

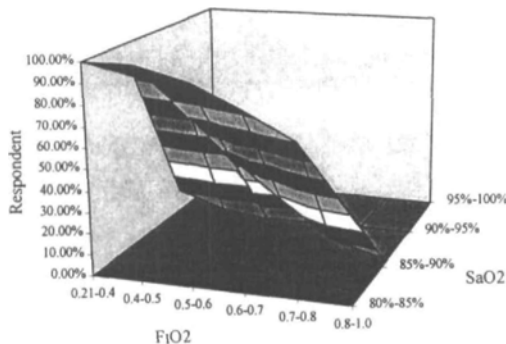
**ATTITUDES AND BELIEFS REGARDING O<sub>2</sub> THERAPY IN MECHANICALLY VENTILATED PATIENTS IN THE ICU - A CANADA-WIDE SURVEY**

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**INTRODUCTION** The optimal level of SaO<sub>2</sub> has not been defined for critically ill patients. Furthermore, risk-benefit characteristics for elevated levels of FiO<sub>2</sub> in the context of reduced SaO<sub>2</sub> are not known. In order to conduct prospective studies relating to optimal use of O<sub>2</sub> in the ICU, the current beliefs and practices of physicians must be documented.

**METHODS** The physician directors [or their deputies] of all the ICUs in Canada were identified from the Canadian Medical Directory, and confirmed by telephone. An 8-part questionnaire was mailed to those individuals, and responses encouraged with aggressive telephone follow-up.

**RESULTS** 48 completed responses were obtained. 48.9% believed that O<sub>2</sub> toxicity is a concern, but 87% believed it to be less so than ventilator associated lung injury. 70.8% indicated that they always conduct assessments of tissue oxygenation, where SaO<sub>2</sub> is reduced and/or elevated levels of FiO<sub>2</sub> are used. 67.4% believed that SaO<sub>2</sub> <80% should not be tolerated for >15 minutes, whereas 95.7% believed that this should not be tolerated for 24-48 hours. Independent of FiO<sub>2</sub>, 26.7% were concerned by SaO<sub>2</sub> = 85% for <2 hours, vs 64.4% were concerned if this SaO<sub>2</sub> was of 48-72 hours duration. For a SaO<sub>2</sub> = 98%, the FiO<sub>2</sub> [mean±SD] above which respondents would not raise the FiO<sub>2</sub> was 0.41±0.17, whereas for a SaO<sub>2</sub> = 85% the FiO<sub>2</sub> below which respondents would not lower the FiO<sub>2</sub> was 0.59±0.23. For a series of ranges of SaO<sub>2</sub>, respondents indicated whether they would increase [Fig. 1], decrease, or not change the FiO<sub>2</sub>.



**DISCUSSION** These data suggest a uniform approach towards qualitative, but not quantitative, titration of FiO<sub>2</sub> in the ICU. Specific cut-off thresholds are not identified.

**PATIENTS WITH AORTIC STENOSIS: CARDIAC COMPLICATIONS IN NON-CARDIAC SURGERY**

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**INTRODUCTION:** Aortic stenosis (AS) was identified as an independent risk factor for cardiac complications in non-cardiac surgery.<sup>1</sup> Since significant advances have occurred in anaesthesia, the current study was undertaken to reassess this risk.

**METHODS:** A 1:1 case-control, retrospective chart audit was performed for all patients in Hamilton with AS who had undergone non-cardiac surgery in 1992 - 1994. Controls were matched to gender, age, procedure, institution, and calendar year. Pre-operative cardiac risk factors and peri-operative management were recorded. Outcomes were defined as: onset of congestive heart failure (CHF), myocardial infarction (MI), or dysrhythmias requiring cardioversion within 7 post-operative days; unplanned or prolonged intensive care unit (ICU) stay due to cardiac causes; and cardiac death. Data analyses were binomial distribution,  $\theta=0.5$ , for categorical data, and unpaired students' t-test for parametric data, two-tailed  $\alpha<0.05$  being significant.

**RESULTS:** There were 55 cases (32 male, 23 female, mean age 73 yrs), with a mean AVA of 0.9 cm<sup>2</sup>. Among pre-operative risk factors, history of CHF was more common in cases than controls. Anaesthesia care was different between groups: use of balanced GA, opiate GA, and central venous lines (Table). Outcomes were no different: 5 cardiac complications in cases and 6 in controls.

**CONCLUSIONS:** Cardiac complications were not increased in patients with AS undergoing non-cardiac surgery. The sample size would detect a difference with an odds ratio  $\geq 4$ . A type II error or the altered anaesthetic care may explain the study outcome.

Table: Perioperative Management

Intervention	Cases	Controls	p
Balanced GA	25	40	0.0018
Opiate GA	10	1	0.004
Regional + GA	6	4	NS
Regional	10	7	NS
Conscious sedation	10	7	NS
Arterial line	27	19	NS (.057)
Central venous line	19	10	0.004
pulmonary art. cath.	8	5	NS
Planned ICU stay	13	9	NS

Reference: N Engl J Med 1977; 297: 856 - 50.

### EFFECTS OF NEBULIZED LIDOCAINE ON THE HYPERDYNAMIC RESPONSE TO TRACHEAL INTUBATION

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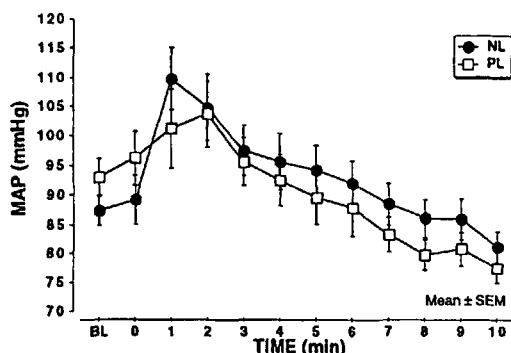
**INTRODUCTION:** Tracheal intubation is associated with a rise in blood pressure and heart rate in the majority of patients. This hyperdynamic response is inconsequential in healthy young people, however, it may have detrimental effects in patients with cardiovascular disease. Accordingly, different therapeutic approaches have been employed to blunt this response. Among these, upper airway anesthesia has not been extensively studied. A prospective, placebo-controlled, single-blind study was undertaken to evaluate the effects of nebulized lidocaine on the hyperdynamic response to endotracheal intubation.

**METHODS:** After ethics board approval, 29 consented, ASA class I-II patients were randomized to either nebulized lidocaine (NL) or placebo (PL). All subjects were premedicated with 20  $\mu\text{g}\cdot\text{kg}^{-1}$  of *iv* midazolam. Patients in group NL received 4 ml of 4% lidocaine by nebulizer, whereas group PL subjects had a band-aid applied to their neck. Subjects were anaesthetized, by a blinded anaesthetist, using curare 50  $\mu\text{g}\cdot\text{kg}^{-1}$  *iv* and propofol 2.5  $\text{mg}\cdot\text{kg}^{-1}$  *iv*. Tracheal intubation was performed 1 min after succinylcholine 2  $\text{mg}\cdot\text{kg}^{-1}$  *iv*. Anaesthesia was then maintained with 1% isoflurane in  $\text{N}_2\text{O}/\text{O}_2$  at 3:1  $\text{L}\cdot\text{min}^{-1}$ . Blood pressure and heart rate were recorded with Dinamap® before induction, at induction, and q 1 min following intubation for a period of 10 min. Surgery was withheld until all data were collected. Results were analyzed by *t*-test, Chi square statistic, and RM ANOVA.

**RESULTS:** Demographic data were similar in the study groups. There were no differences in mean blood pressure (Figure) and heart rate responses to intubation among the two groups.

**CONCLUSION:** The results of this ongoing study suggests that upper airway anesthesia with nebulized lidocaine is ineffective in attenuating the BP and HR response to tracheal intubation. The addition of an opioid may influence the efficacy of this technique as suggested by the findings of others.<sup>1</sup>

**REFERENCE:** J Clin Anesth 1995; 7: 9-13.



BL = Baseline; 0 = Induction; 1 to 10 = min after intubation  
MAP = Mean arterial pressure

A

### EFFECTS OF SUPERIOR LARYNGEAL NERVE BLOCK ON HEART RATE AND BLOOD PRESSURE RESPONSES TO ENDOTRACHEAL INTUBATION

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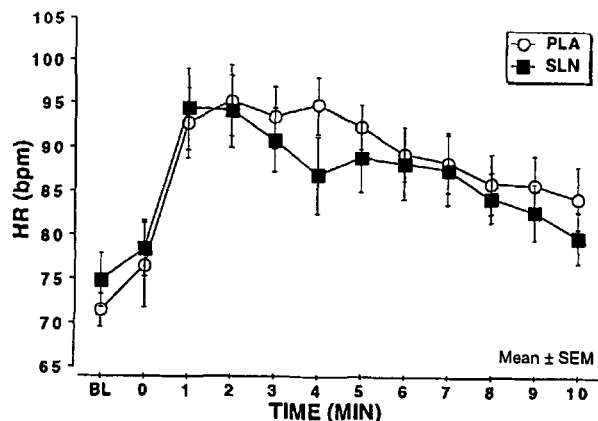
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**INTRODUCTION:** Tachycardia and hypertension, in response to airway instrumentation, are provoked by both laryngoscopy and intubation. Since the superior laryngeal nerve (SLN) innervates the airway above the vocal cords, its anaesthesia may ameliorate the hyperdynamic response to endotracheal intubation. A single-blind, placebo controlled study was, therefore, undertaken to address this question.

**METHODS:** Thirty one ASA class I-II patients consented to the ethics board-approved protocol, and were randomized to either SLN block (group SLN) or placebo (group PLA). All patients received midazolam 20  $\mu\text{g}\cdot\text{kg}^{-1}$  *iv* at the outset. The SLN was then anaesthetized with 3 mL of 2% lidocaine, bilaterally, using a 27-g needle. Patients in group PLA had a band-aid placed on the neck. Anaesthesia was then induced with curare 50  $\mu\text{g}\cdot\text{kg}^{-1}$  *iv*, propofol 2.5  $\text{mg}\cdot\text{kg}^{-1}$  *iv*, and succinylcholine 2  $\text{mg}\cdot\text{kg}^{-1}$  *iv*. Sixty sec later, the trachea was intubated and anaesthesia was maintained with 1% isoflurane in  $\text{O}_2/\text{N}_2\text{O}$  at 1:3  $\text{L}\cdot\text{min}^{-1}$  for the duration of the study. Heart rate, and arterial pressure were measured by Dinamap® prior to induction, at induction, and q 1 min after intubation for 10 min. Surgery started after data collection was completed. Data were analyzed using *t*-test, Chi Square and RM ANOVA.

**RESULTS:** Demographic data were similar among the study groups. Patients in both groups manifested a significant increase in heart rate (Figure) and blood pressure for 10 min post-intubation compared with pre-induction values ( $P < 0.05$ ).

**CONCLUSION:** This study demonstrated that SLN block is insufficient by itself to attenuate the hyperdynamic response to tracheal intubation. Light anaesthesia and isoflurane may have contributed to the persistent tachycardia in these patients.



BL = Baseline; 0 = Induction; 1 to 10 = min after intubation  
HR = Heart rate

B

**EARLY EXTUBATION DOES NOT REDUCE ICU LENGTH OF STAY IN CARDIAC SURGERY PATIENTS**

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**INTRODUCTION:** Early extubation after cardiac surgery is thought to decrease ICU length of stay thereby reducing cost. This has been demonstrated in experimental settings but we questioned whether early extubation alone leads to shorter ICU stay in 'real' clinical practice.

**METHODS:** We conducted a retrospective review of all cardiac surgery patients admitted to our ICU over 12 months from Oct. 1, 1995 to Sept. 30, 1996. During this period there was no formal protocol in place for "fast tracking" cardiac surgery patients. All patients were weaned according to a previously published protocol<sup>1</sup>. Propofol was used for postoperative sedation and morphine for analgesia. Patients were grouped into those extubated in less than 9 hours (EARLY) and those who were extubated between 9 and 18 hours (LATE). Patients ventilated longer than 18 hours were assumed to have a complicated postoperative course and were not included in this analysis.

**RESULTS:** Four hundred and sixty-four cardiac surgery patients were admitted to our ICU during this period. Eighty-eight were extubated in under 9 hours and 226 were extubated between 9 and 18 hours. Although the LATE extubation group were ventilated on average 6 more hours than the EARLY group, they did not leave the ICU any sooner.

	EXTUBATION GROUP		p value
	EARLY	LATE	
Ventilation Time (hrs)	7.4 ± 2	13.5 ± 2.7	----
ICU length of stay (hrs)	27.3 ± 21.3	26.6 ± 22.5	p=0.80
Hospital length of stay (hrs)	133.0 ± 48	148.4 ± 69	p=0.056
APACHE II Score	11.9 ± 3.5	12.0 ± 4.1	p=0.84
Age	58.2 ± 10.4	61.6 ± 10.4	p=0.01

**CONCLUSION:** Early extubation of cardiac surgery patients alone was not sufficient to decrease length of stay in our ICU. The use of newer expensive anaesthetic and postoperative sedative and analgesic agents such as propofol and remifentanyl may actually increase the cost of cardiac surgery care unless a "fast track" protocol is in place to take advantage of the reduction in ventilation times. This can be done by reducing the intensity of nursing care once patients are extubated and by discharging them from the ICU sooner.

**REFERENCES:** 1. Respir Care 1995;40:219-224.

**SAME DAY CARDIAC SURGERY: A CANADIAN PERSPECTIVE**

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**Introduction:** Same-day admission for coronary artery bypass surgery has become a standard of care in the United States.<sup>1,2</sup> To our knowledge, there has been no documentation of similar programs in Canada.

**Methods:** The cardiac surgery program of the University Campus, London Health Sciences Centre introduced same-day admission of coronary artery bypass surgery patients in January 1996. As elsewhere,<sup>1,2</sup> the process consists of a visit to the clinic, an assessment by an anesthetist, nursing and allied health personnel, and the performance of laboratory investigations. On the day of surgery, the patient returns to the unit before proceeding to the operating room. Following IRB approval we reviewed the results from the Cardiac Care Network data base for the first ten months of this program. Statistical analysis consisted of unpaired t-testing for parametric data and chi-square analysis for nonparametric data, with a p value < 0.05 considered significant.

**Results:** The table compares same-day patients admitted to hospital for coronary artery bypass surgery, where LVF refers to left ventricular function on a scale 1-4 and AIW refers to acuity index weighting with a scale 0-16 with scoring based on the following points: age 65-72 = 2, age > 75 = 3 female = 1, valve = 2 valve & CABG = 3, revision = 2, LVF-2 = 1, LVF-3 = 2, LVF-4 = 3, urgent = 1, and emergent = 4. There was no difference in patient age or percentage of females, nor surprisingly AIW or LVF between the two groups. There were however significant differences in postoperative ICU, ward and total hospital stays between the two groups even though intubation times were not different.

	same-day	non-same day
n	97	137
age	61.0 ± 9.5	63.9 ± 8.4
females	15 (15%)	22 (16%)
AIW	1.6 ± 1.3	2.0 ± 1.6
LVF	1.47 ± 0.81	1.61 ± 0.81
preop stay (d)	0	1.9 ± 2.3*
intubation (hr)	14.0 ± 7.8	17.0 ± 26.0
ICU stay (d)	1.3 ± 0.7	1.5 ± 1.4*
(hr)	27.7 ± 14.5	31.1 ± 24.6*
ward stay (d)	4.7 ± 1.9	5.7 ± 3.5*
total LOS (d)	6.1 ± 2.1	8.9 ± 4.7*
mortality	0	6 (4.4%)*

values are means ± S.D. except for n(%) for females and mortality. \* p < 0.05, † p < 0.001

**Discussion:** The introduction of same-day admission for coronary artery bypass surgery at our institution in Canada appears to have no increased risk and offers potential cost savings in terms of decreased ICU and hospital stays.

**References:** 1. J Thorac Cardiovasc Surg 105:444-52, 1993. 2. Ann Thorac Surg 61:1136-40, 1996.

**REDUCTION OF INTRAOPERATIVE BLOOD LOSS BY A SINGLE DOSE TRANEXAMIC ACID**

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**INTRODUCTION:** Many reports have shown that the use of antifibrinolytic agents may reduce perioperative blood loss in cardiac surgical patients<sup>1</sup>. Several dose schemes with different compounds have been advocated. Since the costs of the administration of a synthetic agent like tranexamic acid (TA) is lower than of a natural agent (aprotinin), we studied the effect of a single dose TA in patients undergoing coronary artery bypass surgery (CABG) on intraoperative blood loss.

**METHODS:** Two groups of patients undergoing CABG received a single dose of 30 mg/kg TA (n = 90, group A) or no TA (n = 40, group B) before surgical incision. Intraoperative blood loss, consisting of blood lost due to suction, swaps and wound drains, was determined. A second, retrospective, control group was implicated, consisting of all CABG patients in 1995, involving the same anesthesiologist (n = 149, group C). Only elective cases with no concomittant diseases were included. Statistical analysis was performed using Mann-Whitney U-test.

**RESULTS:** Blood loss in the three groups is depicted in table 1. Blood loss in group A was significantly less than in group B (p < 0.05) and group C (p < 0.001).

**DISCUSSION:** The findings of this study show that a single dose TA before surgical incision causes a decrease in intraoperative blood loss in CABG patients. The advantage of this approach is that TA is effective, has less side effects than aprotinin and is cheaper. Apparently it is not necessary to give an additional dose of TA during or after cardiopulmonary bypass<sup>2</sup>. Further studies are needed to verify if these results can also be obtained in more complicated surgery.

TABLE 1

Groups	Intraoperative blood loss (ml ± SEM)
A (n = 90)	351 ± 28.33
B (n = 40)	466 ± 50.04*
C (n = 149)	532 ± 26.83**

\* = p < 0.05  
 \*\* = p < 0.0001

References:

1. Can J Anaesth 1994;41:1104-12
2. Anesthesiology 1995;82:383-92

**PLASMA LEVELS OF ENDOTHELIN-LIKE IMMUNOREACTIVITY DURING CORONARY BYPASS**

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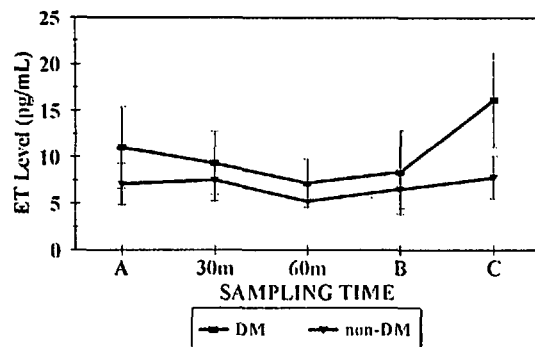
**INTRODUCTION:** Endothelin is known to cause vasospasm in internal mammary arteries and saphenous veins *in-vitro*.<sup>1</sup> Changes in plasma endothelin levels during coronary arterial bypass (CABG), therefore, may have implications for graft vasospasm and viability. This study was undertaken to examine endothelin-like immunoreactivity (ET) during CABG.

**METHODS:** Following institutional approval, informed consent, and standardized anæsthetic, patients undergoing elective CABG to the left anterior descending artery were studied. Pre-op cardiac risk factors were recorded. Coronary sinus (CS) and arterial (ART) samples were taken before aortic cross-clamp (A); at 30 and 60 min. of cardioplegic arrest; release of cross-clamp (B); and after cardiopulmonary bypass (C). Plasma ET levels were assayed by radioimmunoassay. Data analyses were by two-way ANOVA, repeated measures, and by Student-Neuman-Keuls test, α < 0.05 being significant.

**RESULTS:** Eleven patients (9 male, 2 female, mean age 63 yrs) were studied: 5 with diabetes mellitus (DM). No differences were seen in overall mean CS or ART ET levels versus sampling times. Mean CS values were different between DM and non-DM patients, p=0.037, and between sampling times, p=0.003 (see graph). Post-bypass levels (C) were significantly different from every other point, p<0.05. No significant differences were found between means in any other factor pairings.

**CONCLUSIONS:** Changes in ET levels may be masked when all patients are averaged. Endothelin responses in diabetics, however, are significantly different: the elevation in post-bypass coronary sinus levels warrants further investigation.

Coronary Sinus Levels During CABG DM versus non-DM



Reference: Circulation Research 1990; 66: 1088 - 94.

**COMPARISON OF PCA VS IV (ON DEMAND) MORPHINE ANALGESIA IN EARLY EXTUBATED PATIENTS POST CABG SURGERY.**

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Supported in part by Abbott Laboratories, Montreal, Canada.

**INTRODUCTION:** Low dose narcotic and propofol is now being used for anaesthesia to facilitate early extubation (2-6 hours) following CABG surgery.<sup>1</sup> Intense postoperative analgesia is vital to reduce myocardial ischemia following cardiac surgery.<sup>2</sup> This prospective randomized, controlled trial compared Patient Controlled Analgesia (PCA) with intravenous (IV) morphine (on demand) for postoperative analgesia and narcotic consumption in these patients undergoing elective CABG.

**METHODS:** Following institutional ethics committee approval, 39 elective CABG patients less than 75 years old were randomized to PCA and IV groups. Standardized anaesthetic induction included fentanyl (15 mcg/kg), midazolam (0.1 mg/kg), pancuronium (0.15 mg/kg) with or without thiopental (50-75 mg) and maintenance with isoflurane 0.5-2% prior to cardiopulmonary bypass(CPB) and propofol infusion (2-6 mg/kg/hr) during and after CPB. Propofol infusion of 1-4 mg/kg/hr was continued to ICU until extubation. All patients received indomethacin suppository 100 mg prior to extubation and a 2nd dose 12 hours later. After extubation patients received PCA or IV morphine for analgesia. Post-operative pain and patient satisfaction scores (Visual Analog Scale, VAS 1-10) and total analgesic consumption (morphine and equivalent) up to 48 hours were compared. Data were analyzed using a two-way ANOVA and expressed as mean ± standard deviation.

**RESULTS:**

POST-OPERATIVE	PCA(n=17)	IV (n=22)	p
Morphine & equivalent (mg/48 hr)	54.1±23.6	53.8±27.2	0.18
Pain Relief VAS score			
6 hours (n=7)	6.1±2.5	6.6±2.8	0.73
12 hours (n=8)	6.4±2.0	3.4±3.4	0.09
18 hours (n=14)	5.8±3.2	5.8±2.4	0.99
24 hours (n=17)	7.2±2.1	6.5±3.2	0.44
48 hours (n=15)	7.4±2.6	7.3±2.5	0.92
Satisfaction VAS score			
48 hours (n=15)	7.8±2.5	8.4±2.0	0.49

**CONCLUSION:** There is no statistically significant difference between PCA and IV morphine (on demand) for post operative analgesia in regard to pain score, patient satisfaction and total narcotic consumption in early extubated patients after CABG surgery.

**REFERENCES:**

1. *J Thorac Cardiovasc Surg*. 1996;112:755-64.
2. *Anesthesiology* 1992;76:342-53.

**AORTIC ATHEROSCLEROTIC PLAQUE IDENTIFIED BY EPIAORTIC SCANNING PREDICTS CEREBRAL EMBOLIC LOAD IN CARDIAC SURGERY.**

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**INTRODUCTION:** The role of emboli in producing cerebral injury has been confirmed in coronary artery bypass(CAB) surgery. Cerebral emboli detected using transcranial Doppler(TCD), have been found to occur with aortic instrumentation.[1] It is well accepted that an atherosclerotic ascending aorta is a risk factor for post-operative complications including stroke. Aortic instrumentation in cardiac surgery predisposes the patient to embolic events. The purpose of this study was to evaluate the relationship between the presence of aortic plaque detected by epiaortic scanning and the production of cerebral emboli.

**METHODS:** After Ethics Committee approval and obtaining written informed consent, 15 patients undergoing elective CAB, were studied prospectively using TCD of the middle cerebral artery to obtain an emboli count. A 2-MHz Medsonics TCD probe was applied post-induction. Membrane oxygenators were used as were arterial filters. Emboli counts were recorded from induction until after decannulation. In addition to palpation, a hand-held B-mode scanner (Site-Rite II) was used to evaluate the aorta prior to manipulation. The presence of plaque was then correlated with the total embolic load for each of the patients studied.

**RESULTS:** Four out of 15 patients(27%) had an abnormal aorta by palpation. An abnormal aorta by palpation had a significantly higher emboli count(71±75) compared to an unremarkable aorta by palpation(11±18) (p<0.005). Four patients with normal aortas by palpation were found to have abnormal scans. Eight out of 15 patients(53%) had an abnormal epiaortic scan with detection of some degree of plaque. Patients with an abnormal scan also had a greater embolic load(41±52) compared to those who had a normal scan(6±8).

**DISCUSSION:** 50-80% of significant atherosclerotic lesions in the ascending aorta are missed on intra-operative palpation.[2] The use of epiaortic scanning in addition to palpation, resulted in the detection of twice as many abnormal aortas. This study shows that the presence of aortic plaque as detected by palpation and scanning, regardless of location, is associated with a greater risk of embolic events during cardiac surgery where aortic instrumentation is required. Although plaque detected by palpation is associated with a greater embolic load, not all plaques can be detected by palpation. We conclude that aortic scanning is more sensitive than palpation in the identification of patients at risk of cerebral emboli.

- REFERENCES:** 1. *Stroke* 25:2398-2402,1994. 2. *Circulation* 80(1): 1-275-9,1989.

### INTRAOPERATIVE AWARENESS IN CARDIAC SURGERY WITH EARLY EXTUBATION ANAESTHESIA.

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**Introduction:** Early extubation after cardiac surgery is confirmed as a safe technique that results in reduced intensive care unit and hospital lengths of stay.<sup>1</sup> Early extubation anaesthesia (EEA) involves an anaesthetic technique with low dose narcotic, short acting anaesthetic, and sedative agents. This study examines the incidence of intraoperative awareness with recall in cardiac surgical patients receiving EEA.

**Methods:** Data was collected prospectively on all cardiac surgical patients (n=617), over a 4 month period (April-July 1995). All patients received EEA. Core temperature was allowed to drift to 33°C on cardiopulmonary bypass (CPB). Intraoperative awareness was defined by the ability of the patient to recall any events from induction of anaesthesia to recovery of consciousness. Recall was sought at 18 hours post-operatively, by asking if the patient remembered sounds, tactile sensations, pain or paralysis.

**Results:** Six hundred seventeen patients underwent elective and emergency cardiopulmonary bypass during this period. First time aortocoronary bypass (ACB) was performed in 66% of patients, first time valve surgery in 5.5%, combined (ACB plus valve) procedure in 10%; 8.5% had redo valve +/- ACB and 10% had other procedures (Ross procedure, myectomy, heart transplant and aortic root reconstruction surgery). Sedative premedication was given to 94% of patients.

ANAESTHETIC	Dosage [Mean (SD)]
Fentanyl induction	17 (10) µg/kg
Midazolam induction	0.07 (0.06) mg/kg
Thiopentone induction	0-200 mg
Pre-CPB	Isoflurane 0.5-2% End-Tidal
CPB	Propofol (3-6 mg/kg/hr) +/- Isoflurane
Post CPB	Propofol Infusion (2-4 mg/kg/hr)

Two patients (0.3%), 1 female\* (ACB) and 1 male (MVR) had recall of intraoperative events. The female also reported pain.

#### PATIENTS WITH RECALL

	Patient I*	Patient II
Age	54 years	59 years
Pre-medication	Diazepam 10 mg	Lorazepam 2mg
Fentanyl	13.5µg/kg	11.7 µg/kg
Midazolam	0.06mg/kg	0.03mg/kg
Thiopentone	0	2.9mg/kg
Pre- CPB	Isoflurane 0.5-1%	Isoflurane 0.5-2%
On/post CPB	Propofol Infusion	Propofol Infusion
CPB (minutes)	71	80

**Conclusions:** The incidence of intraoperative awareness (0.3%) is much less than previously reported in cardiac surgery (1.4%).<sup>2</sup> This is likely due to the use of continuous propofol infusion during CPB.

1. J Thorac Cardiovasc Surg 1996; 112: 755-64
2. Can J Anaesth 1993; 40(10): 922-26

### MORBIDITY OUTCOME IN PATIENTS UNDERGOING CARDIAC SEPTAL MYECTOMY - EARLY EXTUBATION ANAESTHESIA (EEA) VS. HIGH DOSE NARCOTIC (HDN) ANAESTHESIA

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**INTRODUCTION:** The anaesthetic management of patients with hypertrophic obstructive cardiomyopathy (HOCM) undergoing myectomy is not clearly defined. We are reporting the morbidity outcome of early extubation anaesthesia (EEA)<sup>1</sup> and high dose narcotic anaesthesia (HDN) techniques in 42 patients.

**METHODS:** In-hospital data were retrospectively collected on 42 patients, out of a total of 220 patients to be analysed. EEA technique consisted of low dose fentanyl (15µg/kg), propofol infusion, midazolam and inhalation agent. HDN technique consisted of fentanyl (50-100µg/kg), diazepam, +/- inhalation agent. Data are presented as mean (sd) and were analysed using unpaired Student's t-test, Chi-Square analysis and Mann Whitney U test.

#### RESULTS:

Demographic data	EEA (n=19)	HDN (n=23)	P value
Age (yrs)	40.1 (8.1)	42.2 (9.4)	NS
Sex (M/F)	11 / 8	15 / 8	NS
Preop Dyspnoea	19 (100%)	17 (74%)	< 0.05
Palpitations	3 (16%)	7 (30%)	NS
Angina	12 (63%)	9 (39%)	NS
Syncope	9 (47%)	12 (52%)	NS
Redo operation	2 (11%)	1 (4%)	NS
Cross-clamp (mins)	59 (19)	49 (7)	NS

Postop Events	EEA (n=19)	HDN (n=23)	P value
Extub. (hr:mins)	6:48 (3:24)	18:20 (2:40)	< 0.001
Post CPB pacing	10 (53%)	5 (22%)	NS
Pacemaker (PPM)	2 (11%)	2 (9%)	NS
Arrhythmias	6 (32%)	7 (30%)	NS
Mortality	0 (0%)	0 (0%)	NS
ICU stay (days)	3.7 (1.1)	4.3 (0.9)	0.057
Hospital (days)	10.7 (3.3)	11.3 (2.9)	NS

**DISCUSSION:** These preliminary data suggest that EEA facilitates early tracheal extubation in HOCM patients without increasing the perioperative cardiac morbidity and mortality. Early extubation allows reduction of nursing staff and intensity of care in the ICU.<sup>2</sup> ICU stay tends to be lower in HOCM patients undergoing EEA (P=0.057). Therefore we propose that the practice of EEA is both safe and of cost benefit in cardiac septal myectomy patients.

- References 1. J Thorac Cardiovasc Surg 1996;112:755  
2. Anesthesiology 1996; 85: 1300

**PREDICTORS OF PROLONGED EXTUBATION TIME (EXT) IN CABG PATIENTS UNDERGOING EARLY EXTUBATION ANAESTHESIA**

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**INTRODUCTION:** Early extubation anaesthesia (EEA) utilizing low dose narcotic and propofol has been established in coronary artery bypass graft (CABG) surgery (1). Delay in *extubation time (EXT)* prolongs hospital length of stay and costs. Our objective is to identify perioperative predictors of prolonged EXT in CABG patients undergoing EEA.

**METHODS:** After institutional approval, prospective data were collected on all CABG patients from April to November 1995. The EEA technique consisted of low dose fentanyl (15 µg/kg), propofol, midazolam and isoflurane. Extubation was attempted within 8 hrs of ICU arrival. For each patient, preoperative (*preop*), intraoperative (*intraop*), postoperative (*postop*) data and EXT were recorded. EXT > 10 hrs was considered prolonged EXT. Univariate analyses (t-test, Chi-square) were performed followed by multiple logistic regression analysis to identify independent predictors of prolonged EXT. P values of < 0.05 were considered statistically significant.

**RESULTS:** There were 885 patients; 50 (5.6%) underwent repeat surgery. 23 (2.5%) patients died. The median EXT was 7 hrs (range 0.75-306 hrs). 238 (25%) patients had EXT > 10 hrs. 90% of patients were extubated by 20 hrs. Univariate analyses showed 24 predictors of prolonged EXT. Multiple logistic regression analysis revealed 4 independent predictors of prolonged EXT:

Predictors	No. with Factor (%)	Odds Ratio	P value
Age (vs < 60) : 60-69	338 (38.1%)	1.67	0.0004
: 70-79	193 (21.8%)	2.22	
: ≥ 80	18 (2.0%)	1.86	
Intraop Inotrope Use	61 (6.9%)	1.86	0.004
Intraop IABP	57 (6.4%)	3.58	0.0001
Postop Atrial Arrhythmia	109 (12.3%)	1.85	0.003

**CONCLUSION:** In CABG patients undergoing early extubation anaesthesia, 75% of patients were extubated by 10 hrs, 90% by 20 hrs. Age, intraop inotrope use, intraaortic balloon pump (IABP), and postop atrial arrhythmia were found to be independent predictors of prolonged EXT.

**REFERENCE:** 1. *J Thorac Cardiovasc Surg* 1996; 112: 755

**HEPARIN / PROTAMINE DOSING GUIDED BY IN VITRO TESTING DOES NOT REDUCE BLOOD LOSS AND TRANSFUSION IN CARDIAC SURGERY**

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**Introduction**

The perioperative management of anticoagulation for heart surgery is frequently overlooked and can possibly have an influence on blood loss. It is well known however that there is large patient variability in the heparin response<sup>1</sup>. There are in vitro tests (Heparin dose response test and protamine dose response test) available that allow individualization of a patient's heparin and protamine dose according to his sensitivity. The purpose of the present study was to compare the empirical method of anticoagulation to these in vitro tests with respect to perioperative blood loss, use of blood product and incidence of reoperation for bleeding.

**Methods**

One hundred and twenty-five patients undergoing valve replacement and / or CABG surgery were randomly assigned to one of two anticoagulation protocols. The empirical group (Control gr ; n=64) received 9000 u/ m<sup>2</sup> of Body Surface Area of heparin along with 5000 u added to the pump prime. Between 5000-10000 u were added before or during cardiopulmonary bypass (CPB) when the activated coagulation time (ACT) was lower than 480 sec. After termination of CPB, protamine was administered in the following manner; 1 mg for each 100 u of heparin in initial bolus (including the 5000 u in pump prime) + 20 mg. The in vitro test group (Study gr ; n=61) had a heparin dose-response curve created using the in vitro heparin response test and the heparin dose was given according to the specific patient sensitivity. Five thousand units of heparin were also added to the pump prime. During CPB, additional heparin was added according to the patient's dose-response curve to maintain an ACT above 480 sec. After CPB, protamine was administered according to the in vitro protamine response test. Post-operatively, patients were followed for blood loss until chest tube removal and for blood product use until their discharge from hospital.

**Results**

Demographics were identical between the two groups. There were no statistical difference in blood loss, blood product use or incidence of reoperation for bleeding (table 1). The Student t and Fisher Tests were used for statistical analysis.

Table 1	Total blood loss in ml	RBC transfusion	RBCunits /patient	Reoperation for bleeding
Control gr	949 +/- 470	43 %	1.09	2 patients
Study gr	1045 +/- 503	41%	1.07	3 patients

**Discussion**

Anticoagulation and reversal guided by in vitro testing, although theoretically attractive, does not seem to have a positive effect on patient outcome following cardiac surgery.

**References**

1. Bull BS, Huse WM, Brauer FS. Heparin Therapy during Extra-corporal Circulation. II. The use of a Dose Response Curve to Individualize Heparin and Protamine Dosage. *J Thor Card Surg* 69:685-689, 1975

### SURVEY OF OPERATING ROOM STAFF CONCERNING AIR CONTAMINATION AND OTHER HAZARDS

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#### INTRODUCTION

The purpose of this study was to determine opinions of operating room (OR) personnel about work place hazards.

#### METHODS

A questionnaire was distributed to five hospitals in one province requesting OR personnel to either mark on a 100 mm visual analogue scale (VAS) or write their comments to a number of questions on OR air contamination. The total number of staff was obtained by contacting each OR.

#### RESULTS

103 out of 317 staff (33% response) completed questionnaires. 38 were doctors, 53 nurses and 12 others. There were 62 females, 40 males, and one unknown. The ages were 4 ≤ 25 years, 55 age 25-39 years, 37 age 40-54 and 5 age 55+. The mean (± SD) VAS score for degree of concern about OR air contamination (100 = extreme) by anesthetics was 63.2 ± 34. Nurses (VAS 74.1 ± 28.4) were significantly more concerned than doctors (41.2 ± 34), ( $p < .00001$  using ANOVA). The level of concern was not different between those working < 10 years (VAS = 57) or > 10 years in the OR (VAS = 63). The hazards of concern were: anesthetic gases (VAS 71.1 ± 27), disinfectant vapours (62.2 ± 28), viral/bacterial cautery smoke (60.8 ± 31) and CO<sub>2</sub> (53.7 ± 33). Scores for xray exposure were (59 ± 34.2), needle prick (76.4 ± 26.3), laser (36.3 ± 34.5), and blood in eyes (72.8 ± 28.5). Of the 19 health complaints mentioned by staff, the most frequent were:

Rank	Symptoms experienced	%	Attributed to OR %
1	Fatigue	52	32
2	Headache	44	29
3	Stress	40	21
4	Itchy eyes	22	13
5	Runny nose	19	8

Medical conditions stated by staff were allergies 19%, asthma 5%, hypertension 4%, renal disease 4%, hypothyroidism 4%. 9 staff had miscarried (5 before OR work, 4 during) but mean concern about anesthetics for these staff (VAS = 46.0) was less than nursing averages. Inadequate monitoring of staff health was a major concern, especially among those pregnant while working in the OR.

#### CONCLUSIONS

Substantial concern by OR staff about potential health hazards due to air contamination was identified, especially among nurses. Response bias may have occurred but this seems unlikely since many replies were received from those with low levels of concern.

#### REFERENCES

Anesth 1974;41(4): 321-40. Anesth Analg 1985;64:981-8.

### A COST ASSESSMENT OF INTRAOPERATIVE BLOOD SALVAGE FOR PRIMARY TOTAL HIP ARTHROPLASTY USING THE COBE BRAT 1© SYSTEM.

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#### INTRODUCTION

Intraoperative salvage provides an alternative to allogeneic blood for perioperative transfusion. A cost and efficacy assessment was carried out using intraoperative salvage for primary total hip arthroplasty using the COBE BRAT 1 salvage system.

#### METHODS

Patient records for intraoperative salvage during total hip arthroplasty, done between January 1995 and March 1996 were retrieved and reviewed. The volume of blood salvaged as well as costing of setup for collection and processing for single and multiple units acquired was determined. Finally, the unit acquisition costs were compared to the costs of allogeneic and autologous blood provided by the Red Cross.

#### RESULTS

186 case records were retrieved and reviewed. In 159 (85%) of cases, ≤ 2 units was salvaged; in 66 (35%) cases no units were obtained (Fig 1). With best practices (processing setup not opened until adequate volume salvaged), the mean cost/unit of autologous blood when ≤ 2 units were acquired was \$190.20 (Table 1). If the complete system setup was routinely employed the cost/unit would have been \$249.67. This compares to \$210.00 for an allogeneic unit and \$338.00 for an autologous unit.<sup>1</sup> The acquisition costs for the second and subsequent units was minor.

Figure 1. Units salvaged

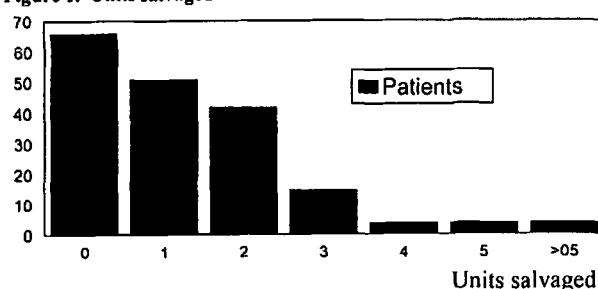


Table 1. Salvage unit acquisition costs, COBE BRAT 1©, (\$Can).

	Disposables	Labour	Total Costs
Collection set-up	97	7.5	104.5
Processing set-up	211.14	7.5	218.64
First unit	308.14	15	323.14
Additional unit	1.14-3.42	7.5	8.64-10.82

#### CONCLUSION

Intraoperative cell salvage for primary total hip arthroplasty yields low volumes of blood. The mean cost of providing salvaged autologous blood via cell saver during these cases can be reduced by not opening the processing disposables until volumes adequate for washing are recovered.

#### REFERENCES

Can Med Assoc J 1996;98:1501.



### INFLUENCE OF ANAESTHETIC DECISION MAKING ON RESOURCE USE IN MAJOR JOINT REPLACEMENT

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Supported, in part, by The Louis Holland Trust.

**INTRODUCTION:** As concern for rapid growth of health care expenditures has developed internationally, there has been tandem interest in gaining greater value from these expenditures. Thus far, anaesthesia strategies have largely focused on choosing anaesthetic regimens with lower pharmaceutical acquisition costs, effectively ignoring the possibility that anaesthetic management may influence resource use beyond the operating room (OR) and postanesthetic care unit (PACU). This study seeks to explore the influence of anaesthetic decision making on resource use in major joint replacement throughout the entire hospital stay.

**METHODS:** As part of an institution-wide, multidisciplinary quality improvement initiative, a data base has been established, containing administrative, financial, patient, surgical, and anaesthetic information, covering all patients having a total hip or knee joint replacement in a university hospital during the period January 1994 through July 1996. Summary statistics were obtained for variables of interest, with  $P < 0.05$  considered statistically significant.

**RESULTS:** The data base contains information on 832 patients. General anaesthesia was administered to 437 patients, with the remainder having received a variety of alternative techniques. Patients receiving general anaesthesia were slightly younger (65.6 vs. 68.7 years,  $P < 0.001$ ). Nonetheless, the use of general anaesthesia had no influence on studied variables, including anaesthesia time, operating room time, PACU time, number of autologous blood transfusions administered, intensive care unit time (if any), physical therapy hours, and charted adverse events. However, general anaesthesia was associated with a longer stay on the ward (6.9 vs. 6.2 days,  $P < 0.003$ ) and longer hospital stay (7.0 vs. 6.3,  $P < 0.008$ ).

**CONCLUSIONS:** These preliminary results indicate that efforts to control anaesthesia expenditures should not be limited to the acquisition costs of anaesthetic drugs and supplies. Rather, we must take a broader perspective, exploring the ways in which our anaesthetic management may influence 'downstream' resource use beyond the OR and PACU. That the use of general anaesthesia was associated with a slightly longer hospital stay prompts continuing analysis of this data set, focusing on the influence of some of the alternative anaesthetic techniques on subsequent hospital resource use.

### LIMITATIONS TO VITAL CAPACITY INHALATION INDUCTION WITH OHMEDA CIRCLE CIRCUIT

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**Introduction:** The time required for induction of anaesthesia using the vital capacity inhalation technique with an Ohmeda circle circuit and 4.5% sevoflurane has been reported by Yurino and Kimura as  $53.8 \pm 9.6$  s (Anesth Analg 1993; 76:598) and  $81 \pm 22$  s (Can J Anaesth 1993; 40: 440). In the study with the longer induction time, the circuit was primed by occluding the patient port and flushing with 8 L/min for more than 4 min as opposed to recirculating the gases in the circuit. We investigated whether the prolonged induction time could be explained by less anaesthetic remaining in the circuit when primed by flushing vs. recirculation.

**Method:** An Ohmeda Modulus SE with fresh Soda lime was studied. Prior to flushing, the 2 L rebreathing bag was emptied, the patient port occluded, and the adjustable pressure-limiting (APL) valve opened. Fresh gas (FG) flow was set at  $3 \text{ L} \cdot \text{min}^{-1}$  with the halothane vaporizer set at 2%. The circuit was flushed for periods of 1 to 6 min after which the APL valve was closed. The patient port was attached to a 3 L gas syringe used to circulate and equilibrate the circuit contents. Gas was sampled for analysis (Datex Capnomac Ultima) from the FG outlet, inspiratory limb, patient port, and expiratory limb. Gas vented out of the APL valve was collected in a bag and analyzed for volume and halothane concentration. The volume of the circuit (VC) was estimated from external measurements, taking into account the volume occupied by the Soda lime. The volume of fresh gas remaining in the circuit was calculated as  $\text{VC} \cdot \text{FEQ}/\text{FP}$ , where FP is the vapour concentration of the priming gas.

Tests were done in duplicate and results were averaged.

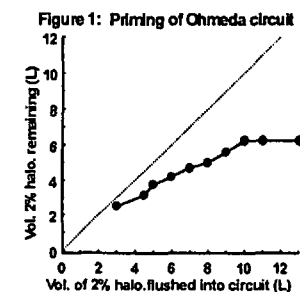
**Results:** There was no detectable halothane in the circuit hoses after priming. All priming gas remained in the  $\text{CO}_2$  absorber and

rebreathing bag. The gas remaining in the circuit for each priming volume is illustrated in figure 1 (dotted line = line of identity). The vapour collected in the scavenger accounted for the balance of fresh gas not in the circuit.

**Conclusion:** During priming of the Ohmeda circle anaesthesia circuit by

means of flushing, most of the gas in excess of 4 L escapes through the APL valve. Furthermore, the initial gas for the first breath consists of gas from the inspiratory limb of the circuit (0.5-0.9 L) which is devoid of vapour. These findings explain the delayed induction time with a single vital capacity inhalation with this circuit when primed by flushing alone.

Supported in part by a grant from Abbott Laboratories Ltd.



## PRIMING CIRCLE ANAESTHETIC CIRCUITS FOR RAPID INHALATION INDUCTION OF ANAESTHESIA

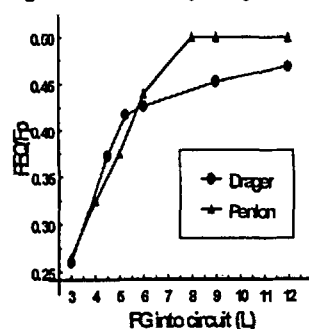
J. A. Fisher MD, G. Volgyesi PEng, J. Silverman, S. Edelstein, J. Rucker B.Sc., L. Sommer B.Sc., S. Dunington R.T. Dept. Anaesthesia, The Toronto Hospital and University of Toronto, Toronto, Canada.

**Introduction:** Anaesthesia may be induced by inhaling a vital capacity breath from an anaesthetic circuit primed with a high concentration of anaesthetic vapour. Thereafter, depth of anaesthesia depends on the equilibrium concentration of the anaesthetic vapour in the circuit (FEQ). In the first 3-4 min, FEQ is principally determined by the initial volume and priming concentration (FP) of anaesthetic gas. We studied the relationship between the volume of anaesthetic flushed through a circuit and the FEQ/FP.

**Methods:** Two circle circuits, each with a 2 L rebreathing bag (RB) either on the expiratory (Drager Narkomed 2 (D)) or inspiratory (Penlon (P)) side of the CO<sub>2</sub> absorber were studied. Prior to flushing, the RB was emptied, the patient port occluded, and the adjustable pressure-limiting (APL) valve opened. The circuits were flushed with a fresh gas (FG) flow of 3 L·min<sup>-1</sup> at halothane vaporizer setting of 2% for periods of 1 to 4 min. The FG flow was then turned off and the APL valve closed. The patient port was attached to a model lung (consisting of bellows attached to a 3 L "functional residual capacity"(FRC)) and equilibrated by simulated breathing. The in vitro test eliminated variability in FEQ arising from vapour absorption and lung volume variation. Gas was sampled for analysis (Datex Capnomac Ultima) from the fresh gas outlet, inspiratory limb, patient port, expiratory limb and scavenger hose. Tests were done in triplicate and the results averaged.

**Results/Discussion:** There was no flow into the circuit hoses during flushing. FEQ / FP increased linearly for the first 4.7 L for D and 6.0 L for P (figure 1). This difference is approximately equal to the volume of the RB. In the D circuit, FG flows retrograde through the CO<sub>2</sub> absorber displacing vapour-free gas into the RB. Once the RB is full, residual plus FG exit from the APL. P is similar except RB fills with FG before there is any flow through the CO<sub>2</sub> absorber. For a target FEQ, the FP = FEQ · (10 + FRC)/5K (for D, K=1.18 and for P, K=0.98; assuming FG volume of 5 L and circuit + RB volume of 10 L).

Figure 1: FEQ/FP vs. "priming" volume



**Conclusion:** The volume of FG priming the P and D circle circuits is confined to the airspace in the CO<sub>2</sub> absorber and RB. Priming circle circuits is more efficient with FG < 5 L (for D and P) and when the RB is on the inspiratory side of the CO<sub>2</sub> absorber.

Supported in part by a grant from Abbott Laboratories Ltd.

**COMBINED USE OF INTRATHECAL MORPHINE AND NONSTEROIDAL ANTI-INFLAMMATORY DRUGS FOR POST CAESAREAN SECTION ANALGESIA.**

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**INTRODUCTION**

The use of intrathecal morphine in the management of post Caesarean section (C/S) pain has gained widespread acceptance but is associated with a high incidence of side effects (1,2). The popularity of nonsteroidal anti-inflammatory drugs (NSAIDs) for postoperative analgesia is increasing (3) and their use in OB patients has been reported (4). In this study, a usual dose of intrathecal morphine is compared to a half-dose of morphine combined to NSAIDs, in terms of analgesia and side effects.

**METHODS**

Following Ethics Committee approval and informed consent, 120 healthy women (ASA I & II) with uncomplicated term pregnancies and scheduled for elective C/S under spinal anaesthesia (hyperbaric bupivacaine 0.75%, fentanyl 10µg and morphine) were randomly assigned to one of two groups. Group 1 (experimental) received 0.1 mg morphine intrathecally and group 2 (control) received 0.2 mg. During the first postoperative day, patients in group 1 received an indomethacine suppository (50 mg) followed by 2 oral doses of naproxen (250 mg), while those in group 2 received a placebo suppository and 2 placebo tablets. Patients were evaluated by a blinded investigator at 2h, 4h, 8h, and 24h after intrathecal morphine injection for wound pain and discomfort due to uterine contractions (at rest and upon mobilization), and for side effects such as nausea, vomiting, and pruritus, using nominal and visual analogue scales. The t-test, the Mann-Whitney Rank Sum test, and the Kruskal-Wallis ANOVA were applied when appropriate. A p<0.05 was considered significant.

**RESULTS**

Up to now, sixty patients have been studied. No difference was found in demographic data, and in intra and postop events. Apart from the pain due to uterine contractions upon mobilization at 8h, which was greater in the experimental group (p=0.01), no statistical difference was noted in the other pain scores. The control group expressed a greater overall degree of satisfaction for pain control (p=0.007). The severity of nausea (p=0.04) at 8h was greater in the control group. Otherwise, the incidence and severity of side effects in the two groups were similar.

**DISCUSSION**

The combination of a smaller dose of intrathecal morphine and NSAIDs provides better control over side effects but is associated with a shorter duration of analgesia and less satisfaction. Combining NSAIDs with a higher dose of morphine might be the best option.

- 1. Anesthesiology 1988;68:925-929.
- 2. Anesth Analg 1988;67:137-43.
- 3. Drugs 1992;44:14-30.
- 4. Anesth Analg 1993;76:284-8.

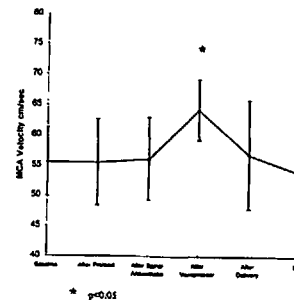
**THE EFFECT OF SPINAL ANAESTHESIA ON CEREBRAL BLOOD FLOW IN PARTURIENTS UNDERGOING CAESAREAN SECTION**

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Spinal anaesthesia is now the anaesthetic of choice for elective caesarean section (C.S.). Acute maternal cardiovascular changes occur both during regional anaesthesia/caesarean delivery. However little is known of their effects on the cerebrovascular circulation. The aim of our study was to measure cerebral blood flow velocity (CBFV) during this period, using previously validated transcranial doppler (TCD) ultrasonography<sup>1</sup>.

**METHODS:** Following institutional approval and informed consent, 13 healthy parturients presenting for C.S. under standardized spinal anaesthesia were recruited. Middle cerebral artery (MCA) flow velocity (using 2MHZ pulsed Doppler ultrasound via the temporal cranial approach) was measured on admission (baseline), after preload (15 mls/kg), after spinal administration, during vasopressor (ephedrine) administration, after delivery of infant, in recovery room (PAR).

**RESULTS:** Demographics mean ± SD.  
Weight (Kg) 78.9 ± 11.5.  
Preoperative Hb (g/L) 116 ± 9  
Blood Loss (mls) 777 ± 188



Mean blood pressure decreased after spinal anaesthesia (p=0.002). MCA velocity increased after vasopressor.(p=0.039) See Figure.

**DISCUSSION:** This is the first report of CBFV measurements during spinal anaesthesia using TCD. Previous studies have suggested increased CBFV (indicative of vasospasm) in preeclamptic patients<sup>2</sup>, which may have implications for anaesthesia and the use of vasopressors. Further studies are necessary.

**REFERENCES**

- 1. J Neurosurg 1984;60:37-41
- 2. Obstet Gynecol 1993;82:334-7

**DEVELOPMENT OF A MATERNAL SATISFACTION SCALE FOR WOMEN UNDERGOING CAESAREAN SECTION: ITEM SELECTION, VALIDITY AND RELIABILITY**

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**INTRODUCTION** Healthy parturients may have different expectations and demands of the health care system than other patients. With decreasing lengths of hospital stay, peripartum maternal satisfaction may become extremely important. There are no valid, reliable scales to assess maternal satisfaction in the patient undergoing Caesarean section. The purpose of this study is to develop a valid, reliable measurement scale to assess maternal satisfaction with regional anaesthesia for operative delivery.

**METHODS** REB approval was obtained and each patient gave verbal consent. To ensure face validity, patients were interviewed before and after Caesarean section to suggest items important to their satisfaction and to evaluate existing descriptors. Content validity was ensured by interviewing until no new items were generated. A draft scale was formed using a 7 point Likert scale and was given to 115 patients. Items endorsed by less than 15% of patients were deleted. Item-total correlations, principal component and factor analysis were performed. Items in factors with less than three items or with complex loadings, were excluded. Construct validity was assessed by correlating the new scale to a 10 cm visual analog scale for satisfaction. Reliability, as measured by internal consistency, was tested using Cronbach's  $\alpha$ .<sup>1</sup>

**RESULTS** Five items of the 33 on the draft scale were excluded because of lack of endorsement. Item-total correlations demonstrated that 'control' was the most important item related to maternal satisfaction. Six items were excluded after principal component and factor analysis. The correlation between the scale total and the VAS was 0.48. Cronbach's  $\alpha$  was 0.82 for the total scale and 0.69, 0.70, 0.45 and 0.45 for factors 1-4.

**DISCUSSION** This scale has been shown to be both valid and reliable. Face validity has been ensured by patient endorsement of items. The correlation between the scale and the VAS demonstrates construct validity. The scale is a more effective means of assessing maternal satisfaction than a simple VAS itself. The high correlation between 'control' and satisfaction mirrors the findings in labour.<sup>2</sup> This tool may now be used in comparison studies that may impact on maternal satisfaction with Caesarean delivery.

**REFERENCES** <sup>1</sup> Health Measurement Scales 2<sup>nd</sup> Edition, pg. 64 <sup>2</sup> Research Nurs Health 10: 301-310

**COMPARISON OF EPIDURAL FENTANYL AND LIDOCAINE WITH SUBARACHNOID SUFENTANIL ANALGESIA DURING LABOUR**

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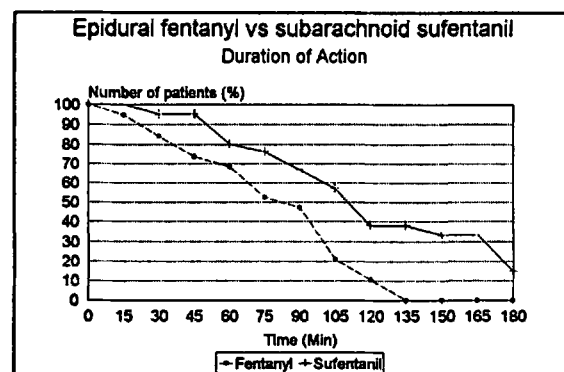
**INTRODUCTION:** Combined spinal epidural (CSE), although more expensive than epidural alone, is a common analgesic technique for women who choose to ambulate during labour<sup>1,2</sup>. This study compares epidural fentanyl with lidocaine (E-FL), a less expensive alternative walking epidural, to CSE with sufentanil (CSE-S) in women in early labour.

**METHODS:** After REB approval and patient consent, a randomized, double blind study was undertaken in women of mixed parity, less than 6 cm dilated. The E-FL group (n=19) received a 3ml epidural test dose of 1.5% lidocaine with 5 $\mu$ g/ml epinephrine followed by 100 $\mu$ g fentanyl diluted to 10ml. The CSE-S group (n=21) received 10 $\mu$ g subarachnoid sufentanil diluted to 2ml. The primary outcome, duration of analgesia, was compared between the two groups using an unpaired *t*-test. VAS scores for pain and pruritus were compared using repeated measures ANOVA. The ability to ambulate was compared using a Fisher's exact test. A *p* value of <0.05 was considered statistically significant.

**RESULTS:** Baseline maternal demographics (including parity) were similar. CSE-S analgesia was longer than E-FL (126 $\pm$  61 min (SD) vs 82.9 $\pm$ 37 min (SD), *p*<0.01 (Figure)). VAS scores for pain were higher for E-FL throughout the study period but both groups had clinically acceptable analgesia (*p*<0.05). The VAS for pruritus was higher in the CSE-S group throughout the study period (*p*<0.05). No patient requested treatment for pruritus in either group. Fewer patients in the E-FL group were able to ambulate (13/19 vs 20/21, *p*<0.04).

**DISCUSSION:** E-FL patients experienced shorter duration analgesia and were less likely to be able to ambulate than CSE-S patients. There was less pruritus in the E-FL group. We cannot endorse E-FL as a cost saving alternative to CSE-S, primarily because of the higher incidence of leg weakness in the E-FL group. Rather, we suggest further investigation into cost-effective epidural drug combinations that will result in prolonged analgesia and reliable ambulation.

**REFERENCES:** <sup>1</sup>Anesthesiology 1994;80:1209-15, <sup>2</sup>Int J Obs Anaesth 1994;3:75-81.



**A RETROSPECTIVE REVIEW OF THE EFFICACY OF INTRAPLEURAL LOCAL ANAESTHETIC INJECTIONS VIA AN INDWELLING CATHETER IN THE TREATMENT OF CHRONIC THORACIC PAIN.**

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**INTRODUCTION**

The intrapleural administration of local anaesthetics has been used in the treatment of post-operative thoracotomy and cholecystectomy pain, the pain of multiple-rib fractures and in chronic pain syndromes including post-herpetic neuralgia, chronic pancreatitis, reflex sympathetic dystrophy of the arms and face, frozen shoulder and lung and upper abdominal cancer pain. This treatment modality has been used in the Chronic Pain Management Unit in the Department of Anaesthesia at the Ottawa General Hospital since 1990 in the management of patients with chronic thoracic pain syndromes. We have conducted a retrospective analysis to assess its efficacy.

**METHOD**

The Guidelines for Research with Human Subjects published by the Research Ethics Board of the Ottawa General Hospital were followed. A chart review revealed that 13 patients, 3 males and 10 females between the ages of 35 and 86 years (mean = 53 years) had been treated with a total of 19 catheter insertions. The catheter insertion technique was done in the lateral position with the affected side up. Insertion sites were T5-T6(7), T6-T7(8), T8-T9(2), T9-10(2). A 17-gauge Tuohy needle was introduced in the posterior chest wall above the rib of the chosen interspace, and advanced obliquely towards the pleural cavity. The pleural space was identified by a loss of resistance technique and an intrapleural catheter was inserted 10 cm into the pleural cavity. A chest x-ray was done one hour later to exclude pneumothorax. The planned regimen was daily injections of 20 ml bupivacaine 0.5% with epinephrine, 5 µg/ml for 10-14 days. A visual analogue score (V.A.S.) 0-10 was recorded prior to treatment and after treatment on each occasion. Complications were documented. Following removal of the catheter the patient was scheduled for follow-up within 4 weeks and the V.A.S. was recorded at that time.

**RESULTS**

The treatment regimen was not completed in five patients because of chest pain (1), catheter infection (1), deterioration of pain (1) and no improvement in pain (2). The mean number of injections was 10.9 range (2-17). The VAS prior to treatment was 7.3 ± 1.63. The mean lowest VAS during treatment was 1.0 ± 1.63. The mean VAS at first follow-up was 6.08 ± 2.42. Statistical analysis was done using a paired Student's t-test. This indicated that the lowest VAS during treatment was significantly lower than the VAS prior to treatment and at the first follow-up (p<0.001). The mean VAS prior to treatment was no different than the VAS at first follow-up (p<0.073). Positive correlation was demonstrated between percentage improvement of the patient's pain and the number of treatments, although it was noted that no patient improved with less than 10 treatments. Eleven complications (58%) occurred and included infection (6), chest pain (3), broken catheter (1) and pneumothorax (1).

**CONCLUSION**

In the majority of patients, the intrapleural administration of local anaesthetic via an indwelling catheter only provided significant analgesia for the duration of treatment. Sustained significant improvement was noted in 4 patients. In order to obtain an improvement, a minimum of 10 treatments would appear to be required. This was a retrospective analysis. Further prospective studies are required to properly evaluate the role of this treatment modality in chronic pain patients. The number of complications (58%) was high. Chest pain occurred in 3 patients and was pleuritic and transient. However, pneumothorax, broken catheter and catheter site infection are serious and point to the need for a meticulous and aseptic technique.

**THE USE OF AN INTRAVENOUS LIDOCAINE TEST TO PREDICT THE RESPONSE TO ANTINEUROPATHIC MEDICATIONS. A RETROSPECTIVE REVIEW**

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**INTRODUCTION:** Anticonvulsants have been utilised in the treatment of neuropathic pain<sup>1</sup> though tempered by high rates of non-response and adverse effects. Currently intravenous lidocaine testing is performed at our pain management unit, prior to prescribing antineuropathic medications. Its use in other pain clinics has been described.<sup>2</sup> There is no data on the accuracy of this test in predicting the patients response to oral anticonvulsants.

**METHODS :** The charts of all patients (n=43) who had the intravenous lidocaine test over a 15 month period were reviewed. Patient demographics were recorded. Following informed consent and starting an intravenous infusion of 5% dextrose, a placebo injection of normal saline was given. A bolus of lidocaine [75-100 mg or 1 mg/kg body weight] was followed by smaller boluses or an infusion. Patients visual analogue scale (VAS) scores were recorded at each stage. Antineuropathic medication doses and duration of treatment were noted. A reduction in the VAS Score of 50% or greater was considered to be a significant response for both the test and treatment. Patients who had less than 2 months treatment or who did not tolerate more than the minimum starting dose were excluded.

**RESULTS:** All patients had clinical features of neuropathic pain. The patients mean age and weight were 48.95 years and 73.12 kg respectively. The mean dose of intravenous lidocaine was 149 mg and the range was 50-350 mg. The average pre-test VAS was 6.56 ± 2.20 and the post-test 2.63 ± 2.08 (p=0.000). The post-treatment VAS was 4.79 ± 3.04 (p=0.005). The lidocaine test was positive in 29 patients (3 placebo responders) and negative in 14 (4-no response and 10 poor). Carbamazepine, Divalproex Sodium, Mexiletine and Clonazepam were used, for an mean duration of 2.8 mths (Range 0.1-9 months). Four patients did not receive treatment and 10 patients were withdrawn due to inadequate treatment, leaving 29 patients for analysis. The response to medications was good in 7 patients and poor in 15 with no response in 7.

TEST	POSITIVE RESPONSE	NEGATIVE RESPONSE
POSITIVE	7	13
NEGATIVE	0	9

SENSITIVITY = 100% POSITIVE PREDICTIVE VALUE = 35%  
 SPECIFICITY = 40.9% NEGATIVE PREDICTIVE VALUE = 100%

**DISCUSSION:** Within the limitations of a retrospective review, the lidocaine test is sensitive but not specific. The finding of a negative predictive value of 100% may be clinically important. Similarly, in a prospective trial<sup>3</sup> to predict the efficacy of oral mexiletine by intravenous lidocaine in the suppression of arrhythmias, a positive predictive value of only 50% but a negative predictive value of 100% was found.

**CONCLUSION:** The intravenous lidocaine test is very sensitive and has a strong negative predictive value when used to predict patients' response to antineuropathic medications.

- REFERENCES:**1. BMJ 1995 October 21;311:1047-52  
 2. Neurology 1995;45, Suppl 9:517-25  
 3. Clin Pharmacol Ther 1988;44:389-95

## POSTOPERATIVE PAIN MANAGEMENT WITH IV SUFENTANIL PCA : A PROSPECTIVE OPEN STUDY

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### INTRODUCTION

Sufentanil(S) is a new synthetic opioid characterised by high analgesic potency along with a rapid onset and short duration of action. These properties make S particularly suitable for PCA use<sup>1</sup>. The present prospective open study intends to evaluate the feasibility of IV S PCA in patients suffering postoperative(PO) pain.

### METHODS

After IRB approval and informed consent were obtained, 60 consecutive, ASA 1 or 2 patients scheduled for major abdominal surgery were enrolled. Anesthetic technique consisted in propofol combined with clonidine and sufentanil. Immediately after the recovery, an IV PCA device (Abbot Life care 4200) was connected to the patient. It was programmed to deliver S 10 µg/ml at the dose of 5 µg per request with a lockout interval of 8 min and a 4 hour limit of 80 µg without basal infusion. The quality of PO analgesia was assessed by recording the analgesic demands (both met and unmet), the S requirements, the patients' pain (0=no, 1=light, 2=hard but tolerable, 3=unbearable) and sedation scores (0=alert, 1=drowsy, 2=asleep but easily arousable, 3=asleep with difficulty to respond to verbal command) and the side effects (respiratory depression, nausea, vomiting, pruritus) at 6, 12, 18, 24, 36, 48 PO hours.

### RESULTS

The mean age of the patients was 51±13 years. Their weight 73±16 kg. Analgesic demands and S consumption are summarised on table 1(results are means ± SD). Pain scoring : 695 evaluations were performed. 530 disclosed a score 0, 161 a score 1, 2 a score 2 and 2 a score 3. Sedation : 18 patients reported a score 0 at the 6 periods, 12 a score of 1 once, 13 a score of 1 more than once, 9 a score of 2 once, 8 a score of 2 more than once. Eight patients presented with nausea or vomiting. No other side effects were detected

### DISCUSSION

The results of the present study demonstrate that S may be suitable for IV PCA PO pain management even without basal infusion at least in patients who received clonidine during surgery.

### REFERENCE

1-J.Clin.Anesth 8 (2) 123-9,1996.

PO period	Unmet demands(n)	S consumption(µg/h)
0 to 6h	2.3 ± 2.1	6.3 ± 4
6 to 12h	0.9 ± 0.6	4.6 ± 3.8
12 to 18h	0.7 ± 0.7	5.6 ± 3.7
18 to 24h	1.2 ± 1.6	6.2 ± 3.1
24 to 36h	0.9 ± 0.9	5.6 ± 2.7
36 to 48h	0.9 ± 0.8	4.7 ± 3.7

## EFFECT OF TREATMENT OF SUBARACHNOID MORPHINE-INDUCED PRURITUS ON POSTOPERATIVE NAUSEA AND VOMITING

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### INTRODUCTION:

The effects of drug therapy provided for spinal morphine-induced pruritus on the incidence of nausea and vomiting following cesarean section is not well established. Data obtained from a double-blind, prospective study comparing nalbuphine with diphenhydramine were analyzed to address this question.

### METHODS:

Sixty two class I-II ASA patients, at term, and booked for elective cesarean section, gave written informed consent to the institutionally-approved protocol. All patients received 200 µg of morphine intrathecally. Patients were randomly allocated to either nalbuphine (NAL) or diphenhydramine (DIP) for treatment of subarachnoid morphine-induced pruritus. The control group consisted of subjects who did not receive pruritus treatment, but developed nausea and vomiting. Postoperative nausea and emesis were recorded q 1 hr for 12 hrs, then q 4 hr for a total of 24 hrs. Data were analyzed using ANOVA, Chi-square test, and Fisher Exact test; significance was assumed when P<0.05.

### RESULTS:

Demographic data were similar among the study groups. At least 29% of patients experienced postoperative nausea and vomiting in all study groups. However, there were no differences in the incidence of nausea and vomiting among patients treated with either nalbuphine or diphenhydramine compared with the control group (Table).

Group	Control (n=49)	NAL (n=16)	DIP (n=17)
PONV (n)	20	5	5
PONV (%)	41	31	29

PONV=Postoperative nausea and vomiting.

### DISCUSSION:

Treatment of spinal morphine-induced pruritus with either nalbuphine or diphenhydramine did not influence the incidence of postoperative nausea and vomiting following cesarean section with subarachnoid morphine. This study is ongoing.

**ANALGESIA/ SEDATION REQUIREMENTS DURING ESWL OF RENAL CALCULI WITH THE SIEMENS LITHOSTAR MULTILINE**

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**INTRODUCTION**

The purpose of this study was to establish whether patients with renal calculi undergoing non immersion ESWL with the new Siemens Lithostar Multiline required analgesia/sedation.

**METHODS**

With Ethics Committee approval and informed consent, 47 patients underwent ESWL. All patients were unpremedicated and NPO, verbal pain scores (0 to 10) were recorded at start and end of the procedure, at time of first analgesia request, at 2000 shocks, at discharge from the PACU and 24 hours after treatment. Patients were instructed to ask for analgesia/sedation (fentanyl and midazolam) when pain became intolerable. Patients who had previously experienced immersion ESWL (under regional or general anaesthesia) were asked to rate their preference of techniques.

**RESULTS**

30/47 patients studied requested analgesia/ sedation. 29 patients received fentanyl, 50 to 400 ug (mean 181 ug), whilst 29 patients received midazolam 0.5 to 6.0 mg (mean 1.76 mg). 28 patients received both medications. The mean shock level at which medication was first requested was 2.6 (median 3.0). Prior to the start of the procedure, the mean pain score was 0.3 (median 0), in those patients requesting medication immediately prior to administration 6.2 (median 5.5), at 2000 shocks 3.6 (median 3.0), at completion of the procedure 1.4 (median 1.0), at time of discharge from PACU 1.0 (median 1.0), and 24 hours after the procedure 0.8 (median 0). 18 patients received acetaminophen with codeine for postoperative analgesia, 2 patients received meperidine and 1 patient received ketorolac. 25/25 patients who had previously had immersion ESWL preferred this machine.

**DISCUSSION**

Newer generation lithotripters are associated with less shock wave induced pain(1). However, a recent trial revealed 92% of patients undergoing initial treatment required combined parenteral analgesia and sedation (mean pain score 3.9)(2). Our results indicate 63% of patients required analgesia and sedation, but also prefer this method of treatment. It would appear that while the severity of pain with newer generation lithotripters is decreased, a significant proportion of patients will continue to require analgesia and sedation for ESWL.

**REFERENCES**

1. J Urology 146:718-720.
2. J Urology 155:834-838.

**THE EFFECT OF 24 HOURS OF POST-OPERATIVE EPIDURAL ANALGESIA ON POST-OPERATIVE CARDIAC MORBIDITY AND MORTALITY: A META-ANALYSIS**

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**INTRODUCTION:** Epidural anaesthesia and analgesia have long been thought to reduce perioperative morbidity and mortality. Several studies designed to show this effect failed to demonstrate a significant difference. The most common problem is sample size. Most cardiac morbidity occurs in the first 24-48 hours. The beneficial effects on epidural analgesia in addition to superior pain relief include a sympatholytic effects, favourable effects on coagulation, and nitrogen balance. We postulated that the effectiveness of epidurals on morbidity will only be seen in patients in whom the epidural is continued through the critical first 24-48 hours.

**METHODS:** Prior to our search our inclusions were controlled trials where epidural analgesia was continued for more than 24 hours. For inclusion studies had to quote incidence of any or all of congestive heart failure, myocardial infarction, and death. We then conducted an English language medline search under the headings of epidural, surgery, analgesia, anaesthesia, post-operative pain. The Meta-analysis was conducted using the Peto method<sup>1</sup>.

**RESULTS:** This search yielded 7 papers. Analgesia was extended into the postoperative period for at least 1 day, and reported hard cardiac endpoints. This report comprises 492 patients. Epidural reduced all endpoints (C.H.F. was 11.6% vs 5.8%; myocardial infarction was 6.0% vs 4.1% and death was 3.6% vs 2.1%). The results of the meta-analysis are seen in Table 1:

EVENT	ODDS RATIO	95% C.I.
C.H.F	8.16	2.88 p<.01
INFARCT	2.11	1.85 ns
DEATH	2.34	2.45 ns

**DISCUSSION:** Of the three endpoints that we surveyed there was only a significant reduction in the rate of heart failure. The sample size required to demonstrate a difference in infarction rate would be 900 patients. These results must of course be viewed with all the pitfalls of meta-analysis and the bias inherent in this type of study. However, along with superior pain relief, coagulation parameters, in pooled results it appears that epidural analgesia which extends through the critical first day reduces congestive failure.

**REFERENCE:** 1.) Yusef et.al Prog. Cardiac Dis. 1985 27, 335-371.

### ELECTROMOTIVE DRUG ADMINISTRATION (EMDA) OF LIDOCAINE FOR TRANSURETHRAL SURGERY

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**INTRODUCTION:** Local/ regional anaesthesia for transurethral surgery reduces patient risk and side effects with potential cost savings. A new technique for the urologist is EMDA (ElectroMotive Drug Administration) of intravesical lidocaine to produce bladder and bladder neck local anaesthesia. A multicentre study was undertaken to demonstrate the safety, efficacy, and cost-effectiveness of EMDA as an alternative to traditional methods of anaesthesia (spinal or general).

**METHODS:** Following institutional approval and informed consent, patients were enrolled with: 1) a history of bladder tumour [n=28] who required cold cup bladder biopsy with fulguration for possible recurrence as a randomized comparison trial, 2) bladder tumour undergoing transurethral resection/ fulguration TURBT (Transurethral Resection of Bladder Tumour) [n=39], and 3) benign prostatic hyperplasia/ carcinoma of prostate undergoing transurethral resection [n=5] with the Vesalius radio frequency resectoscope or conventional electrocautery. Pain scores using a 0-10 Verbal Rating Scale were recorded for each individual biopsy, fulguration, and resection event. Cost data for both direct and indirect costs were collected using a standardized form for each patient to capture the details of the procedure including times, drugs, and disposables. Cost data was also collected for patients not undergoing EMDA for comparison.

**RESULTS:** There was a significant reduction in pain with EMDA (p<.03 for the biopsy patients compared to controls) with accompanying high patient satisfaction for bladder biopsy and TURBT patients. Preliminary estimates suggest that the cost of EMDA therapy is in the order of \$500 Cdn/ patient. Costs were similar to those with general/ spinal anaesthesia and dependent upon local practice.

**CONCLUSION:** EMDA can be a safe, effective, and affordable form of anaesthesia for transurethral surgery and is particularly suitable for ambulatory care.

### COMPATIBILITY OF MORPHINE AND TORADOL AS A MIXTURE

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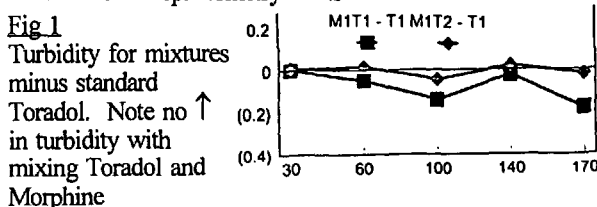
### INTRODUCTION

Ketorolac is often used for breakthrough pain in patients receiving morphine from a patient controlled analgesia (PCA) pump. Concerns about chemical compatibility have precluded mixing both in the same PCA syringe.

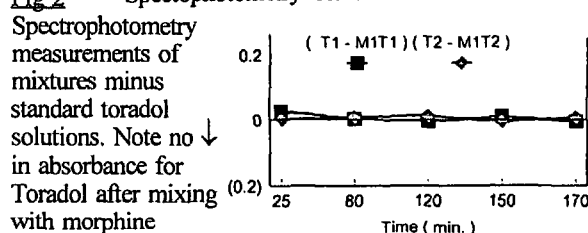
### METHODS

Five solutions were studied at room temperature (20°C) over 4 hours: Morphine 1 mg/ml (M1), Toradol 1 mg/ml (T1), Toradol 2mg/ml (T2), Morphine 1 mg/ml + Toradol 1 mg/ml (M1T1), and Morphine 1mg/ml + Toradol 2 mg/ml (M1T2). A nephelometer was used to detect turbidity due to any precipitates. A spectrophotometer was used at 320 nm to measure absorbance due to Toradol (morphine has minimal absorbance at this wavelength). Each experiment was performed twice.

### RESULTS Nephelometry Units Time (min.)



### Fig 2 Spectrophotometry Units



### DISCUSSION

At the concentrations studied the data suggest that morphine and Toradol may be mixed in the same syringe. Whether biologic activity of the two drugs is preserved when mixed cannot be determined by the methods described. A controlled trial is underway to investigate the analgesic efficacy of the drug mixture given by PCA pump.

### REFERENCES

1. Floy BJ et al. Am J Hosp 1990; 47:1097
2. Knapp AJ et al. Am J Hosp Pharm 1992; 49:2960.
3. "Toradol" Product Monograph



**A MATHEMATIC EVALUATION OF THE TEMPERATURE DEPENDENCE OF THE VAPOR PRESSURE OF DESFLURANE**

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**INTRODUCTION:** Desflurane is a volatile anaesthetic which is currently employed in clinical practice. In this investigation, an equation was derived which can be employed to accurately compute the vapor pressure of desflurane as a function of the temperature from 20 to 26°C.

**METHODS:** Vapor pressure data for desflurane at six temperatures was obtained from Anaquest, Inc.<sup>1</sup> (Liberty Corner, NJ, USA) (see Table 1). Employing the iterative method of Nahrwold, et al.,<sup>2</sup> linear regression analysis of the common logarithm of the vapor pressure of desflurane as a function of the reciprocal of the temperature in degrees centigrade plus a constant A,  $[T(^{\circ}\text{C})+A]^{-1}$ , was undertaken for various values of the constant. By the process of trail and error, a value of A was sought which would give the best correlation coefficient.

**RESULTS:** It was determined that a value of 192.7895 for the constant A was best. This resulted in a correlation coefficient of -0.9999966738. By way of algebraic manipulations, and by employing the linear regression coefficients that were obtained, we found that the vapor pressure of desflurane can be expressed as a function of the temperature by the following equation:

$$\text{Vapor Pressure (mm Hg)} = 9340017.221 \times 10^{-882.0030067 (T+192.7895)^{-1}}$$

A relation of this type for the vapor pressure of a volatile anaesthetic has been termed an Antoine equation.<sup>2</sup> When this formula was employed to calculate the vapor pressure of desflurane at the temperatures listed in Table 1, the agreement between the calculated values and the experimentally determined data was perfect given the precision of the data (see Table 1).

**Table 1. Experimentally Determined and Calculated Values for the Vapor Pressure of Desflurane at Six Temperatures.**

Temperature (°C)	Vapor Pressure (mm Hg)	
	Experimentally Determined *	Calculated (see text)
20	669	669
22	731	731
22.8	757	757
23	764	764
24	798	798
26	869	869

\* Source: Reference 1

**DISCUSSION:** A knowledge of the vapor pressures of a potent inhaled anaesthetic at various temperatures is important for its proper clinical use. In this investigation, an iterative method which was previously employed to derive equations for the vapor pressures of volatile anaesthetics as a function of the temperature was used for desflurane.<sup>2</sup> Starting with the experimentally determined vapor pressures at six different temperatures, the derived Antoine equation was shown to accurately predict the vapor pressures as a function of the temperature from 20 to 26°C.

<sup>1</sup> Eger, E. Desflurane: a compendium and reference. Publication No. 742018. Anaquest, Inc., Liberty Corner, NJ. Healthpress Publishing Group. Rutherford, NJ, 1993.

<sup>2</sup> Nahrwold ML, Archer PG, Cohen PJ. Estimation of an equation relating saturated vapor pressure to temperature. Anesthesiology 30:444, 1973.

**PROPOFOL-THIOPENTAL STABILITY STUDY**

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**INTRODUCTION:** Propofol and thiopental have been used clinically as a mixture for the induction of anesthesia. There are studies that suggest that this combination may have synergistic activity<sup>1</sup>, that it provides equally rapid and qualitatively similar recovery to that afforded by propofol alone<sup>2</sup>, and that the mixture does not support the growth of *C. albicans*, and is in fact bactericidal towards *E.coli*, *S. aureus*, and *P.aeruginosa*<sup>3</sup>. These findings would suggest that this mixture may be clinically useful, as well as a cost effective agent. What has not yet been established is the chemical stability of these agents once combined. The purpose of this study was to answer this question.

**METHODS:** We designed an assay using high performance liquid chromatography (HPLC) to quantitate the concentration of both propofol and thiopental in a given sample. This technique should also allow us to detect any loss of drug concentration as well as the formation of breakdown products as a result of drug interaction. Samples of each agent alone were assayed as HPLC standards. 10 preparations of a 1:1 mixture by volume of propofol and thiopental were prepared. The samples were divided into aliquots that were assayed at time 0, 24 and 72 hours as well as after one week. Half the samples were incubated in a 23°C water bath and the rest in a 4°C refrigerator. Samples were also samples pre and post microfiltration. Samples of thiopental were assayed with nuclear magnetic resonance.

**RESULTS:** The assay was able to accurately measure the quantity of drug present in the samples. There was no significant decrease in the quantities of either propofol or thiopental in the mixture nor was there a trend for the quantity of either drug decrease over the time parameter of this study. There was a small but statistically significant decrease in propofol concentration following filtration through the 20 micron filter. This occurred at all time intervals tested. Thiopental was found to be impure.

**CONCLUSIONS:** It is concluded that the 1:1 by volume mixture of propofol and thiopental is chemically stable for up to one week at room temperature and at 4°C. Based on the findings of this study we feel that the mixture is likely to be a chemically safe agent for induction of anesthesia as well as having some potential benefits over the use of either agent alone.

**Reference:** Br. J. Anaesth 1991;67:4-6.  
Can. J. Anaesth 1994; 41:12; 1167-71.  
Anesth Analg 1996 82:475-8.

**EFFECTS OF INHALATIONAL AND LOCAL ANAESTHETICS ON THE SENSITIVE PLANT *MIMOSA PUDICA*: A POTENTIAL MODEL FOR THE INVESTIGATION OF ANAESTHETIC MECHANISMS**

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**INTRODUCTION:** The sensitive plant *mimosa pudica* has a visible reaction, consisting of the closing of the plants' leaflets and dropping of the stems, to a variety of stimuli including touch, light and temperature. This motor mechanism is due to phloem unloading and opening of potassium, calcium and chloride channels in specialized motor cells. This stimulation causes the cell to be evacuated of liquids, resulting in its being too weak to support the stem or leaflet, which will then fold (1). Claude Bernard studied the effects of ether on the *mimosa*, and proved that it rendered the plant insensitive after being exposed for 25 min. (2). The objective of this study was to investigate the effects of inhalational and local anaesthetics on *mimosa's* reaction to a variety of stimuli.

**METHODS:** In a series of experiments the reactions of the *mimosa* to stimuli under normal conditions were tested. The stimuli which caused the greatest reactions were tactile stimulation of the leaves, and putting a lit match to the end of one of the leaflets. The reactions of the plants (n = 4, Q 5min.) were tested after exposure to 4% halothane and O<sub>2</sub> 6 L/min., or O<sub>2</sub> 6 L/min. as control. To test the *mimosa's* reaction under the effect of a local anaesthetic, lidocaine or vehicle was administered through the roots and cut stems of plants, as well as sprayed directly on the leaves (n = 4).

**RESULTS:** After 15 min. of exposure to 4% halothane, the *mimosas* had very slow and incomplete reactions to tactile stimulation. Following 20 min. of exposure, the plants had no visible reaction to touch, a stimulus which would normally cause the collapse of the entire leaf. The *mimosas* tested in the control experiments reacted normally. The lidocaine spray had a more immediate effect on the leaves of the *mimosa*; after one minute those which were sprayed had no reaction to a lit match being touched to the tips of the leaves, contrary to the control in which the leaves collapsed completely. After exposure to lidocaine 2% through the roots and cut stems, the *mimosa's* reaction gradually became slower and less complete. After four hours of soaking in the solution the leaves were either completely insensitive or had an incredibly slow reaction to tactile stimuli.

**CONCLUSIONS:** The inhalational and local anaesthetics used in these experiments had an obvious effect on the motor mechanisms of the sensitive plant *mimosa pudica*. This may be a useful model to further elucidate the mechanisms of action of general and local anaesthetics.

**REFERENCES:**

- (1) *Physiologia Plantarum* 1991; 83 : 529-533.
- (2) *Lectures on Phenomena of Life Common to Animals and Plants*, 1878.

**SEVOFLURANE DOES NOT APPEAR TO HAVE ANY EFFECT ON SA NODE FUNCTION AND INTRAATRIAL CONDUCTION IN WOLFF-PARKINSON-WHITE SYNDROME (WPW)**

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**INTRODUCTION:**

Human studies have described variable heart rate responses to sevoflurane which include an increase, decrease and no change in heart rate<sup>1</sup>. We therefore studied the direct effects of sevoflurane on SA node function and intraatrial conduction in WPW patients undergoing catheter ablation.

**METHODS:**

With ethics approval and informed consent, six WPW patients were studied. During alfentanil/midazolam/vecuronium anaesthesia, the following measurements were made according to our previous protocol<sup>2</sup>: 1) PA (intraatrial conduction time), 2) SNRT (sinus node recovery time), 3) CSNRT (corrected sinus node recovery time), 4) SACT (sinoatrial conduction time and 5) AH (atrial HIS interval). Alfentanil/midazolam administration was then discontinued. Sevoflurane was then administered at 1 MAC (2% end-tidal) and the EP measurements were repeated. Paired Student's t-tests compared measurements prior to and during sevoflurane administration. P<0.05 was considered significant. Values expressed as Mean ± SD.

**RESULTS:**

Preliminary data suggests that sevoflurane had no significant effects upon the measured parameters of SA node function and intraatrial conduction. (Table)

TABLE:	(msec)		P Value
	Baseline	Sevoflurane	
PA	37±9	37±8	.90
SNRT	1522±209	1457±262	.34
CSNRT	494±123	449±140	.19
SACT	109±30	91±26	.11
AH	71±19	68±16	.37

**CONCLUSIONS:**

Sevoflurane has no direct effects upon SA node function or intraatrial conduction to account for the intraoperative changes in heart rate previously described during its administration.

**REFERENCES:**

1. *Anesth Analg* 1995;81(suppl):S11-S22.
2. *Anesthesiology* 1995;82:888-895.

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**UNSCHEDULED POST-OPERATIVE DISCHARGE IN SAME DAY ADMISSION SURGERY PATIENTS - INCIDENCE AND CAUSES**

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**INTRODUCTION**

The incidence of Same Day Admission Surgery (SDAS) patients being discharged following their operative procedure instead of being admitted is not known. Patients undergoing Day Patient Surgery (DPS) have a less costly pre-operative evaluation and preparation process than SDAS patients. If specific factors resulting in early discharge could be identified it might be possible to achieve cost savings. This study was undertaken to determine the incidence of post-operative discharge of SDAS patients on the day of surgery and reasons for this early discharge.

**METHODS**

As part of the hospital QA process all charts of SDAS patient discharged on the day of surgery from July 1, 1995 to August 31, 1996 were reviewed. Demographic data, ASA classification, surgical service, diagnosis, operative procedure (planned and/or performed), co-morbidities, surgical time, PACU time, type of anaesthesia and recorded reason for early discharge were noted.

**RESULTS**

31 of 2951 (1.05%) SDAS patients were discharged on the day of surgery. The incidence by service was General Surgery, 0.98%; Plastic Surgery, 1.23%; Orthopaedic Surgery, 1.62%; Gynaecology, 0.88%; and Urology 1.6%. Average age was 44.7 years, average weight was 79.7 kg and the male:female ratio was 2:3. The average surgical time was 34.3 minutes and the average time spent in the PACU was 120.9 minutes. 17 patients were ASA 1 and 14 patients were ASA 2. 11 patients had reasons for early discharge - 5 (16%) had no pathology at surgery, 5 (16%) had a rapid recovery with no side effects and 1 had less extensive surgery than planned. 20 patients had no apparent reason for early discharge - 19 (61%) had no recorded reason and 1 was changed to DPS status on the morning of surgery.

**DISCUSSION**

No previous study has determined the incidence of post-operative discharge on the day of surgery of patients presenting under an SDAS program. The incidence of unscheduled, or early discharge, is low (1.05%) and in two thirds of these patients there is no particular reason or indicator why this occurs. Cost savings of approximately \$2,000 only (\$100 per patient) could be achieved by identifying these patients and changing their status to DPS instead of SDAS prior to their initial preoperative evaluation.

**READMISSION FOR BLEEDING FOLLOWING DAY CARE SURGERY.**

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**INTRODUCTION:** The number of same day surgical procedures have escalated in recent years, but the recovery time allowed for expected complications limits the total number of procedures performed. At the Vancouver Hospital Surgical Day Care Centre (VH-SDCC), a 45 minute stage I, and a 1 hour stage II recovery periods are used. This study proposes a total recovery time of 45 minutes, and examines whether patient safety will be compromised should these time limits be adopted.

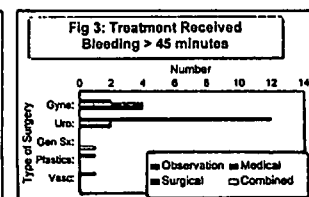
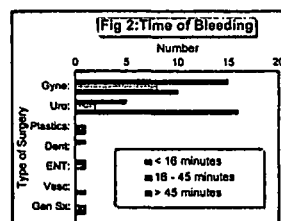
**METHODS:** A retrospective chart review was undertaken of all surgical day care procedures performed at the VH-SDCC from January 1984 until December 1992 inclusively. The charts of all the patients readmitted to the hospital within 48 hours of surgery were examined with respect to age, sex, the reason for the readmission, the time the reason was documented, the type of surgery performed, and the type of treatment received. Reasons for readmission were classified as bleeding, surgical (more extensive surgery than anticipated), and medical (drowsy, nausea and vomiting, pain, pyrexia, hypertension, or bronchospasm).

**RESULTS:** During the study period there were 172 710 day care procedures performed, resulting in 96 readmissions. Bleeding occurred in 64 pts, primarily in urological and gynecological surgery (fig 1). The onset of the bleeding is shown in figure 2. In the 29 patients that presented with bleeding after 45 minutes, surgical re-exploration was needed in 7 (fig. 3).

**DISCUSSION:** If the proposed recovery times were implemented, then no patient undergoing day care procedures in plastic, dental, ENT, or vascular surgery, would require surgical re-exploration for bleeding. The safety of these recovery guidelines should be conclusively studied in a prospective manner.

Figure 1:

	Bleeding	Surgical	Drowsy	PONV	Pain	B/spasm	HT	Pyrexia
Gynecological:	33	1	3	2	1	2		10
Urological:	23	1					1	1
Orthopaedics:			1	1				
Plastics:	2				4			
Dental:	1			1				
ENT:	2			1				
Vascular:	1							
General Surgery:	2	1						
Ophthalmology:						1		



### WHAT IS THE BEST NON-DEPOLARIZING RELAXANT TO PREVENT SUCCINYLCHOLINE FASCICULATIONS AND MYALGIA ?

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**INTRODUCTION:** Succinylcholine is still a fast and effective short acting neuromuscular relaxant for endotracheal intubation. We usually like to prevent fasciculations resulting from its use. Pretreatment with D-tubocurarine was often used but this drug is now difficult to obtain. Vecuronium, atracurium, mivacurium, rocuronium and D-tubocurarine were compared to 0.9 NACL as non-depolarizing pretreatment in the present study.

**METHODS:** In a double blind randomized study, 120 consenting female patients were studied. They all had gynecologic laparoscopic procedures. They were divided into 6 groups of 20 patients each according to the non-depolarizing relaxant pretreatment used which were: 0.9 NACL (control), vecuronium 0.01 mg/kg-1, atracurium 0.05 mg/kg-1, mivacurium 0.02 mg/kg-1, D-tubocurarine 0.05 mg/kg-1, and rocuronium 0.06 mg/kg-1. After the installation of a standard monitoring which included a NMT 221 Relxograph monitor®, the non-depolarizing pretreatment was administered at time zero. Two minutes later, the patients were asked for possible side effects. Three minutes after pretreatment, fentanyl 1 µg/kg-1 and propofol 2.5 mg/kg-1 were injected, followed 1 minute later by succinylcholine 1.5 mg/kg-1. The patient was observed the following 1.5 minute for the presence (and magnitude) of fasciculations (0 to 3). The trachea was then intubated and its ease graded (0 to 3). Anaesthesia was maintained by a perfusion of propofol, a mixture of N<sub>2</sub>O/O<sub>2</sub>/isoflurane and fentanyl 50 µg bolus injections. Mivacurium was used in all the patients when the twitch had recovered to 20 % of its control value. The patient were evaluated in the recovery room, 24 hours and 48 hours post-surgery in regard to possible myalgia, graded on a 0-10 pain scale. Chi-squared and Kruskal-Wallis tests were used to analyze the non-parametrics results; analysis of variance, Fisher PLD and Bonferroni-Dunn tests for parametrics results.

**RESULTS:** The only side effect which differed in the 5 pretreated groups was the incapacity for 4 patients in the mivacurium group to sustain a 4 seconds head-lift ( $p < 0.05$ ). Fasciculations were observed in 19 of the 20 patients in the 0.9NACL control group and in 3 of the 20 patients in the rocuronium group, the best of the 5 pretreatments groups in that aspect. Intubations conditions were better in the 0.9 NACL control group ( $p < 0.05$ ). The speed of action of succinylcholine was also faster and its duration of action longer in that group ( $p < 0.05$ ). Pain in the neck, shoulders, thighs, back and chest did not differ significantly 1, 24 and 48 hours postoperatively among the 6 groups. Myalgia was present in 71 % of the patients at 24 hours and in 51 % of them 24 hours later, especially in the shoulders and chest. Intensity of the pain was graded 6.8 on 10 in the chest 24 hours postoperatively.

**CONCLUSION:** Rocuronium (0.06 mg/kg-1) is the best agent among the 5 tested to prevent fasciculations, followed by atracurium, D-tubocurarine, vecuronium and mivacurium. The presence of fasciculations does not seem to be related to an increased incidence myalgia in the postoperative period. Finally, succinylcholine is more effective (intubations conditions, speed and duration of action) without a non-depolarizing relaxant pretreatment.

### Cerebral Hypoxia during Cardiopulmonary Bypass: A Magnetic Resonance Imaging Study

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**Background:** Neurocognitive deficits following open heart surgery have been correlated to jugular venous O<sub>2</sub> desaturation on rewarming from hypothermic cardiopulmonary bypass (CPB)<sup>1</sup>. Using a porcine model, we looked for evidence of cerebral hypoxia by magnetic resonance imaging (MRI) during CPB. Brain oxygenation was assessed by T2\*-weighted imaging, based on the blood oxygenation level dependent (BOLD) effect (decreased T2\*-weighted signal intensity with increased tissue concentrations of deoxyhemoglobin)<sup>2</sup>.

**Methods:** Pigs were placed on normothermic CPB, then cooled for 2 hr (hypothermic CPB; 28°C) then rewarmed to baseline temperature. T2\*-weighted imaging was undertaken at pre-CPB, normo-CPB, at 30 min intervals during hypo-CPB, following rewarming, then 15 min after death. Imaging was with a Bruker 7.0 Tesla, 40 cm bore MR scanner with actively shielded gradient coils. Regions of interest (ROIs) from the MR images were analyzed to identify parenchymal hypoxia and correlated to jugular venous O<sub>2</sub> saturation. Post-hoc fuzzy clustering analysis was used to examine spatially distributed ROIs whose pixels followed similar time courses<sup>3</sup>. Attention was paid to pixels showing decreased T2\* signal intensity over time.

**Results:** T2\* imaging with fuzzy clustering analysis revealed two diffusely distributed pixel groups during CPB. One large group of pixels (50 ± 13% of total pixel count) showed increased T2\* signal intensity (well oxygenated tissue) that corresponded to increased jugular venous O<sub>2</sub> saturation during hypothermia, with decreased intensity on rewarming. A second group of pixels (34 ± 8% of total pixel count) showed an inexorable decrease in T2\* signal intensity, independent of temperature, suggestive of progressive brain hypoxia during CPB.

**Conclusions:** Decreased T2\* signal intensity in a diffuse spatial distribution indicates that large proportions of the cerebral parenchyma is hypoxic (evidenced by an increased proportion of tissue deoxyhemoglobin) during CPB in this porcine model. Neuronal damage secondary to parenchymal hypoxia may offer an explanation for the postoperative neuropsychological dysfunction seen following cardiac surgery.

#### References:

1. Croughwell ND, Newman MF, Blumenthal JA, et al.: Jugular bulb saturation and cognitive dysfunction after cardiopulmonary bypass. *Ann Thorac Surg* 1994;58:1702-1708.
2. Ogawa S, Lee TM, Kay AR, Tank DW.: Brain magnetic resonance imaging with contrast dependent on blood oxygenation. *Proc Natl Acad Sci* 1990;87:9868-9872.
3. Scarth G, McIntyre M, Wowk B, Somorjai R.: Detection of novelty in functional images using fuzzy clustering. *Soc Magn Reson 3rd Annual Meeting* 1995;238:(Abstract)

**TREATMENT OF INTRATHECAL MORPHINE-INDUCED PRURITUS; DIPHENHYDRAMINE VS. NALBUPHINE**

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**INTRODUCTION:** Pruritus following subarachnoid morphine administration occurs in up to 80% of patients<sup>1</sup>. Among the drugs used to treat this side effect, nalbuphine and diphenhydramine have been used most frequently. However, there are no studies that directly compare these two drugs. A double-blind study was undertaken to compare the efficacy of nalbuphine and diphenhydramine for treating spinal morphine-induced pruritus, and to establish their cost-effectiveness.

**METHODS:** Sixty ASA class I-II patients, scheduled for elective cesarean section under spinal anaesthesia, gave written informed consent to the institutionally-approved protocol. Subjects were randomized, from the outset, to either nalbuphine (N) or diphenhydramine (D) group. All patients received 200 µg of morphine intrathecally, mixed with 0.75% hyperbaric bupivacaine. Postoperatively, pruritus was assessed by the patient's nurse using a visual analogue scale (VAS). Patients were evaluated, when awake, q 1 hr for 12 hrs, then q 4 hr for a total of 24 hrs. Patient satisfaction was determined by an interview, based on a questionnaire, conducted 24-48 hr postoperatively. Data were analyzed using Chi-square, t-test, and Fisher Exact test; significance was assumed when P<0.05.

**RESULTS:** Demographic data were similar in the study groups. More than 84% of patients experienced pruritus in both groups, however, only half of those affected requested therapy. Although there were no differences among the study groups with regard to ΔVAS, achieving a VAS of zero, and side effects, a trend towards more treatment failures was seen in group D (P=0.17). Direct drug costs were much higher for nalbuphine compared with diphenhydramine (P<0.0001, Table).

Group	Nalbuphine (n=30)	Diphenhydramine (n=30)
Treatment requested (n)	16	16
Dose required per patient (mg)	16.3 ± 8.3	88.6 ± 45.2
Treatment side-effects (n)	2	3
Treatment failure (n)	1	5
VAS = 0 after therapy (n)	13	7
ΔVAS	4.0 ± 2.8	2.4 ± 2.2
Direct costs (\$CND)	6.7 ± 3.3*	0.7 ± 0.8
Patient satisfaction (n)		
Excellent/Good	15	11
Poor/Fair	1	5

\*P<0.0001, different from diphenhydramine group.

**DISCUSSION:** Nalbuphine and diphenhydramine are equally effective in the treatment of spinal morphine-induced pruritus. However, the uniformly high patient satisfaction observed in both study groups may not justify the increased costs associated with the use of nalbuphine. This study is still ongoing.

**REFERENCE:** Anesth Analg 1988; 67: 137-43.

**POSTOPERATIVE NAUSEA AND VOMITING (PONV): COMPARISON OF INTRAOPERATIVE USE OF ALFENTANIL, FENTANYL AND SUFENTANIL.**

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**INTRODUCTION:** PONV is one of the most frequent side effects of general anaesthesia. In outpatient surgery, its incidence ranges from 20 to 40%. Use of opioids during anaesthesia is a well known risk factor of PONV.<sup>1</sup> The purpose of this study was to verify whether the use of equipotent doses of alfentanil (A), fentanyl (F) or sufentanil (S) as part of a general anaesthetic technique would be associated with different incidences of PONV in outpatient surgery.

**METHODS:** Following Ethics Committee approval, 289 adults patients scheduled for an elective outpatient surgery consented to be included in this prospective study. Patients were randomized to receive in a double-blind manner a bolus of either A (7.5µg.kg<sup>-1</sup>), F (2.5µg.kg<sup>-1</sup>) or S (0.25µg.kg<sup>-1</sup>), followed by an infusion of A (9µg.kg<sup>-1</sup>.hr<sup>-1</sup>), F (3µg.kg<sup>-1</sup>.hr<sup>-1</sup>) or S (0.3µg.kg<sup>-1</sup>.hr<sup>-1</sup>) respectively. These doses were determined based on the steady state plasma concentrations required to obtain a 50% reduction in MAC of isoflurane.<sup>2</sup> In all groups, anaesthesia was induced with thiopental. Isoflurane (0.6% end tidal) and N<sub>2</sub>O/O<sub>2</sub> mixture (60%/40%) were used for maintenance. Short or intermediate duration muscle relaxants were administered as clinically required. In the post anaesthesia care unit (PACU) and the ambulatory surgery unit (ASU), ketorolac 30-60 mg, followed if necessary by meperidine 1 mg.kg<sup>-1</sup>, was used for pain control. Metoclopramide 10 mg, followed if necessary by droperidol 0.625 - 1.25 mg, was used for nausea and vomiting. Episodes of nausea and vomiting, antiemetic medication and analgesics received were recorded in the PACU and ASU. The following day, the same information was collected during a phone interview.

**RESULTS:** Two hundred sixty seven (267) patients completed the study (A 89, F 82, S 96). The 3 groups were comparable for age, sex, ASA physical status, weight, previous history of motion sickness and PONV, period of menstrual cycle, type of surgery, intraoperative use of neostigmine and nasogastric tube, and duration of anaesthesia (60 ± 28 min for all patients). Patients in the 3 groups received equipotent opioid doses (A 1389 ± 499 µg, F 455 ± 206 µg, S 45 ± 18 µg). Data on the incidence of PONV are presented in the Table. The use of antiemetic medication in PACU and ASU followed the same pattern as the incidence of PONV (PACU no difference, ASU: A 8%, F 27%, S 25%, P < 0.005)

Table. Incidence of PONV (%)

	A	F	S	P
PACU	20	22	20	NS
ASU	12	34	34	< 0.001
After discharge	25	33	33	NS
Cumulative incidence	38	57	53	< 0.05

**DISCUSSION:** The use of A as part of a general anaesthetic technique, compared to equipotent doses of F or S, is associated with a significantly lower incidence of PONV. We suggest that differences between the pharmacokinetic characteristics of A, F and S most probably explain these observations. However we cannot exclude a pharmacodynamic difference between the three opioids studied.

**REFERENCES:** 1. Anesth Analg 1994; 78 : 7-16.  
2. Anesthesiology 1993; 78: 864-9.

### DENSITY OF SPINAL ANAESTHETICS AFTER ADDITION OF NEUROAXIAL OPIOIDS

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**INTRODUCTION:** Spinal anaesthetic density relative to cerebral spinal fluid (CSF), or baricity, is an important determinant of the level of anaesthesia attained with intrathecal administration<sup>1</sup>. Intrathecal opioids have been used extensively in conjunction with spinal anaesthesia for post-operative analgesia. Addition of opioids, including morphine and fentanyl, to standard spinal anaesthetic preparations may significantly alter their density, possibly affecting the level and duration of anaesthesia. The purpose of this study was to measure changes in density of spinal anaesthetics after addition of opioids.

**METHODS:** Density was determined to four significant figures using a pycnometer with a calibrated volume of  $25.027 \pm 0.0021$  ml at  $37^\circ\text{C}$ , based on the known density of water ( $0.9933328$  g/ml at  $37^\circ\text{C}$ )<sup>2</sup>. Densities of hyperbaric 0.75% bupivacaine (15 mg), isobaric 0.5% bupivacaine (10 mg) (Marcaine, Sanofi Winthrop) and hyperbaric 5% lidocaine (100 mg) (Xylocaine, Astra) were determined before and after addition of morphine 400ug (0.8 ml) (Sabex) and fentanyl 25ug (0.5 ml) (Abbott). Four determinations were made per sample and densities were reported in g/ml (mean  $\pm$  standard deviation).

#### RESULTS:

SOLUTION	DENSITY g/ml, 37°C
Water <sup>2</sup>	$0.9933 \pm 0.0001$
Cerebral Spinal Fluid <sup>3</sup>	$1.0003 \pm 0.0003$
Bupivacaine 0.75%	$1.0249 \pm 0.0039$
Bupivacaine 0.75% + M	$1.0168 \pm 0.0037^*$
Bupivacaine 0.75% + M + F	$1.0135 \pm 0.0032^*$
Bupivacaine 0.5 %	$0.9994 \pm 0.0033$
Bupivacaine 0.5% + M	$0.9995 \pm 0.0036$
Bupivacaine 0.5% + M + F	$0.9989 \pm 0.0033$
Lidocaine 5%	$1.0248 \pm 0.0037$
Lidocaine 5% + M	$1.0177 \pm 0.0048^*$
Lidocaine 5% + M + F	$1.0140 \pm 0.0042^*$

Tukey; \*  $p < 0.0002$  vs anaesthetic only, M; morphine, F; fentanyl

**CONCLUSIONS:** Standard hyperbaric anaesthetics have a density of about 1.0250 g/ml. Addition of morphine  $\pm$  fentanyl significantly reduced the density to as low as 1.0135 g/ml. Bupivacaine 0.5% had a density slightly hypobaric to CSF at  $37^\circ\text{C}$ <sup>4</sup> with little change after addition of opioids. Standard hyperbaric spinal anaesthetics have a significantly reduced density after addition of opioids for neuroaxial administration possibly altering the level and duration of anaesthesia.

#### REFERENCES:

- 1) Br J Anaesth 1990;64:232-4
- 2) Geigy Scientific Tables 1981; 1:50
- 3) Anesth Analg 1981; 60:814-7
- 4) Anesth Analg 1993;76:1015-8

### WALK-IN WALK-OUT SPINAL ANAESTHESIA FOR OUTPATIENT LAPAROSCOPY: EVALUATION OF THREE HYPOBARIC SOLUTIONS

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**INTRODUCTION:** The utilisation of spinal anaesthesia in many outpatient facilities remains low due of the delayed recovery of motor and sensory block. Although walking epidurals have been described in obstetrics there is no information on walking spinals for outpatient surgery. This randomised study evaluated three hypobaric solutions for use with spinal anaesthesia during outpatient laparoscopy. Recovery and ability to ambulate after surgery were the primary variables studied.

**METHODS:** After institutional ethics committee approval and with informed consent, 24 ASA I-II patients scheduled for laparoscopy under spinal anaesthesia were randomised to three groups: Gp I - 1% Lidocaine 20 mg + Fentanyl 25  $\mu\text{g}$ , Gp II - 1% Lido 20 mg + Sufentanil 10  $\mu\text{g}$ , Gp III - 1% Lido 10 mg + Sufentanil 10  $\mu\text{g}$ . With the patient in sitting position a 25 G Whitacre needle was placed at L 3-4. After 1 min the patient was placed supine in reverse Trendelenburg until the level to pinprick was at T 6-7. Alfentanil was administered if the patient experienced shoulder tip pain from intra peritoneal  $\text{CO}_2$ . Detailed methodology of this technique has been described.<sup>1</sup>

**RESULTS:** All three Groups were comparable with respect to demographics. Duration of laparoscopy was 10-24 min. Absence of motor block, presence of light touch and proprioception, pin prick level and % fit to walk out immediately after surgery are summarised below

	Gp I	Gp II	Gp III
Alfenta $\mu\text{g}$	250(0-1000)	0(0-500)	500(0-1000)
Surgery	8 excellent	7 excellent	6 excellent
Shoulder pain %	100	63	63
No Motor bk	7	5	8
Light touch+	7	6	7
Pin-prick	T 5	T 6	T 5
Propiocep+	8	7	8
Walk out %	88	63	100

**DISCUSSION:** All three solutions provided good surgical conditions. All patients in Gp III were fit to walk out of the OR immediately after surgery.

#### REFERENCES:

1. Anesth Analg 1997, Jan (accepted August 26, 1996)

### CHARACTERISTICS OF RESPIRATORY MUSCLES ACTIVITY FOLLOWING ANESTHESIA AND SURGERY.

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Supported by MRC of Canada and Fonds de développement en anesthésie (UdeM).

**INTRODUCTION:** The purpose of our study was to determine if either the type of surgery or of anesthetic used is responsible for increased activity of abdominal muscles (ABm) already described<sup>(1)</sup> in postoperative period. We also wanted to characterize this activity. Following institutional approval, we studied 12 patients receiving either a combination of thiopental and halogenated agent (HALO) or a combination of propofol and alfentanil (TIVA) for minor orthopedic surgery (OS) or receiving HALO for laparoscopic cholecystectomy (LAPC).

**METHODS:** We recorded esophageal (Pes) and gastric (Pga) pressures with air-coupled transducers, rib cage (Vrc/Vt) and abdominal (Vab/Vt) relative contributions to tidal breathing by inductive plethysmography (Respirace) during anesthesia paralysis and in the PACU at 15-min intervals for 90 min following anesthesia. Vt was measured by spirometry in the OR. Transdiaphragmatic pressure (Pdi=Pga-Pes)<sup>(2)</sup> was obtained. Abdominal pressure (Pab), a corollary of Pga was plotted against Vt for both paralyzed and spontaneous breathing states in search of tonic (Pab<sub>ton</sub>) and phasic (Pab<sub>phas</sub>) ABm activities. Pab<sub>ton</sub> was defined as persistent increase in Pab during spontaneous breathing relative to relaxation pressure and Pab<sub>phas</sub> as the difference between Pab at end-expiration and Pab<sub>ton</sub>. Based upon the type of surgery and anesthesia, patients were grouped as follow: OS-HALO, OS-TIVA and LAPC-HALO.

**RESULTS:** Repeated measures ANOVA showed no significant difference among the 3 groups for any studied variable (Vt, Vrc/Vt, Vab/Vt, Pdi, Pab<sub>ton</sub>, Pab<sub>phas</sub>). In all 3 groups significant Pab<sub>ton</sub> and Pab<sub>phas</sub> were seen in a majority of patients. This ABm activity tended to decrease over time during recovery whereas Vrc/Vt remained constant. The predominance of Pab<sub>ton</sub> and Pab<sub>phas</sub>, however, varied in different patients. When considering all patients together, no relationship was found between Vrc/Vt and Pab<sub>ton</sub> (p=0.6), suggesting that tonic ABm contraction had no effect on respiratory system impedance. In contrast to what would be expected, we also found a significant positive relationship between Vrc/Vt and Pab<sub>phas</sub> (p=0.0002), suggesting an uncoupling between phasic ABm contraction and Vab changes.

**CONCLUSION:** The presence of ABm activity following anesthesia previously reported and confirmed here could not be attributed to the type of surgery or of anesthetic used. General anesthesia by itself could explain it. However, our results should be interpreted cautiously as the number of patients studied was small. Significantly higher ABm activity could have been found in LAPC, as described before.<sup>(1)</sup> Conservation of Vrc/Vt in the presence of Pab<sub>ton</sub> could be explained by the parallel arrangement of the rib cage and abdomen compartments with the latter having a much higher impedance. With this arrangement, the respiratory system impedance should be governed by that of the rib cage and relatively independent of ABm contraction. Uncoupling between Vab changes and Pab<sub>phas</sub> could be explained by the difference in diaphragmatic compliance among patients. A stiffer diaphragm could allow ABm to build up higher pressures but also reduce ABm capacity to produce changes in Vab.

**REFERENCES:** (1) Anesth Analg; 78: 733-9 and (2) Am Rev Respir Dis; 127: 431-6

### A PROSPECTIVE QUALITY ASSURANCE REVIEW OF ANAESTHETIC TECHNIQUE FOR ORTHOPAEDIC LOWER EXTREMITY SURGERY

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**INTRODUCTION:** Spinal anaesthesia is frequently perceived by OR staff as being time inefficient. It has been shown that regional anaesthesia for vaginal hysterectomy and outpatient knee arthroscopy does not delay the start of surgery.<sup>1,2</sup> No prospective information is available regarding OR time utilization for orthopaedic procedures on the lower extremity surgery.

**METHODS:** With departmental quality assurance committee approval, a prospective survey of current anaesthetic practice for orthopaedic hip and knee replacement surgery was conducted from Jan 11/96 to Feb 6/96. Surgical procedures included hip arthroplasty, total knee arthroplasty, and hip fracture fixation. Type of anaesthetic (Regional-Group 1; General-Group 2), demographic data, anaesthesia start, surgical start/finish times, and the time the patient entered and left the OR were recorded. Induction time was the interval between the patient entering the OR and the start of surgery, and emergence time was the interval between the end of surgery and the time the patient left the room. Total anaesthesia time was the sum of induction and emergence times. Results were analysed with the student t-test and chi-square test.

**RESULTS:** Data from 43 patients was collected, 25 patients in Group 1, 18 in Group 2, and 1 patient received a GA following a failed spinal giving a failure rate of 3.8% (1/26). There was no significant difference between groups 1 and 2 with regard to age, sex or surgical procedure. There was no significant difference between Group 1 and 2 for total surgical time (74.1 min vs 79.2 min, p=.33). Total anaesthesia time was significantly longer by 4.9 minutes for the spinal group (34.6 min vs 29.7 min p<0.05). Emergence was significantly shorter in the spinal group (5.1 min vs 6.7 min p<0.05) and induction was significantly longer ( Group 1 29.5 min vs Group 2 23 min p<0.05).

**DISCUSSION:** This QA review reveals that emergence time for spinal anaesthesia for orthopaedic hip and knee surgery was shorter than GA. Induction and total anaesthesia time were longer with spinal anaesthesia. Given the length of the surgical time involved these differences are unlikely to be clinically significant.

**REFERENCES:** 1. Anesth Analg 1995;81:694-6  
2. Anesth 1991;75:A884

### DENSITY OF VARIOUS LOCAL ANAESTHETIC-OPIOID SOLUTIONS AND THEIR SPREAD IN AN IN VITRO MODEL OF THE SPINAL CANAL

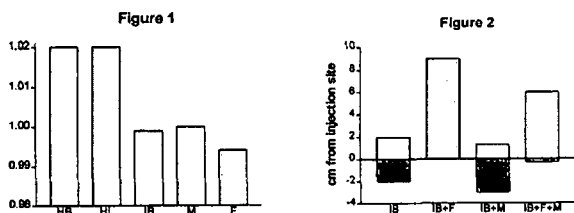
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**INTRODUCTION:** Opioids are frequently added to intrathecal local anaesthetic drugs to enhance surgical anaesthesia and provide post-operative analgesia. The effect of mixing opioids with local anaesthetics on the density of the final intrathecal solution is unclear, although density is a main determinant of the direction and extent of spinal anaesthesia (1). The purpose of this two-part study was 1) to measure the density of different local anaesthetic-opioid combinations commonly used for spinal anaesthesia and 2) to determine the effects of adding opioids on the spread of different local anaesthetic solutions using a model of the spinal canal.

**METHODS:** Part 1: The density of 0.75% hyperbaric bupivacaine (HB), 0.5% isobaric bupivacaine (IB), 5% hyperbaric lidocaine (HL), fentanyl (F) and morphine (M) were determined using volumetric pipettes and a Mettler P1200 top-loading balance. Five measurements were repeated for each solution to ensure adequate precision.

Part 2: A model of the spinal canal was constructed to enable the comparison of the direction and extent of spread of different local anaesthetic-opioid solutions. The system was filled with Ringer's Lactate to simulate the density of cerebrospinal fluid. HB, IB, and HL were mixed with F, M and both F+M in proportions simulating clinical practice. Methylene blue dye was used as a colour indicator. Using a controlled rate of injection, the direction and extent of movement of the solutions were determined and compared.

**RESULTS:** The comparative densities of the various local anaesthetic solutions are shown in Figure 1. Fentanyl and morphine did not alter the spread of the hyperbaric solutions of bupivacaine and lidocaine in the spinal model. When added to isobaric bupivacaine (Figure 2), fentanyl alone resulted in a hypobaric solution, while the addition of morphine alone rendered the solution hyperbaric. The addition of both fentanyl and morphine to isobaric bupivacaine resulted in a slightly hypobaric solution.



**CONCLUSIONS:** The addition of opioids to isobaric local anaesthetics alters the density of the resulting solutions, as well as the direction and extent of spread in a spinal model. The movement of hyperbaric local anaesthetics is unaffected by the addition of opioids. This may have clinical relevance when predicting the spread of intrathecal solutions.

**REFERENCES:**  
(1) Anesth Analg 1985;64:715

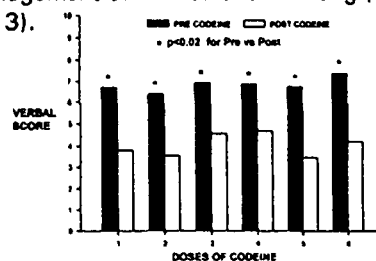
### THE EFFICACY OF INTRAMUSCULAR (IM) CODEINE FOR POST-CRANIOTOMY PAIN

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**INTRODUCTION** Investigators suggest that pain after craniotomy is more severe than is generally recognized<sup>1</sup> and 97% of neuroanaesthetists polled felt that IM codeine did not provide adequate analgesia in this group of patients<sup>2</sup>. Our aim was to determine if IM codeine optimally controlled our patients' symptoms in the first 24 hours post-craniotomy.

**METHODS** Following IRB approval and informed consent, 29 patients scheduled for elective craniotomy under general anaesthesia were prospectively studied for 24 hours following discharge from PACU. Codeine phosphate IM 60 mg q 3 hr PRN was prescribed for analgesia and dimenhydrinate IM 50 mg q 4 hr PRN for nausea. Patients were asked to rate: (1) the severity of their pain, pre and 30 min post IM codeine, (verbal score: 0 = no pain; 10 = worst pain), and (2) overall satisfaction with the treatment of their pain and nausea (1 = very dissatisfied, 5 = very satisfied).

**RESULTS** 16 males and 13 females, 49 ± 15 yr, were studied. The median number of doses of codeine given was 4 (range 1-7). Codeine significantly decreased pain scores (figure) resulting in high levels of patient satisfaction (24/29 had scores >3). 97% of patients received antiemetics with 38% receiving >3 doses. 90% of patients were satisfied with their management of nausea and vomiting (26/29 had scores >3).



**DISCUSSION** We have shown that IM codeine is efficacious in treating post-craniotomy pain and results in a high level of patient satisfaction. We know of no other study which has examined the appropriateness of codeine for post-craniotomy pain. The prevention of the high rate of nausea/vomiting warrants further investigation. **REFERENCES** 1. Neurosurgery 1996; 38:466-70. 2. Eur J Anaesthesiol 1995; 12(6):571-5.



**A prospective randomized study showed a decrease in Red Blood Cell and Fresh Frozen Plasma Transfusion when Conjugated Estrogen (Premarin) administration is compared to Placebo during Orthotopic Liver Transplantation**

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**INTRODUCTION:** Coagulation abnormalities are common in patients with advanced liver disease and such patients often have complications related to abnormal bleeding during Orthotopic Liver Transplantation (OLT). Computerized thromboelastograph (CTEG) is used to monitor whole blood coagulation and guided blood product transfusion during OLT. Previous retrospective studies showed the efficacy of Conjugated Estrogens (CE) in decreasing blood product utilization<sup>1,2</sup>. The purpose of this prospective randomized study was to determine the effectiveness of Conjugated Estrogen (CE) compared to placebo (PL) in reducing blood product usage during OLT.

**METHODS:** After IRB approval 18 patients presenting for OLT were included in the study. Every patient who received coagulation products before the study was not included in the study. Every patient included in this study was divided into two groups. Group I represented the PL group and Group II represented the CE group. At the beginning of the surgery, the first 20 ml syringe containing 100 mg of CE (or 20ml of placebo) was given when the CTEG showed a R-TIME longer than 15 minutes or 30 mm. The second syringe containing 100 mg of CE (or 20ml of placebo) was given after reperfusion of the new graft. Both syringes issued to study patients contained the same product. The syringes were given only when the Reaction Time of the CTEG was greater than 15 minutes or 30 mm, which represents abnormal results. Only the pharmacist who prepared the syringes knew the contents of the syringes. Statistical analyses were performed using Student t-Test for two samples assuming equal variances with statistical significance of  $p < 0.05$ . Values are presented as mean  $\pm$  SD.

**Results:** There were no significant differences in either age or weight of the patient, or amount of platelet (PLT) infused (Table 1). Significantly less Fresh Frozen Plasma (FFP) and Red Blood Cell (RBC) was transfused in the CE group (Table 1).

TABLE 1

	Group I (Placebo)	Group II (CE)
Age (Years)	50.5 $\pm$ 9.8	48.9 $\pm$ 12.6
Weight (kg)	82.0 $\pm$ 22.2	80.4 $\pm$ 11.0
<b>Transfusion (Units)</b>		
RBC	9.4 $\pm$ 7.8	*6.5 $\pm$ 3.1
FFP	6.0 $\pm$ 5.4	*2.0 $\pm$ 2.4
PLT	16.7 $\pm$ 10.0	12.2 $\pm$ 9.7

\*  $p < 0.05$

**Discussion:** CE fulfills the objective of reducing blood products during OLT. CE reduced the FFP and RBC requirement during OLT. Further studies are needed to determine the exact mechanism, the intervals and the optimal dosages of CE during OLT.

**References:**

1. Anesthesiology 79 (3A): A180, 1993
2. Anesthesiology 81 (3A): A 278, 1994

**ADDITIONAL DOSE OF APROTININ MAY IMPROVE HEMODYNAMICS DURING POSTREPERFUSION PERIOD IN PATIENTS UNDERGOING ORTHOTOPIC LIVER TRANSPLANTATION (OLT)**

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**Introduction:** The role of possible antiinflammatory effects of Aprotinin (APR) in different clinical situations has been reported (1). The positive influence of APR on hemodynamics during OLT was recognized as well (2). The reperfusion of the transplanted liver graft by unclamping inferior vena cava and portal vein causes depression of cardiovascular system. The most common findings are: hypotension, bradyrhythmia, low systemic vascular resistance, increased venous filling pressure, decreased cardiac output and myocardial depression. This could be related to vasoactive substances or myocardial depressant factors released from the grafted liver (3). We assessed the effects of additional dose of APR given before reperfusion on hemodynamics during postreperfusion period.

**Methods:** Eighteen patients, aged 36-66, who underwent OLT without veno-venous bypass (VVB) were given APR in high dose: 2,000,000 kallikrein inactivation units (KIU) at the beginning of surgery followed by continuous infusion of 500,000 KIU/h until the end of surgery. Patients were divided into two groups: nine patients received 500,000 KIU of APR 5 min before reperfusion. The second group of 9 patients did not. The following hemodynamic data were recorded 5 min before and 5 min after reperfusion: mean arterial pressure (MAP), central venous pressure (CVP), mean arterial pulmonary pressure (PAP-M), pulmonary artery wedge pressure (PAWP), systemic vascular resistance (SVR), and cardiac index (CI). Statistical analysis was done using Student's t-test, and  $p < 0.05$  was considered as significant.

**Results:** No significant differences were found regarding age, weight, Child's classification of liver failure, and hemodynamics before reperfusion. Significantly higher SVR, MAP, a lower PAP-M, CVP, and trend toward lower PAWP and CI were noted in APR group.

	with 500,000 KIU of APR n = 9	without 500,000 KIU of APR n = 9
MAP mmHg	54 $\pm$ 12	42 $\pm$ 16*
CVP mmHg	12 $\pm$ 6	18 $\pm$ 8*
PAP-M mmHg	16 $\pm$ 8	24 $\pm$ 6*
PAWP mmHg	14 $\pm$ 4	18 $\pm$ 6
SVR DS/cm <sup>5</sup>	575 $\pm$ 86	385 $\pm$ 64*
CI L/min/m <sup>2</sup>	3.6 $\pm$ 1.4	4.2 $\pm$ 0.8

\*  $p < 0.05 \pm$  SD

**Discussion:** These results suggest that additional dose of APR before reperfusion may improve hemodynamics during postreperfusion period. These findings could be explained by possible antiinflammatory effects of APR. Higher dose of APR may be needed to achieve these effects.

- References:** 1. J Thorac Cardiovasc Surg 110(6), 1995. 2. Br J Anaesth 75(6), 1995. 3. Transplant Proc 19:54, 1987.

### POSTOPERATIVE ELEVATION OF CREATINE KINASE (CK-MB): DOES IT CONTRIBUTE TO DIAGNOSIS OF MYOCARDIAL INFARCTION?

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**Introduction:** The practice of measuring fractionated myocardial isoenzymes in addition to the 12 lead surface electrocardiogram (ECG) for the detection of postoperative myocardial infarctions (PMI) appears to have evolved from coronary care guidelines for investigation of symptomatic chest pain<sup>1</sup> and a desire not to miss a complication (PMI) which carries with it significant morbidity and mortality.<sup>2</sup> This retrospective study sought to determine the value-added benefit of measurement of changes in plasma creatine kinase - myocardial band (CK-MB) levels in elective postoperative high risk surgical patients beyond that obtained from the surface 12 lead ECG.

**Methods:** The charts of 111 patients admitted to the surgical intensive care unit (SICU) of a tertiary level university teaching hospital were reviewed. Using predetermined definitions of myocardial infarction (MI), as reflected by changes in the 12 lead surface electrocardiogram (Minnesota code) or elevations in CK-MB, complications (pulmonary edema, congestive heart failure, arrhythmias, cardiogenic shock, pneumonia, pulmonary embolism) were screened for. Four groups were identified based on changes in the ECG indicative of MI (Present - [ECG+] or Absent - [ECG-]) and elevations of CK-MB (Present - [CK-MB+] or Absent - [CK-MB-]). The incidence of complications between groups was compared. Chi-Square analysis was applied to categorical data. One-way ANOVA was used to test the difference between the mean values for continuous data.  $p < 0.05$  was considered statistically significant.

**Results:** Demographically, the groups were similar except that patients with ([ECG+];[CK-MB+]) results had a significantly higher incidence of previous ischemic heart disease (12/14 patients). No patient with [ECG-] findings ( $n=96$ ) had a complication. Fifteen patients with [ECG+] findings were identified and all had complications. Fourteen of these patients had [CK-MB+] results. In contrast, 29 patients with [CK-MB+] results alone (i.e. [ECG-]) had no complications. The direct additional cost related to CK-MB determinations was \$2,775.00 CDN.

**Conclusions:** Clinically significant postoperative myocardial infarctions were detected by ECG changes. The value-added benefit of determining changes in CK-MB was minimal from a therapeutic perspective but added costs to overall patient care.

**References:** 1. AM J Cardiol 1981;48:595-602.  
2. JAMA 1992;268:233-9.

### CLONIDINE IMPROVES PERIOPERATIVE AUTONOMIC CONTROL OF THE CARDIOVASCULAR SYSTEM IN HYPERTENSIVE PATIENTS UNDERGOING MAJOR SURGERY

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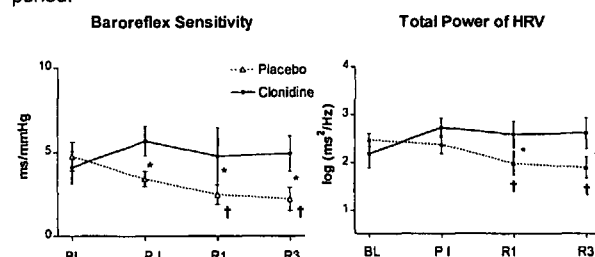
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**INTRODUCTION:** Hypertensive patients have reduced autonomic control of the cardiovascular system and often show marked circulatory lability perioperatively. The alpha-2 adrenoceptor agonist clonidine has been shown to improve hemodynamic stability in the perioperative period (1) and reduce episodes of myocardial ischemia (2). This may be due in part to favourable effects on autonomic circulatory control. The purpose of this study was to determine the effects of perioperative clonidine administration on autonomic control of the cardiovascular system in hypertensive patients undergoing major surgery.

**METHODS:** After institutional ethics approval, twenty hypertensive patients scheduled to undergo surgical procedures lasting over three hours signed informed consent. Patients were randomized to receive clonidine  $6 \mu\text{g}\cdot\text{kg}^{-1}$  po at least 90 min. prior to induction of anaesthesia and  $2 \mu\text{g}\cdot\text{kg}^{-1}$  iv during the last hour of surgery, or identical placebo. A standardized alfentanil-midazolam-isoflurane based anaesthetic protocol was used, as well as a standardized protocol for treating adverse circulatory events. Autonomic control of the cardiovascular system was assessed using spontaneous baroreflex sensitivity and spectral analysis of heart rate variability (HRV) at baseline (BL), pre-induction (PI), and at 1 hour (R1) and 3 hours (R3) postoperatively. Catecholamine levels were determined and all circulatory events and interventions recorded. Data were analyzed using two-factor repeated measures ANOVA for continuous variables and non-parametric methods where appropriate with  $P < 0.05$  as significant.

**RESULTS:** The groups were similar with respect to demographic data, length and type of procedure and anaesthetic doses. Clonidine reduced catecholamine levels, mean blood pressure and heart rate. In addition, episodes of perioperative hypertension and tachycardia and postoperative antihypertensive requirements were reduced. Clonidine prevented the postoperative impairment of baroreflex sensitivity and heart rate variability seen in placebo patients while decreasing overall blood pressure lability.

**DISCUSSION:** Clonidine administration protects against perioperative impairment of autonomic control of the cardiovascular system in hypertensive patients undergoing major surgery. This may be the mechanism by which clonidine improves circulatory stability and reduces myocardial ischemia in the perioperative period.



**REFERENCES:** (1) Anesthesiology 1987; 67:3-10  
(2) Anesthesiology 1996; 85:706-12

**DO WE HAVE TO TREAT ACUTE RESPIRATORY DISTRESS SYNDROME (ARDS) WITH INHALED NITRIC OXIDE?**

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**INTRODUCTION**

This pilot randomized controlled clinical trial of ARDS patients was implemented to study: i) the efficacy of inhaled nitric oxide (inhNO) on lung function; ii) the impact of inhNO on morbidity and mortality; iii) the feasibility of implementing a larger multicenter trial.

**METHODS**

This study was approved by the Human Research and Ethics Committee of Centre Hospitalier de l'Université de Montréal. Thirty ARDS patients were randomly allocated to usual care or usual care plus inhNO. All therapeutic interventions were standardized. Lung function was assessed by hypoxia score (HS = PaO<sub>2</sub> / FiO<sub>2</sub>), dead space ventilation, lung compliance, and venous admixture. The optimal dose of inhNO was determined daily between 0.5 and 40 parts-per-million. Non responders to inhNO were defined as patients presenting a  $\leq$  20% increase in HS after initial optimal inhNO administration.

**RESULTS**

ARDS resulted mainly from sepsis (25 / 30). Observed baseline characteristics were similar between groups except for the mean (SE) HS that was lower in the inhNO than in the control group: 119.4 (13.6) and 152.1 (18.5) mmHg, respectively.

During the first day, HS increased greatly in patients treated with inhNO: +70.4 mmHg (+59%) vs. +14.2 mmHg (+9.3%) for control group (P=0.02), venous admixture decreased from 25.7 to 15.2% in the inhNO group, and only from 19.4 to 14.9% in the control group (P= 0.05). Five / 15 patients were nonresponders. After the first day of therapy, no further beneficial effect of inhNO could be detected, whereas studied parameters were never affected by usual care in the control group.

Forty percent of patients treated with inhNO were alive and weaned from mechanical ventilation 30 days after randomization compared to 33.3 % in the control group (P=0.83). The 30-day mortality rate was similar in the two groups: 60% in patients treated with inhNO vs. 53.3% without inhNO (P= 0.71); most deaths (11 / 17) were due to multiple organ dysfunction syndrome (MODS). On the 5 direct lung injury-induced ARDS, only 1 / 3 died in the control, 0 / 2 in the inhNO group. The 30-day mortality rate of nonresponders, and responders to inhNO was 80%, and 50%, respectively.

**DISCUSSION**

This trial shows that inhNO, in this population, may improve initial gas exchanges but does not affect mortality, and questions the ætiology of ARDS as prime factor for the prognosis. While our sample was representative of a population with sepsis-induced established ARDS resulting in MODS, this pilot study suggests that demonstrating an effect of inhNO on ARDS-mortality in this population would be difficult to achieve even with a large multicenter trial. In these conditions, further studies should focus on early treatment (when the condition is more likely to be reversible) and on the use of inhNO on selected populations such as patients with ARDS induced by direct lung injury (in the studies done by Rossaint *et al.*<sup>1</sup> and Gerlach *et al.*<sup>2</sup>, the survival rate of these patients with inhNO was high: 10 / 13) or those responsive to the therapy whatever the ætiology. These populations should benefit the most from the use of inhNO with a possible effect not only on gas exchanges but also on mortality.

<sup>1</sup>. *N Engl J Med* 1993; **328**: 399-405.

<sup>2</sup>. *Intensive Care Med* 1993; **19**: 443-449.

**HYPEROXIA ALTERS THE URINARY ORGANIC ACID EXCRETION OF MICE**

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**INTRODUCTION**

Prolonged exposure to hyperoxia can have an adverse pulmonary and neurologic effects, possibly due to toxic levels of O<sub>2</sub> free radicals (OFRs). OFRs are known to inactivate intracellular enzyme systems whose associated metabolites are excreted in the urine<sup>1</sup>. In this study a preliminary comparison was made of the urinary organic acids (UOA) excreted by mice when exposed first to normal air and then to pure oxygen at atmospheric pressure.

**METHODS**

Twenty mice were housed in a gas-tight cage having provision for the continuous collection of pooled urine. The mice breathed normal air for 14 days, and eight 24 hour urine specimens were collected to establish baseline UOA excretion. Air was then replaced by 100% O<sub>2</sub> and a further four 24 hour specimens obtained. UOAs were extracted from urine and determined by gas chromatography<sup>2</sup>.

**RESULTS**

The relative proportions of Krebs's Cycle acids (succinic, aconitic, citric) decreased progressively with cumulative O<sub>2</sub> exposure while vanillyl mandelic acid (VMA) and 5-hydroxy-indolacetic acid (5HIAA) were significantly increased (table 1).

Table 1: % total UOA during AIR and O<sub>2</sub> (day) breathing

	AIR (mean $\pm$ SD)	O <sub>2</sub> (1)	O <sub>2</sub> (2)	O <sub>2</sub> (3)	O <sub>2</sub> (4)
Succinic	12.1 $\pm$ 2.8	12.9	14.7	11.5	5.3*
Aconitic	1.3 $\pm$ 0.5	0.9	1.0	0.4	0.1*
Citric	6.2 $\pm$ 1.2	5.0	7.0	3.3*	1.5*
VMA	0.15 $\pm$ 0.06	0.5*	0.3*	0.4*	1.9*
5HIAA	0.08 $\pm$ 0.02	0.1	0.1	0.2*	0.6*

\*Change exceeds  $\pm$  2SD from mean AIR value.

**DISCUSSION**

The progressive fall in the excretion of the Krebs's Cycle acids is consistent with published studies on the inhibition of key enzymes by hyperoxia<sup>3</sup>. The effects of hyperoxia on VMA and 5HIAA were observed at an early stage. The analysis of UOAs might have potential for non-invasive monitoring of oxygen toxicity in humans.

**REFERENCES**

1. Extrapulmonary manifestations of respiratory disease, p185
2. *Clin. Chem Acta* 131: 247(1983)
3. Proc. 6th Int. Cong. on Hyperbaric Med. p 44.

### APROTININ MAY AFFECT EXTUBATION TIME AFTER ORTHOTOPIC LIVER TRANSPLANTATION

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**Introduction:** The administration of Aprotinin (APR) during orthotopic liver transplantation (OLT) has been proven to decrease bleeding and transfusion requirements of blood and blood products.<sup>1,2</sup> Also it has been reported that APR could have an impact on extubation time, and hemodynamics during postreperfusion syndrome.<sup>3,4</sup> These findings may suggest possible antiinflammatory effects of APR during OLT. We analyzed extubation time in patients stratified as status 1, 2 and 3, according to Child's classification, who underwent OLT in our institution. We excluded status 4 patients to obtain more homogeneous groups.

**Methods:** One hundred and eight (108) patients (status 1-22, status 2-41, status 3-45), aged 32-63, who underwent OLT without veno-venous bypass were reviewed retrospectively. Sixty-two (62) of them received APR in high dose; 2,000,000 Kallikrein inactivation units (KIU) at the beginning of surgery followed by continuous infusion of 500,000 KIU/hr until the end of surgery. Red blood cells (RBC), fresh frozen plasma (FFP) and platelets intraoperative transfusion were recorded. Extubation time was analyzed in both groups. 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 the end of OLT values of hemoglobin, and duration of surgery. Significantly less RBC, FFP and platelets units were transfused in the APR group. Extubation time was significantly shorter in APR group.

DATA	With APR n=62	No APR n= 46
age	44 ± 8	48 ± 14
weight (kg)	66 ± 10	64 ± 12
HB (g/dl)		
preoperative	9.6 ± 1.2	9.8 ± 1.6
end of OLT	9.4 ± 1.4	9.2 ± 1.4
Transfusion (units)		
RBC	4.2 ± 2.6	7.6 ± 2.4*
FFP	5.4 ± 1.2	3.2 ± 2.8*
Platelets	2.2 ± 1.8	6.8 ± 2.4*
Operative Time (mean)		
Total	408 ± 142	446 ± 128
Preanhepatic	148 ± 34	162 ± 48
Anhepatic	72 ± 16	76 ± 22
Extubation Time (hrs)	38 ± 18	64 ± 26*

\*  $p < 0.05 \pm SD$ .

**Discussion:** These results suggest that Aprotinin is effective not only in reducing blood loss and transfusion requirements during OLT, but also shortens extubation time. Shorter extubation time may be related to lower transfusion rate, however, other mechanisms, possibly antiinflammatory, should be taken into consideration. These findings deserve further investigation.

**References:** 1. Transfusion 34(6):507-11, 1996. 2. Transplantation 58(12):1356-60, 1994. 3. Transplant Proc 23(3):1931-51, 1991. 4. Br J Anaesth 75(6):747-51, 1995.

### IMPAIRED GAS EXCHANGE IS NOT PREDICTED BY HAEMODYNAMICS IN EXPERIMENTAL PORCINE PLEURAL EFFUSION - A PILOT STUDY.

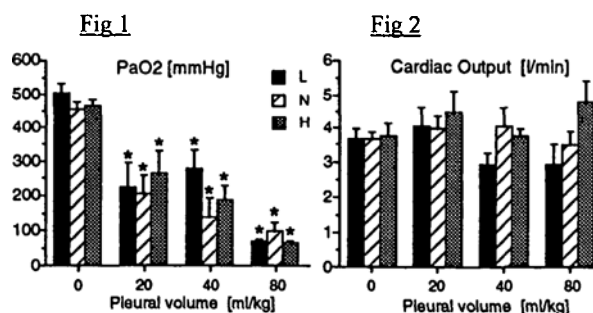
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**INTRODUCTION** The pathophysiology of acute pleural effusion is poorly understood. While large effusions impair gas exchange and cardiac output, the role of smaller effusions is unclear. We investigated the effects of graded bilateral pleural effusions, in the anaesthetized pig, randomized to conditions of low, normal or elevated intravascular volume.

**METHODS** Following institutional approval, 5 pigs were anaesthetized using isoflurane. Intubation was followed by mechanical ventilation, and placement of an intraarterial catheter and a pulmonary artery catheter. Bilateral chest tubes were inserted and serial pleural effusions were created using saline: 0, 20, 40, and 80 ml/kg, divided equally between each side. At each pleural volume [PV], intravascular volume [IV] was randomly altered [by phlebotomy or transfusion of colloid] to: normal-N, low-L (-10ml/kg), or high-H (+10ml/kg). Haemodynamics, Hb, and blood gases were measured. Statistical analysis included ANOVA and Dunnett's test.  $P < 0.05$  was considered statistically significant.

**RESULTS** 5 pigs were studied and 3 animals survived the complete protocol. 87% of the data were available. Pleural effusions resulted in a dose-dependent and early increase in  $Q_s/Q_t$  and reduction in  $PaO_2$  [Fig 1].  $Q_s/Q_t$  was related to IV only at max. IP. Cardiac output [Fig 2], CVP and MAP were relatively unrelated to IP, but were directly related to the IV status. Intrapleural pressure and PVR were related to IP only.



[IV: L Low, N Normal, H High; \*  $P < 0.05$  vs IP 0 ml/kg]

**CONCLUSIONS** These preliminary data suggest that in the presence of pleural effusions, hypoxemia occurs early and is unrelated to systemic haemodynamics. Systemic haemodynamics mostly altered by intravascular volume.

**ENHANCEMENT OF CNS ACTIVITY BY THIOPENTONE: COMPARISON OF NOCIFENSIVE REFLEX THRESHOLDS WITH HIPPOCAMPAL ELECTROENCEPHALOGRAPHY**

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Supported by Burroughs-Wellcome CAS Research Award

**ANAESTHESIA FOR STEREOTACTIC BIOPSY: A COMPARISON OF MIDAZOLAM AND PROPOFOL**

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**INTRODUCTION:** Thiopentone has a biphasic effect (enhancement followed by inhibition) upon the hippocampal electroencephalogram<sup>1</sup> (hEEG) and hippocampal excitatory transmission<sup>2</sup>. A similar biphasic effect of thiopentone on nocifensive responses has been observed<sup>3</sup>. This study compares the pharmacodynamic descriptors for the hEEG and nocifensive reflex effects of thiopentone.

**METHODS:** Following institutional animal care committee approval, all studies were performed on Sprague Dawley rats in a randomized prospective design, with saline injected animals used as controls. The animals were chronically instrumented with electrodes inserted into the dentate gyrus of the hippocampus. The nocifensive response was quantified with the mechanical withdrawal threshold (MWT, grams) of the tail (modified Randall-Sellitto technique). Hippocampal EEG and MWT values were recorded during continuous intravenous infusion of thiopentone in partially restrained rats. Hippocampal EEG was subjected to power spectral analysis. The relationships between plasma drug concentration and drug effects (hEEG power or 1/MWT(%of control values)) were described by maximal activation (% of control), and the plasma thiopentone concentrations (C<sub>p</sub>) at peak effect, at centroid and at 50% inhibition<sup>3</sup>. Results for hEEG and for MWT were compared by paired t-test.

**RESULTS:** Twenty one animals were studied. Total power of hEEG correlated with 1/MWT (P=0.006) in the plasma thiopentone range 0-20 µg/ml. A biphasic effect (enhancement followed by depression) of the thiopentone infusion was observed for EEG power and 1/MWT. The pharmacodynamic relationship differed for the two effects, with C<sub>pmax</sub> and C<sub>pcentroid</sub> occurring at significantly lower concentrations for the nocifensive response (Table).

**CONCLUSIONS:** The results confirm previous reports of biphasic effects of thiopentone on EEG and nocifensive measures of CNS drug effect. The findings suggest that these measures reflect pharmacodynamically distinct effects of thiopentone.

**Table: Pharmacodynamic Descriptors**

Rat	Maximal Effects % of Control Values		Plasma Thiopentone Concentration, µg·ml <sup>-1</sup>					
	EEG Power	1/MWT	Maximal Effect		Centroid		50% Inhibition	
	EEG Power	1/MWT	EEG Power	1/MWT	EEG Power	1/MWT	EEG Power	1/MWT
STP7	177	150	12	10	28	23	42	38
STP8	181	189	13	12	32	25	42	37
STP9	175	444	20	16	36	29	57	52
STP10	200	166	16	12	39	32	52	52
STP11	240	170	19	16	35	24	57	37
Mean	195	223	16 (4)	13 (3)	34 (5)	27 (4)	50 (9)	43 (9)
(95 CI)	(31)	(142)						
CV%	14	55	19	21	13	15	16	19
P value	0.312		0.006		0.001		0.250	

CV - coefficient of variation. CI - 95% confidence interval

1. Anesthesiology 1996;84:1411-24
2. Can J Physiol Pharmacol 1987;65:385-94
3. Anesthesiology 1995;83:160-8

**Introduction:** Patients with intracranial lesions undergoing stereotactic biopsy present difficulties as the procedure is performed with a fixed head frame which limits access to the airway. Aim of this study was to compare 2 conscious sedation techniques, midazolam (M) and propofol (P), with fentanyl (F), during biopsy.

**Methods:** With IRB approval, 90 patients were randomized to M or P. In the MRI or CT suite, the neurosurgeon placed the stereotactic frame using only local anaesthesia. After arrival in OR, patient's levels (VAS) of anxiety, pain and sedation were documented. Monitors included ECG, NIBP, SpO<sub>2</sub> and ETCO<sub>2</sub> via nasal cannula which also provided O<sub>2</sub>. After positioning, patients received F 0.25-1.0µg.kg<sup>-1</sup> followed by M 1.5µg.kg<sup>-1</sup> or P 0.5mg.kg<sup>-1</sup>. Additional F 0.5µg.kg<sup>-1</sup>, M 0.7µg.kg<sup>-1</sup> or P infusion 25-75µg.kg<sup>-1</sup>.min<sup>-1</sup> and droperidol 1.5µg.kg<sup>-1</sup> were administered for pain, sedation or nausea, respectively. All complications and the surgical condition (VAS) were recorded. One hour postoperatively the patient was assessed for pain, sedation, nausea, and overall experience (VAS) and questioned on their memory of intraoperative events. Student's T test and Chi square were used for analysis.

**Results:** The only significant difference was the greater recall of events with M group, though overall satisfaction was the same for patients and surgeons (M 7.2±2.3, 9.7±0.7; P 8±2, 9.8±0.4) respectively. Three patients (P) had intracranial bleeds requiring craniotomy.

Table (mean±SD)	Midazolam(n=45)	Propofol(n=45)
Age(yr)	56±17	61±17
Sex (M:F)	27:18	25:20
Weight(kg)	68±14	69±14
Study drug (mg)	1.7±1.2	64±77
Fentanyl (µg)	56±32	53±34
<b>Intraoperative Complications(number of patients)</b>		
Bleed	0	4
Mental status change	4	3
Respiratory	5	6
Pain	2	5
Anxiety	1	0
Oversedation	2	4

**Discussion:** Greater recall occurred with M, but both techniques of conscious sedation were acceptable to patients and surgeons. Level of sedation needs to be adjusted to each patient as requirements vary and complications may occur.

**Reference:** J Neurosurg 1994; 81:165-8

**INCIDENCE OF IMMEDIATE POSTOPERATIVE COMPLICATIONS IN NEUROSURGICAL PATIENTS**

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**Introduction:** The extent and gravity of immediate post-operative complications arising in the neurosurgical population has not been well defined. The aim of this study was to assess prospectively the incidence and characteristics of these complications.

**Method:** With IRB approval, data was obtained on all consecutive patients undergoing a neurosurgical procedure over a four month period. Information collected included diagnosis, pre-operative assessment, intraoperative events and surgical procedure. The post-operative study period was limited to the first 4 hours in either the PACU or ICU. All untoward events and complications were documented on a designated form. Data was tabulated and analyzed.

**Results:** 486 patients (M:F, 259:227) with a mean age of 52±18yr (range 17 to 96) were followed. Patients were divided into four major surgical groups (Table). Two patients required reintubation (1 spine, 1 vascular). Acute intracranial haemorrhage requiring emergency craniotomy occurred on two occasions (1 tumor, 1 vascular). There was a significantly higher incidence of complications in both spine and vascular groups compared to tumour and other groups (Chi square, P<0.05).

Surgery	Tumor(b)	Spine	Vascular	Other	Total
n (%)	132 (27)	169 (35)	54 (11)	131 (27)	486
<b>Complications:</b>					
Neurological	22 (17)	11 (7)	9 (17)	6 (5)	48 (10)
Respiratory	4 (3)	25 (14)	5 (9)	5 (4)	39 (8)
CVS	9 (7)	14 (8)	13 (24)	13 (10)	49 (10)
Bleeding	1 (1)	2 (1)	1(2)	1 (1)	5 (1)
Nausea/vomiting	38 (28)	78 (46)	21 (39)	37 (29)	174 (36)
Shivering	12 (9)	24 (14)	2 (4)	5 (4)	43 (9)
1 comp/patient	48 (36)	82 (49)	24 (44)	42 (32)	196 (40)
2 comp/patient	20 (15)	24 (14)	10 (19)	14 (11)	68 (14)
>2 comp/patient	3 (2)	9 (5)	5 (9)	2 (2)	19 (4)
Ventilated	7 (5%)	3 (2%)	8 (15%)	22 (17%)	40 (8%)

n = number, b = brain

**Discussion:** In our study 58% of the patients experienced at least one complication. We found a higher incidence of complications than previously reported in the general population.<sup>1</sup> This could be accounted for by the high incidence of nausea/vomiting and the nature of the surgical population.

**Reference:** Anesth Analg 1992; 74: 503-9

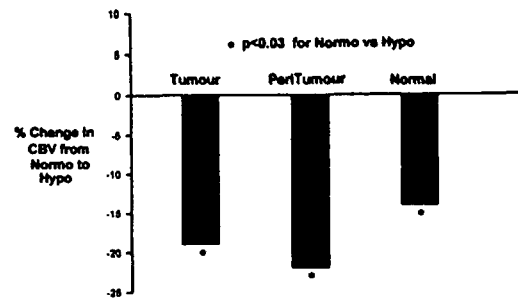
**THE EFFECT OF HYPOCAPNIA ON CEREBRAL BLOOD VOLUME DURING ISOFLURANE ANAESTHESIA IN RABBITS WITH BRAIN TUMOURS**

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**INTRODUCTION** Investigators have suggested that cerebrovascular responses may be impaired in patients with brain tumours<sup>1</sup>. As hyperventilation is a common adjunct in neuroanaesthesia, the aim of our study was to determine if the cerebral blood volume (CBV) response to hypocapnia was altered in the presence of a metastatic brain tumour.

**METHODS** VX2 tumour cells were injected into the brains of 13 New Zealand white rabbits. We studied the rabbits once the tumours had grown to a standard size. Under air/O<sub>2</sub> and isoflurane anaesthesia (1 MAC), CBV was measured during steady state at PaCO<sub>2</sub> of 40 mmHg (Normo) and 25 mmHg (Hypo). Using dynamic contrast enhanced CT developed in our laboratory, regional CBV was measured in tumour, peritumour and contralateral normal brain tissues. Mean arterial pressure (MAP) and rectal temperature (TEMP) were monitored continuously. Phenylephrine was used to maintain MAP at 70-80 mmHg.

**RESULTS** CBV (ml/100gm) was markedly increased in the tumour (9.8 ± 0.9) and peritumour (6.3 ± 0.9) regions compared to normal (3.5 ± 0.2). Hypocapnia reduced CBV more in the tumour.



**DISCUSSION** The % change in CBV in normal tissue was similar to that in rabbits without tumours using the same protocol<sup>2</sup>. In this metastatic tumour model, CBV-CO<sub>2</sub> responses were increased in the tumour regions. These results support the practice of inducing hypocapnia during isoflurane anaesthesia in patients with brain tumours and suggest that the major reduction in CBV that follows occurs in the area of the tumour.

**REFERENCES** 1. J Neurosurgery 1969; 31:149-63. 2. Anesthesiology 1993; 79:A203  
 Supported by Zeneca Pharma Can Research Award

**CYTOKINES IN HUMAN TRAUMATIC BRAIN INJURY**

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**INTRODUCTION:** Neurologic deterioration in patients who suffer severe traumatic brain injury (TBI) may occur for days. The precise mechanisms driving this remain unclear. We have previously evaluated intracranial physiology (somatosensory evoked potentials, intracranial pressure, cerebral blood flow, arteriovenous oxygen extraction and cerebral metabolic oxygen consumption), as well as putative biochemical mediators (glutamate). That work suggested that early elevations in AVDO<sub>2</sub> and CSF glutamate are associated with subsequent neurological deterioration and that electrophysiologic deterioration occurred at 48h post injury. However, recent laboratory and human studies have suggested that TBI may initiate a central nervous system inflammatory response. In this study, three cytokines were evaluated following human TBI in order to provide supportive evidence of central nervous system (CNS) inflammation, to determine the temporal pattern of this response, and to establish a rational basis for an in depth study of outcome and intervention.

**METHODS:** After institutional ethical approval nineteen patients suffering traumatic brain injury (Glasgow Coma Score  $\leq$  8) were intensively monitored for 5 days. They were sedated, paralysed, and ventilated according to previously established protocols, while hemodynamic stability was maintained. The protocol to manage intracranial pressure was, in order, cerebrospinal fluid (CSF) drainage, mannitol, and moderate hyperventilation, if necessary. At 12 hour intervals post injury, CSF was collected, and concurrent blood was taken for cytokine (IL-1 $\beta$ , IL-6, and TNF- $\alpha$ ) analysis. Cytokine concentrations were measured using an ELISA sandwich technique (pg/ml; mean + (SEM)) and compared using students T test between non-survivors and survivors at 48h post injury.

**RESULTS:** Admission GCS was 5.3 (3-8) with a mortality of 26%. CSF and plasma IL-6 concentrations were 800(240) and 260(78) (normal < 4). CSF IL-1 $\beta$  concentrations were 5.2(1.2) (normal < 2). CSF and plasma IL-6 concentrations peaked at 48h and both CSF IL6 and IL1 $\beta$  concentrations remained above normal throughout the 5 day study. CSF and serum TNF- $\alpha$  concentrations of most patients were within normal limits (< 2) but CSF concentrations were elevated in two patients (peaks of 58 and 60) while in two patients (1 overlap) plasma levels exceeded normal (peaks of 57 and 7.5). At 48h post injury CSF IL6 concentrations were significantly higher in the non-survivors than survivors (1600(860) vs 550(180) p=.02.

**DISCUSSION:** This study demonstrated that an inflammatory process involving cytokines occurs following human TBI. The ratio of CSF to plasma cytokines suggests that cytokines were originating within the CNS. The prolonged elevation of CSF cytokines and the higher IL-6 levels in nonsurvivors suggest a role for cytokines in the pathophysiology of neurologic deterioration following TBI. The usefulness of agents to alter this inflammatory response remains to be determined.

Supported by Physicians' Services Incorporated Foundation

**LIDOCAINE ALTERS THE MEMBRANE PROPERTIES OF NEURONS IN THE THALAMUS -- THE GATEWAY TO SENSORIUM.**

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**INTRODUCTION**

In addition to the well known peripheral effects, the CNS toxicity and systemic analgesic properties of the local anaesthetic, lidocaine, imply a central site of action [1, 2]. The symptoms of CNS toxicity include alterations in sensorium, sedation, and unconsciousness. The ventroposterolateral thalamic nucleus (VPL) has a significant role in mediating these states and also, nociception [3, 4]. We determined the effects of lidocaine on the intrinsic membrane properties of VPL neurons and defined their dose-dependency.

**METHODS**

We performed whole-cell patch-clamp recordings in thalamic slices *in vitro* (Sprague-Dawley rats, 12-21 days old) at 20-26 °C. The slices (300-500  $\mu$ m thick) were perfused with ACSF (aerated with 95% O<sub>2</sub>/ 5% CO<sub>2</sub>) at 1.5 ml/min in a submersion recording chamber (volume, 1.5 ml). The electrodes were filled with a solution containing (in mM): K-gluconate, 140; EGTA, 10; KCl, 5; NaCl, 4; MgCl<sub>2</sub>, 3; HEPES (free acid), 10; CaCl<sub>2</sub> (pCa = 7.91), 1; Na<sub>2</sub>-ATP, 3; Na-GTP, 0.3.

**RESULTS**

In a concentration-dependent fashion, lidocaine increased the magnitude requirement of current needed for the generation of action potentials in the tonic pattern (associated with wakefulness *in vivo*). Low concentrations of lidocaine (10 to 200  $\mu$ M) reversibly increased input conductance and depolarized neurons by 4 to 11 mV. Higher concentrations (0.6 to 1 mM) did not change the membrane potential but decreased the input conductance in a concentration-dependent manner. Neurons still were depolarized while under conditions of blockade of presynaptic transmitter release. Lidocaine (300  $\mu$ M) also suppressed spike bursts (associated with sleep *in vivo*), consisting of action potentials on top of a low threshold Ca<sup>2+</sup> spike (LTS). This effect is similar to the suppression of the LTS by the volatile general anaesthetic, isoflurane [5].

**CONCLUSIONS**

We found that lidocaine produced concentration-dependent alterations in the intrinsic membrane properties and excitabilities of VPL neurons. Our findings suggest that low concentrations of lidocaine exert a postsynaptic action on thalamic neurons distinct from Na<sup>+</sup> channel blockade. These central actions may contribute to alterations in sensorium or consciousness as well as to the analgesic properties of lidocaine. The reduction in the LTS by isoflurane may be attributed to increased K<sup>+</sup> and decreased Ca<sup>2+</sup>-conductances. Future studies will address the question whether lidocaine's effects on the LTS result from a similar mechanism of action.

**REFERENCES**

1. Handbook of Experimental Pharmacology 1987; 81: 253-284
2. Anesth Analg 1996; 82: 91-97
3. Jpn J Physiol 1989; 39: 335-348
4. J Neurophysiol 1996; 76: 2661-2674
5. Neurosci Lett 1993; 159: 91-94

### THE ATTITUDE OF THE GENERAL PUBLIC TOWARD ANAESTHETISTS AND THE PROSPECT OF GENERAL ANAESTHESIA

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#### INTRODUCTION

Admission of patients the day of surgery has resulted in the development of outpatient based preadmission assessment clinics.<sup>1</sup> Although assessment by an anaesthetist may be part of the preadmission process,<sup>2</sup> frequently anaesthetic involvement is only triggered by concerns of nursing personnel or by an algorithm based process. This survey examined the perceptions of the general public towards the preoperative anaesthetic visit and the prospect of requiring surgery under general anaesthesia.

#### METHODS

A province wide telephone survey was conducted. The sample surveyed was representative of the adult population of the province, and included appropriate percentages of urban and rural individuals. General anaesthesia was defined and a case scenario involving the participant requiring major knee surgery described. Participants were asked to use a seven point scale to rate how important it was for them to see an anaesthetist prior to surgery and also questioned as to the timing of such a visit. Their attitude to common fears associated with general anaesthesia were also assessed.

#### RESULTS

1216 people were surveyed. More than 30% of respondents felt it was very important to see an anaesthetist prior to surgery and 50% felt that such a visit should occur a day other than the day of the procedure. Approximately 20% were very concerned about brain damage, memory loss and waking up during general anaesthesia, whilst 15% had an equivalent level of anxiety about death and the possibility of brain damage. Respondents living in rural areas appeared to have greater level of concern than urban dwellers. Surprisingly, only 9% were very concerned about postoperative pain and less than 3% very concerned about talking when under general anaesthesia.

#### CONCLUSIONS

A visit by an anaesthetist on a day other than that of the scheduled procedure is still considered an important component of preoperative preparation by the general public. Fears of death and brain damage attributable to general anaesthesia are still prevalent, particularly among rural dwellers and suggest that education of patients preoperatively should address these concerns. Recent progress in pain management may explain the attitude of the public about postoperative discomfort. The case for maintaining an anaesthetic presence in preadmission assessment clinics is supported by the results of this survey.

#### REFERENCES

1. Canadian Journal of Anaesthesia 1995;42:391-4
2. Canadian Journal of Anaesthesia 1992;39:1009-11

### The Cost for Construction and Maintenance of a Simulation Centre

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#### INTRODUCTION

Realistic simulation is a new but rapidly expanding field in health care generating significant interest in Canada. However the lack of financial information results in planning difficulties and may delay introduction of this potentially useful resource for medical education and research. We describe a budget plan for the construction and maintenance of a simulation centre.

#### METHODS

After obtaining informed consent, the financial statements of the Canadian Simulation Centre at Sunnybrook Health Science Centre in Toronto were reviewed (July 1994 through July 1996). Costs were separated into construction and maintenance phase and a list of the ongoing simulation centre educational and research activities compiled. We included the donated equipment as well as costs absorbed by third parties (construction, rent and utilities by the hospital; salaries by the department and the university). Full time equivalent (FTE) salaries were defined as follows: anaesthetist (FTE-anae: \$175,000), fellow (FTE-fel: \$90,000), respiratory therapist (FTE-RT: \$30,000) and secretary (FTE-sec: \$25,000).

#### RESULTS

All dollar figures are in 1996 Canadian Dollars. The planning and construction took place from July 1994 through June 1995 and was overseen by an individual with extensive experience in simulation at the cost of a fellow FTE. A breakdown of the capital costs (total \$665,000.00) is listed in Fig. 1. The current activities are summarized in Fig. 2 and the operating costs from July 1995 through June 1996 displayed in Fig. 3 (total \$167,250.00).

#### DISCUSSION

While substantial resources have to be mobilized to fund the capital costs of a simulation centre (\$665,000.00), total operating costs (\$167,250.00 per year) consist mostly of salaries (75%), which are likely absorbed into the existing educational resources of the affiliated teaching institutions.

Fig. 1 Capital costs for construction of the simulation centre

\$250,000.00	Simulator purchase
\$25,000.00	Audio-visual equipment
\$50,000.00	Room renovation, office equipment
\$250,000.00	Misc. OR equipment
\$90,000.00	FTE-fel (oversees construction)
<b>\$665,000.00</b>	<b>TOTAL CONSTRUCTION COSTS</b>

Fig. 2 Current activities of the Canadian Simulation Centre

1 day/wk	Administration (accounting, scheduling, etc.)
0.25 day/wk	Tours (visitors, press conferences, filming etc.)
1 day/wk	Research (simulator as assessment tool, 2-3 publications per year)
0.5 day/wk	Crisis Management Workshops (CRM, every 6 weeks plus course design)
0.1 day/wk	Corporate Training (full day course for pharmaceutical companies)
0.5 day/wk	Resident Training (20 residents annually)

Fig. 3 Annual operating costs of educational and research activities

\$82,437.50	Administration (15% FTE-anae, 0.75% FTE-sec, \$30,000 rent, \$20,000 simulator upgrades and maintenance, \$6,000 misc. charges)
\$7,187.50	Tours (4% FTE-anae, 0.75% FTE-sec)
\$45,800.00	Research (20% FTE-anae, 36% FTE-RT)
\$16,887.50	CRM (8% FTE-anae, 9% FTE-RT, 0.75% FTE-sec)
(\$5,000.00)	Net revenue from CRM course fees
\$7,187.50	Corporate Training (4% FTE-anae, 0.75% FTE-sec)
(\$10,000.00)	Net revenue from Corporate Training
\$22,750.00	Resident Training (13% FTE-anae)
<b>\$167,250.00</b>	<b>TOTAL OPERATING COST</b>



### CONSTRUCTIVE FEEDBACK USING SIMULATOR VIGNETTES

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**INTRODUCTION** Educational psychologists have identified feedback as an essential component in the learning process. Yet the giving of constructive feedback designed to improve performance remains problematic in the health professions, with many faculty uncomfortable with the process in the learning situation. In a needs assessment conducted in the Department of Anaesthesia, faculty identified feedback as a topic for Faculty Development. In the planning of a feedback workshop, video vignettes were developed in the simulation centre to illustrate common problems and to generate discussion.

**METHODS** The establishment of the Anaesthesia Simulation Centre offered an opportunity to video-tape simulated clerk/faculty interaction in an OR setting that would illustrate various feedback behaviours. Five, 5 minute vignettes were scripted, acted and taped, demonstrating time constraints, faculty impatience, gender insensitivity, lack of attention and the over confident student. At the workshop pre and post questionnaires were administered to explore the value of video vignettes in faculty development and to measure the impact of the session on faculty understanding and attitudes. Questions included reasons for attending as well as attitudinal and behaviour aspects of teaching. Open ended questions elicited comments which were categorized for review.

**RESULTS** The data indicated that faculty rated the workshop as a positive experience with 23 of the 24 respondents rating the workshop as stimulating/helpful (1,2 on a 5 point scale). Extrapolating the questions that focused on attitudes, interest and change potential from pre and post evaluations, a one tailed  $\tau$  test indicated the difference significant at  $\tau$  5.1,  $p < 0.001$ . The video vignettes were highly rated (mean 4, sd .8 on a 5 point scale where 1 is low and 5 is high) and the topic interested the participants (mean 4.16, sd .47).

**DISCUSSION** The preparation of video vignettes using the Anaesthesia Simulation Centre facilities proved to be a valuable asset in capturing interest, focusing the discussion on realistic issues in context and stimulating involvement of participants. The method encouraged people to express their reactions to events and reflect on possible improvements in giving constructive feedback to students and faculty at diverse points in their careers.

### RESIDENT ATTITUDES TOWARDS PROBLEM BASED LEARNING SEMINARS IN ANAESTHESIA.

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### INTRODUCTION

Problem Based Learning (PBL) is an instructional method introduced in the Health Sciences in 1969,<sup>1</sup> and adopted by many medical schools. A review of Canadian anaesthesia education highlights a need to place greater emphasis on problem solving rather than fact recall.<sup>2</sup> Our residency program has tried to incorporate these themes with a set of resident led PBL seminars similar to those reported in the literature.<sup>3</sup> The purpose of this study was to assess resident attitudes towards this form of instruction.

### METHODS

Following a seminar on the foundations of PBL, residents were assigned seminar topics and developed PBL cases with a faculty supervisor. The seminars took place over a three month period. At the end of this period a written survey of eleven statements dealing with the PBL sessions, their format, utility, timing and applicability was completed by twelve residents. A five point scale was used in the survey from strongly agree to strongly disagree. The data was analysed using the Sign test with statistical significance set at  $P < 0.05$ .

### RESULTS

There were significant positive resident attitudes to three areas. These were: that PBL sessions reflected problems encountered in the operating room (OR), one week was enough time to research an area, identified as important to the seminar discussion, and the learning of anaesthesia in the PBL format was relevant. There were no statistically significant negative responses.

### DISCUSSION

The residents have no negative attitudes towards PBL that reach statistical significance. This may reflect their desire to learn anaesthesia. Residents have a positive attitude towards the types of patient problems used in PBL, and their applicability to OR practice. It is not surprising that the residents found the PBL format relevant to learning anaesthesia material. As well, a week appeared to be adequate time to research areas identified as important to a patient problem in a PBL seminar. This method of instruction is of particular relevance to resident training and future practice as it is in keeping with the instructional methodology and style of the RCPSC-MOCOMP programme.

<sup>1</sup> Medical Education 1991, 25:421-29.

<sup>2</sup> Can J. Anaesth 1992, 39:2 158-65.

<sup>3</sup> Medical Education 1992, 26:163-65.

## STRESS IN CANADIAN ANAESTHESIA RESIDENCY TRAINING

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**INTRODUCTION:** Postgraduate medical training has typically been recognized as stressful. Previous studies have reviewed stress in such residencies as internal medicine, pediatrics, and radiology. Anaesthesia has long been recognized to have a significant prevalence of alcohol and drug abuse. Furthermore, earlier studies have reviewed the negative effect of fatigue on performance in anaesthesia. Therefore the purpose of this study was to determine the major sources of residency-related psychological stress in anaesthesia residents.

**METHODS:** A questionnaire was distributed to all 38 residents in the UBC anaesthesia program in November 1996. The residents were asked to anonymously grade on a five point (Likert) scale 37 stressors which were identified by a literature review and a preliminary survey. These stressors included educational, technical, and emotional sources of stress. A global severity index (GSI) was calculated for each stressor, representing the mean score for that item. Demographics such as sex, marital status and seniority were also studied using Mann-Whitney tests.

**RESULTS:** The response rate was 86.8% (33/38). The top six stressors for all respondents were: examinations and evaluations, volume of material, lack of time for other personal interests, inadequate personal time with family and friends, uncertainty regarding job prospects. The items with the lowest GSI scores were: selection of anaesthesia as the correct career goal, presence of harassment in the work place, lack of gratitude/respect from the anaesthesia staff, peer competition. Overall, GSI scores were higher for females for almost every question, except regarding uncertainty of job prospects which the males scored higher, however these differences reached statistical significance for only two questions (feeling of lack of competence, and fiberoptic intubation). The single residents ranked peer competition significantly higher than married residents ( $p < 0.05$ ). The three most stressful technical skills were: miscellaneous nerve blocks, brachial plexus blocks, fiberoptic intubations.

**CONCLUSIONS:** It appears that this cohort of anaesthesia residents are content in their career selection and that harassment or lack of respect in the workplace are not major issues. Continued development of efficacious and supportive teaching methods should be a high priority given the high ranking of volume of material to know and the examination process. The time allocated to teaching certain technical skills, and the actual number of times these skills are practiced should be reviewed. Female residents may have higher stress levels due to fewer social supports and faculty role models. A further national study is planned.

## INTEGRATION OF CRISIS MANAGEMENT USING SIMULATION-BASED EDUCATION INTO POSTGRADUATE TRAINING: FIRST YEAR'S EXPERIENCE

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**Introduction:** Organized programs to teach Anaesthesia Crisis Resource Management (ACRM) are being introduced into postgraduate programs. In 1995-96, a three staged program for PGY2 and PGY3 residents was initiated. The objectives of the course were to i) demonstrate a methodical approach to avoiding accidents, ii) identify the concepts of "event management" and key types of errors in clinical anaesthesia, iii) provide practice of event management skills and iv) observe and critique behaviour in simulated crises. We report the evaluations of residents and faculty after the first year's experience.

**Methods:** Eighteen interested faculty were trained in ACRM by colleagues from the Simulation Centres at Harvard and Stanford Universities. Junior residents were given the opportunity to participate in a three-phase ACRM program. Phase 1 was a seminar focused on the principles and skills for managing critical events using the SRK model (skill-based errors, rule-based errors and knowledge-based errors). In phase 2, all residents used the screen-based computer program called "Anesthesia Simulator Consultant" (ASC) which simulates many rare critical events using a graphic interface, allowing trainees to select appropriate clinical interventions. After completing the first two phases, residents practised crisis management in the Simulation Centre which houses the "Virtual Anesthesiology Training Simulation System"™ manufactured by CAE Link Corporation. Each resident managed one crisis as a primary anaesthetist and one as the "first responder" to the event. The scenarios were developed specifically for junior residents and tested by the interest group. Immediately after each scenario, the videotaped event was reviewed by all participants to focus on specific learning objectives. At the end of each phase, a questionnaire was completed by every resident. A fourth questionnaire was sent to 20 Instructors who participated in any phase of the program. Responses on a 5-point visual analogue scale were used to answer specific questions regarding the program. Data from the four questionnaires were collated and impressions from the residents and faculty were analyzed.

**Results:** Responses were received from all residents (20) and faculty (20). The seminar resulted in a significantly improved response to questions related to the terminology of ACRM. Mean score increased from  $6.2 \pm 2.8$  to  $13.7 \pm 3.1$  ( $p < 0.001$ ). Only 8 residents rated the ASC program as 4 or 5 on a 5-point scale as a valuable learning experience. The main criticism of the ASC program was the lack of feedback on performance which limited learning. All residents and faculty rated the Simulation Centre experience as a 4 or 5 on the 5-point scale as a learning experience. Fourteen of twenty residents rated the simulation as a 4 or 5 relative to a day in the operating room with an outstanding teacher. The other six rated it as equivalent (3 on the 5-point scale). The main advantage noted by faculty and residents was deemed to be the immediate feedback on performance to enhance the learning of ACRM. Resident anxiety concerning the videotaping of their performance in the simulation centre was noted by both faculty and residents, however residents did not think that this impaired their ability to benefit.

**Discussion:** The program continues to be an integral part of resident training. Scenarios have been modified as a result of these evaluations. Immediate feedback was noted to be a valuable part of phase 3, whereas lack of feedback using the ASC program limited its value.

**TEACHING AND LEARNING IN THE OPERATING ROOM FOR THE ANAESTHESIA RESIDENT: IMPORTANT ADULT LEARNING PRINCIPLES**

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**INTRODUCTION**

James<sup>1</sup> has developed a listing of adult learning principles (ALP's):

1. Adults are a highly diversified group of individuals with widely differing preferences, needs, backgrounds, and skills.
2. Experience of the learner is a major resource in learning.
3. Self-concept moves from dependency to independency as individuals grow in responsibility, experience and confidence.
4. Adults tend to be life-centered in their orientation to learning.
5. Adults are motivated to learn by a variety of factors.
6. Active learner participation contributes to learning.
7. A comfortable learning environment is a key to learning.

Are these principles important for operating room (OR) teaching and learning processes? If so, which are most important?

**METHODS**

Faculty (F) and resident (R) anaesthetists at the University of Calgary responded to two questionnaires asking them to rate the importance of each of these nine adult learning principles on a 5-point Likert-like scale (from 1=*unimportant* to 5=*very important*). Respondents were asked to rate these to the specific context of teaching and learning in the OR. Approval for research on human subjects was obtained from the ethics committee. Respondents gave informed written consent. Differences between F and R ratings were assessed using the Mann-Whitney U-test.

**RESULTS**

Overall response rate to the two questionnaires was 35/49=71.4% for F and 14/19=73.7% for R groups. Mean ratings on the 5-point scale by factor were:

Principle	F	R	p value
1. Differing needs	3.09	3.13	NS
2. Experiential learning	4.64	4.38	NS
3. Dependency to independency	4.64	4.75	NS
4. Life-centered learning	3.70	3.88	NS
5. Motivation to learn	3.90	4.13	NS
6. Active participation	4.67	4.88	NS
7. Comfortable environment	3.81	4.63	0.021

Both groups ranked the items in a similar order. F and R felt that the most important ALP relating to OR teaching was that of active student participation (principle 6). Also rated highly were principles 2 and 3. Residents rated principle 7 higher than faculty. All 7 items received ratings greater than 3 out of 5 (*moderately important*).

**DISCUSSION**

James<sup>1</sup> found that the relative rankings of ALP's varied depending on the context of the particular adult educational programme. For anaesthesia residency education in the OR, ALP's were perceived to be of importance. In particular, active student participation, experiential learning, and the move from dependency to independency were those ALP's that appeared most important for teaching and learning processes in the context of the OR.

**REFERENCE**

1. James WB. Proceedings of the Adult Education Research Conference. Montreal, 1983, no. 24, pp. 130-35.

**TEACHING AND LEARNING IN THE OPERATING ROOM FOR THE ANAESTHESIA RESIDENT: IMPORTANCE OF STUDENT CLASSROOM LEARNING PRINCIPLES**

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**INTRODUCTION**

Perhaps the most widely studied learning context is that of the classroom. Causal influences on student classroom learning outcomes from kindergarten to Grade 12 have been defined<sup>1-3</sup>.

1. Student aptitude: a) ability, b) development, c) motivation
2. Teacher instruction: a) amount, b) quality
3. Environmental factors: a) home, b) classroom, c) peers

Are these factors applicable to operating room (OR) teaching for the anaesthesia resident? If so, which of these are most important?

**METHODS**

Faculty (F) and resident (R) anaesthetists at the University of Calgary responded to two questionnaires asking them to rate the importance of each of these classroom learning principles on a 5-point Likert-like scale (from 1=*unimportant* to 5=*very important*). Respondents were asked to rate these to the specific context of teaching and learning in the OR. Approval for research on human subjects was obtained from the ethics committee. Respondents gave informed written consent. Differences between F and R ratings were assessed using the Mann-Whitney U-test.

**RESULTS**

Overall response rate to the two questionnaires was 35/49=71.4% for F and 14/19=73.7% for R groups. Mean ratings on the 5-point scale by factor were:

Factor	F	R	p value
1a) capability to learn	4.59	4.63	NS
1b) prior learning	3.76	3.38	NS
1c) motivation to learn	5.00	4.62	0.00003
2a) instructional quality	3.36	3.88	0.0046
2b) instructional quantity	3.91	4.75	0.043
3a) home life	3.75	3.88	NS
3b) OR environment	3.48	3.75	NS
3b) service requirements	3.69	3.63	NS

All student classroom learning factors were perceived to be greater than of *moderate importance* to anaesthesia residency education in the OR. Faculty, more than residents, felt that resident motivation was an important relevant principle whereas residents, more than faculty, felt that instructional quality and quantity was important.

**DISCUSSION**

While the context of anaesthesia education in the OR differs from that of the classroom, some factors are of similar importance, such as the student's motivation and capability to learn as well as the teacher's quality and quantity of instruction. Other important factors for school learning (such as classroom management) were not found to be of influence for anaesthesia education in the OR. The particular nature of the students, teachers, and content of this post-graduate educational system may account for these differences.

**REFERENCES**

1. Wang MC, et al. Rev of Educational Research 1993; 63: 249-94.
2. Walberg HJ. Educational Leadership 1984; 41(8): 19-27.
3. Wittrock MC. Handbook of Research on Teaching, 1986.

### EFFECTS OF INHALED SALBUTAMOL AND IPRATROPIUM BROMIDE ON AUTONOMIC CONTROL OF THE CARDIOVASCULAR SYSTEM

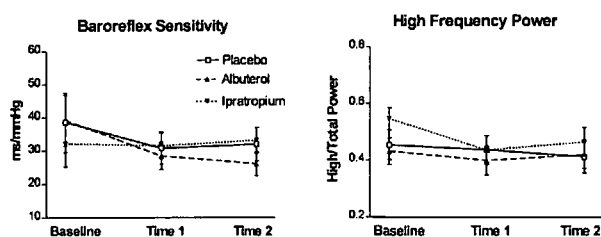
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**INTRODUCTION:** Anticholinergic drugs such as ipratropium and beta agonist drugs such as salbutamol are frequently used in the treatment of chronic lung disease, although their use may be hampered by adverse cardiovascular side effects (1). Systemic administration of these drugs markedly impair normal autonomic heart rate control, while the effects of inhaled salbutamol and ipratropium have not been clearly elucidated. Impaired autonomic control is associated with poor outcome after episodes of myocardial ischemia (2), and patients with chronic lung disease have a high incidence of coexisting coronary artery disease. The purpose of this study was to determine whether high-therapeutic doses of inhaled ipratropium and salbutamol cause impairment of autonomic control of the cardiovascular system.

**METHODS:** After institutional ethics approval, twelve healthy volunteers signed informed consent to participate in this randomized, double-blind, placebo-controlled, crossover design study. On three different testing sessions, each subject self-administered four puffs through a spacer device from one of three identical inhalers containing either salbutamol (100 µg per puff), ipratropium (20 µg per puff) or placebo. Electrocardiogram and non-invasive continuous blood pressure (Finapres®) traces were recorded at baseline and at 45-60 min (Time 1) and 60-75 min (Time 2) after administration of the drug. Autonomic control of the cardiovascular system was quantified by analysis of spontaneous baroreflex sensitivity (BRS) and power spectral analysis of heart rate variability (HRV). Continuous variables were analyzed using 2-way repeated measures ANOVA with  $P < 0.05$  significant.

**RESULTS:** Baseline measures were similar for all study sessions. Heart rate, blood pressure and respiratory rate and peak flow measurements were similar before and after drug administration. Neither salbutamol nor ipratropium caused a significant alteration in baroreflex sensitivity or low or high frequency power of heart rate variability. No adverse effects were reported by subjects.

**CONCLUSIONS:** Inhalation of salbutamol (400 µg) or ipratropium (80 µg) do not alter autonomic control of the cardiovascular system in young healthy subjects. Further investigations in patients with chronic lung disease and chronic bronchodilator therapy would be important.



**REFERENCES:** (1) N Engl J Med 1992; 326:501-06  
(2) Circulation 1988; 78:969-79

### HALOTHANE DOES NOT ATTENUATE THE VASORELAXATION INDUCED BY A NITRIC OXIDE SOLUTION

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### INTRODUCTION

Previous studies in our laboratory have shown that volatile anesthetics such as halothane and isoflurane play important roles in modulating the vasorelaxation of isolated denuded aortic rings induced as a result of the bradykinin stimulated release of the endothelium-derived relaxing factor/nitric oxide (EDRF/NO). We examined if halothane can attenuate the relaxation induced by a NO solution.

### METHODS

This research protocol was approved by the Research and Animal Welfare Committee; the animals were treated according to the guidelines set by the Canadian Protective Animal Committee. Isolated denuded rabbit aortic rings precontracted with phenylephrine (PE) were treated in a perfusion system. The relaxation of the rings were induced either by increasing amounts of perfused NO alone or in the presence of 2 or 4% halothane ( $n = 6$  for each set of experiments). We verified that NO and anaesthetic concentrations were well maintained and stable throughout the open perfusion.

### RESULTS

Halothane (2 or 4%) increased the vascular tension of the PE-precontracted rings by  $11.7 \pm 2.8\%$  and  $8.7 \pm 3.1\%$  (SEM) respectively but did not significantly attenuate the vasorelaxation induced by the NO solution directly added to the perfusate.

### DISCUSSION

The attenuation of endothelium-dependent relaxation induced by halothane in different *in vitro* preparations is not due to a decrease in the relaxing effect of NO. This also suggests the possibility that halothane may interfere with another vasodilator, one of the most likely is the endothelium-derived hyperpolarizing factor (EDHF) which has recently been identified as an epoxyeicosatetraenoic acid<sup>1</sup> derived from the arachidonic acid metabolism.

1. Am J Physiol, 1993; 264: H327-H335.

### AMP AND SNP INDUCED ALTERATIONS IN REGIONAL VASCULAR CONDUCTANCE IN DOGS WITH ACUTE LEFT VENTRICULAR DYSFUNCTION

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#### INTRODUCTION

Sodium Nitroprusside (SNP) and adenosine monophosphate (AMP) increase cardiac index (CI) and decrease systemic vascular resistance index in animals following induction of acute LV dysfunction.<sup>1</sup> The relative effects of these drugs on tissue vascular conductance (1/resistance) has not been established.

#### METHODS

Following approval by the animal ethics review board, 17 mongrel dogs were anaesthetised with sodium thiopental and fentanyl, ventilated mechanically and instrumented for haemodynamic monitoring. Following stabilization, LV dysfunction was induced by the administration of glass microbeads (50 µm) into the left main coronary artery until LV end diastolic pressure was increased from 5 to 15 mmHg; this was associated with a decrease in systemic vascular conductance and CI of 29% and 35% respectively. Dogs were randomly assigned to receive infusion of Normal Saline (NS), AMP or SNP. Doses of SNP and AMP were titrated to achieve a MAP of 80 mmHg. MAP was maintained at 80 mmHg for 75 minutes. Regional blood flow to the heart and peripheral organs were measured using radioactive microspheres and was assessed at four time points: baseline, following induction of LV failure and after 35 and 75 min of drug infusion. Blood flow to each tissue sample was expressed as ml/min/g. As blood pressure was not controlled in the NS group we compared the effects of the drugs on tissue conductance rather than actual blood flows. Differences between groups were compared using repeated measures ANOVA.

#### RESULTS

Haemodynamic parameters were not different among the groups either at baseline or following establishment of acute LV failure. At 75 min of drug infusion SNP and AMP both increased CI compared to pre-drug failure values. Both LV epicardial and endocardial conductance were increased by AMP and SNP. Liver conductance was increased by SNP but not by AMP. Skeletal muscle conductance did not differ significantly between groups. Renal cortex conductance was increased by SNP but not by AMP.

#### CONCLUSIONS

These data suggest that AMP and SNP have equivalent effects on the epicardial and endocardial vasculature in the setting of acute LV failure, when given at equipotent hypotensive doses. Also AMP dose not adversely alter renal cortical conductance under these conditions.

#### REFERENCES

1. Finegan *et al.* Br J Pharmacol 1991;103:1691-6

### SEVOFLURANE DOES NOT APPEAR TO HAVE ANY ELECTROPHYSIOLOGICAL EFFECTS UPON THE ACCESSORY PATHWAY IN WOLFF-PARKINSON-WHITE (WPW) PATIENTS

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#### INTRODUCTION:

Volatile agents have been shown to increase refractoriness of accessory pathways (AP) and the normal atrioventricular conduction system which may confound interpretation of post ablation treatment, in WPW patients undergoing ablative procedures during general anaesthesia<sup>1</sup>. Yet, the electrophysiological (EP) effects of sevoflurane has not been studied in humans.

#### METHODS:

With ethics approval and informed consent, six WPW patients were studied. During alfentanil/midazolam/vecuronium anaesthesia, which has been shown to have no EP effects in humans<sup>2</sup>, a baseline EP study was done as follows: 1) right atrial effective refractory (RAERP), AP effective refractory period (APERP) at cycle length 400/500 msec; 2) right ventricular effective refractory (RAERP); 3) shortest cycle length with 1:1 conduction for AP conduction (SCL-AP). Alfentanil-midazolam administration was then discontinued and sevoflurane was administered at 1 MAC (2% end-tidal) and the EP study was repeated. Paired Student's t-tests compared EP variables prior to and during sevoflurane administration.  $P < 0.05$  was considered significant. Values are Mean  $\pm$  SD.

#### RESULTS:

Our preliminary data suggests that no effect was demonstrated during sevoflurane administration on the accessory pathway during antegrade or retrograde conduction.

TABLE:	Antegrade Conduction (msec)		P Value
	Baseline	Sevoflurane	
RAERP	233 $\pm$ 41	207 $\pm$ 33	.31
APERP	326 $\pm$ 19	324 $\pm$ 29	.78
SCL-AP	342 $\pm$ 41	352 $\pm$ 39	.27
Retrograde Conduction (msec)			
RVERP	222 $\pm$ 24	220 $\pm$ 19	.54
APERP	302 $\pm$ 40	300 $\pm$ 41	.11
SCL-AP	325 $\pm$ 45	340 $\pm$ 35	.38

#### CONCLUSIONS:

Sevoflurane does not effect the refractoriness of the AP therefore is an appropriate anaesthetic agent to administer, in patients undergoing ablative procedures requiring a general anaesthetic.

#### REFERENCES:

1. Anesthesiology 1994;80:63. 2. Can J Anaesth 1992;39:816. Supported by Abbott Laboratories Limited.

**COMPARISON OF NEUROMUSCULAR BLOCKADE ON THE THUMB AND ON THE BIG TOE AFTER ADMINISTRATION OF ROCURONIUM.**

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**INTRODUCTION :** The neuromuscular blockade is conventionally monitored by electrical stimulation of the ulnar nerve. Instead of the arm, however, the leg is sometimes used for this monitoring when a patient is to undergo an operation of the head. It's useful in this conditions to know the correlation between the electrical stimulation of the ulnar nerve and the tibial nerve after administration of a bolus of rocuronium.

**MATERIALS AND METHODS :** Following institutional approval, 24 patients (ASA 1&2 ) were enrolled. Anesthesia was induced with sufentanil 0,3 µg/kg and propofol 2,5 mg/kg. After loss of consciences, the cutaneous electrodes of the Accelerograph (TOF GUARD, Biometer, Copenhagen, Denmark) were simultaneously applied to the wrist and ankle to stimulate the ulnar nerve and the tibial nerve. The acceleration transducers were fastened to the thumb and the big toe. After calibration, a single bolus intravenous injection of rocuronium 0,6 mg/kg was administered and anesthesia was maintained with 66 % nitrous oxide in oxygen and a continuous infusion of propofol 6 mg/kg/hr. The patients were intubated at maximal block. Lag time, onset time (time to maximal block), first sign of recovery (T1 R.), Twitch 1 25%, 50% and 75% recovery, TOF ratio 25%,50%,75% and recovery index (R.I.= TOF 25-75%) were measured. Wilcoxon Test was used for analysis of data. Results are provided as mean ± SD.

**RESULTS :** The mean values (± SD) obtained are shown in the following Table. Lag time and onset time are shorter on the thumb than on the big toe. There is no statistically significant difference between the different times of spontaneous recovery of the control twitch height excepted for the recovery to 75%.

**DISCUSSION AND CONCLUSION :** As far as concern the lag and onset times, the varying duration of the response to rocuronium is probably due to more rapid equilibration in muscles of the arm which possess a greater blood flow. As far as recovery is concerned, there is no significant difference. We conclude that monitoring at the big toe could be a useful alternative when the hand is not accessible.

Time	Thumb	Big Toe	P
Lag time (sec)	29 ± 7.4	36 ± 8.5	≤ 0.0001
Onset time (sec)	52 ± 8.5	61 ± 11.6	≤ 0.001
T1 R (min)	21 ± 7.2	27 ± 8	NS
T1 25 % R (min)	30 ± 6.4	36 ± 9.7	NS
T1 50 % R (min)	36 ± 8.8	42 ± 13.3	NS
T1 75 % R (min)	45 ± 13.1	45 ± 12.2	0.02
TOF ratio 25 % (min)	34 ± 8.7	37 ± 10.2	NS
TOF ratio 50 % (min)	40 ± 11.1	40 ± 10.8	NS
TOF ratio 75 % (min)	46 ± 12.8	45 ± 12.7	NS
Recovery Index (min)	12.5 ± 7	13 ± 5.2	NS

**REFERENCES :** - Anesthesiology V 69, N°1, Jul 1988.  
- J. Anesth. 8 : 143-145, 1994.

**PHARMACOKINETICS OF MULTIPLE DOSES OF INHALED LIPOSOME-ENCAPSULATED FENTANYL (LEF) IN HEALTHY VOLUNTEERS.**

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**INTRODUCTION:** Inhalation of liposome encapsulated fentanyl has been demonstrated to provide a rapid increase of plasma fentanyl concentration (C<sub>fen</sub>) and a prolonged analgesic C<sub>fen</sub>.<sup>1</sup> The goal of this study is to determine the pharmacokinetics of a modified LEF preparation following multiple pulmonary administrations in healthy volunteers.

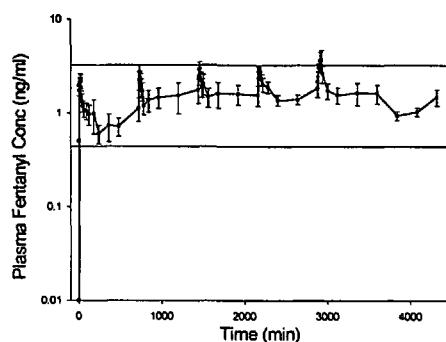
**METHODS:** After obtaining the approval of the IRB and informed consent, healthy volunteers were studied. Each subject participated in 3 studies. Following the application of routine monitors, each subject received on separate occasions: (1) 200 ug fentanyl iv; (2) 4000 ug of LEF aerosol; (3) 5 doses of 4000 ug of LEF aerosols at 12 hr intervals. Venous blood (3 ml) was collected regularly for 24 hrs for Study 1 and 2 and 72 hrs for Study 3 to determine plasma fentanyl concentration (C<sub>fen</sub>) using RIA. Pharmacokinetic parameters were estimated using Rstrip® (MicroMath, Salt Lake City, Utah).

**RESULTS:** The mean (±sd) age, weight, and height were 24.0 (±8.9) yr, 71.1(±10.1) kg, and 171.8 (±7.8) cm respectively. The mean (±sem) C<sub>fen</sub> vs time profile following the inhalation of the 5 doses of LEF is shown in the figure. The mean (±sd) peak C<sub>fen</sub> (C<sub>max</sub>), minimum C<sub>fen</sub> (C<sub>min</sub>), and time to peak C<sub>fen</sub> (T<sub>max</sub>) following multiple aerosols are shown in the Table. The range of T<sub>max</sub> was between 12.5 to 19.2 min following LEF aerosol. The C<sub>fen</sub> was maintained within analgesic therapeutic concentrations (0.5 to 2.0 ng.ml<sup>-1</sup>) during the 72 hour study. The mean bioavailability of inhaled LEF was 0.20 ± 0.07.

**DISCUSSION:** Our data suggest that repeated pulmonary administration of liposome-encapsulated fentanyl can provide a rapid increase and a sustained plasma fentanyl concentration suitable for pain management. Future clinical studies are necessary to determine its clinical efficacy and safety in patients with acute or chronic pain.

**REFERENCES:** 1. Anesthesiology 1995;83:277-284

Dose	1	2	3	4	5
Tmax (min)	16.7±6.9	12.5±6.3	19.2±18.8	14.2±8.4	18.3±12.5
Cmax (ng.ml <sup>-1</sup> )	2.64±0.88	2.92±1.4	3.3±1.45	3.48±1.09	3.54±1.15
Cmin (ng.ml <sup>-1</sup> )	0.6±0.33	1.2±0.6	1.5±0.86	1.39±0.46	0.93±0.26



### RESPIRATORY EFFECTS OF REPEATED PULMONARY ADMINISTRATION OF LIPOSOME-ENCAPSULATED FENTANYL (LEF) IN HEALTHY VOLUNTEERS.

OR Hung, MD, E Coonan, SC Whynot, MLT, M Mezei, Ph.D.  
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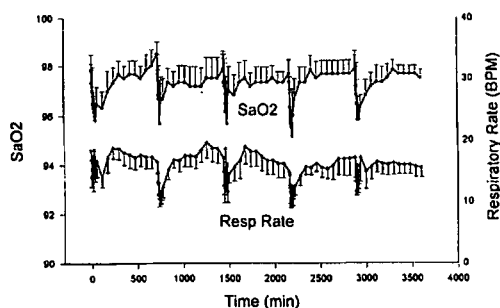
**INTRODUCTION:** Although pulmonary delivery of LEF has the potential to provide a rapid increase of plasma fentanyl concentration ( $C_{fen}$ ) and a sustained analgesic  $C_{fen}$  for pain management, its clinical safety, particularly respiratory depression, is unknown.<sup>1</sup> The goal of the study is to determine the respiratory effects of multiple pulmonary administrations of LEF in healthy volunteers.

**METHODS:** After obtaining the approval of the IRB and informed consent, healthy volunteers were studied. Following the application of a non-invasive respiratory function monitor (Respirace™), ECG and pulse oximeter, 5 doses of 4000 µg of LEF (0.8 mg.ml<sup>-1</sup> fentanyl) were administered via an aerosol at 12 hr intervals. The respiratory rate (RR), tidal volume (Vt), minute ventilation (Vm), oxygen saturation (S<sub>a</sub>O<sub>2</sub>), and heart rate (HR) were monitored and recorded throughout the study. Venous blood was collected regularly for 72 hrs to determine  $C_{fen}$ .

**RESULTS:** Apart from minor nausea (2 subjects), no complications occurred during the study. The mean (±sd) age, weight, and height were 24.0 (±8.9) yr, 71.1(±10.1) kg, and 171.8 (±7.8) cm respectively. The mean  $C_{fen}$  was maintained within analgesic therapeutic concentrations (0.5 to 2.0 ng.ml<sup>-1</sup>) during the study. There were no significant changes in the ECG or HR following each LEF aerosol. The mean (±sem) RR and SaO<sub>2</sub> during the study are shown in the figure. Although both parameters were decreased following each LEF aerosol, these changes were small and probably clinically insignificant. Similarly, there were small but clinically insignificant changes of Vt and Vm following each LEF aerosol administration.

**DISCUSSION:** There were minimal hemodynamic and respiratory changes following repeated pulmonary administrations of liposome-encapsulated fentanyl in healthy volunteers. However, clinical safety of inhaled LEF in patients with cardiovascular or respiratory diseases remains unknown. Future clinical studies are necessary to study the clinical efficacy and safety in these patient populations.

**REFERENCES:** 1. Anesthesiology 1995;83:277-84.



A

### AN *IN VITRO* STUDY OF THE CONTAMINATION SUSCEPTIBILITY OF THREE NEEDLELESS AND A STANDARD NEEDLE INJECTION SYSTEMS

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\*Funded by The Physicians Services Incorporated Foundation.

**INTRODUCTION:** Needleless injection systems may decrease needlestick injuries. They have pre-formed latex or synthetic ports for injections with blunt cannulae; one design uses a two-way valve. The contamination susceptibility of three needleless and one needle systems were prospectively compared.

**METHODS:** The Baxter InterLink, St. Paul Medical Key-Lok, and Braun SafSite needleless systems and a standard heparin lock were tested, using 50 of each make. Each of the 200 injection ports was pierced through the cork of a resin aerobic blood culture bottle. All injection port-culture bottle sets stayed connected until sent for bacterial analysis (microbiologist blinded). Each port was injected 30 times, each time with a new injector, over 72 hours. The InterLink and Key-Lok ports were injected with blunt cannulae, the SafSites directly from 3 mL syringes, and the heparin locks with 18G needles. Each injection of 0.25 mL of saline was drawn with a new 3 mL syringe from a new 10 mL bottle. Injections were done by the same nurse with clean non-gloved hands in a vacant intensive care unit room. Prior to each injection, a port was cleaned with a new alcohol swab according to its manufacturer's guidelines. The SafSites required no swabbing but each was recapped with the same cap in between injections. All culture bottles, with the ports removed after 72 hours, were incubated at 35°C in an ambient air incubator after addition of Fastidious Organism Supplement. The bottles were subcultured after 18-24 hours of incubation, and after 72 hours of incubation, and finally after 5 days of incubation. The contamination rates between samples were analyzed using  $\chi^2$  test with significance set at 0.05.

**RESULTS:** The contamination rates (Table) of the 4 systems were significantly different ( $\chi^2(df=3)=81.82, p<0.001$ ). SafSite was compared against all the other systems combined and had a significantly higher contamination rate ( $\chi^2(df=1)=77.93, p<0.001$ ). The overall analysis without SafSite showed no significant difference in contamination rates between the heparin lock, InterLink, and Key-Lok ( $\chi^2(df=2)=1.188, p>0.1$ ). All positive cultures grew coagulase-negative staphylococcus species except one which also grew a streptococcus species.

**CONCLUSIONS:** The InterLink and Key-Lok needleless injection systems have the same risk of line contamination when compared to a standard needle injection system. The common practice of recapping a SafSite port with the same cap after each injection, rather than with a brand new cap as suggested by its maker, may increase line contamination.

**TABLE:** Bacterial contamination rates of the injection sets.

	Heplock	InterLink	Key-Lok	SafSite
Growth	3	6	4	36
No growth	47	44	46	14

B

**EFFECT OF HEAD-UP POSITION ON SPEED OF ARTERIAL HAEMOGLOBIN OXYGEN DESATURATION AT INDUCTION OF GENERAL ANAESTHESIA**

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**INTRODUCTION:** Changing from the sitting to the supine position reduces FRC.<sup>1,2</sup> The effect of changes of body position on the speed of arterial haemoglobin oxygen desaturation (AHOD) was studied at induction of general anaesthesia.

**METHODS:** After IRB approval of the randomized study, informed consent was obtained from 100 ASA I-II patients aged 20-65 years scheduled for elective gynecological or general surgical procedures under endotracheal anaesthesia. The study was to determine the time taken for AHOD to reach 93% at induction of general anaesthesia in the supine (Group A) and 20° head-up tilt (Group B) positions. With ongoing routine monitoring including pulse oxymetry and after 3 minutes pre-oxygenation, general anaesthesia was induced with sodium thiopentone, 4-6 mg·kg<sup>-1</sup>, followed by succinylcholine 1.5 mg·kg<sup>-1</sup>. Intubation of the trachea was performed, the endotracheal tube secured in position and left open to the atmosphere connected to a capnometer to confirm apnea. Anaesthesia and apnea were maintained with 30-40 mg boluses of propofol and succinylcholine infusion respectively. The time in seconds taken for AHOD to reach 93% was measured starting from the end of injection of the intubating dose (2-3 ml) of succinylcholine. On reaching SpO<sub>2</sub> of 93%, the succinylcholine infusion and propofol administration were discontinued and manual ventilation of the patient's lungs commenced with 100% oxygen and 1.5% halothane until SpO<sub>2</sub> rose to over 97%, at which point routine anaesthesia for the surgery planned began. Data entry and analysis were with Epi-info computer software, Kruskal-Wallis and Student's t-test methods.

**RESULTS:** The two groups did not differ significantly in age, weight, BMI, haemoglobin levels or vital signs before and during the study period. The AHOD time, however, showed a significant difference; median Group A 277.0 seconds and Group B 341.7 seconds, p=0.007.

Table 1. Demographic Variables

	Group A		Group B		P value
	Range	Median	Range	Median	
Age (yrs)	20-65	32.5	19-56	33.5	0.582
Weight (kgs)	31-104	65.5	39-106	61.5	0.239
Desaturation time (sec)	163.9-637.2	277.0	155.0-672.1	341.7	0.007

**CONCLUSION:** The 20° head-up tilt position improves oxygen stores and lengthens 'Safe Apnea Time' at induction of anaesthesia.

**REFERENCES:** 1. J Appl Physiol 1977; 31:717-21. 2. J Appl Physiol 1970; 28:445-51.

**Peaks and Valleys of Anaesthetic Charting**

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**INTRODUCTION**

Anaesthetic charting must accurately reflect intra-operative events. Reasons for charting inaccuracy may include lapses of memory, omission during high task situations and legal concerns. We hypothesized that increased anaesthetic training would improve charting accuracy.

**METHODS**

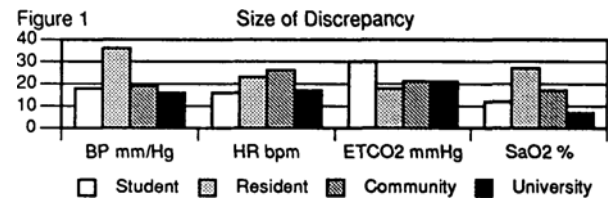
After research ethics board approval, anesthetists and students were asked to participate in a study which evaluated the simulator as a testing tool. All subjects were given a standardized patient in the simulator environment and asked to conduct the induction and maintenance phase of an anaesthetic in which standardized problems were presented. Subjects were given an anaesthetic chart and were instructed to manage the patient and deal with the chart as was their normal practice. During the simulated anaesthetic, 3 critical events took place resulting in changes to blood pressure (BP), heart rate (HR), end-tidal carbon dioxide (ETCO<sub>2</sub>) concentration and oxygen saturation (SaO<sub>2</sub>). The critical events were recorded to videotape by processing the video output of the physiological monitor with a digital to analogue converter and recorded simultaneously with the anaesthesia workspace camera. At the end of the simulated scenario the anaesthesia chart was collected and compared to the values displayed on the videotape recording of the physiological monitor with respect to lowest BP, highest HR, highest ETCO<sub>2</sub> and lowest SaO<sub>2</sub> measurements. Subjects were not informed that their charting would be compared to actual (physiological monitor) values. Data was analyzed with respect to 4 groups; students, residents, community anaesthetists and university anaesthetists. The 4 groups were compared with respect to completeness of charting with a 1-way ANOVA and the actual (physiological monitor) and anaesthesia chart values were compared by group with a 2-way ANOVA. A P<0.05 was considered significant.

**RESULTS**

Data from 43 subjects were analyzed. The number of the subjects in each group and completeness of charting is outlined in Table 1. While charting appeared to be more complete in the university anaesthetist group this did not achieve statistical significance (Table 1). The discrepancy in charting as defined by the actual value minus the charted value is presented in Figure 1. All groups were significantly discrepant in their charting (P<0.0001) and there were no significant group differences.

Table 1

	Student	Resident	Community	University
Number	9	11	16	7
% Complete	11.1	27.3	31.3	42.9



**DISCUSSION**

All groups tended to round charted data towards physiological norms. We were unable to document a difference in charting, both accuracy or completeness due to prior training. Despite electronic storage of physiological data charting of data to a paper record remained incomplete and inaccurate.

This study was supported with a grant from the physicians of Ontario through the PSI foundation.



### HEMATOLOGIC EFFECTS OF AN ULTRA FILTRATION AUTOTRANSFUSION DEVICE

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**Introduction** Autotransfusion devices generally use centrifugation and washing of blood collected during or after surgical procedures to produce a product that is suitable for retransfusion<sup>1,2</sup>. A new processor was developed that uses ultra filtration technology for processing shed mediastinal blood. Animal studies and a small pilot study demonstrated an increase in the yield of platelets using this device when compared to standard centrifugation devices. This study was undertaken to compare the effects of this new technology to standard technology on platelet function in human subjects.

**Methods** This study was approved by the institutional Research Ethics Committee. Written informed consent was obtained from 14 patients undergoing reoperative open heart surgery. Patients were randomized into two groups in whom blood was collected, processed and transfused in either a conventional centrifugation processor or in the ultra filtration processor. Following separation from CPB and after the administration of protamine, shed mediastinal blood was collected in either the standard device or the new device. Blood was collected over 4 hours, processed and retransfused. Blood samples were taken from the radial artery catheter prior to anaesthesia, 10 minutes following the administration of protamine and 1 hour and 24 hours following CPB. Blood was also collected from the chest tubes and from each of the devices. A final sample was taken from the container following processing and prior to reinfusion.

Platelets were isolated by centrifugation and resuspended in modified Tyrodes solution at a platelet count of 150,000/ml. Half of the sample was tested for aggregation after the addition of ADP and thrombin. The other half of the samples were fixed in paraformaldehyde neutralized in glycine and washed. Agglutination was tested in these samples after the administration of ristocetin and platelet poor plasma. Fluorescein isothiocyanate-labelled antibodies including CD-42 (anti-GP1b), CD-62 (anti-PADGEM) and controls were added to 5µL aliquots of fixed samples and analysed. Platelet counts were also recorded. All results were evaluated using ANOVA.

**Results** The platelet count decreased significantly during CPB and returned to normal 24 hours after the procedure. The platelet count was <150,000/µL from mediastinal drainage samples before and after processing. Administration of protamine caused a decrease in the platelet response to ADP and thrombin. Reinfusion of processed blood did not change the response of platelets to the soluble agonists. Ristocetin agglutination decreased significantly following CPB. Mediastinal shed blood taken both before and after processing demonstrated a marked drop in expression of GP 1b (post-protamine; 80 ± 7%, processed blood; 52 ± 7%, both groups, p,0.001). Platelets were significantly activated in shed blood as demonstrated by measurement of PADGEM (pre-pump 28 ± 12% vs shed blood 54 ± 12%, p,0.001). There was no significant activation in circulating blood after reinfusion of shed blood.

**Discussion** This study shows that shed mediastinal blood processed by either ultra filtration or centrifugation contain cellular elements including platelets. The platelets are dysfunctional, showing a lack of GP 1b receptor activity necessary for platelet agglutination and cell adhesion. When transfused, these cells produce no systemic effects as measured by platelet aggregometry and flow cytometry. Further study is needed to determine whether platelet activation in shed mediastinal blood has procoagulant activity which is not cleared by cell processing.

- 1) J. Cardiovasc Thorac Surg, 104:94-107, 1992
- 2) Ann Thorac Surg, 57:615-22, 1994

### CO<sub>2</sub> ABSORBENTS DO NOT SHARE THE SAME PHYSICAL PROPERTIES.

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**INTRODUCTION.** This study was designed to compare physical properties of 7 brands of CO<sub>2</sub> absorbents, namely Baralyme® (B) and the 6 soda limes Drägersorb® (D), Intersorb® (I), Medisorb® (M), Sodasorb® (Sd), Sofnolime® (Sf) and Viosorb® (V).

**METHODS.** The size of absorbent granules was evaluated with a sieve analysis, using a set of eight sieves stacked on a mechanical shaker (Retsch Vibrotronic type VE1). Friability was assessed by the percent weight loss after treatment in an Erweka TAP friabilator, and the loss on drying was measured with a Mettler LP16 infrared desiccator. Each sample was dried to constant weight at 105°C. Surface area was directly measured by the Brunauer, Emmett and Teller (BET) method. Bulk density, apparent volume (untapped and tapped), and volume reduction under tapping were assessed using an Erweka SVM. Results were compared by ANOVA or Kruskal Wallis test, where appropriate.

### RESULTS.

Parameters	Range	p
Size of granules (%) · retained on 4.5 mm	0.08 (D) - 14.44 (V)	p < 0.0001
· passing 4 mm and retained on 2.5 mm	64.43 (Sf) - 88.61 (D)	p < 0.0001
· passing 1 mm	0.35 (D) - 1.70 (Sf)	p < 0.0001
· passing 400 µm	0.20 (D) - 0.84 (Sf)	
Friability (%)	1.3 (D) - 2.5 (Sd)	p = 0.08 NS
Loss on drying (%)	14.2 (B) - 17.4 (I)	p < 0.001
Surface area (m <sup>2</sup> /g)	3.8 (B) - 20.1 (V)	p < 0.0001
Volume reduction under tapping (ml)	2.2 (Sf) - 5.8 (V)	p < 0.001
Bulk density (g/ml) · untapped	0.747 (Sd) - 0.857 (B)	p < 0.001
· tapped	0.796 (Sd) - 0.906 (B,D)	

**DISCUSSION.** Significant differences were observed in the physical characteristics of the various CO<sub>2</sub> absorbents. These properties may have clinical implications. The granules should be dust free<sup>1</sup>. Granulometry and friability respectively quantify presence of and ability to produce dust. Loss on drying evaluates water content, which should remain between 12.0 and 19.0 percent for soda limes and between 11.0 and 16.0 percent for Baralyme®<sup>2</sup>. The other parameters may play a role in resistance to flow and CO<sub>2</sub> absorbency. The potential influences of these differences on CO<sub>2</sub> absorbency, on promotion of other chemical reactions, and on patient safety deserve further study.

**References:**<sup>1</sup>Martindale, The Extra Pharmacopoeia, 30<sup>th</sup>., p1412.  
<sup>2</sup>U.S. Pharmacopoeia 23 National Formulary 18, p165 and p2300.

**NURSING WORKLOAD AND PACU COMPLICATIONS**

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**Introduction:** Surrogate outcomes such as complications in the Post Anaesthetic Care Unit (PACU) have been used in anaesthesia outcome studies. However, it has been suggested that true outcomes such as impact on resource utilization are more meaningful. Since nursing remains the largest component of PACU costs, we studied a nursing workload system, the PRN, to determine if PACU complications have a major impact on nursing care.

**Methods:** Following Ethics approval, for all patients admitted to PACU (3 months, 8 am - 11 pm weekdays, n = 2,013) direct nursing care was measured using the PRN system. Each of 214 nursing tasks listed in the PRN system was assigned a point value based on the complexity of the task and the time for completion. For each patient admitted to PACU the total number of PRN points was tabulated by the investigators. Over the same time period, nurses independently recorded patient complications on the PACU record (defined as deviations of physiological parameters or problems requiring treatment). Additional patient, surgical, and anaesthetic factors were identified from the OR anaesthetic record. The mean PRN point values for patients with PACU complications and with specific characteristics were compared to the values for patients without the complications or characteristics using the unpaired T-test (P<0.01).

**Results:** For patients who had general anaesthesia (GA) with mechanical ventilation (n = 1,213), PACU complications and PRN values (± standard error - s.e.) are noted below:

n	PACU Complication	PRN Value (± s.e.)	P Value†
600	No complications	35.0 ± 0.6	
6	Unexpected ICU admit	113.5 ± 21.4	0.01
23	Critical respiratory event	74.7 ± 8.3	<0.01
58	Hypotension/tachycardia	58.1 ± 3.1	<0.01
21	Hypertension	53.9 ± 4.1	<0.01
27	Excessive drowsiness	48.8 ± 3.4	<0.01
50	Excessive pain	46.9 ± 2.2	<0.01
83	Nausea & vomiting	39.6 ± 1.9	0.03
43	Shivering	36.9 ± 2.6	0.4

† P value - compared to patients with no complications.

Characteristics of patients (GA/mechanical ventilation) which influenced nursing workload included ASA physical status (ASA 1-2 vs 3-5, PRN value 40.3 ± 0.6 vs 49.3 ± 1.6), age (<70 vs ≥70 yr, 41.1 ± 0.6 vs 47.5 ± 1.5), and OR duration (2-3 hr vs ≥4 hr, 42.0 ± 1.0 vs 65.7 ± 2.4). Mean PRN value for patients with GA/mechanical ventilation (41.8 ± 0.6) was higher than for patients having GA/spontaneous ventilation (n = 394, 28.6 ± 0.6) or neurolept analgesia (n = 361, 22.5 ± 0.9).

**Conclusion:** Nursing workload measured by the PRN system identified complications in PACU which increased nursing care, i.e. true meaningful outcomes. Since costs for PACU nursing care are high, nursing workload could be used as an important outcome indicator when new strategies to prevent PACU complications are evaluated for cost effectiveness.

**HAS THE PRACTICE OF AIRWAY MANAGEMENT CHANGED?**

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**Introduction:** Over the last 6 years airway guidelines have been circulated and new techniques identified. However, no studies have determined if these interventions have changed practice or altered outcome. Therefore, techniques for airway management, outcomes, and prediction of difficulties were compared for all patients who had general anaesthesia (GA) over 3 periods, Jan 91-Mar 93 (n=18,206), Apr 93-Dec 94 (n=12,543), and Jan 95-Sept 96 (n=12,247).

**Methods:** Following Ethics approval, techniques for intubation (awake, asleep/GA; direct, indirect, lightwand, fiberoptic; oral, nasal, trach) and use of a regular mask or laryngeal mask (LMA) were identified. Alternative techniques for intubation included all methods other than asleep/GA direct. Outcomes following asleep/GA direct were noted (number of laryngoscopies, additional assistance needed, and failures). Difficulty with mask ventilation was noted. Four preoperative tests (mouth opening, neck movement, visualization of hypopharynx, and thyromental distance) were used to determine sensitivity (proportion of ≥3 laryngoscopies identified with any abnormality) and positive predictive value (proportion of those with any abnormality who required ≥3 laryngoscopies) for the 3 time periods. Results were compared using chi squared and Fisher's exact tests.

**Results:**

**Techniques: % of all GA patients \*p<0.01 different Period 1**

	Period 1	Period 2	Period 3
Total (n)	(22,542)	(15,176)	(15,291)
Asleep/GA direct	80.1	82.7	80.1
Alternative technique	1.5	1.5	1.6
Regular mask	14.9	7.5*	5.4*
LMA	2.8	8.3*	12.9*

Following asleep/GA direct the proportions of patients with ≥3 laryngoscopies were unchanged over time (1.8%, 1.6%, and 1.6%).

**Outcome: % of all Patients Requiring ≥3 laryngoscopies**

	Period 1	Period 2	Period 3
Total ≥3 laryngoscopies (n)	(325)	(196)	(197)
3-4 direct laryng. successful	80.0	75.6	79.7
≥5 direct laryng. successful	3.4	4.1	3.0
Fiberoptic assist successful	9.5	14.2	13.7
Other assist successful	1.8	1.0	1.0
Failed - neurolept or mask	2.5	3.1	2.0
Failed - case cancelled	2.8	2.0	0.5

There were no cases where intubation failed and mask ventilation was impossible, and transtracheal jet ventilation was never used.

**Predicting ≥3 laryngoscopies †p<0.05 different Period 1**

	Period 1	Period 2	Period 3
Sensitivity	35.5%	43.4%†	43.8%†
Positive predictive value	6.9%	4.6%†	4.5%†

**Conclusion:** Over time the LMA replaced the regular mask during GA. There were no changes in the rate of alternative techniques or difficulty, and prediction continued to be poor. The number of failed (case cancelled) was small and reduced in Period 3. So far, it appears that interventions have not altered patient outcomes.

### A MULTIFACTORIAL RISK INDEX FOR PREDICTING DIFFICULT TRACHEAL INTUBATIONS

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**Introduction:** Previous studies have failed to provide an accurate instrument for predicting difficult laryngoscopic intubations. A valid instrument should include important patient history and physical factors, reproducible physical measurements, a better outcome definition and reliable performance of the tests. In this study, using these strategies, we developed a multifactorial risk index to help predict difficult laryngoscopic intubations.

**Methods:** Following institutional approval, 440 randomly selected patients requiring tracheal intubation were assessed preoperatively. In addition, 53 patients, 27 of whom were difficult to intubate, were assessed postoperatively. Patient assessment consisted of historical factors: e.g. age, gender, obstructive sleep apnea (OSA), rheumatoid arthritis, hypertension, snoring - and physical factors: 1) body mass index, 2) maximum inter-incisal gap, 3) subluxation: maximal forward protrusion of the mandible; 4) dentition; 5) best oropharyngeal view (modified Mallampati), 6) profile; 7) thyromental distance (TMD); 8) chin size, length of mandible anterior to line connecting upper teeth to the tip of thyroid cartilage (sniffing position, mouth open); 9) cervical spine flexion, distance from sternal notch to tip of chin (complete flexion); and 10) atlanto-occipital extension, angle traversed from complete flexion to sniffing position. Reliability of tests was maximised by using a single specially trained anaesthetist, clear definitions for each test, an accurate measuring device, and having patients repeat manoeuvres until carried out correctly. Intubations were classified as difficult if the number of laryngoscopy attempts plus the grade of best laryngoscopy view [grade 1 (all of cords visible) to 5 (not even epiglottis visible)] as graded by the attending anaesthetist was greater than five, or if fiberoptic assisted intubation was required. Factors associated with difficult intubation, identified by univariate analysis, were subsequently analysed using stepwise logistic regression ( $P < 0.05$ ) to obtain the most predictive combination. The score for each factor was derived from odds ratios. The risk index was then applied to the sample to determine its predictive ability.

**Results:** 44 patients were classified as having difficult intubation. The best risk index is shown (patients with full upper denture excluded):

Factor	Definition	Score
gender	male	1.5
subluxation	mandible $\leq$ maxilla	1.5
oropharyngeal view	only base of uvula seen	1.5
inter-incisal gap	$\leq$ 3.5 cm	2.0
	$>$ 3.5, $<$ 4.0 cm	0.5
chin size	$\leq$ 2.0 cm	3.0
	$>$ 2.0, $<$ 2.5 cm	1.0
A-O extension	$\leq$ 20 degrees	3.0
	$>$ 20, $<$ 35 degrees	0.5
TMD	$\leq$ 4.5 cm	3.0
	$>$ 4.5, $<$ 5.5 cm	2.0

At a cut-off score of  $>$ 7, difficult intubation is predicted. At this level, the risk index has a sensitivity of 84% and specificity of 98%.

**Discussion:** Some important factors, such as OSA and rheumatoid arthritis, were not statistically significant due to their low prevalence. We have developed a preliminary risk index which, when reliably obtained, predicts difficult laryngoscopic tracheal intubations. However, additional studies will be required to determine the accuracy and feasibility of this risk index when applied to a large sample of new patients by multiple anaesthetists.

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### SERUM CONCENTRATIONS OF BUPIVACAINE DURING PROLONGED CONTINUOUS PARAVERTEBRAL INFUSION IN YOUNG INFANTS

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#### INTRODUCTION

Analgesia provided by a paravertebral bupivacaine infusion can be prolonged with the addition of adrenaline. [1].

#### PATIENTS AND METHOD:

The study was approved by the local Ethics Committee. Written parental consent was obtained in 23 infants less than 6 months for thoracotomy. A standard anaesthetic technique was used with fentanyl  $2 \mu\text{g kg}^{-1}$  for per-operative analgesia. An epidural catheter was sited under direct vision [2]. After a 1.0ml test dose of bupivacaine 0.125% with 1:400,000 adrenaline, a 0.5 ml  $\text{kg}^{-1}$  loading dose of bupivacaine 0.25 % was injected before an infusion of bupivacaine 0.125%, with adrenaline 1:400,000, at 0.2 ml  $\text{kg}^{-1} \text{hr}^{-1}$  was commenced and continued for 48 h. Assessments of pain were made using a modified CRIES scale [3]. I.V. morphine  $10 \mu\text{g kg}^{-1}$  was used for scores  $>$ 3/10. All patients received paracetamol 15 mg  $\text{kg}^{-1}$  every 6 h, from 24-72 h. Blood samples were taken at 0,6,12,18,24,30,36,42 and 48h of infusion and 6 h after stopping.

#### RESULTS

The median age was 1.6 (0.1-24.1) weeks and median weight 3.2 (2.5-5.5) kg. In 19 patients the median of the mean hourly pain score was 0.28 (0.00 - 1.63); 3 patients required morphine. Technical problems prevented sampling in 2 patients. The mean maximum serum bupivacaine concentration was 1.65 (0.47)  $\mu\text{g ml}^{-1}$  in 18 of 21 patients. Three patients had maximum concentrations of 3.29, 3.14 and 3.21  $\mu\text{g ml}^{-1}$  at 30, 42 and 48 h respectively. No patient exhibited signs of bupivacaine toxicity.

#### DISCUSSION

In 18 infants maximum serum concentrations were well below toxic concentrations, however, in three these were high. One required additional analgesia and perhaps exceptional vascularity of the paravertebral space may explain these findings. Prolonged infusion of bupivacaine  $>$ 30 h in young infants may result in high bupivacaine concentrations in a small, but unpredictable proportion. We recommend infusions are reduced after 30 h and paracetamol be given regularly. We achieved effective analgesia in 86% (19/22) of our patients. Our "success" rate is lower than described in studies in infants [2] and children [4], using higher doses of bupivacaine. This could indicate in some that the bupivacaine dose was too low. A temporary increase in infusion would appear safe within the first 24 h, though after 30 h, may lead to an increased toxicity risk.

#### REFERENCES

1. *British Journal of Anaesthesia* 1987;69:1441-1450.
2. *British Journal of Anaesthesia* 1996;76:811-815.
3. *Paediatric Anaesthesia* 1995;5:53-61.
4. *Journal of Paediatric Surgery* 1992;27:556-557.

**RECOVERY CHARACTERISTICS OF SEVOFLURANE AND PROPOFOL AFTER AMBULATORY UROLOGICAL SURGERY IN CHILDREN**

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**INTRODUCTION:** Sevoflurane and propofol have been shown to facilitate rapid recovery after anaesthesia, however they have not been compared in children.<sup>1,2</sup> The purpose of this study was to evaluate the recovery characteristics of these two anaesthetics in children undergoing ambulatory surgery.

**METHODS:** After ethical committee approval and informed parental consent, 50 healthy unpremedicated children scheduled for urological ambulatory surgery between 2 and 8 years of age were randomly allocated to one of two groups: 1) Sevoflurane for induction and maintenance of anaesthesia or 2) Propofol for induction (2-3 mg/kg iv) followed by an infusion (10 mg/kg/hr then 7.5mg/kg/hr) for maintenance of anaesthesia. Both groups received 70% N<sub>2</sub>O in oxygen. Neuromuscular blockade was achieved with rocuronium (0.5-0.8 mg/kg). An epidural was inserted before surgical incision. At the end of surgery the anaesthetic agent was discontinued and the times to extubation, spontaneous eye opening, response to a command, orientation, a modified Aldrete score of ≥8, tolerating oral fluids and discharge from hospital were collected by an observer blinded to the treatment assignment. Adverse events during emergence, recovery and the first 24 hours postoperatively were recorded. Data were analysed using an unpaired t-test with a Bonferroni correction and Fisher's Exact test. The overall level of significance was fixed at an alpha<sub>2</sub> of 0.05.

**RESULTS:** Demographic data and emergence and recovery indices for the two treatment groups were similar (Table). The incidence of emesis in the first 24 hours postoperatively was 36% in the Sevoflurane group and 24% in the Propofol group (P=0.54). No major adverse events occurred in either group.

Table: Emergence and recovery times (min) (mean ± SD)

	Sevoflurane (n=25)	Propofol (n=25)	95% CI*	
			lower	upper
Anaesthesia time	88.6 ± 44.5	84.0 ± 44.5	-20.7	29.9
Extubation	7.8 ± 2.2	6.7 ± 2.8	-0.3	2.5
Eye opening	18.1 ± 8.1	14.4 ± 9.2	-1.2	8.6
Verbal commands	23.9 ± 9.6	18.8 ± 9.1	-0.2	10.4
Aldrete score ≥ 8	24.4 ± 11.6	20.2 ± 7.3	-1.3	9.7
Orientation	26.8 ± 10.1	24.8 ± 8.5	-3.2	7.3
Oral fluids	67.2 ± 33.5	71.1 ± 36.1	-23.6	15.9
Hospital discharge	132.0 ± 40.7	131.3 ± 40.8	-24.4	25.8

\* 95% confidence intervals for the difference between means.

**DISCUSSION:** Preliminary analysis indicates that the recovery profiles of sevoflurane and propofol in combination with epidural analgesia in children are similar. The rapid recovery times and low incidence of postoperative side effects suggest that both anaesthetics are appropriate for ambulatory urological surgery in children.

**REFERENCES:** 1) Anesthesiology 1996 ;84: 1332-40  
2) C.J.A. 1994; 41: 12-18

**ACKNOWLEDGMENT:** Supported in part with a grant from Abbott Laboratories Ltd, Quebec.

**VENTILATION STRATEGIES AFFECT THE FUNCTIONAL LUNG INJURY AFTER ASPIRATION OF HUMAN BREAST MILK IN RABBITS**

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**Introduction:** Aspiration of human breast milk (HBM) causes an acute lung injury (ALI) characterised by an increased AaDO<sub>2</sub>, decreased compliance and activation of circulating neutrophils.<sup>1-3</sup> Ventilation strategies aimed at maintaining alveolar volume reduce the severity of ALI.<sup>4,5</sup> The purpose of this study was to determine whether the maintenance of alveolar volume by HFO and the avoidance of the cyclic atelectasis associated with conventional minute ventilation (CMV) reduces the ALI after HBM aspiration.

**Methods:** With animal care committee approval, twelve pathogen-free New Zealand white rabbits (3.0±0.2kg) were anaesthetised and a tracheostomy and arterial and central venous catheters were inserted. Rabbits were randomly assigned to one of three groups - intra-tracheal instillation (2ml/kg) of normal saline (NS, n=4) or HBM at pH 1.8±0.1 (CMV, n=4 or HFO, n=4). NS and CMV rabbits were ventilated with CMV (FiO<sub>2</sub>=1, V<sub>T</sub>=10ml/kg, respiratory rate adjusted to maintain normocarbica) for 3 hours after HBM aspiration. HFO rabbits were ventilated with CMV for 1 hour after aspiration to establish ALI and then with HFO for 2 hours (f=15Hz, MAP=10mmHg, ΔP adjusted to maintain normocarbica). Static pulmonary PV curves and arterial and central venous blood gases were measured hourly. Data (mean ± SD) were analysed for intergroup differences with ANOVA and SNK tests (p <0.05 was significant).

**Results:** HBM aspiration produced an ALI as evidenced by an increase in AaDO<sub>2</sub> and shunt fraction (Qs/Qt) compared with both baseline and NS (figure). HFO returned these values towards baseline (figure): the values were significantly less than those in the CMV group, but were not different from the NS group at 2 and 3 hours. Pulmonary compliance decreased after HBM injury and improved with HFO. Static PV curves shifted rightward and the volume plateau decreased compared with baseline. After HBM aspiration, HFO shifted the curves leftward towards their baseline.

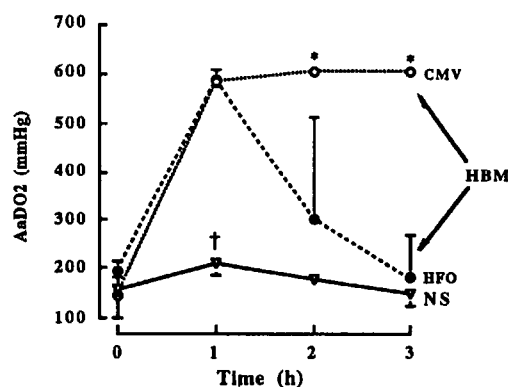


Fig: \* p <0.01 vs HFO, † p <0.01 vs CMV and HFO

**Discussion:** These results indicate that HFO reverses the functional ALI after HBM aspiration. The mechanism of this response remains to be established, but may be due to the maintenance of alveolar volume and the prevention of cyclic atelectasis associated with CMV.

**References:** 1. Anesthesiology 84; 1386 2. Anesthesiology 85; A1145 3. Surgery 114; 13 4. Int Care Med 18; 112 5. J. Appl. Phys 77;1355

### PLASMA CONCENTRATIONS OF FLUMAZENIL FOLLOWING INTRANASAL ADMINISTRATION IN CHILDREN.

Louis Scheepers MD, Carolyne Montgomery MD, Gillian Dunn MD, Russell Bourne MD, Anna Kinahan MD, James McCormack PharmD.

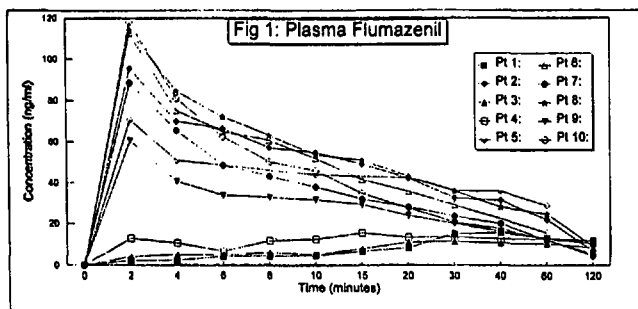
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**INTRODUCTION:** Flumazenil, a competitive benzodiazepine antagonist, reverses the central nervous system effects of the benzodiazepines. The therapeutic plasma concentration after intravenous administration is 10-20  $\mu\text{g/L}$ . Midazolam, a benzodiazepine, is often administered via the oral or intranasal route in pediatric patients, when intravenous access is not obtained. Adverse reactions such as excessive sedation, agitation and restlessness may occur, and require antagonism. This study was designed to determine peak plasma concentrations of flumazenil resulting from intranasal administration in pediatric patients.

**METHODS:** Following institutional approval and informed written consent, 10 ASA physical status I-II patients, aged 2 to 6 yr, undergoing general anaesthesia for dental surgery were recruited. After induction, flumazenil 40  $\mu\text{g/kg}$  (Anexate<sup>®</sup>, Roche, 0.1 mg/mL (0.4 mL/kg)) was administered via a syringe as drops, divided equally between each nostril, just prior to nasal intubation. Venous plasma samples were drawn prior to the administration of flumazenil ( $t=0$ ), and then at 2, 4, 6, 8, 10, 15, 20, 30, 40, 60, and 120 minutes thereafter. The plasma samples were immediately processed by the on-site laboratory and then stored at  $-70^{\circ}\text{C}$ , prior to analysis via high performance liquid chromatography assay (Dr. Tam, University of Alberta).

**RESULTS:** 11 patients were studied, but data for 1 patient was discarded due to insufficient sampling. The median age was 4.3 years (range 3 to 6), with a median weight of 18.9 kg (range 14.9 to 22.2). There were 7 males and 3 females.  $C_{\text{max}}$  was 67.8 ng/mL (SD 41.9), and  $T_{\text{max}}$  was 2 min (fig. 1).

**DISCUSSION:** The peak plasma concentration of flumazenil should be adequate to antagonize the effects of the benzodiazepines. These levels were reached at 2 minutes, and lasted for 60 minutes. This route of administration may be useful when the intravenous route is not readily available. A potential disadvantage to this technique is the high volume of solution required.



**REFERENCES:** Clinical Pharmacokinetics 14:1-12, 1988.

### THE EFFECTIVENESS OF ORAL CLONIDINE AS A PERIOPERATIVE ANALGESIC IN PAEDIATRIC ADENOTONSILLECTOMY.

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**INTRODUCTION:** Clonidine, an  $\alpha^2$  agonist, when used as an oral premedicant is an effective analgesic and thus may decrease perioperative opioid use.<sup>1</sup> This randomized controlled triple blind study examines the use of clonidine vs fentanyl as an analgesic for children undergoing adenotonsillectomy.

**METHODS:** After institutional approval and informed written parental consent was obtained, patients were randomized to receive either clonidine 4.0  $\text{mcg}\cdot\text{kg}^{-1}$  or placebo po 90 min prior to surgery. Sedation and anxiolysis scores were graded on separation from the parents. Intraoperatively, the control group received fentanyl 3  $\text{mcg}\cdot\text{kg}^{-1}$  IV and the clonidine group received placebo IV. After induction of anaesthesia, the tonsillar fossae were infiltrated with 2.5 mL 0.5% bupivacaine by the surgeon. Intraoperatively, any changes  $>20\%$  in MAP and HR and blood loss were recorded. Postoperative pain was assessed using a verbal analogue scale (0-10) both at rest and on swallowing at 10 min intervals in PACU and prior to discharge. Children with pain scores of  $\geq 5$  at rest received morphine 0.05  $\text{mg}\cdot\text{kg}^{-1}$  IV up to 3 doses. If pain scores remained  $\geq 5$ , codeine 1.5  $\text{mg}\cdot\text{kg}^{-1}$  po and acetaminophen 20  $\text{mg}\cdot\text{kg}^{-1}$  po were given. Morphine administration and postoperative vomiting (POV) were recorded. A sedation score was recorded on discharge.

**RESULTS:** 30 children have been studied. The median age was 8 yrs (7-12) and the median weight was 29 kg (20-48). The preoperative sedation score was higher in the clonidine group. The number of patients who received IV morphine and the amount given was similar in both groups (Table 1). No difference in intraoperative blood loss, haemodynamics, POV, need for postoperative airway support or IV fluid resuscitation was found.

Parameter	Clonidine (n=16)	Fentanyl (n=14)	P
Sedation $>2$	10 (63%)	1 (7%)	.0017 <sup>‡</sup>
Morphine ( $\text{mg}\cdot\text{kg}^{-1}$ ) <sup>*</sup>	0.05 (0-0.21)	0.07 (0-0.15)	NS <sup>†</sup>
Morphine	10 (63%)	9 (64%)	NS <sup>‡</sup>
24 hr POV	3 (19%)	5 (36%)	NS <sup>†</sup>

<sup>\*</sup>Median (range); <sup>‡</sup>Chi-square; <sup>†</sup>Mann-Whitney; <sup>‡</sup>Fisher exact  
**DISCUSSION:** The effects of preoperative clonidine were comparable to the effects of intraoperative fentanyl. Clonidine reduced perioperative opioid usage and was an effective non-opioid analgesic for children undergoing adenotonsillectomy. Clonidine produces preoperative sedation which may be an advantage in paediatric patients. Further recruitment is in progress.

1. Anesth Analg 1996;82:225-30

**PLASMA LEVELS OF ACETAMINOPHEN AT 24 HOURS  
AFTER A PERIOPERATIVE ORAL DOSE REGIMEN OF 20  
MG/KG Q6H IN PAEDIATRICS**

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**Introduction:** Oral acetaminophen is frequently used as an adjuvant for postoperative analgesia in paediatric patients. While the plasma concentrations required for analgesia are not defined in the literature, the accepted therapeutic plasma concentration range for an antipyretic effect is 70-130  $\mu\text{Mol.L}^{-1}$  (10-20  $\mu\text{g.mL}^{-1}$ ).<sup>1</sup> Acetaminophen usage is most likely to exceed 90  $\text{mg.kg}^{-1}.\text{day}^{-1}$  when a 10-15  $\text{mg.kg}^{-1}.\text{day}^{-1}$  q4h PRN dosage regimen is used.<sup>2</sup> The purpose of this study was to examine the plasma levels resulting from perioperative scheduled dosing of 80  $\text{mg.kg}^{-1}.\text{day}^{-1}$ .

**Methods:** After institutional review and informed written parental consent, 9 ASA PS class 1/2 children were studied. One hour prior to induction and then q6h for 3 scheduled doses postoperatively, acetaminophen elixer 160 mg/ 5 mL formulation (Tylenol®, McNeil) in a dose of 20  $\text{mg.kg}^{-1}$  was administered. Venous plasma levels were sampled at 1 h prior to (trough) and at 1 h after (peak) the 4th dose. Acetaminophen plasma concentrations were determined using a TdxFLX® fluorescence polarization immunoassay. (Abbott Laboratories, Toronto, Ontario)

**Results:** Nine patients were studied. Data from two patients were excluded from analysis; one received acetaminophen rectally and the other had PONV and was unable to tolerate the oral route. The remaining 7 patients were aged 6.4 (3.9-9.8) yr. and weighed 29.4 (14.9-35.4) kg. median(range) The acetaminophen plasma levels are shown in Table 1. Patient #6 partially vomited the 4th dose; the peak level was 70  $\mu\text{Mol.L}^{-1}$ . All patients received opioids in addition to acetaminophen for pain management.

Patient #	Trough ( $\mu\text{Mol.L}^{-1}$ )	Peak ( $\mu\text{Mol.L}^{-1}$ )
1	51	45
2	83	131
3	52	139
4	21	135
5	40	80
6	40	excluded
7	50	102
<b>Median (range)</b>	50 (21-83)	106 (45-139)

**Discussion:**

This oral dosing regimen is higher than previous recommendations (65  $\text{mg.kg}^{-1}.\text{day}^{-1}$ ) but did not result in levels associated with toxicity (> 800  $\mu\text{Mol.L}^{-1}$ ). The advantages of scheduled po dosing q6h compared to PRN dosing are more consistent plasma levels, and a decreased chance of exceeding the dosage recommendation of 90  $\text{mg.kg}^{-1}.\text{day}^{-1}$ . The low trough levels indicated lack of accumulation and may be a limitation to this dose regimen when no other analgesics are given.

**References:**

1. Pediatrics 1978, 62 (suppl): 904-9.
2. J Paediatr Child Health 1993;29:104-6

**CEREBRAL OXYGEN EXTRACTION DURING INTRACRANIAL ANEURYSM SURGERY: THE INFLUENCE OF PaCO<sub>2</sub>**

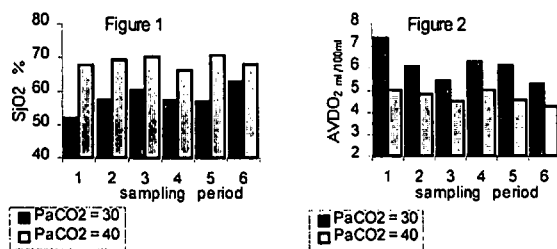
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**INTRODUCTION:** Ventilation to moderate hypocapnia (PaCO<sub>2</sub> = 30mmHg) is commonly practised during anaesthesia for intracranial aneurysm surgery<sup>1</sup>, with the intention of reducing brain bulk to improve exposure for the surgeon. A side-effect of this technique is the diminution of global cerebral blood flow, with the possibility of cerebral ischaemia. This randomized study examined cerebral oxygen extraction under conditions of moderate hyperventilation and normoventilation (PaCO<sub>2</sub> = 40mmHg).

**METHODS:** With institutional ethics committee approval and with informed consent, cerebral oxygen extraction was assessed in 13 patients undergoing clipping of intracranial aneurysm. Under general anaesthesia with N<sub>2</sub>O/O<sub>2</sub>, propofol, sufentanil and rocuronium infusions, patients were ventilated to a PaCO<sub>2</sub> of 30mmHg (group 1) or 40mmHg (group 2). Jugular bulb catheterisation was performed according to established guidelines. Serial assessments of cerebral oxygen extraction and cerebral lactate production were undertaken at six intervals during the surgery.

**RESULTS:** Six out of seven (85.7%) of subjects in group 1 had at least one episode of significant<sup>2</sup> jugular desaturation (SjO<sub>2</sub><50%). None of the six subjects in group 2 had episodes of desaturation. This was statistically significant (p=0.004). Subjects in group 1 had lower jugular bulb oxygen saturations than those in group 2 (see figure 1). The arteriovenous oxygen content difference was higher in group 1 subjects (figure 2). There were no significant differences in lactate production between the groups.

**DISCUSSION:** Our results suggest that, during craniotomy for cerebral aneurysm clipping, moderate hyperventilation reduces cerebral blood flow to levels which render patients susceptible to cerebral ischaemia.



**REFERENCES:**

1. British Journal of Anaesthesia 75:527-30
2. Acta Neurochirurgica 134: (1-2); 71-75

**Cardiac Arrest in the OR: How bad are our ACLS skills?**

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**INTRODUCTION**

Cardiac arrest is a rare but potentially fatal complication under anaesthesia in the operating room. While advanced cardiac life support (ACLS) training is widely available, there are no mandatory requirements for anaesthetists. The recent introduction of full scale anaesthesia simulators allows realistic recreation of rare intraoperative events and evaluation of resuscitative skills. We tested the hypothesis that adherence to ACLS guidelines during resuscitation of ventricular fibrillation (VFib) would be poor by anaesthetists not trained in ACLS.

**METHODS**

With approval by the ethics review board, 56 subjects participated in the study. The simulation system (CAE Electronics) consisted of a computer controlled mannequin with lifelike qualities (ECG, pulse, blood pressure, saturation, heart and breath sounds) set in a completely equipped mock operating room. After completion of a demographic data sheet, each subject was given a test scenario that contained several standard anaesthetic problems. A VFib cardiac arrest occurred after approximately one hour. Audio-video recordings of the anaesthetic as well as hardcopies of the computer generated case-log were analyzed for adherence to the current ACLS guidelines for the treatment of VFib arrest. A perfect score (score=A) indicated complete compliance with the ACLS guidelines, whereas minor deviations (score=B) included changes in the energy levels of defibrillation, drug doses or treatment order. The failure to discontinue the anaesthetic, defibrillate or administer epinephrine were considered major deviations (score=C). Anaesthetists with ACLS training were compared to anaesthetists without training with respect to adherence to the VFib ACLS protocol by chi-square analysis.

**RESULTS**

All results are expressed as mean±SD. Eleven university staff anaesthetists (group 1), 23 community staff anaesthetists (group 2), 12 anaesthesia residents (group 3) and 10 medical students (group 4) participated in the study. Their mean age was 37±10 yrs and 31 of the 34 staff anaesthetists (91% of group 1 and 2) were certified by the Royal College of Physicians and Surgeons of Canada in anaesthesia. Thirty-seven of the 56 participants (66%) had taken the ACLS course (7±5 years ago). Anaesthetists with prior ACLS training achieved higher scores compared to anaesthetists without training (p<0.01, Fig. 1). Three subjects followed the ACLS guidelines (5%, score=A), while 14 subjects showed minor (25%, score=B) and 39 subjects major deviations (70%, score=C). Thirty-two participants (57%) did not discontinue the anaesthetic, 8 (14%) never gave epinephrine and 2 (4%) never used the defibrillator.

**DISCUSSION**

Overall adherence to ACLS guidelines was poor. A greater proportion of subjects without prior training in ACLS had deviations from protocol when compared to subjects who had prior training. We need to consider ways to ensure that anaesthetists obtain and retain resuscitation skills according to ACLS guidelines.

Fig. 1 Anaesthetists with prior ACLS training achieved higher scores than those without (p<0.01 by chi-square)

	ACLS trained (n=37)	non ACLS trained (n=19)
perfect adherence (score=A)	3 (8%)	0 (0%)
minor deviations (score=B)	13 (35%)	1 (5%)
major deviations (score=C)	21 (57%)	18 (95%)

This study was supported by a grant from P.S.I. Foundation

**POSTOPERATIVE ANALGESIC EFFECT OF LOW DOSE BUPIVACAINE FOR INTERSCALENE BRACHIAL PLEXUS BLOCK FOR SHOULDER SURGERY, A DOSE FINDING STUDY.**

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**INTRODUCTION:** Shoulder surgery is associated with severe post-operative pain, often requiring high doses of opioids. A combined general and regional anaesthetic technique would be ideal<sup>1</sup>. We hypothesized that an interscalene brachial plexus block (ISBPB) using low dose bupivacaine could provide effective post-operative analgesia and facilitate early nerve function examination. To determine the minimum effective dose, three bupivacaine doses are studied.

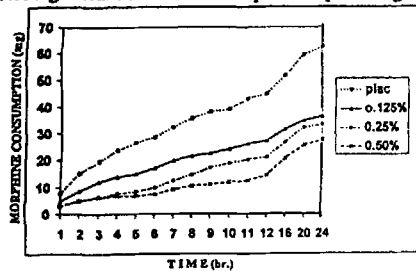
**METHODS:** After IRB approval, 28 patients scheduled to undergo open shoulder surgery gave informed consent. In a randomized, double-blind manner, patients received pre-operatively an ISBPB as described by Winnie<sup>2</sup> with either 10ml of normal saline or one of the following concentrations of bupivacaine - 0.125%, 0.25% and 0.5%. The brachial plexus was localized using a nerve stimulator. A standardized general anesthetic was administered with a total dose of fentanyl 2µg/kg. Post-operative assessments included VAS pain scores, sensory and motor functions, hourly morphine, the incidence of nausea and vomiting and a telephone interview at 48 hours. Data was analyzed using one-way ANOVA and chi-square tests. Results are expressed as mean ± SD; p<0.05 was regarded as significant.

**RESULTS:** The groups did not differ with respect to demographics or O.R. course. The results are shown in the table and graph. The motor and sensory block was not significant at 120 mins post-operatively in any of the four groups.

Table

Data	Placebo	0.125% bupiv.	0.25% bupiv.	0.5% bupiv.
No. Of patients	4	9	10	5
VAS 20 min	8.5 ± 2.4	4.5 ± 2.2*	2.9 ± 3.2*	2.6 ± 2.3*
VAS 60 min	7.3 ± 1.7	3.9 ± 2.0	2.0 ± 2.4*	2.6 ± 1.7*
VAS 120 min	5.2 ± 2.1	3.7 ± 2.5	1.9 ± 2.4	2.8 ± 0.8
VAS 24 hr	5.0 ± 0	2.7 ± 0.6	4.3 ± 1.2	3.6 ± 1.1
Morphine use over 24h (mg)	62.5 ± 21.3	36.4 ± 15.3	33.3 ± 22.4*	27.6 ± 9.9*
N/V(%)	75%	22%	30%	80%

\*Denotes significant difference compared to placebo group.



**CONCLUSIONS:** Our preliminary data show that a ISBPB with 10ml of 0.25% or 0.5% bupivacaine provide the most effective analgesia as indicated by low VAS and morphine consumption, yet produce minimum sensory and motor block

**REFERENCES:** 1. Anaesthetist 1991; 40:537-42. 2. Anesth Analg 1970; 49:455-466.

**DOES RADIANT HEAT ON THE BLUSH AREA INHIBIT SHIVERING AND DECREASE REWARMING TIME THROUGH PERIPHERAL VASODILATION? A PROPOSED NEW METHOD FOR REWARMING POSTOPERATIVE CARDIAC AND SURGICAL PATIENTS.**

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\*Supported by a grant from the Vancouver Foundation.

**INTRODUCTION:** Patients commonly experience the dangers of postoperative shivering and hypothermia when recovering from anaesthesia.<sup>1</sup> Applying radiant heat to the blush area activates the trigeminal nerve heat sensors.<sup>2</sup> This stimulation from heat overrides the cold sensors' input to the hypothalamus. This study is testing the hypotheses that applying radiant heat on the blush area: 1. decreases the number and severity of shivering epochs, 2. decreases the rewarming time required to reach normothermia by inhibiting peripheral vasoconstriction, thereby increasing the effectiveness of the convective rewarming technique, and 3. increases the mean skin temperature.

**METHODS:** These hypotheses are being tested by dividing post-operative surgical and cardiac surgical patients into two groups. The conditions are as follows: 1.convective rewarming technique(CH) (n=11), 2.the combination of convective rewarming technique and radiant heat on the blush area (41°C) (RH) (n=8). Following UBC's approved informed consent, cold stable surgical (eg.CABG) patients that meet prescribed protocol are randomly assigned to a rewarming group, and have block reversals upon admission to post-operative recovery in the CSICU or PAR. Measures observed include shivering evaluation by the VOSS (Maximum Visual Observation Scale)<sup>3</sup>, the core temperature by pulmonary artery thermistor, and mean skin temperature weighted according to the Ramanathan formula.<sup>4</sup> Between group variables were compared using a two-tailed t-test, using Bonferroni's Correction with the multiple mean skin temperature measures, with a P-value of <0.05 being considered significant.

**RESULTS:** The groups did not differ with respect to demographics, surgical time, or pre-trial temperatures (table). With radiant heat the rewarming time decreased significantly (CH=150.4±37.5 vs RH=94.4±15.7min); the mean skin temperature was no different at minute 1, but significantly warmer at minutes 26 and 52 (CH=32.7±0.9°C and 33.6±0.6°C vs RH=34.3±0.6°C and 35.7±0.5°C, respectively); and the radiant heat group shivered significantly less than the convective heat group (VOSS: CH=(1)13.5, (2)6.5, (3)2.9, (4)1.4 epochs vs RH=(1)2.6, (2),(3),(4) zero epochs).

**CONCLUSIONS:** Our results suggest that radiant heat on the blush area significantly decreases shivering; decreases rewarming time; and increases mean skin temperature. This suggests a healthier post-operative recovery for patients.

DEMOGRAPHICS	CH (n=11)	RH (n=8)
Age (yrs)	67.4±10	70.3±3
Height (cm)	166.6±10.3	170.8±9.3
Weight (kg)	75.6±11.3	79.4±12.6
BSA (m2)	1.87±.18	1.91±.18
Surgical Time (min)	272±101	257±30
CSICU ambient temp (C)	22.5±1.0	22.5±1.3
CSICU entry temp	34.9±.5	35.3±.4

References: 1. Heart & Lung 21(1): 1-5, 1992; 2. Acta Physiologica Scandinavica 125(4): 633-7, 1985; 3.AACN Clinical Issues 4(2): 276-91, 1993; 4.Journal of Applied Physiology 19: 531-533, 1964.



**PRETREATMENT OF HIPPOCAMPAL SLICES WITH A NOVEL DIPHENYL HYDANTOIN (DILANTIN) DERIVATIVE PROTECTS SYNAPTIC TRANSMISSION AFTER BRIEF ANOXIC INSULTS**

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**INTRODUCTION**

Excessive calcium influx during anoxia leads to irreversible neuronal injury. Blocking non-inactivating sodium conductances may decrease calcium influx by preventing activation of calcium channels and attenuating reverse sodium/calcium exchange. The present abstract reports that pretreatment with a known sodium channel blocker, 5,5-diphenyl hydantoin (dilantin) and its novel derivative 5-monophenyl hydantoin, ensures the recovery of neuronal function after brief anoxic insults.

**METHODS**

Adult Wistar rats were anaesthetized and decapitated. The hippocampi were rapidly removed and transversely sectioned into 400 µm thick slices which were incubated at 30°C in artificial cerebrospinal fluid (ACSF). Subsequently slices were placed in a submerged recording chamber and constantly perfused with ACSF at 35°C. Population spikes were evoked by stimulation of stratum radiatum with a bipolar tungsten electrode and recorded extracellularly in the pyramidal cell body layer of the CA1 region using a glass micro pipette filled with 150mM NaCl. Slices were superfused with 5,5-diphenyl hydantoin (100 µM), 5-monophenyl hydantoin (150 µM) dissolved in dimethyl-sulfoxide (DMSO; 0.03%) or control ACSF with DMSO 0.03% before application of anoxic insults for 20 minutes. Anoxia was applied by perfusing the slice with perfusate previously bubbled with 95% N<sub>2</sub> / 5% CO<sub>2</sub> mixture.

**RESULTS**

During the application of anoxia, the population spikes were completely suppressed in all slices including those treated with the hydantoin compounds. The table below shows the mean percent recovery of population spike amplitudes after perfusion with oxygenated solutions for 90-120 minutes following the application of brief anoxic insults.

	Slices recovered after anoxic insults	%Recovery from baseline <sup>a</sup>
Control	0/8	7.6±2.3
5,5-diphenyl hydantoin	5/8	86.7±5.4
5-monophenyl hydantoin	4/7	78.3±6.8

[<sup>a</sup>Data are calculated from recovered slices. Data are presented in mean ± SEM. \* Indicates statistical significance (p<0.05, Mann-Whitney test) between control and treatment post-anoxia.]

**DISCUSSION**

These preliminary results suggest that 5,5-diphenyl hydantoin (dilantin) and its novel derivative 5-monophenyl hydantoin ensures recovery of neuronal electrophysiologic activities after anoxic insults. However, they do not protect cellular function during oxygen deprivation. The advantage of 5-monophenyl hydantoin is an anticipated low toxicity profile and a similar relative potency compared with its prototype. Therefore, future investigations are necessary to explore the pharmacology of this new compound which might be a useful neuroprotector agent.

**EFFECT OF N<sub>2</sub>O ON CEREBELLAR EVOKED POTENTIALS**

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**INTRODUCTION:** Intraoperative Evoked Potential (EP) monitoring is common during major spinal surgery. The most popular EP measured are Somatosensory Evoked Potentials (SSEP). SSEP are known to be influenced by anaesthetic agents.<sup>1</sup> They may also allow an isolated ventral cord infarct to go undetected as the pathway of SSEP is via the dorsal columns. Cerebellar Evoked Potentials (CEP) have been reported as a possible monitor of ventral cord integrity.<sup>2,3</sup> Their use has been limited & thus poorly characterized. The purpose of this study was to further characterize these promising EP's & determine the N<sub>2</sub>O (N) effect on CEP during Propofol (P) or Isoflurane (I) anaesthesia.

**METHODS:** Following IRB approval, consent was obtained from 16 ASA I&II patients, with no significant neurologic deficit, scheduled for spinal surgery. They were randomly allocated to receive a Fentanyl (F) infusion 1µg·kg<sup>-1</sup>·hr<sup>-1</sup> & either a P infusion (100-200 µg·kg<sup>-1</sup>·min<sup>-1</sup>) with varying concentrations of N or 1.2 MAC equivalents of I & N. CEP were measured using Posterior Tibial Nerve (PTN) stimulation & recorded using needle electrodes located 2-3 cm lateral to the midline on the superior nuchal line & referenced to the forehead (FPz). Simultaneous PTN elicited SSEP, utilizing standard electrode placement, were also recorded. Baseline EP were obtained 30 mins after a standard induction. All EP were measured 15 mins after steady state with varying N & I levels (Tables). EtCO<sub>2</sub>, BP, SpO<sub>2</sub> & temp were maintained constant during the study period. Analysis of results used ANOVA & Fisher's test.

**RESULTS: Effect of N<sub>2</sub>O on CEP & SSEP With Propofol**

Table 1.

E.P.		P/N 50%	P/N 0%	P/N 70%
CEP (µV)	amplitude	0.37±0.18	0.32±0.2	0.30±0.11
	(msec) latency	31.9±4.9	33.3±3.1	33.0±2.8
SSEP (µV)	amplitude	0.83±0.14*	1.35±0.68*#	0.78±0.37#
	(msec) latency	41.7±4.8	41.6±4.1	42.5±4.9

**Effect of N<sub>2</sub>O on CEP & SSEP With Isoflurane**

Table 2.

E.P.		1.83%N/50%	1.6%N/70%	1.38%N/0%
CEP (µV)	amplitude	0.26±0.08	0.24±0.07	0.24±0.14
	(msec) latency	35.1±3.2	35.3±3.3	35.7±3.3
SSEP (µV)	amplitude	0.72±0.19	0.58±0.24	0.55±0.17
	(msec) latency	45.7±3.6	46.3±3.6	46.7±3.6

mean ±SD significant \* & # (p<0.05)

**DISCUSSION:** CEP were reliably monitored & independent of SSEP. They were resistant to the effects of N<sub>2</sub>O under the study conditions. SSEP showed a significant decrease in amplitude with increased N<sub>2</sub>O levels during Propofol anaesthesia. CEP require further investigation to elucidate their exact pathways & their clinical utility as a non-invasive spinal cord monitor in the intraoperative setting.

**REFERENCES:**1. Can J Anaesth 41:295-300. 2. Spine 20:2318-27. 3. J Neurotrauma 10:181-200.

### THE IMPORTANCE OF SAMPLING SITE IN THE MEASUREMENT OF WHOLE BLOOD PLATELET FLOW CYTOMETRY

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**INTRODUCTION:** Platelet flow cytometry is a technique in which monoclonal or polyclonal antibodies are used to identify the surface expression of platelet membrane glycoproteins and other membrane-bound proteins found on the cell surface after platelet activation. The degree of antibody binding may be quantitated in a flow cytometer and compared with total cell population to determine the percentage of expression. Sampling methods may influence the results of these sophisticated platelet function testing techniques. This study was done to determine if a difference occurs when samples are taken from a peripheral vein, a radial artery cannula or an internal jugular vein catheter.

**METHODS:** The study was approved by the Research Ethics Committee. Written informed consent was obtained from adult patients (n=8) scheduled for open heart surgery and healthy volunteers (n=3). Samples were taken prior to the induction of anaesthesia from three sites 1) antecubital vein 2) radial artery cannula 3) internal jugular cannula. In all cases, withdrawal under suction was avoided. Samples were taken from the antecubital vein in the normal volunteers. Platelets were prepared by adding blood samples to eppendorf tubes containing Tyrode's albumin. Human  $\alpha$ -thrombin was added to the samples from the normal volunteers. The tubes were incubated for 30 minutes. Antibodies to platelet-associated activated factor XIII, activated GP IIb/IIIa, platelet thrombospondin and GP Ib were added to the samples, incubated and read on the flow cytometer. The degree of activation from normal volunteers was analyzed using a Student's t-test. Due to the significant inter-patient variability in the cardiac surgical population in baseline markers of platelet surface proteins, triplicate samples were analyzed in two patients and the site-specific differences analyzed by ANOVA. For each patient, the difference between the three sample sites was determined and tested by paired t-test. In all tests, a p-value of <.05 was considered significant.

**RESULTS:** In the normal volunteers, thrombin activation caused a significant increase in the degree of surface expression of the platelet activation marker. Inpatient analysis of triplicate samples (n=2) showed a marked increase in activation in samples taken from the radial artery. When mean differences between sample sites were calculated, the arterial-peripheral vein differences for platelet-associated activated factor XIIIa was found to be significantly greater than that for the central vein-peripheral vein difference (p=0.005). There was a trend to greater activation for the other markers in samples taken from the radial artery.

**DISCUSSION:** Sensitive tests of platelet function have been developed which assess the degree of platelet activation in patients. These tests aid in the understanding of platelet abnormalities and assist in the understanding of platelet abnormalities which occur during cardiopulmonary bypass. Access to sampling sites is restricted in cardiac surgery and the central venous line or the radial artery line are often used for blood specimens. Exposure of samples to synthetic surfaces may result in platelet activation, leading to erroneous conclusions. This study shows that platelet activation occurs when blood samples are taken from the radial artery. Samples taken from the central venous catheter did not show the same degree of activation. This sampling technique produces results that are similar to those obtained from the antecubital vein.

### THE EFFECT OF ANTIHYPERTENSIVE AGENTS ON OXYGENATION FOLLOWING CARDIAC SURGERY

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**INTRODUCTION:** Nitroglycerine (NG) and sodium nitroprusside (SNP) are commonly used to control hypertension following cardiac surgery. One limitation of these agents is that they can decrease PaO<sub>2</sub> and increase venous admixture (Qs/Qt) by inhibiting hypoxic pulmonary vasoconstriction. This study substituted labetalol for NG and SNP and recorded the changes in PaO<sub>2</sub> and Qs/Qt.

**METHODS:** Ventilated post cardiac surgery patients were included in this study if their FiO<sub>2</sub> requirement prevented them from being weaned from mechanical ventilation by the protocol utilized by this centre (the need for a FiO<sub>2</sub> of >.60 to maintain a PaO<sub>2</sub> of >70 mmHg). To be included subjects also had to be receiving >50 $\mu$ g/min of NG and/or >0.5 $\mu$ g/kg/min of SNP to maintain a systolic BP of <130 mmHg. Patients were excluded if there was any contraindication for the use of labetalol (EF <40%, cardiac index <2.2 L/min/m<sup>2</sup>, or reactive airways disease). The PaO<sub>2</sub> and Qs/Qt were measured before (PRE) and after (POST) stopping NG and SNP. The time between measurements was limited to 30 minutes or less. Once NG and SNP were stopped, labetalol was administered intravenously at an initial dose of 10 mg followed by doses of 20 mg every 3-5 minutes to maintain the BP below the target level. Following the POST measurements, the FiO<sub>2</sub> was reduced to 0.6 to determine if the patient now met the criteria to be weaned.

**RESULTS:** During the 17 month study period, 657 elective cardiac surgery patients were admitted to the ICU and thirty were eligible for the study and were enrolled. Stopping NG and SNP led to an increase in PaO<sub>2</sub> and a fall in Qs/Qt in all 30 subjects. Due to the improved oxygenation all but 2 subjects met the criteria to be weaned from mechanical ventilation after NG and SNP were stopped. A mean of 55  $\pm$  51.5 mg of labetalol was used to control the BP. No adverse events were experienced by subjects although the average cardiac index (CI) fell 13%. No subject had a CI under 2.0 L/min/m<sup>2</sup> in the POST period.

	PRE	POST	p value
PaO <sub>2</sub> (mmHg)	79.3 $\pm$ 15	118.3 $\pm$ 38	p<0.01
Qs/Qt (%)	26.4 $\pm$ 5.8	17.6 $\pm$ 5.6	p<0.01
Cardiac Index (L/min/m <sup>2</sup> )	3.7 $\pm$ 0.9	3.3 $\pm$ 0.85	p<0.01
Oxygen Delivery (ml/min)	455.0 $\pm$ 106	412.0 $\pm$ 98	p<0.05

**CONCLUSIONS:** Substituting labetalol for NG and SNP improves PaO<sub>2</sub> and Qs/Qt and may allow for faster weaning from mechanical ventilation in a select group of patients.

**AORTIC CANNULATION IS ASSOCIATED WITH THE GREATEST EMBOLIC LOAD IN CARDIAC SURGERY.**

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**INTRODUCTION:** Significant atherosclerosis of the ascending aorta is present in over 30% of cardiac surgical patients aged 50 years or older. Atheroemboli from the ascending aorta have been identified histologically in 37% of patients with severe aortic disease following cardiopulmonary bypass(CPB). [1] It is well accepted that an atherosclerotic ascending aorta is a risk factor for post-operative complications including stroke and that aortic instrumentation required for initiation of cardiopulmonary bypass(CPB) predisposes the patient to embolic events. The purpose of this study was to examine the relationship between specific manipulations of the aorta, required for initiation of cardiopulmonary bypass, and the production of emboli.

**METHODS:** After Ethics Committee approval, 26 patients undergoing elective CABG, were studied prospectively using transcranial Doppler(TCD) of the middle cerebral artery to count the number of emboli associated with specific events. A 2-MHz Medsonics TCD probe was used. Membrane oxygenators were used as were arterial filters. The TCD was applied post-induction for baseline measurements. Embolic counts were recorded during 1) manual palpation of the aorta, 2) aortic cannulation, 3) start of CPB pump, 4) aortic cross-clamp on, 5) aortic cross-clamp off, 6) aortic side-clamp on, 7) aortic side-clamp off and 8) decannulation. Six patients did not have a side-clamp applied due to the presence of palpable plaque.

**RESULTS:** All eight manipulations were found to be associated with the production of emboli. Twenty-one out of 26 patients(81%) had emboli detected at some point during the monitored period. The most common events leading to cerebral emboli were cannulation(13/26 patients)(50%) and cross-clamp application(14/26)(54%). The highest emboli counts were reported with cannulation(6.7±10.0), and aortic cross-clamp application(4.5±15.7). All counts were significantly higher than baseline values. In three patients(12%) emboli were detected during manual palpation of the aorta.

**DISCUSSION:** This study confirms that aortic instrumentation does lead to the production of cerebral emboli, with cannulation and cross-clamp application being the primary contributors to the total embolic load. These results are unlike previously published data showing the release of aortic clamps as the primary contributors of emboli production.[2] In their study, TCD monitoring began after aortic cannulation and would have missed a significant source of emboli. We conclude that aortic cannulation can significantly increase the risk of embolic injury. TCD is a useful monitoring tool for the evaluation of techniques used in cardiac surgery where the risk of cerebral emboli is present.

**REFERENCES:** 1. J Thorac Cardiovasc Surg 103:1104-12,1992. 2. Stroke 25:2398-2402,1994.

**PHARMACOKINETICS OF SUFENTANIL IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS GRAFTING**

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**INTRODUCTION**

The current trend in cardiac anaesthesia is towards use of lower opioid doses, combined with other intravenous or inhaled agents, to facilitate recovery of ventilatory drive and early tracheal extubation. Accurate pharmacokinetic data are needed to implement dose regimens compatible with these goals. Therefore, we determined the pharmacokinetics of sufentanil in patients with left ventricular EF<sub>2</sub>0.30 undergoing elective coronary artery bypass surgery (CABG).

**METHODS**

Institutional ethical approval and informed consent were obtained. Antianginal medications were continued on the morning of surgery. Premedication was lorazepam 60 µg/kg PO (n=51), morphine 0.15 mg/kg + scopolamine 6 µg/kg IM (n=11), or clonidine 5 µg/kg PO (n=10). Sufentanil was administered with a computer-driven syringe pump controlled by the program STANPUMP. Four different sufentanil regimens were used: maintaining target effect-site concentrations of 1.5 (n=15), 3.0 (n=13), or 4.5 ng·ml<sup>-1</sup> (n=11); or a zero-order infusion of sufentanil 2.0 µg·kg<sup>-1</sup> over 12.5 min, then maintaining an effect-site concentration of 0.75 ng·ml<sup>-1</sup> throughout the prebypass period (n=33). Isoflurane and/or vasoactive drugs were used as needed to maintain hemodynamic stability. Sufentanil concentrations were measured by radioimmunoassay in arterial blood samples drawn at intubation, skin incision, sternotomy, sternal spreading, and placement of the first aortic stitch. Population pharmacokinetic modelling (Naive Pooled Data and Mixed Effects Modelling) was used to derive pharmacokinetic parameters for 2 (NPD2 & MEM2) and 3-compartment (NPD3 & MEM3) models. The optimal model was identified by analysis of the prediction error ( PE=(Measured-Predicted)/Predicted ) and its absolute value (APE), and compared with previously published parameters.<sup>1</sup>

**RESULTS**

MEM3 had the lowest PE (Table). The final values of V1 (L, not weight-adjusted) and the microconstants (min<sup>-1</sup>) were: V1=6.5, k<sub>10</sub>=1.33·10<sup>-5</sup>, k<sub>12</sub>=0.298, k<sub>21</sub>=0.0943, k<sub>13</sub>=0.261, k<sub>31</sub>=0.00237.

Model	Median PE (%) (25th, 75th percentiles)	Median APE (%) (25th, 75th percentiles)
NPD2	-0.34 (-23.2, 28.2)	25.8 (14.0, 43.0)
NPD3	-0.45 (-22.9, 28.3)	25.7 (13.0, 42.5)
MEM2	-5.07 (-24.8, 23.7)	24.5 (13.5, 40.1)
MEM3	0.044 (-22.1, 27.6)	25.0 (12.9, 40.9)
Gepts et al <sup>1</sup>	5.83* (-18.4, 37.8)	27.9 (12.8, 46.0)

\* = versus all other groups, P=0.017 by the Kruskal-Wallis test

**DISCUSSION**

The median PE for MEM3 of 0.04% indicates virtually no systematic under- or over-prediction of measured concentrations (zero bias), and is 13-fold lower than that obtained using the parameters of Gepts et al.<sup>1</sup> APE measures the variability of the measured concentrations around the predicted values (precision). APE was comparable for all models, and less than the generally accepted upper limit of 30%.<sup>2</sup> In this population, prior to cardiopulmonary bypass, dose regimens based on MEM3 should produce median sufentanil concentrations that are virtually identical to the target, with an acceptable degree of variability.

**REFERENCES**

1. Anesthesiology 1995;83: 1194-1204.  
 2. Anesthesiology 1990;73: 1082-90

**PERIOPERATIVE CARDIOVASCULAR EVALUATION AND ACC/AHA GUIDELINES - DO WE CHANGE OUR PRACTICE.**

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**INTRODUCTION:** ACC/AHA recently introduced guidelines for perioperative cardiovascular evaluation for Non-Cardiac Surgery (N-CSx) that were endorsed and accepted.<sup>1</sup> Their purpose is to rationalize testing and prevent unnecessary interventions in surgical patients.

**OBJECTIVE:** To assess whether perioperative anesthesia/cardiology evaluation at a University teaching hospital prior to the introduction of guidelines were similar to that proposed by ACC/AHA. If not, then is there a need to change our practice.

**METHODS:** We reviewed data on 120 consecutive in-patients undergoing N-CSx and perioperative cardiovascular evaluation between Jan 95-March 96. Surgery specific risk (high, intermediate or low) based on the type of surgery, clinical predictors (major, intermediate or low) based on patient's cardiac condition, lab investigations, cardiology consultant's recommendations and adverse clinical outcomes were recorded. ACC/AHA algorithm was applied to each patient to determine the recommended investigations and interventions before proposed surgery and compared to the actual recommendations. Outcome differences were analyzed by chi-square statistics. p≤.05 was significant.

**RESULTS:** 14 out of 120 (12%) were canceled/modified based on preoperative assessment. Adverse events occurred in 15 (14%) out of 106 patients who underwent surgery. (CHF 5, MI/ischemia 4, Arrhythmia 3, Resp.failure 1, death 2). There was a trend to more adverse outcomes with higher risk surgery (p>.05, Chi sq.) (table 1).

Surgical Risk	Adverse Outcomes
High	5/16 (31%)
Intermediate	10/77 (13%)
Low	0/13 (0%)

Tests	Hi risk n=17	Int. risk n=89
Echo	5	23
Angio	3	3
Stress Echo	0	2
Exer Stress	0	1
24hr Holter	1	0

116 of 120 (97%) consults followed the ACC/AHA guidelines partially or completely. Clinical assessment of exercise tolerance and further risk assessment by non invasive tests was notably absent (table 2). Echocardiogram was the most commonly utilized test (table 2).

**CONCLUSIONS:** ACC/AHA guidelines are followed for low and high risk patients. In order to fulfill ACC/AHA guidelines, the intermediate risk patients need clinical assessment of exercise tolerance supported by non-invasive cardiac tests. This may improve risk stratification and avoid unnecessary testing.

1. Anesth Analg 82:854, 1996

**A RANDOMIZED DOUBLE-BLIND STUDY EVALUATING THE HAEMODYNAMIC EFFECTS OF TWO DOSES OF CIS-ATRACURIUM TO VECURONIUM IN PATIENTS UNDERGOING CABG DURING O<sub>2</sub>/SUFENTANIL/PROPOFOL ANAESTHESIA**

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**INTRODUCTION:** Cis-atracurium (cis-Atr) is one of 10 isomers which comprise atracurium, but has greater neuromuscular blocking potency and less propensity to release histamine. The purpose of this study was to evaluate the haemodynamic effects of 2 doses of cis-Atr to vecuronium (Vec) in patients undergoing coronary artery bypass grafts (CABG) during O<sub>2</sub>/sufentanil/propofol anaesthesia.

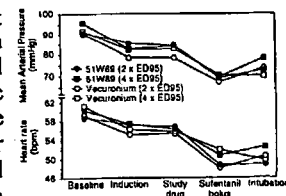
**METHODS:** After institutional ethical committees approval and signed informed consent, 86 patients undergoing elective CABG were randomized to 4 study groups. On the day of surgery a standard premedication consisting of oral lorazepam and IM morphine along with their usual cardiac medications was administered. General anaesthesia was induced with midazolam (0.05-0.2 mg/kg) followed 3 minutes later by a rapid bolus administration of either 2×ED<sub>95</sub>, or 4×ED<sub>95</sub>, cis-Atr or Vec. Three minutes following study drug administration, a bolus of sufentanil (0.7-1.0 µg/kg) was administered, and tracheal intubation was attempted 5 minutes post-study drug administration.

Haemodynamic parameters used for evaluation were heart rate (HR), systolic, diastolic and mean arterial blood pressure (SBP, DBP, MAP), central venous pressure (CVP), cardiac index (CI) and systemic vascular resistance index (SVRI). Haemodynamic determinations were done prior to induction, one minute after each of the following: induction, study drug administration, sufentanil and tracheal intubation. Comparison between doses was made by unpaired t-test and ANOVA. P value of <0.05 was judged as significant.

**RESULTS:** There was no demographic and operative differences between the 4 study groups. Following induction of anaesthesia, there was a similar but significant decrease in HR and MAP (Fig). Adminis-

tration of study drugs did not cause any further decrease in HR and MAP. A proportional decrease in haemodynamic values, similar to the decrease at induction, was recorded after the sufentanil bolus in all groups (Fig). There was no difference in the other haemodynamic values.

**CONCLUSION:** The results indicate that unlike the composite parent compound atracurium, cis-Atr in bolus doses of 2×ED<sub>95</sub>, and 4×ED<sub>95</sub>, does not cause any clinical significant haemodynamic changes, making it acceptable for safe use in cardiovascular compromised patients.



**MYOCARDIAL ISCHEMIA IN FIRST DAY SURGERY PATIENTS UNDERGOING CORONARY ARTERY BYPASS GRAFT SURGERY**

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**Introduction:** It has recently become common practice to admit patients undergoing elective coronary artery bypass surgery (CABG) on the morning of their surgery (first day surgery, FDS). Physical and emotional stress, which are established triggers for myocardial ischemia, may be different for FDS patients. We sought to determine whether ischemia increases in the 24 hours immediately prior to CABG and whether a difference exists between FDS and inpatients (INP) admitted the day prior to surgery.

**Method:** After ethics approval and informed consent, 29 patients were randomized to either an FDS group, admitted to hospital on the morning of their surgery, or an inpatient (INP) group, admitted on the day prior to their surgery. At the time of the booking and at least 5 days prior to surgery a 48 hour baseline ambulatory ECG (Holter monitoring) was performed. The 2nd ambulatory ECG was done for the 24 hours prior to surgery and ended on induction of anaesthesia. Patients' usual cardiac medications were maintained during each recording (including day of surgery). Standard premedication was administered 1 hour preop to both groups. The ECG tapes were analyzed by a trained person blinded to the patient study group. Myocardial ischemia was determined using standard criteria ( $\geq 1$ mm ST depression or  $\geq 2$ mm ST elevation 60 msec after the J point and  $>1$  min duration). Patients completed a series of questionnaires including Spielberger's state-trait anxiety inventory at baseline and during the 24 hours preop. Data was analyzed using Wilcoxon nonparametric procedure for comparison between FDS & INP, and Wilcoxon sign rank test for paired data.

**Results:** The groups were matched for age, sex, ASA status, CCS class, preoperative left ventricular function, coronary anatomy and anxiety status. Anxiety scores differed little from other preoperative populations.

Table:	FDS (n=14)		INP (n=15)	
	baseline	preop	baseline	preop
Pts with ischemia (%)	10 (71)	9 (64)	7 (47)	4(27)*
No. ischemic episodes	5.4 $\pm$ 6.1	3.5 $\pm$ 5.2	2 $\pm$ 3.3	0.7 $\pm$ 1.3*
Total Ischemia (min / hr)	0.9 $\pm$ 1.1	0.9 $\pm$ 1.3	0.3 $\pm$ 0.8	0.2 $\pm$ 0.7*
Area under curve (mm <sup>2</sup> -hr)	1.0 $\pm$ 1.2	1.0 $\pm$ 1.3	0.6 $\pm$ 1.5	0.2 $\pm$ 0.5*
Anxiety State†	31.2 $\pm$ 12.7	35.1 $\pm$ 11.6	37.8 $\pm$ 9.1	40.7 $\pm$ 12.7

Value = mean  $\pm$  standard deviation †FDS n=10, INP n=13  
\*p<0.05 FDS preop vs. INP preop

**Conclusions:** Myocardial ischemia is common in patients awaiting CABG surgery, even with anti-ischemic medical therapy. The immediate preoperative period does not appear to be associated with a further increase in ischemic burden. The smaller amount of preoperative ischemia in the INP group may be related to different activity levels. Our results suggest that further optimization may be beneficial in patients awaiting CABG surgery.

**PREDICTORS OF HOSPITAL MORTALITY IN CABG PATIENTS UNDERGOING EARLY EXTUBATION ANAESTHESIA**

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**INTRODUCTION:** Early extubation anesthesia (EEA) utilizing low dose narcotic and propofol has been established in coronary artery bypass graft (CABG) surgery (1). EEA allows tracheal extubation within 8 hrs postoperatively (*postop*) compared to 16-24 hrs with conventional anesthesia. Our objective is to identify preoperative (*preop*) and intraoperative (*intraop*) predictors of mortality in CABG patients undergoing EEA.

**METHODS:** After institutional approval, prospective data were collected on all CABG patients from April to November 1995. The EEA technique consisted of low dose fentanyl (15  $\mu$ g/kg), propofol, midazolam, and isoflurane. Extubation was attempted within 8 hrs of ICU arrival. For each patient, demographics, preop medical and cardiac data, intraop surgical and patient data, and hospital mortality were recorded. Univariate analyses (t-test, Chi-square) were performed followed by multiple logistic regression analysis to identify independent predictors of mortality. P values of  $< 0.05$  were considered statistically significant.

**RESULTS:** There were 885 patients; 50 (5.6%) were undergoing repeat surgery. 23 patients (2.5%) died. The median time to extubation was 7 hrs (range 1-306 hrs). Univariate analyses showed 14 predictors of mortality: *Preop*: age, gender, emergency, myocardial infarct (MI)  $< 1$  week, left ventricle grading, arrhythmia, renal insufficiency or failure, stroke, inotrope use; *Intraop*: number of grafts, myocardial ischemia, inotrope use, intraaortic balloon pump, and cardiopulmonary bypass (CPB) time. Multiple logistic regression analysis revealed 5 independent predictors of mortality:

Predictors (preop and intraop)	No. with Factor (%)	Odds Ratio	P value
<i>Preop</i> Inotrope use	36 (4.1%)	4.02	0.05
Gender (female vs male)	197 (22.3%)	3.17	0.03
MI $< 1$ week	54 (6.1%)	3.16	0.001
<i>Intraop</i> Inotrope use	61(6.9%)	12.99	$<0.001$
CPB time $>120$ mins	72 (8.1%)	4.12	0.005

**CONCLUSION:** In CABG patients undergoing early extubation anesthesia, *preop* inotrope use, female gender, myocardial infarct  $<1$  week, *intraop* inotrope use and CPB time  $>120$  mins were found to be independent predictors of hospital mortality. These predictors should be further validated in prospectively collected data.

**REFERENCE:** 1. *J Thorac Cardiovasc Surg* 1996; 112: 755

### SERUM CONCENTRATIONS OF LIGNOCAINE AND PAIN RELIEF AFTER INTRAPERITONEAL ADMINISTRATION DURING HYSTERECTOMY.

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**INTRODUCTION:** Intraperitoneal administration of local anaesthetic has been shown to produce good analgesia after gynaecological laparoscopy<sup>1</sup> but not after laparoscopic cholecystectomy<sup>2</sup>. Absorption of local anaesthetic has not been studied previously after total abdominal hysterectomy, so we measured serum concentrations following a dose of lignocaine 200mg and assessed any analgesic effects.

**METHODS:** After obtaining local District Ethics Committee approval and informed consent, we studied 40 patients undergoing total abdominal hysterectomy. All patients were given a standard anaesthetic together with morphine 10mg and prochlorperazine 12.5mg. Subsequently, they were allocated randomly to receive into the pelvic cavity, either 50ml normal saline or 50ml saline containing lignocaine 200mg with adrenaline 1:500,000. Venous blood samples were collected for up to three hours and postoperative pain scores were assessed using visual analogue scores (LAS) by a blinded research nurse. Postoperative analgesia was provided with morphine via patient-controlled analgesia. Data were subjected to Kolmogorov Smirnov Goodness of Fit tests, found to be distributed normally and compared using t-tests.

**RESULTS:** There were no significant differences between the two groups in age, weight, or morphine consumption in the first 48 hr (Saline group 43.2±1.5yr, 63.8±2.3kg, 89.4±5.4mg, Lignocaine group: 39.6±1.4yr, 63.1 ±1.9kg, 75.8±6.9mg respectively). However, LAS pain scores were significantly higher at rest in the saline group at 24hr (39.4±4.7 v 26.0±4.7mm) and 48hr (23.2±3.9 v 11.5±2.7mm) but not on movement. Serum lignocaine concentrations increased rapidly but the maximum value in any patient was 0.8µg/ml

**CONCLUSIONS:** These data suggest that mild visceral analgesia may be produced by intraperitoneal lignocaine 200mg. The measured serum concentrations were considerably below reported toxic levels and therefore it is safe to increase the dosage of local anaesthetic.

- References:** 1. *Obstet Gynecol* 1994; 84: 877-880.  
2. *Anesth Analg* 1995; 81: 379-384.

### THE RELATIONSHIP BETWEEN METHODOLOGIC QUALITY AND EFFECT SIZE: IMPLICATIONS FOR META-ANALYSES

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**INTRODUCTION** A previous study in the field of perinatal medicine showed that poor quality randomized controlled trials (RCTs) are bias in favour of the experimental group (1). When the study was repeated in orthopaedic surgery, no relationship was found (2). The purpose of this study was to determine whether or not bias in favour of the treatment group could be demonstrated in a subset of RCTs from the anaesthetic literature.

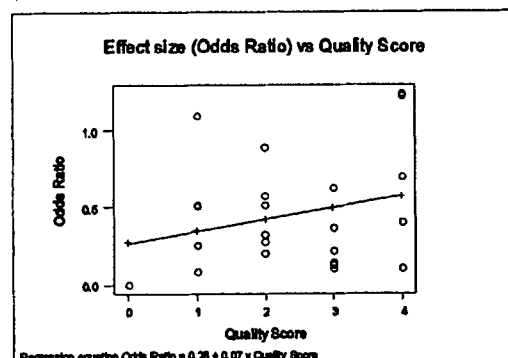
**METHODS** RCTs, identified for a previously published meta-analysis with a primary outcome of postdural puncture headache were examined but excluding non-English language studies (3). Methodological quality was assessed by two independent reviewers using a validated, three item quality score (4). The final score for each RCT was obtained by consensus or by averaging the two scores when consensus was not possible. A correlation coefficient between effect size (odds ratio) and quality score was computed. Regression analysis was also done. The slope of the regression line was computed and was considered significant if statistically different from 0 ( $P < 0.05$ ).

**RESULTS** 23 RCT's were identified. The correlation coefficient between effect size and the quality score was 0.25 (NS). A plot of effect size vs quality score is shown in the figure. The slope of the regression line was 0.07 ( $P = 0.26$ , NS).

**CONCLUSIONS** While poor quality may be a factor in causing bias in RCTs, we were unable to demonstrate it in this sample of studies. If this were the case, a negatively sloped regression line would be expected. We conclude that RCTs in other domains of medicine should be studied to determine how universal the relationship between quality and effect size is. In addition, all RCTs, regardless of quality score should be included in meta-analyses. Sensitivity analysis should be performed in the meta-analysis if bias is suspected because of poor quality.

#### REFERENCES

- 1) *JAMA* 1995;273:408-12
- 2) *JAMA* 1995;274:1942-8
- 3) *Anesthesiology* 1994;81:1376-83
- 4) *Controlled Clinical Trials* 1996;17:1-12.



**PROSPECTIVE RANDOMISED DOUBLE BLIND EVALUATION OF EPIDURAL VS INTRAVENOUS FENTANYL.**

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**INTRODUCTION:** Despite widespread clinical use of the newer more lipophilic opiates, there remains much controversy with respect to their administration epidurally. The controversy is based partly on theoretical grounds and partly on the equivocal findings of many investigators. We developed a double blind trial, using a patient titrated technique, to investigate the efficacy and tolerability of epidurally vs intravenously (IV) administered fentanyl, both in conjunction with low dose epidural bupivacaine.

**METHODS:** Following Ethics and Research Committee approval, 40 consenting patients undergoing major thoracic or upper abdominal surgery, in whom thoracic epidurals were placed, were randomly allocated into 2 groups; Group 1- Received epidural bupivacaine 0.0625% @ 10 mls/hr, with supplementary analgesia as IV fentanyl, delivered by Patient Controlled Analgesic pump, (PCA). Group 2- Received epidural bupivacaine 0.0625% @ 10 mls/hr, with supplementary analgesia as epidural fentanyl, delivered by PCA pump. All patients were "plumbed" in an identical fashion, PCA settings were standardized, (bolus 40mcg, lockout 15mins, no background) and blinding was achieved by means of a concealed three way tap set to run the PCA either IV or epidurally. All patients were monitored in a High Dependency Unit over a 24 hr period, and closely observed for adequacy of analgesia, fentanyl consumption, and side effects. No other analgesics or analgesic techniques were allowed during the study period.

**RESULTS:** The demographics were similar, 19 patients were randomized into the intravenous fentanyl group and 21 into the epidural fentanyl group, all patients completed the study protocol. Patients receiving IV fentanyl supplementary analgesia, required an average 37.6% more fentanyl at 24 hrs, than those patients receiving epidural fentanyl supplementary analgesia, mean fentanyl consumption iv group 1545 mcg, sem 107 mcg vs epidural group mean 1123 mcg, sem 114 mcg, (p=0.01). Overall analgesia was good with a trend toward lower pain scores in the epidural group, (p=0.07). There was no differences with respect to side effects, and no serious complications.

**DISCUSSION:** In summary, we have shown that in conjunction with low dose bupivacaine, epidurally administered PCA fentanyl is an appropriate and effective analgesic technique. We have shown, using a patient titrated technique, that mean fentanyl consumption at 24 hrs is significantly higher when administered IV as opposed to epidurally. We have added further evidence in support of a local spinally mediated action for fentanyl.

**THE DURATION OF ACTION OF INTRATHECAL MORPHINE; DOES TIMING OF ADMINISTRATION MAKE A DIFFERENCE?**

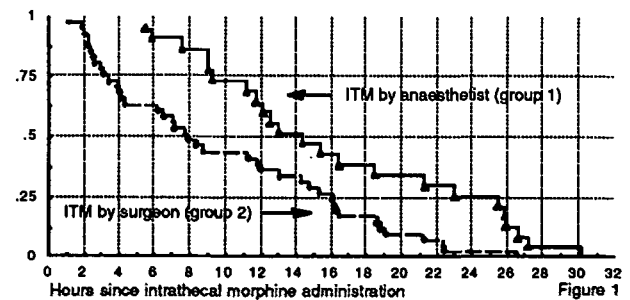
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**INTRODUCTION:** Intrathecal morphine (ITM) has been used to provide postoperative analgesia in spinal fusion surgery for scoliosis correction. There are conflicting reports regarding the duration of action of ITM. Therefore we analyzed all cases of spinal fusion performed at the Hospital for Sick Children since we began using ITM.

**METHODS:** Under human research committee guidelines sixty four cases were reviewed retrospectively and divided into two groups. Patients in group 1 (n=23) received ITM from the anaesthetist via lumbar puncture immediately following induction of anaesthesia and prior to incision. Patients in group 2 (n=41) received ITM by the surgeon intraoperatively. Patient demographics, anaesthetic and surgical times, time of ITM administration, and time of first dose of postoperative opioid were recorded. The data were analyzed with Fisher's exact test, Student's t test, Mann-Whitney test, and Gehan's Wilcoxon test. The data are presented as mean ± standard deviation.

**RESULTS:** Patient demographics were not different except patients in group 1 were older than those in group 2 (15.1±1.9 yrs vs. 14.0±1.7 yrs, p= 0.02). Group 1 received the same amount of ITM as group 2 (18.3 ± 4 µg/kg vs 21.7 ± 8 µg/kg, p=0.06). Group 1 received ITM 3.6±1.8 hours earlier than group 2. Group 1 received less intraoperative fentanyl than group 2 (184 ±132 µg vs. 302±224 µg, p=0.01). Duration of action of ITM (figure 1) was significantly longer in group 1 than group 2 (16.4±7.7hrs vs 10.0±7.1hrs, p= 0.03). No patient had delayed respiratory depression.

Cumulative proportion of patients not requiring postoperative opioid



**DISCUSSION:** ITM is reported to be effective for 22-36+ hours<sup>1,2</sup> after administration. In this study the majority of patients did not demonstrate this duration of action. At 22 hours only 30% of the patients in group 1 and 7% of the patients in group 2 had not received postoperative opioids. There may be an advantage to preoperative administration of ITM in order to increase the duration of analgesia and delay the administration of the first postoperative opioid. Whether this finding supports the preemptive analgesic effect of spinal opioids<sup>3</sup> remains to be determined.

**REFERENCES:**

1. Br J Anaesth 56:137, 1984
2. Spine 13(5):494, 1988
3. Anesthesiology 77:439, 1992

**EFFICACY OF CONTINUOUS FEMORAL BLOCK FOLLOWING TOTAL KNEE ARTHROPLASTY**

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**COMPARISON OF PREEMPTIVE ANALGESIC EFFECTS OF EPIDURAL VS INTRAVENOUS FENTANYL**

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**Introduction:** The purpose of this study was to compare the analgesic efficacy of continuous femoral 3 in 1 block following total knee arthroplasty.

**Methods:** After IRB approval and informed consent patients received spinal anaesthesia with bupivacaine. At the end of surgery a femoral catheter was inserted using a peripheral nerve stimulator. A 30 ml bolus of the study solution was injected, followed by a continuous infusion at 10 ml/h. The study was randomized and double blind, patients received either placebo, low dose bupivacaine 0.1%, or high dose bupivacaine 0.2%. All patients received rectal indomethacin 100 mg q12h and morphine by patient-controlled analgesia for 48 hours. Visual analogue pain scores during rest and activity, and morphine consumption were documented every 12 hours. Postoperative nausea and vomiting and joint range of motion were documented daily. Statistical analysis was performed using ANOVA for parametric data, chi-square for nonparametric data, and a p value of <0.05 as significant.

**Results:** There were no detectable differences in postoperative analgesia, morphine requirements, nausea, vomiting or joint range of motion between the groups at any time. The power of the study was sufficient to determine a 30% difference in pain scores. One patient had motor weakness lasting six weeks.

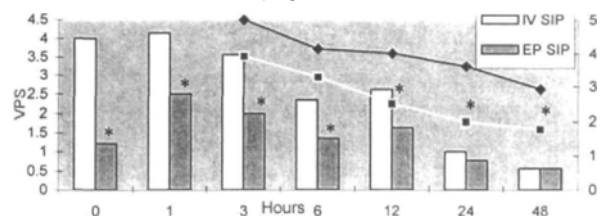
Study Drug	Placebo	Low Dose	High Dose
Patients (#)	16	13	12
Age (years)	70 ± 9	65 ± 7	70 ± 7
Height (cm)	166 ± 7	165 ± 10	169 ± 11
Weight (kg)	87 ± 19	85 ± 18	89 ± 17
Sex (m/f)	8/8	9/4	5/7
Surgery (min)	83 ± 16	80 ± 18	71 ± 15
<b>Pain at Rest VAS 0-100 mm</b>			
Day of Surgery PM	38 ± 26	49 ± 35	31 ± 31
Postop Day One AM	25 ± 30	32 ± 38	20 ± 28
Postop Day One PM	25 ± 30	9 ± 18	17 ± 19
Postop Day Two AM	7 ± 15	2 ± 6	11 ± 18
Postop Day Two PM	6 ± 17	19 ± 33	18 ± 27
<b>Pain with Motion VAS 0-100 mm</b>			
Day of Surgery PM	40 ± 39	8 ± 26	22 ± 32
Postop Day One AM	31 ± 30	15 ± 30	23 ± 31
Postop Day One PM	36 ± 26	26 ± 24	37 ± 27
Postop Day Two AM	24 ± 24	15 ± 18	15 ± 19
Postop Day Two PM	21 ± 23	29 ± 36	27 ± 30
<b>Morphine (mg)</b>			
Postop 0-12 hrs	17 ± 11	27 ± 27	20 ± 13
Postop 12-24 hrs	20 ± 12	20 ± 19	8 ± 8
Postop 24-36 hrs	10 ± 7	12 ± 22	5 ± 5
Postop 0-48 hrs	73 ± 36	79 ± 66	46 ± 3

**Discussion:** Multimodal analgesia with indomethacin and morphine produced excellent results even in the placebo group. The addition of femoral nerve block increases the cost and potential risks without any further benefits.

**INTRODUCTION:** Preemptive analgesia may prevent the noxious inputs generated during surgery from inducing central sensitization and hyperalgesia, therefore reduce postoperative pain. The preemptive analgesic effect of fentanyl, given both intravenously(1) and epidurally(2), have been demonstrated in previous two studies. In this study we tested the hypothesis that Fentanyl given epidurally would be more effective in this regard, comparing it with intravenous route.

**METHODS:** Following institutional approval and informed consent, twenty-eight ASA I-II patients, undergoing minor abdominal surgery, were randomized into two groups. Twenty minutes before the incision, patients received 3µg/kg fentanyl bolus followed by 1 µg/kg/h continuous infusion, either intravenously (Group IV) or epidurally (Group EP) through a 20 G catheter placed via L2-3 or L3-4 interspace. All patients were intubated after induction with thiopental+atracurium and general anesthesia was maintained with Isoflurane (0.8-1.0%)+N<sub>2</sub>O(50%)/O<sub>2</sub>(50%) inhalation. At the end of surgery the infusion was discontinued. At different time periods postoperatively, spontaneous incisional pain (SIP) and movement associated pain (MAP) were determined using Verbal Pain Score (VPS) and meperidine consumption was recorded. Data were analyzed by unpaired Student's t-test and p<0.05 was considered significant.

**RESULTS:** During the entire postoperative period the VPS in Group EP were less than those in Group IV. The difference in SIP between two groups was significant at 0,1,3 and 6th hours in MAP at 12, 24 and 48th hours. Meperidine consumption in 0-1, 12-24, 24-48 postoperative hours as well as total meperidine consumption was significantly less in Group EP. Data are as shown below. (\* : p<0.05)



**Meperidine consumption (Mean ± SD) : (mg) (\* : p<0.05)**

	0-1h	1-3h	3-6h	6-12h	12-24h	24-48h	total
Gr. IV	42±20	19±14	10±12	16±15	19±23	14±21	126±79
Gr. EP	*16±18	8±15	10±12	10±16	*5±10	*1±6	*53±39

**CONCLUSION:** The results of this study suggest that the blockade of noxious stimuli reaching central nervous system at spinal level can provide more effective preemptive analgesia.

**REFERENCES:** 1-Anaesth Analg 1994;78:205-209  
2-Anesthesiology 1992;77:439-446



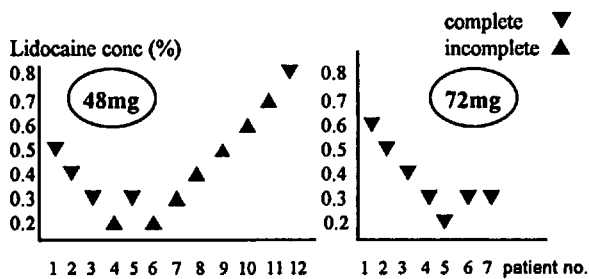
**DOSE-DEPENDENCY OF MINIMUM EFFECTIVE ANAESTHETIC CONCENTRATION (MEAC) OF HYPERBARIC LIDOCAINE FOR SPINAL ANAESTHESIA**

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**Introduction:** In clinical practice, dilute lidocaine solution (1.5%) can produce effective surgical anaesthesia<sup>1</sup>. However, the lowest effective concentration of lidocaine for spinal anaesthesia in humans and how this varies with different doses has not been determined.

**Methods:** Following IRB approval and patient consent, 19 patients (18-42y.o., 55-110kg, 150-190cm) receiving knee and ankle orthopedic surgery were studied. Using combined spinal-epidural technique, 48mg or 72mg of hyperbaric lidocaine (dextrose 7.5%) at concentrations ranging from 0.2-0.8% was administered intrathecally. The choice of concentration was determined by Dixon's up-and-down method<sup>2</sup>, i.e., depending on the response of the previous concentration, the concentration for the next patient would be adjusted up or down in increments of 0.1%. Anaesthesia was considered complete if patient achieved: (1) pinprick anaesthesia at or higher than T12 level, (2) anaesthesia to transcutaneous tetanic electric stimulation (50Hz at 80mA for 5 sec) at the knees, (3) complete leg paralysis; all occurring in both lower extremities within 20 minutes and (4) effective surgical anaesthesia. Epidural anaesthesia was initiated if anaesthesia was incomplete. Neurological assessment was done by a blinded observer.

**Results:** In 48mg group, MEAC of hyperbaric lidocaine is 0.46%. Anaesthetic effect was variable (7 patients with incomplete anaesthesia) and brief, lasting 20-45 minutes with maximum sensory level ranging from T3-T10. In contrast, all patients in 72mg group achieved complete anaesthesia, lasting 30-60 minutes with maximum sensory level from T3-T8. No further injection using 0.2% was attempted in 72mg group as one patient developed headache and drowsiness on injection.



**Discussion:** Spinal anaesthesia can be accomplished with very dilute lidocaine solutions (0.2-0.8%). The anaesthetic effect is variable at low dose (48mg) but more consistent at high dose (72mg). Using 72mg, maximum sensory level achieved tends to be higher, likely secondary to the large volume of injectate. The MEAC in 72mg group can be lower than 0.3%.

**References:** 1. Anesth Analg 1993;77:453-456. 2. Introduction to Statistical Analysis. McGraw Hill. 1983;428-439

**REDUCING PAIN AFTER ARTHROSCOPIC ANTERIOR CRUCIATE LIGAMENT REPAIR- COMPARISON OF KETOROLAC vs FEMORAL NERVE BLOCK**

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**INTRODUCTION:** Arthroscopic anterior cruciate ligament (ACL) repair is a painful day surgical procedure. Both femoral nerve block (FNB) and ketorolac provide effective analgesia in this procedure. The aim of this study is to compare these two methods in their efficacy in postoperative analgesia.

**METHOD:** With IRB approval, 31 patients receiving arthroscopic ACL repair were studied in a double blind manner. All patients received FNB prior to the standard protocol of general anaesthetic. They were randomized into 3 groups: 1. FNB (15ml 0.5% bupivacaine) and intravenous normal saline (1ml); 2. FNB (15ml normal saline) and intravenous ketorolac (30mg); 3. FNB (15ml normal saline) and intravenous normal saline (1ml). Postoperatively, pain was assessed by visual analogue score (VAS), demand and consumption of morphine via patient-control analgesia pump. Time for patients to tolerate oral fluid, solid food, sit up, ambulate and void was also noted. Data was analyzed with ANOVA and chi-squared test.

**RESULT:** Except for the weight (Gp1-75.1±12.3 kg; Gp2-91.6±14.8 kg; Gp3-82.7±15.7 kg), there was no significant difference in demographic and surgical data. There was also no significant difference in VAS, morphine consumption, demand and the time to eat, drink, sit, ambulate, void and hospital stay.

	I.	II.	III.
morphine consumption(mg)			
-total in PACU	8.3±8.5	11.2±10.0	12.7±5.1
-postop to 9am POD1	35.9±24.6	39.6±24.0	39.1±18.8
morphine demand			
-postoperative 180min	44.3±51.2	8.0±9.1	19.6±20.1
-postop to 9am POD1	56.1±53.7	29.6±26.0	59.8±56.2
PACU stay(min)	87.3±18.3	82.4±25.0	80.8±16.1
postop hospital stay(hr)	34.0±19.0	37.3±17.4	35.1±15.8
time to sit(hr)	1.4±0.4	1.4±0.3	4.0±7.2
time to drink(hr)	1.8±0.7	2.3±2.3	2.4±1.4
time to eat(hr)	7.4±6.4	4.8±3.0	11.1±9.6
time to mobilise(hr)	18.6±6.0	18.5±5.2	19.6±10.2
time to void(hr)	5.9±3.5	7.6±5.5	9.3±10.1

Value are mean±S.D. POD1-postoperative day 1

**CONCLUSION:** Our preliminary data did not show any advantages of using either FNB or ketorolac in improving postoperative analgesia or facilitate early discharge in patient undergoing ACL repair. Although there was trend that FNB decrease morphine consumption in early postoperative period, larger sample size is required to show the difference.

### INTRAOPERATIVE ADVERSE EVENTS DURING AMBULATORY SURGICAL PROCEDURES

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### ANESTHESIA PREADMISSION ASSESSMENT A NEW APPROACH THROUGH USE OF A SCREENING TOOL

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**INTRODUCTION:** The fact that increasing proportion of all surgical procedures are done without overnight hospitalization of the patients, makes it necessary to identify those factors, which could be relevant to the safety of ambulatory anaesthesia. In this study, we describe the frequency and pattern of all intraoperative adverse events.

**METHODS:** Institutional approval was obtained, and 17,877 patients, scheduled for ambulatory surgery during a 36-month period, were prospectively studied. Preoperative (age, sex, height, weight, ASA status, medical history), intraoperative (type and duration of surgery and anaesthesia, adverse events), and postoperative (adverse events, nausea, pain, etc.) data were collected. In the following, the frequency distribution and incidence rates of the different intraoperative adverse events are reported.

**RESULTS:** We found that 775 intraoperative events occurred (43.35 events/1000 surgeries) involving 652 patients (3.65%). Details are shown in table.

Type of adverse events	Number of events	Percent of all events	Rate per 1000 surgeries
<b>Cardiac events (all)</b>	<b>506</b>	<b>65.29</b>	<b>28.30</b>
hypertension	285	36.77	15.94
hypotension	68	8.77	3.80
bradycardia	77	9.94	4.31
tachycardia	15	1.94	0.84
dysrhythmia	59	7.61	3.30
ischemia	1	0.13	0.06
hypovolemia	1	0.13	0.06
<b>Respiratory events (all)</b>	<b>84</b>	<b>10.84</b>	<b>4.70</b>
laryngospasm/stridor	28	3.61	1.57
bronchospasm	23	2.97	1.29
desaturation	25	3.23	1.40
apnea	3	0.39	0.17
aspiration	3	0.39	0.17
high airway pressure	1	0.13	0.06
pneumothorax	1	0.13	0.06
<b>Intubation related (all)</b>	<b>44</b>	<b>5.68</b>	<b>2.46</b>
difficult intubation	32	4.13	1.79
unplanned intubation	8	1.03	0.45
unintentional extub.	1	0.13	0.06
esophageal intubation	2	0.26	0.11
dental damage	1	0.13	0.06
<b>Vomiting</b>	<b>5</b>	<b>0.65</b>	<b>0.28</b>
<b>Technical problems</b>	<b>30</b>	<b>3.87</b>	<b>1.69</b>
<b>Other events</b>	<b>106</b>	<b>13.68</b>	<b>5.93</b>

**CONCLUSION:** Ambulatory surgery can be done safely with an observed rate of 43.35 intraoperative adverse events per 1000 surgeries, involving 3.65% of the patients. Further research is needed to characterize the patients at risk and to identify preoperative predictors for these adverse events.

**Introduction:** Preadmission of patients one to two weeks preoperatively has become the standard across North America. Some clinics have an anesthetist evaluate every patient.<sup>1</sup> Since many patients are healthy and do not require further physician assessment this seems excessive. In other clinics, anesthetists evaluate only those patients referred by the surgeon.<sup>2</sup> This approach has the potential to miss significant coexisting diseases that may require further investigation.<sup>3</sup> We have devised a hybrid model, that utilizes a preoperative questionnaire designed to determine the patient's health status. To our knowledge however the effectiveness of this technique has not been studied.

**Methods:** Patients booked for same-day (SD) or outpatient (O/P) surgery complete the preoperative questionnaire which is forwarded to the preadmission clinic (PAC) where it is reviewed by a nurse. An assessment is made by an anesthetist if there are positive responses to the questionnaire and the patient is scheduled to undergo outpatient surgery or if a specific anaesthesia related issue is identified. If the procedure requires same-day admission and there are positive responses, a medicine assessment is performed. If necessary, after the initial assessment, the anesthetist or internist can have the patient assessed by the other service during the clinic visit. The surgeon may also consult one or both services directly. Following IRB approval we evaluated this screening procedure over a six week period. During this period, the attending anesthetist for each patient processed through the preadmission clinic was asked to complete a separate study survey on the day of surgery. This anesthetist survey questioned the appropriateness of the assessment, the likely consequences if no assessment had been made, and if any time was saved or lost on the day of surgery based on the assessment or the lack thereof.

**Results:** 370 patients who were processed through the PAC had operations (243 SD, 111 O/P, and 16 as inpatients) in the six week period. 225 were assessed in the PAC (101 by medicine, 85 by anaesthesia and 39 by both), 43% (96) based on the questionnaire, and 57% (129) due to direct consultation. The assessments were felt appropriate 181/215 (84%), inappropriate 34 (16%), and 10 no answer. The assessments were felt inappropriate because 25/34 (74%) were unnecessary, while in the other 9 (26%) the patient was not optimized or did not have the appropriate lab tests performed. If the 181 appropriate assessments had not been performed, the attending anesthetist would have cancelled 21 (12%), delayed for more history 50 (20%), or lab tests 19 (10%), for a mean estimated delay of  $20 \pm 23$  min, while 93 (51%) would have done the case anyhow. 145 patients were not assessed by a physician. The attending anesthetists felt that only 9/145 (6%) not seen should have been assessed. This assessment should have been by an anesthetist 7 times and an internist once, (one no answer). In these eight cases, 4 were done without a change in management, two required more history taking and two required extra lab testing for a mean delay of  $6.3 \pm 3.2$  min. If the attending anesthetist is considered the gold standard as to the necessity of patients obtaining an assessment in the PAC, our process had a sensitivity = 96%, specificity = 80%, PPV = 84% and NPV = 94%.

**Discussion:** We feel that the use of our screening tool in combination with direct referrals appropriately determines assessment needs of patients booked for SD or O/P surgery, and allows for more efficient use of medical personnel in the PAC.

**References:** 1. Can J Anaesth 42:391-4, 1995. 2. Can J Anaesth 39:1051-7, 1992. 3. Can J Anaesth 43:A61B, 1996.

**ASSESSMENT OF LEVEL OF CONSCIOUSNESS DURING INTRAVENOUS SEDATION: CORRELATION BETWEEN A TRAINED OBSERVER AND BISPECTRAL INDEX.**

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**INTRODUCTION:** Opiates and benzodiazepines used for sedation depress consciousness and respiration. During sedation for gastrointestinal endoscopy cardiorespiratory problems have an estimated morbidity of 1:1000 and mortality 1:2000-3300<sup>1</sup>. This study was designed to determine the incidence and compare level of sedation during gastrointestinal endoscopy using a trained observer and a computer processed EEG - Bispectral index (BIS)<sup>2</sup>.

**METHODS:** With IRB approval, 100 consenting adults undergoing GI endoscopy were studied. Following placement of appropriate monitors, mouth and pharynx were sprayed with 10% lidocaine. Intravenous sedation was provided with incremental doses of meperidine and midazolam as necessary to perform the procedure by the endoscopist. The level of sedation was assessed by a trained observer using the Observer's Alertness/Sedation Scale (OA/SS), (1=no response to tactile stimulation, 2=responds only after mild shaken, 3=responds only after name is called loudly, 4=lethargic response to name spoken in normal tone, 5=fully awake). BIS (0=no cortical activity to 100=fully awake) was recorded continuously by placement of bilateral frontal leads using the A-1050 monitor (Aspect Medical System, MA). Supplemental oxygen was administered to patients if oxygen saturation decreased below 90%. Statistical analyses were performed using logistic regression to estimate the tolerance distribution and  $p < 0.05$  was considered to be significant.

**RESULTS:** There is a significant positive correlation between OA/SS and BIS (Spearman's  $\rho = 0.620 \pm 0.068$ ,  $p < 0.001$ ). OA/SS scores increase significantly as BIS increases. Table 1 shows the distribution of patients according to OA/SS and BIS. Fig. 1 shows the probability of increased OA/SS assessment is directly proportional to increased BIS.

Bispectral Index	Observer's Alertness / Sedation Scale				
	1	2	3	4	5
0-60	3	1	1	1	0
61-70	0	4	5	1	0
71-80	0	1	11	2	0
81-90	0	1	11	18	0
91-100	0	0	7	23	9

Table 1.

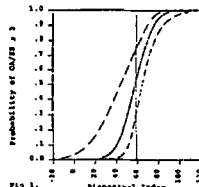


Fig 1.

**CONCLUSION:** Our study demonstrates there is good correlation between observer assessment and BIS. BIS can provide an objective, continuous, and easy technique to monitor level of sedation without arousing the patients.

**REFERENCES:** 1-BMJ 1995;310:886. 2-Journal of Clinical Monitoring 1994; 10:392.

**LOSS OF CONSCIOUSNESS AND HYPOXEMIA IN PATIENTS DURING SEDATION FOR DIGESTIVE ENDOSCOPY.**

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**INTRODUCTION:** Benzodiazepines and opioids are usually given for conscious sedation during digestive endoscopy. However, these drugs synergistically depress the central nervous system, leading to loss of consciousness, airway collapse, ventilatory depression, hypoxemia and eventually death<sup>1</sup>. The mortality rate during sedation for digestive endoscopy is 1:2000-3300<sup>2</sup>. In this observational study, our purpose was to assess the correlation between depth of sedation and hypoxemia during digestive endoscopy.

**METHODS:** 100 consecutive adults were studied after written informed consent and IRB approval. Following standard monitoring, mouth and pharynx were sprayed with 10% lidocaine. Incremental doses of meperidine and midazolam were given at the discretion of the endoscopist as judged necessary for performing the procedure. Bispectral index (BIS) a computer processed EEG was recorded continuously by placement of bilateral frontal leads using the A-1050 monitor (Aspect Medical System, MA). Its scale range from 0 = no cortical activity, to 100 = fully awake. Level of sedation was assessed every five minutes by a trained observer using the Observer's Alertness/Sedation Scale (OA/SS), being 1= no response to tactile stimulation, 2 = responds only after mild shaking, 3 = responds only after name is called loudly, 4 = lethargic response to name spoken in normal tone, 5 = fully awake. Supplemental oxygen was administered if oxygen saturation (O<sub>2</sub> sat) decreased to less than 90%. Statistical analyses were performed using logistic regression to estimate the tolerance distribution.

**RESULTS:** Loss of consciousness developed in six patients (defined by BIS < 60) and in ten patients (defined by OA/SS ≥ 3). There was no difference in the proportion of patients who had BIS >60 (94%) and in those with an OA/SS ≥ 3 (90%) using McNemar's test for correlated proportions ( $p=0.157$ ). Hypoxemia (O<sub>2</sub> sat ≤ 90%) developed in 22 patients with OA/SS ≥ 3 and 6 patients with OA/SS < 3 ( $p=0.018$ ). The risk of hypoxemia was 1.7 times higher in patients who lost consciousness.

**CONCLUSION:** Unintended loss of consciousness and hypoxemia occurs frequently during sedation for digestive endoscopy. BIS can provide an effective measure of drug induced central nervous system depression and potentially help prevent hypoxemia progressing to cardiorespiratory collapse in these patients.

**REFERENCES:** 1-Gut 1991;32:12. 2- BMJ 1995; 310:886. 3-Journal of Clinical Monitoring 1994; 10:392.

### USE OF NITROUS OXIDE IMPROVES OUTCOME AFTER BRIEF OUTPATIENT SURGERY

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### INTRODUCTION

The effect of nitrous oxide on postoperative outcome, especially nausea and vomiting, is controversial. This patient-observer blinded study randomized subjects to one of two similar anesthetic techniques—one using nitrous oxide (N), the other not (TIVA)—and compared early postoperative outcomes.

### METHODS

Following institutional approval and informed consent, patients undergoing outpatient gynecologic laparoscopy were anesthetized with alfentanil (25 µg/kg) and propofol (2-2.5 mg/kg bolus and 100-150 µg/kg/min infusion). The N group was ventilated with 70% nitrous oxide in oxygen, while TIVA was ventilated with 100% oxygen. Both groups received supplemental doses of alfentanil (5-10 µg/kg) as required. Other aspects of intraoperative and postoperative care were standardized. Assessments including severity of postoperative pain (VAS), severity of nausea (VAS), the number of emetic episodes, use of analgesics and antiemetics, and readiness for discharge home (*PAD Score*) were made by a blinded observer. Statistical comparisons between groups were made by Student's *t* test or Fisher's Exact test. Multiple regression was used to examine relationships between variables.  $\alpha$  was set at 0.05.

### RESULTS

Groups were comparable except for a greater proportion of smokers in the N group (56%) compared to the TIVA group (25%). Results are tabulated below:

OUTCOME	N=39	TIVA=35	p
ANESTHETIC TIME (min)	20	23	0.09
ALFENTANIL (µg)	2184	2456	0.14
MAX. PAIN (VAS cm)	5.7	6.0	0.66
MAX. NAUSEA (VAS cm)	1.9	2.2	0.73
VOMITING (%)	13	29	0.14
MORPHINE (%)	74	94	0.03
MORPHINE (mg)	8.3	8.5	0.86
ANITEMETICS (%)	8	20	0.18
DISCHARGE TIME (min)	160	181	0.04
AWARENESS (%)	3	6	0.60

### DISCUSSION

TIVA was associated with longer time to discharge likely due to increased in-hospital opioid use and subsequent vomiting. Propofol did not reduce the high incidence of vomiting in the TIVA group. We recommend the use of nitrous oxide as an adjunct to brief alfentanil-propofol anesthesia.

### MUSIC ENHANCES PATIENT CONTROLLED SEDATION FOR MONITORED ANAESTHESIA CARE

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**INTRODUCTION:** Several studies have demonstrated the utility of patient controlled sedation (PCS) in monitored anaesthesia care. The product monograph for propofol describes settings for infusion only. The goal of this study was to determine if PCS with propofol would result in less agent being used than by infusing to a set level of sedation. Also, the goal was to determine whether the addition of music via headphones would further reduce the amount of propofol that patients would use with PCS.

**METHODS:** With IRB approval and with written consent 60 ASA I-II patients having minor surgical procedures under local anaesthesia and monitored care were randomized to one of three groups. Propofol was administered as either an infusion, Group 1 (INF), 25-150 µg/kg/min attempting to titrate to a sedation score of 3; Group 2 (PCS), by pressing a handset attached to a Graseby 3300 PCA pump programmed to give a 25mg bolus over 30 sec with no lockout time. Patients were instructed to "press the button" whenever they felt anxious. In Group 3 (PCS+M), patients were provided with headphones and listened to self-selected music as well as self-administering propofol with the same programmed settings and instructions as Group 2. Infiltration with local anaesthetic was provided by the surgeon. All patients were monitored with non-invasive blood pressure, EKG and pulse oximetry. All patients received O<sub>2</sub> supplementation. The following were recorded: total propofol used (normalized for duration and body weight), sedation score, SpO<sub>2</sub>, readiness for discharge (time to PADS score of 9)<sup>1</sup> and 24 hour post-op satisfaction score. Sedation Scale: 1-alert, 2-drowsy, 3-eyes closed but arousable to voice, 4-eyes closed but arousable only to physical stimulus.

Comparisons of total drug utilization were made using the non-parametric test Kruskal-Wallis one way ANOVA for ranks.

**RESULTS:** The level of sedation obtained was the same for all groups. PCS patients used less propofol (standardized for weight and duration of procedure) when compared with patients who had their level of sedation controlled by infusion. PCS+M patients used the least propofol. Patients self-administering propofol were just as satisfied as those whose drug intake was controlled by infusion. There was no SpO<sub>2</sub> less than 98%. There were no differences in the time to discharge readiness (i.e. PADS score of 9) between the three groups.

**CONCLUSIONS:** PCS decreases the amount of propofol required to obtain satisfactory analgesia compared to titrated infusion. Music further enhances the use of PCS.

TABLE:

	INF	PCS	PCS+M
Total propofol (µg/kg/min)	105	85*	64*^
Time to PADS score of 9 (min)	7.6±2.2	10.7±4.4	7.3±2.5

\*p<0.05 compared with INF; ^p<0.05 compared with PCS

### REFERENCES:

1. Anaesthesia 1991; 46:553-556.
2. Anesthesiology 1991; 75:A1105

**COMPARISON OF RECOVERY FOLLOWING PROPHYLACTIC ONDANSETRON, DIMENHYDRINATE AND PLACEBO IN OUTPATIENT LAPAROSCOPY**

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**Introduction:** The purpose of this study was to compare psychomotor recovery following prophylactic antiemetic therapy; dimenhydrinate, ondansetron and placebo.

**Methods:** After IRB approval, informed written consent was obtained from 87 women scheduled for gynecological laparoscopy. The study was randomized and blind. Patients received either placebo (P), ondansetron 8 mg (O), or dimenhydrinate 50 mg (D) intravenously immediately prior to the induction of anaesthesia. All patients received propofol, mivacurium, nitrous oxide, isoflurane and fentanyl. No reversal agents were used. Time of recovery milestones from extubation to ambulation were documented. Psychomotor recovery was assessed using p deletion and digit symbol substitution at one and two hours postoperatively. Statistical analysis was performed using ANOVA for parametric data, chi-square for nonparametric data, and a p value of <0.05 as significant.

**Results:**

	P	D	O
Patients (#)	29	28	30
Age (years)	32 ± 7	33 ± 7	33 ± 6
Height (cm)	165 ± 8	165 ± 5	162 ± 16
Weight (kg)	68 ± 15	69 ± 12	68 ± 15
Surgery (min)	28 ± 16	22 ± 8	25 ± 24
Anesthesia (min)	35 ± 19	28 ± 7	36 ± 25
Extubation (min)	4 ± 3	6 ± 4	5 ± 2
Eyes Open (min)	5 ± 4	8 ± 5*	5 ± 3
Oriented (min)	7 ± 4	12 ± 8*	8 ± 4
Sit (min)	143 ± 78	129 ± 59	121 ± 59
Stand (min)	183 ± 62	171 ± 40	167 ± 54
Fluids (min)	89 ± 64	71 ± 34	80 ± 38
Walk (min)	183 ± 62	171 ± 40	170 ± 54
PACU Discharge (min)	56 ± 17	57 ± 14	54 ± 20
<b>One Hour Postop</b>			
Tests Incomplete (%)	20%	63%*	36%
P Deletion Test Score	62 ± 34	31 ± 44*	59 ± 38
Digit Symbol Test Score	41 ± 23	19 ± 26*	36 ± 23
<b>Two Hour Postop</b>			
Tests Incomplete (%)	0%	15%*	0%
P Deletion Test Score	54 ± 10	41 ± 21*	50 ± 10
Digit Symbol Test Score	76 ± 18	59 ± 38	71 ± 19
Satisfaction VAS (0-10 cm)	8 ± 2	7 ± 2	8 ± 2
<b>Home</b>			
Home Discharge (min)	205 ± 74	199 ± 40	189 ± 12
Satisfaction VAS (0-10 cm)	8 ± 2	8 ± 2	8 ± 2

\* different from placebo, p <0.05, mean ± SD or % patients

**Discussion:** Dimenhydrinate is a commonly used antiemetic. Sedative properties produce a slight delay in immediate recovery and subsequent impairment of psychomotor abilities, however this does not delay discharge or reduce patient satisfaction.

**PROPOFOL VS. ISOFLURANE FOR MAINTENANCE OF GENERAL ANESTHESIA IN OUTPATIENT BILATERAL REDUCTION MAMMOPLASTY**

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**Introduction:** The purpose of this study was to compare recovery following intravenous vs. inhalational anesthesia for bilateral reduction mammoplasty and to assess the feasibility of same day discharge.

**Methods:** After IRB approval and informed written consent 40 patients (20 patients per group) scheduled for elective bilateral reduction mammoplasty (BRM) were randomized to receive either propofol or isoflurane for maintenance of general anaesthesia. All patients received morphine 15 mg, dimenhydrinate 50 mg, metoclopramide 10 mg and propofol during induction, nitrous oxide during maintenance, and mivacurium was used for muscle relaxation (without reversal). The patients, nurses and research assistant were blind. Postoperative nausea, drowsiness and pain were measured, using a 10 cm visual analogue scale (VAS), prior to PACU discharge again on the first postoperative day. After PACU discharge patients were treated as "sham" outpatients; oral medications were prescribed for pain or nausea, and intravenous infusions were discontinued. Statistical assessment was performed using chi square and unpaired t-tests with a p value of <0.05 considered significant.

**Results:**

	Propofol	Isoflurane
Height (cm)	163 ± 9	160 ± 14
Weight (kg)	83 ± 16	79 ± 14
Surgical Time (min)	126 ± 20	124 ± 17
Anesthesia Time (min)	135 ± 19	135 ± 17
<b>PACU</b>		
Discharge Time (min)	104 ± 24	101 ± 29
IV Morphine (mg)	5 ± 4	5 ± 4
Antiemetic Given (% pts)	5%	30%*
Emesis (% pts)	0%	25%*
Nausea (% pts)	25%	45%*
Nausea VAS (mm)	15 ± 21	27 ± 39
Drowsiness VAS (mm)	57 ± 37	70 ± 30
Pain VAS (mm)	54 ± 31	53 ± 30
<b>Ward</b>		
Pain Pills (#)	7 ± 3	6 ± 4
Antiemetic Given (% pts)	30%	60%*
Emesis (% pts)	20%	55%*
Nausea (% pts)	55%	85%*
Nausea VAS (mm)	20 ± 31	25 ± 32
Drowsiness VAS (mm)	33 ± 31	28 ± 31
Pain VAS (mm)	38 ± 30	41 ± 28

\* different from propofol, p <0.05, mean ± SD or % patients

**Discussion:** Propofol reduces the incidence of nausea and vomiting. Postoperative analgesia can be managed using oral medications. Bilateral reduction mammoplasty can be performed on an outpatient basis.