TIME TO EXTUBATION IN INFANTS UNDERGOING PYLOROMYOTOMY

- Isoflurane Inhalation vs Remifentanil Infusion -

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Abstract

Background: Infantile hypertrophic pyloric stenosis (IHPS) associated with metabolic alkalosis, could induce late anesthesia recovery, especially when opioids are used. The aim of this study was to compare the time of extubation and the quality of perioperative analgesia in infants scheduled for pyloromyotomy, receiving either isoflurane inhalation or remifentanil infusion.

Methods: Thirty full-term infants scheduled for pyloromyotomy were prospectively studied. A standardized anesthetic induction was performed. For maintenance of anesthesia, infants were randomly allocated to receive either isoflurane 0.75% of inspired concentration (GI n = 15), or remifentanil as a continuous infusion of 0.4 $\mu g.kg^{-1}.mn^{-1}$ (GR n = 15). At the beginning of skin closure, the anesthetic was discontinued and 15 $mg.kg^{-1}$ of paracetamol administered. Non parametric tests were used in statistical analysis.

Results: The time to extubation was similar in both groups. The intraoperative heart rate was significantly lower in the GR group.

Conclusion: Remifentanil provided better intraoperative analgesia than isoflurane in infants undergoing pyloromyotomy without increasing time to extubation.

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Introduction

Infantile hypertrophic pyloric stenosis (IHPS) is one of the most common infant gastrointestinal disorders requiring surgery. Pyloric outlet obstruction causes projectile vomiting thus inducing electrolyte and metabolic disturbances. The classic abnormality is a hypochloremic metabolic alkalosis that could induce late anesthesia recovery, especially when opioids are used[1]. Therefore, inhalational agents are usually used as maintenance anesthetics.

The aim of the present study was to compare time to extubation and quality of perioperative analgesia with the use of remifentanil infusion and compare it to that of isoflurane inhalation, in infants scheduled for pyloromyotomy.

Methods and Materials

Following the Ethics Committee's approval and written parent's informed consent, thirty ASA I or II full term infants (gestational age ≥37 weeks) admitted for IHPS, were prospectively included in a randomised single-blind study. They underwent pyloromyotomy after normalization of their metabolic and electrolyte imbalance (serum bicarbonate ≤30 mmol.L^{-1}, serum sodium ≥130 mmol.L^{-1}). Infants who presented difficult intubation were excluded from the study.

Infants were not premedicated. Induction was performed with propofol 5 mg.kg^{-1} and succinylcholine 2 mg.kg^{-1}. For maintenance, infants were allocated, using a random-number table, to receive nitrous oxide and oxygen (50%50%), with either isoflurane at 0.75% inspired concentration (GI n = 15), or remifentanil as a continuous infusion at 0.4 µg.kg^{-1}.mn^{-1} (GR n = 15).

If signs of light anesthesia appeared (movement, increases in systolic arterial blood pressure (SABP) and/or in heart rate (HR) 20% above basal values), the inspired concentration of isoflurane and the infusion rate of remifentanil were increased by respective increments of 0.25% (GI) and 0.05 µg.kg^{-1}.mn^{-1} (GR) until a maximum infusion rate of 2 µg.kg^{-1}.mn^{-1} (GR) was reached. In infants who developed hypotension (decreases in SABP 20% of basal value), the inspired concentration of isoflurane and the infusion rate of remifentanil were respectively decreased by 0.25% (GI) and 0.05 µg.kg^{-1}.mn^{-1} (GR). Bradycardia, defined as a decrease of the HR 30% compared to the previous value, was treated with atropine 20 µg.kg^{-1}.

At the beginning of skin closure, the anesthetic maintenance was discontinued and intravenous paracetamol 15 mg.kg^{-1} was administered. Extubation was performed when infant was awake, had regained his airway reflexes and was adequately warmed.

In the PACU, the BP, HR and PSO_2 were monitored. The postoperative pain was assessed by Amiel-Tison score, which is a behavioral approach using facial expressions, body movements, intensity and quality of crying as indices of reponse to nociceptive stimuli[2]. If the score was higher than 7, nalbuphine 0.2 mg.kg µg^{-1} was administered by i.v. route.

The following data were collected: demographics, time to extubation, duration of surgery, intraoperative HR and SABP at induction, after intubation, at the skin incision, and then at five-minute intervals until the end of surgery. Postoperatively, the Amiel-Tison score was recorded every 20 min. after extubation for 2 hours, Occurrence of intraoperative incidents (movement at incision, bradycardia) were noted.

Data were analysed using package SPSS 13.0. Statistical analysis involved Chi-square and Mann-Whitney tests. P values ≤0.05 were considered statistically significant.

Results

No statistical difference was noted between the two groups with regard to demographics, duration of surgery and basic hemodynamic values (Table 1).

Table 1
Patient characteristics and intraoperative data among infants anesthetized for pyloromyotomy

	GI	GR	p
Age (days)	43 ± 12	37 ± 14	0.12
Weight (Kg)	3.85 ± 1	3.51 ± 0.5	0,13
Sex-ratio	5	5	1
Duration of surgery (min.)	33 ± 9	31 ± 9	0.70
Basic HR (beats per minute)	148 ± 18	137 ± 19	0.06
Basic SABP (mmHg)	88 ± 12	84 ±15	0.39

Data are mean ± SD except for sex-ratio of patients. No significant difference (p >0.05) was found between the two groups

On admission, biochemical findings showed metabolic alkalosis (serum bicarbonate ≥30 mmol.L^{-1} in 7 cases), hypokalemia (serum potassium ≤3.7, in 3 patients) and hyperkalemia (serum potassium ≥4.8 mmol.L^{-1} in 3 other infants). After preoperative correction, serum bicarbonate and natremia were similar in the two groups (Table 2).

Table 2
Preoperative biochemical findings among infants scheduled for pyloromyotomy

	GI	GR	p
Serum bicarbonate (mmol.L^{-1})	24 ± 2	24 ± 5	0.62
Natremia (mmol.L^{-1})	135 ± 3	134 ± 3	0.34

Data are mean ± SD. No significant difference (p >0.05) was found between the two groups

Time to extubation was similar between the two groups: 17 ± 10 min (GI) and 20 ± 11 (GR), p = 0.42. The intraoperative HR was lower in GR compared to GI group:

	GR	GI
At skin incision	118	135 p = 0.01
5 min.	119	132 p = 0.022
10 min.	122	133 p = 0.049

Intraoperative tachycardia requiring increases of the inspired concentration of isoflurane occurred in one patient of GI. No statistical difference could be found between the groups regarding intraoperative SABP.

There was no significant difference between the groups with regard to postoperative Amiel-Tison score, HR and SABP.

At skin incision, movement was recorded in 3infants in each group. Three patients in GT group had developed episodes of bradycardia, but with favourable progress.

Discussion

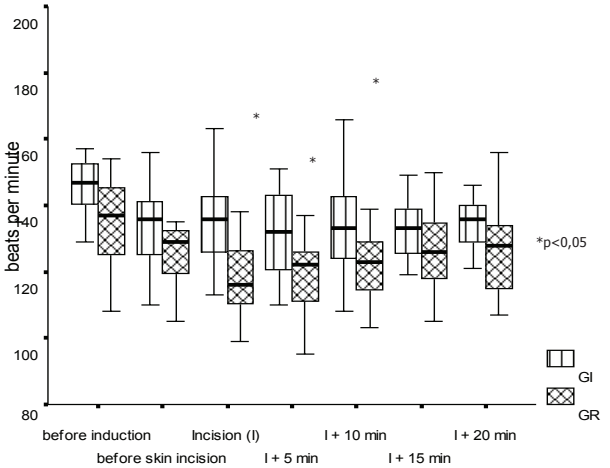
In view of its metabolic disorders, there is no ideal anesthetic technique for the care of IHPS: the use only of inhalational agents for the maintenance of anesthesia neglects intraoperative analgesia, while the administration of opioids could induce late anesthesia recovery due to persistent cerebrospinal fluid alkalosis[3].

The use of remifentanil, a short-acting opioid, provides analgesia during pylorotomy without increasing time to extubation, meanwhile, narcosis is ensured by propofol and N_2O/O_2 mixture. The open-label study comparing halothane to remifentanil in infants who underwent pylorotomy, inspired our trial[4].

In our study, we chose isoflurane instead of halothane. The time to tracheal extubation as comparable in both groups: 16.8 ± 10.2 in GI group versus 19.6 ± 10.6 in GR group (p = 0.47). A similar result was found in Davis' study[4] (7.7 ± 3.2 versus 7.4 ± 6.3). A retrospective cohort study showed a shorter time to discharge from the OR when remifentanil was used as maintenance anesthetic with propofol (12.5 ± 10.6 min), compared to isoflurane (14.2 ± 7.8), sevoflurane (18.5 ± 11.7) and halothane (24.8 ± 11.1) (p<0.01)[5].

Intraoperative analgesia was assessed by SABP and HR variation during surgery and movement at surgical incision. Intraoperative HR was significantly lower in GR group when compared to the GI group at skin incision, and after 5 and 10 minutes, showing a better analgesia for the remifentanil-anesthetized infants (Fig. 1). Davis et al did not find differences between the two groups regarding intraoperative hemodynamic parameters[4]. In our study, movement at skin incision was observed in 3 infants of each group and required deepening of anesthesia.

Fig. 1
Intraoperative heart rate (HR) among infants scheduled for pyloromyotomy: comparison between remifentanil (GR) and isoflurane (GI). HR was lower in GR compared to GI at skin incision (p = 0.01), 5 (p = 0.022) and 10 minutes after (p = 0.049)



Postoperative pain, as assessed by the Amiel-Tison score, was higher in GR, but without any significant difference. No infant of the two groups required supplementary analgesic during the two postoperative hours. Davis et al, had found a similar result in the postoperative period comparing halothane to remifentanil, in infants undergoing pylorotomy[4], while children who received remifentanil had worse postoperative pain scores in other kinds of surgery. The comparison of remifentanil to fentanyl in tonsillectomy and adenoidectomy in pediatric ambulatory surgery, found higher postoperative pain scores in the remifentanil than in the fentanyl groups[6]. After elective strabismus surgery, pain scores were also higher in the remifentanil group, compared to children who received alfentanil, propofol or isoflurane[7]. During SHP, the alkaline pH of the cerebrospinal fluid could induce analgesic effect, explaining the absence of increase in the postoperative pains cores following pyloromyotomy.

Bradycardia occurred in 3 infants in GR group, whereas hypotension occurred in one patient in each group. The occurrence of bradycardia in the GR patients could be related to the flow of remifentanil and the lack of administration of atropine at induction in our infants[8,9]. In the study comparing halothane with remifentanil, no infant developed bradycardia, but a tendency to hypotension was noted in the halothane group, yet without any significant difference ($p = 0.08$)[4].

No postoperative respiratory complication was found among our infants. In Davis' study[4], only children belonging to halothane group had developed episodes of postoperative apnea. The incidence of postoperative apnea and hypoxia was similar with remifentanil compared to propofol and isoflurane, but lower than with alfentanil[7].

Conclusion

Remifentanil in association with an N_2O/O_2 mixture provided better intraoperative analgesia than did isoflurane, thus providing proper narcosis and a comparable time to extubation. Quality of postoperative analgesia was similar in both groups. Therefore, a remifentanil-based anesthesia is an interesting alternative to the inhaled anesthetic technique of isoflurane, for IHPS.

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