TITLE: PATIENT-CONTROLLED ANALGESIA IN CHILDREN AND ADOLESCENTS: A RANDOMIZED COMPARISON WITH INTRAMUSCULAR MORPHINE

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Introduction

Preliminary studies suggest that patient-controlled analgesia (PCA) may be effective in children and adolescents.[1-4] Some clinicians have favored PCA plus a continuous low-dose background infusion (PCA+). Most previous reports have not been randomized or controlled. We compared efficacy and side-effects of intramuscular morphine (IM), PCA and PCA+ for postoperative pain relief in children and adolescents.

Materials and Methods

82 children, ASA I or II, ages 7-19, undergoing major elective orthopedic surgery, were enrolled according to procedures approved by the Committee on Clinical Investigation. Standardized inhalational anesthesia was supplemented by morphine sulfate (MS) 0.15 mg/kg IV at induction. Patients were randomly assigned to receive MS by IM, PCA, or PCA+ routes postoperatively [Table 1]. Pain, sedation, nausea, anxiety and satisfaction were assessed every 2 hours for up to 48 hours by the patient and nurse using 10 cm visual analog scales (VAS). Respiratory rates were recorded hourly. Data were analyzed by repeated measures ANOVA (Scheffe's S test post -hoc) or chi square as appropriate.

Results

Patients receiving PCA+ had lower scores than patients receiving IM, and patients receiving PCA alone had lower pain scores than patients receiving IM [Tables 2,3]. Patient satisfaction (mean±SD) was a highest in the PCA+ group (PCA+=8.5±2.0; PCA=7.7±2.4; IM=7.8±2.3; p=.0007, ANOVA). There were no differences between the groups in total MS use, time to oral fluid intake, or incidence of urinary retention, nausea, or emesis. Patients receiving PCA+ had less sedation than those receiving IM (p=.0175). No incidents of respiratory depression or other complications were observed.

Discussion

PCA and PCA+ appear to be safe and more effective than IM for postoperative analgesia in children and adolescents undergoing orthopedic surgery.

References

1. J Ped Surg, 23:259-62, 1988 2. Anesthesiology, 69 (3A): A772, 1988 3. Anesthesiology 69(3A):A372, 1988
4. Anaesth Inten Care, 17:264-68, 1989

Table 1. Protocol for morphine administration

	IM	PCA	PCA+
Morphine dose (intermittent)	0.1-0.18 mg/kg	0.025 mg/kg	0.018 mg/kg
Dosing interval (IM) or Lockout time (PCA, PCA+)	q3h, prn	10 min	10 min
Morphine dose (continuous)	0	0	0.015 mg/kg/h
Four-hour morphine limit	0.24 mg/kg	0.24 mg/kg	0.24 mg/kg

Table 2. Mean nursing pain VAS scores

Group	Post-op-11pm	11pm-7am	7am-3pm	Mean (±SD)*
IM	4.17	5.14	4.46	4.59 ±2.26
PCA	2.64	3.05	3.92	3.20 ±1.94
PCA+	2.65	2.64	2.46	2.58 ±1.77

*p <0.0001, repeated measures ANOVA, post-hoc testing: PCA+ vs. IM (p=.0001); PCA vs. IM (p=.0024), PCA+ vs. PCA (p= n.s.)

Table 3. Mean patient self-report pain VAS scores

Group	Post-op -11pm	11pm -7am	7am-3pm	Mean (±SD)*
IM	5.93	5.17	5.55	5.55 ±2.46
PCA	4.05	4.31	5.38	4.58 ±2.45
PCA+	3.64	3.64	3.63	3.63 ±2.39

*p = 0.034, repeated measures ANOVA, post-hoc testing: PCA+ vs. IM (p = .038); PCA vs. IM (p = n.s.); PCA+ vs. PCA (p = n.s.)

Title: PHARMACODYNAMICS OF HIGH DOSE VECURONIUM IN CHILDREN DURING BALANCED ANESTHESIA

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Rapid sequence induction is used to secure the airway in emergency surgical procedures in order to prevent aspiration of gastric contents. Succinylcholine is the standard muscle relaxant used for rapid sequence induction. However, its use is contraindicated in many patients.[1] Vecuronium has been shown to be a safe alternative drug to succinylcholine for rapid sequence induction in adult patients either when preceded by a priming dose[1] or when given in bolus doses up to 0.4 mg/kg.[2] This study was undertaken to assess the speed of onset, duration of action, and recovery following vecuronium 0.1, 0.2, and 0.4 mg/kg when used during balanced anesthesia in children and to compare these variables to those of succinylcholine.

After ethical committee approval and informed consent, 31 fasted and unpremedicated children, 2 to 8 years of age were studied. All children were ASA I or II and scheduled for minor elective surgery. Patients with renal or hepatic disease or in whom a difficult intubation was anticipated were excluded. Patients were randomly assigned to one of 4 treatment groups to receive 0.1, 0.2, or 0.4 mg/kg of vecuronium or 2.0 mg/kg of succinylcholine.

Anesthesia was induced with thiopental 5.0 mg/kg, atropine 0.02 mg/kg, diazepam 0.15 mg/kg, and either morphine 0.15 mg/kg or fentanyl 5.0 µg/kg. Ventilation was assisted with 70% N_2O in O_2 by mask. A continuous caudal block (bupivacaine 0.25%) was inserted when appropriate.

After the loss of consciousness, a Datex Relaxograph EMG monitor was calibrated and a control value obtained. When the height of the first twitch (T1) reached 5% of control (onset), laryngoscopy and intubation were performed. The intubating conditions were assessed according to criteria adapted from Lund and Stovner.[3] Anesthesia was maintained with 70% N_2O in O_2 and incremental doses of narcotics.

Recovery of neuromuscular blockade was allowed to proceed spontaneously, and the time for T1 to return to 5%, 25%, and 75% of control was recorded. The interval between 95% depression of the first twitch and the return of T1 to 25% of control was considered the duration of neuromuscular blockade. The recovery index was taken as the time for 25-75% recovery of T1. Statistical analysis ($p<0.05$ considered significant) was performed using one way ANOVA and the Student-Newman-Keuls test. Onset times were determined by linear regression.

There were no significant differences in ages or weights of the four groups of patients. All doses of vecuronium produced statistically significant slower onset times and had greater duration of action than succinylcholine (table I). The time to laryngoscopy and intubation with succinylcholine did not differ significantly from that of vecuronium 0.4 mg/kg. All intubating conditions were graded as excellent.

While succinylcholine is still the fastest acting muscle relaxant, we have shown that reliable intubating conditions can be achieved in 60 sec or less using vecuronium 0.4 mg/kg in children. The decreased onset time is accompanied by an increased duration of action which is still less than 90 min using a single bolus injection of vecuronium 0.4 mg/kg.

Supported with a grant from Organon, Canada.

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3. Acta Anesthesiol Scand, 37:S238, 1970

Table I: HIGH DOSE VECURONIUM - Comparison between doses and sux

GROUP	ONSET (sec)	LARYNGOSCOPY (sec)	DURATION (min)	REC INDEX (min)
Sux 2.0 (n=5)	19.1±5.5	46.2±9.0	5.6±0.8	1.7±0.5
Vec 0.1 (n=9)	85.1±20.5*	111.2±23.3*	24.0±5.4*	7.9±2.2*
Vec 0.2 (n=8)	60.7±18.4*	79.4±22.5*	54.4±11.1*	16.6±6.9*
Vec 0.4 (n=9)	39.3±11.1*	58.1±13.2**	76.3±9.5*	22.6±2.1*

all data are mean±SD
* $p<0.05$ compared to succinylcholine and other doses of veccuronium
** $p<0.05$ compared to other doses of vecuronium

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