p < 0.05

Discussion: The incidence of side effects was similar to that reported from two major U.S. institutions,[2,3] and confirms the estimation based on a recent Canadian survey.[1]

References:
1. Can J Anaesth 40:568-75, 1993. 2. Anesthesiology 79:A794, 1993.
3. Anesthesiology 79:A888, 1993.

COMPARISON OF REGIONAL INTRAVENOUS GUANETHIDINE AND BRETYLIUM IN THE TREATMENT OF SYMPATHETICALLY MEDIATED PAIN

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INTRODUCTION: Intravenous regional guanethidine (I.V.R.) is frequently used to treat sympathetically mediated pain (SMP) but can only obtained through emergency drug release. Bretylium, which is readily available has also been used to treatment S.M.P.[1,2] We have conducted a randomized, double-blinded, crossover study, comparing IVR guanethidine to IVR bretylium.

METHODS: The study included patients with documented S.M.P. Written informed consent was obtained from 6 patients recruited to date. The study was designed as a randomized, double-blind crossover trial. Part A randomized the patient to receive two treatments separated by two weeks, of either bretylium or guanethidine. The patient was then crossed over to Part B to receive two treatments, also separated by two weeks, of the medication which they did not receive in Part A. Sympathetic blockade was performed according to the Hannington-Kiff procedure[3], and guanethidine 20 mg or bretylium 100 mg diluted in 40 ml of 0.5% lidocaine was administered. The tourniquet remained inflated for 30 minutes. Skin temperature was measured using a skin surface temperature probe. Temperature was measured before medication administration, every 5 minutes for 30 minutes, every 10 min for the next 30 min and, at 90 minutes post-medication administration. Pain was measured using a visual analog scale (V.A.S.) in centimetres. The scale was completed by the patient before medication administration (time = 0 minutes), at 1 minute post-administration and at 15 minute intervals until 60 minutes then at 90 min. The scale was also completed daily until the patient returned to hospital for the next treatment. All adverse effects were recorded. The data obtained from V.A.S. and temperature measurements were analysed using a two tailed Students t-test. Differences in the incidence of adverse effects were compared using Fisher's exact test.

RESULTS The mean maximal temperature increase with bretylium was 2.3 ± 4.5°C and 2.4 ± 3.7 °C with guanethidine. This was not significant ($p > 0.05$). VAS pain scores for each patient are shown in the table.

	VISUAL ANALOG SCALE PAIN SCORES					
	BASELINE SCORE (CM)		14 DAY AVG. SCORE (CM)		†PERCENTAGE OF BASELINE SCORE (%)	
PATIENT#	*BRET	*GUAN	BRET	GUAN	BRET	GUAN
1	3.2	2.4	0.9	1.1	28.2	45.8
2	11.7	13.8	5.7	7.7	48.6	55.6
3	9.5	9.3	5.1	9.9	53.5	106.1
4	5.6	3.2	4.5	2.0	80.0	62.8
5	12.1	10.0	13.1	12.2	108.3	122.0
6	2.8	1.3	3.9	2.6	124.9	201.5

Guanethidine caused a burning sensation on injection, but not bretylium. This was statistically significant ($p < 0.01$). There was no difference in the incidence of other side effects.

DISCUSSION Preliminary data indicate that I.V.R. bretylium and I.V.R. guanethidine used in the treatment of S.M.P. have equivalent efficacy in terms of sympathetic blockade. I.V.R. guanethidine is a more uncomfortable treatment. I.V.R. Bretylium is an acceptable alternative treatment to I.V.R. Guanethidine in patients with S.M.P.

REFERENCE 1.Anesth Anal 1992; 74:818-21
2.Anaesthesiology 1988; 68:137-40
3.Lancet 1974; 1; 1019-20.

FACTORS RELATED TO POSTDURAL PUNCTURE HEADACHE: A HIGHER INCIDENCE IN PATIENTS ON DISABILITY COMPENSATION

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INTRODUCTION

This prospective clinical double blind, randomized study was undertaken to evaluate factors related to postdural puncture headache in patients having myelograms.

METHODS

After HIC and institutional approval, 109 consecutive patients having myelograms performed by an experienced radiologist over a four-month period all gave informed consent. Demographic data including age, sex and disability insurance status were collected and needle size (22 or 25g Quincke needle) and patient position post myelogram were randomly assigned. Patients were evaluated clinically on day 1,2,3 and 7 by one of two experienced anesthetists who were blinded to previously collected information and an assessment of presence or absence of postdural puncture headache was made. Phone interviews were done if patients were discharged from hospital before day 7. Chi Square with Yates' correction and ANOVA were used to analyse the data.

RESULTS

All patients having myelograms over the four-month period consented to the study. Of 109 patients entered, data were collected on 108 (one patient refused to be interviewed). Overall, 42 (39%) had a postdural puncture headache. Age, sex, needle gauge and patient position post myelogram were not statistically related to headache. However, patients with disability compensation had a higher incidence of postdural puncture headache - 60% vs. 22% ($p<0.001$). In addition, length of stay was greater (4.0 days vs. 1.7 days, $p<0.01$)) in patients with postdural puncture headache. Characteristics of patients with and without disability compensation were similar.

DISCUSSION

Our data indicate that patients with disability compensation are at greater risk for postdural puncture headache. This is a risk factor which has not previously been described.

	Disability Insurance	No Disability Insurance	p Value
n	48	60	-
Age (mean)	39.3	43.6	N.S.
Sex (% female)	31%	52%	N.S.
Patient position up/flat	22/26	29/31	N.S.
Needle Size 22/25	28/20	30/30	N.S.
Epidural Blood Patch	9/48	4/60	N.S.
Headache (%)	60%	22%	p<0.001
Severity of HA VAS (0-10)	6.7	6.8	N.S.

A

Intraarticular Bupivacaine Provides Analgesia for Knee Joint Replacement But Not Evidence of Preemptive Blockade

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Introduction: Intraarticular injection of bupivacaine has been shown to improve analgesia and decrease narcotic requirements when given following knee arthroscopy.[1] Timing of the injection may also be important as preincisional injection of local anaesthetic is superior to postincisional injection for control of inguinal herniorrhaphy pain.[2] To our knowledge neither of these methods have been utilized for elective knee joint replacement.

Methods: Following IRB approval and written informed consent 72 patients undergoing elective knee joint replacement under general anesthesia were studied. Patients were excluded for: age > 75 years, weight > 110 kg, psychiatric history or alcohol or narcotic dependence. Patients were randomly assigned into 3 groups to receive in double-blind fashion either 30 ml of 0.5% bupivacaine with 1:200,000 epinephrine (BUP) preincisionally and 30 ml normal saline (N/S) postincisionally (group PRE), 30 ml N/S preincisionally and 30 ml BUP postincisionally (group POST) or 30 ml N/S both pre and postincisionally (placebo). Postoperatively patients received morphine 0.02 mg/kg IV q5min prn in PACU until comfortable and then PCA morphine in a dose of 0.02 mg/kg with an 8 minute lock-out and no basal infusion on the ward. Assessments of pain intensity using a visual analog scale (VAS:0=no pain to 10=worst pain possible) and verbal rating scale (VRS: none, mild, moderate, severe, very severe) were made 1, 2, 4 and 24 hours following arrival in the PACU. Determination of side effects including nausea, vomiting, pruritus or urinary retention were made at the same times. Range of motion (ROM) of the operative knee was made preoperatively and at discharge. Venous samples were obtained at PACU arrival and 2 hours later, centrifuged and stored at -20°C for bupivacaine analysis. Statistical analysis included ANOVA for parametric data and chi-square and Kruskal-Wallis analysis for nonparametric data.

Results: There were no significant differences between the three groups in terms of demographic data, duration of surgery, or intraoperative narcotic use. The VAS scores and morphine requirements are shown in the table. The POST group had better discharge ROM than either PRE or placebo groups (85.4 ± 8.6° vs 80.4 ± 6.6, and 80.0 ± 6.4, $p < 0.02$). There was no difference in the incidence of side effects or in the VRS scores amongst the groups.

VAS	placebo	PRE	POST
1 hour	64.9 ± 4.9	48.6 ± 6.0*	49.6 ± 5.4*
2	52.3 ± 4.7	41.9 ± 4.2	43.3 ± 3.8
4	56.1 ± 4.5	49.1 ± 4.8	46.8 ± 5.3
24	35.8 ± 4.2	40.5 ± 3.3	35.2 ± 4.7
MORPHINE (mg)			
0-1 hr	8.0 ± 1.1	6.3 ± 1.0	8.0 ± 1.0
1-2 hr	8.4 ± 0.6	5.6 ± 0.8#	5.9 ± 0.5#
2-4 hr	11.8 ± 1.2	10.2 ± 1.3	8.0 ± 0.5*
4-8 hr	14.2 ± 1.6	12.1 ± 1.6	11.0 ± 1.3
8-24 hr	39.1 ± 4.4	35.2 ± 3.5	31.0 ± 3.7
total	81.3 ± 6.6	67.5 ± 6.5	60.8 ± 5.5*

values are means ± SEM, *p<0.05 vs placebo, #p<0.01 vs placebo

Discussion: Intraarticular bupivacaine improves analgesia, decreases postoperative narcotic requirements, and improves ROM following elective knee joint replacement. There was however no evidence for preemptive analgesia as it was the postincisional injection that improved discharge ROM and more consistently decreased narcotic requirements than did the preincisional injection.

References: 1. Anesth Analg 73:536-9, 1991. 2. Anesth Analg 70:29-35, 1990.

B

A COMPARISON OF THE LATERAL DEVIATION OF 22 GAUGE SPINAL NEEDLES

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INTRODUCTION: The advancement of bevelled spinal needles through the tissues of the back may cause their tips to deviate from the intended linear path. As a result, the tip may fail to reach the subarachnoid space. We evaluated the tendency of two types of bevelled and one type of pencil point spinal needle to deviate laterally using an *in vitro* model.

METHODS: A device was constructed for fully advancing 22 gauge 3.5 in long spinal needles perpendicularly through a stack of precisely aligned metal spacers. The spacers allowed strips of 0.5 in wide fiberglass strapping tape to be placed in the path of the needle at 42.5 mm and then every 4.4 mm from the top of the device. The strips of strapping tape were arranged in a parallel fashion, one below the other, and were used to simulate the predominantly longitudal alignment of tissues in the back. Each needle was then advanced through the strapping tape until fully inserted. Two types of bevelled spinal needles were studied: (1) Becton-Dickinson (BD) Quincke, and (2) Monoject Diamond tip. In separate runs, new bevelled needles were inserted with the bevel either parallel or perpendicular to the strapping tape's fibers. The pencil point BD Whitacre needle was also investigated. The degree of lateral deviation of the spinal needle was determined by examining the spacer covered with strapping tape microscopically using a calibrated reticate.

RESULTS: Insertion of the Quincke and Diamond tip needles with their bevels parallel to the strapping tape's fibers resulted in progressive lateral deviations along the path of the needle in the direction opposite to the needle's opening of up to >5 and 4.5 mm, respectively. When these needles were inserted with their bevels perpendicular to the tape's fibers, the deviations were again progressive and in the direction opposite from the needles' openings but the maxima were only 3.35 and 2.4 mm respectively for the Quincke and Diamond tip needles. The maximum deviation of the Whitacre needle was 0.85 mm.

DISCUSSION: We investigated whether lateral deviation could be a reason for the inability to place a spinal needle in the subarachnoid space using a model. Our results show that bevelled spinal needles are deflected to the greatest extent when they are inserted with the bevel oriented parallel to the model's fibers. The pencil point Whitacre spinal needle was deflected minimally and is the spinal needle of choice to avoid lateral deviation.

RANDOM DOUBLE BLIND COMPARISON OF THE EFFECTS OF KETOROLAC VS. MORPHINE ON RECOVERY FROM GENERAL ANAESTHESIA DURING OUTPATIENT KNEE ARTHROSCOPY

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INTRODUCTION

Short acting opiates are commonly used during ambulatory anaesthesia. They have been associated with rapid and improved recovery. Non-steroidal-antiinflammatory agents have minimal effects on psychomotor function. The purpose of this study was to compare the effects of ketorolac and. morphine on recovery from general anaesthesia.

METHODS

Institutional ethics approval was obtained and informed written consent was obtained from 40 patients, ASA I, undergoing elective knee arthroscopy. Patients received a standardized anaesthetic with propofol, nitrous oxide, atracurium. Patients were randomly assigned to receive either intravenous ketorolac 60 mg or morphine 10 mg. Preoperative psychomotor tests were performed including; mini mental status, p deletion tests, digit symbol substitution and trieger dot test. These tests were repeated postoperatively to assess recovery from anaesthesia. Subjective assessment of overall well-being, nausea and drowsiness were made at the time of discharge using a 10cm visual analogue scale. The following day they were interviewed by telephone and rated these parameters on a 10 point verbal scale. Patient were also asked to report any emesis. Statistical analysis was performed using t-tests. A p value of <0.05 considered statistically significant.

RESULTS

Duration of anaesthesia and surgery and discharge times were similar for both groups. Patients who received morphine experienced more drowsiness. Three patients (17%) who received morphine could not complete the psychomotor tests prior to discharge home.

	Morphine n = 18	Ketorolac n = 22
Surgery (min)	39 ± 15	33 ± 15
Anaesthesia (min)	54 ± 15	53 ± 15
Discharge Time (min)	138 ± 17	130 ± 19
Psychomotor Tests	**n = 15**	**n = 22**
Preop P Deletion	60 ± 19	63± 9
Postop P Deletion	53 ± 16	62 ± 10*
Preop Digit Symbol	91 ± 25	101 ± 14
Postop Digit Symbol	89 ± 29	106 ± 14*
Tests Not Completed	**17 %**	**0 %**
Subjective Data		
PACU Overall Well-being	3 ± 2	3 ± 3
Home Overall Well-being	3 ± 2	2 ± 2
PACU Drowsiness	4 ± 2	2 ± 2*
Home Drowsiness	3 ± 3	3 ± 3
PACU Nausea	1 ± 1	1 ± 2
Home Nausea	0 ± 1	0 ± 2
PACU Emesis	6 %	9 %
Home Emesis	0 %	5 %

all values are mean ± SD *p value < 0.05

DISCUSSION

Both objective and subjective data reveal a more complete recovery following ketorolac compared to morphine.

PREOPERATIVE MULTI-MODEL ANALGESIA FACILITATES SAME DAY DISCHARGE IN LAPAROSCOPIC CHOLECYSTECTOMY -- A RANDOMIZED DOUBLE BLIND PLACEBO-CONTROLLED STUDY

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Laparoscopic technique has shortened recovery in cholecystectomy but pain and nausea remain.[1] Since surgical incision may induce CNS sensitization that enhances postop pain,[2] we hypothesized that preop multi-model nociceptive blockade with bupivacaine, ketorolac and pethidine would quicken recovery and facilitate same day discharge.

METHODS After institutional approval, 49 pts were randomized to either Rx group (Gp T) or control group (Gp C) in a prospective double-blind design. Gp T (n=24) received demerol 0.6 mg/kg + ketorolac 0.5 mg/kg IM, 45 m preop, & 2 mg/kg 0.5% bupivacaine 10 m pre-incisional local infiltration. Gp C (n=25) received placebo injections & infiltration. Anaesthesia was induced with propofol, N_2O/O_2, atracurium, droperidol, and fentanyl 1.5 ug/kg. Supplemental fentanyl 25 ug was given when BP & HR > 20% preop. A visual analogue score (VAS) assessed pain, nausea, anxiety & verbal score for pain and sedation preop at 0, 1/2, 1, 2, 3, 4 h postop at discharge. Postop pain & nausea Rx were standardized. Patients were discharged by PADS.[3] Data analysis was by t-test & chi-square where appropriate, $p<0.05$ was considered significant.

RESULTS Demographic data were similar. 4 pts were excluded due to open cholecystectomy. The PACU duration, time to sit, drink, void, ambulate & to discharge were longer in Gp C vs Gp T (Fig. 1). Patients had significantly more pain at all the times in Gp C.($p<0.01$) Nausea in Gp C vs Gp T was 25% vs 4.5% in PACU. In Gp C, 4 pts had SaO_2 < 92%, on room air, due to narcotics. 73.5% of all pts were discharged same day. 2 pts (Gp C) were admitted due to persistent pain & nausea, 5 pts (3 from C and 2 from T Gp) for social reason & 2 for follow up (C Gp.).

CONCLUSIONS Multi-model balanced preop analgesia in laparoscopic cholecystectomy provides less side effects, quicker recovery and discharge with greater savings for the hospital.

REFERENCE 1) Br J Analg 78:155-159, 1991
2) Pain 33:289-90, 1988
3).J of Clin Anesth 5:64S-68S, 1993