Journal of Clinical Anesthesia 25 (2013) 198–201

Contents lists available at SciVerse ScienceDirect

Journal of Clinical Anesthesia

journal homepage: www.JCAfulltextonline.com

Original Contribution

A dose study of remifentanil in combination with propofol during tracheobronchial foreign body removal in children ☆

Leyla Teksan MD (Associate Professor), Sibel Baris MD (Associate Professor) *, Deniz Karakaya MD, PhD (Professor), Ahmet Dilek MD (Assistant Professor)

Department of Anesthesiology, Ondokuz Mayis University, Faculty of Medicine, 55139, Atakum, Samsun, Turkey

ARTICLE INFO

Article history:
Received 23 May 2012
Received in revised form 22 August 2012
Accepted 6 October 2012

Keywords:
Anesthesia pediatric
Bronchoscopy
Foreign body removal
Propofol infusion
Remifentanil infusion

ABSTRACT

Study Objective: To assess the effect of two different remifentanil infusion doses on hemodynamic stability and recovery characteristics in children undergoing tracheobronchial foreign body removal during rigid bronchoscopy.
Design: Prospective, randomized, clinical comparison study.
Setting: Operating room of a university hospital.
Patients: 70 ASA physical status 1 and 2 children, aged 3–12 years, presenting for tracheobronchial foreign body removal during rigid bronchoscopy.
Interventions: Children were divided equally into two groups to receive either a 0.1 μg/kg/min (Group R1) or 0.2 μg/kg/min (Group R2) remifentanil infusion. Ten minutes after the remifentanil infusion, 3 mg/kg of propofol and 0.02 mg/kg of atropine were given. Anesthesia was maintained with 0.1 μg/kg/min of remifentanil and 100–250 μg/kg/min of propofol in Group R1 and 0.2 μg/kg/min of remifentanil and 100–250 μg/kg/min of propofol in Group R2. After baseline measurements were recorded, 0.2 mg/kg of mivacurium was given intravenously. Ventilation was maintained with 100% O_2 via a "T" piece connected to the side arm of the bronchoscope.
Measurements: Heart rate (HR), systolic (SBP), diastolic (DBP) and mean arterial pressures (MAP), and O_2 saturation (SpO_2) were recorded before (baseline) and after induction, and 1, 3, 5, 10, 15, 20, 25, and 30 minutes after insertion of the rigid bronchoscope into the trachea. Emergence characteristics and complications were noted. Statistical analysis was performed using independent samples t-test, repeated measures, and *chi-square* test as appropriate.
Main Results: Groups were similar in demographics and duration of bronchoscopy and anesthesia ($P > 0.05$). In Group R1, HR, SBP, DBP, and MAP increased one minute after insertion of the bronchoscope in Group R1 ($P < 0.01$). Propofol consumption was significantly higher in Group R1 (63.6 ± 30.1 mg) than Group R2 (39.8 ± 26.6 mg; $P < 0.01$). Time to spontaneous eye opening was 8.6 ± 1.3 minutes in Group R1 and 6.3 ± 1.1 minutes in Group R2 ($P < 0.05$). The time to recovery to an Aldrete score of 9 was greater in Group R1 (19.8± 3.0 min) than Group R2 (16.1±3.0 min; $P < 0.01$).
Conclusion: A remifentanil 0.2 μg/kg/min infusion with propofol provides hemodynamic stability and early recovery in children undergoing foreign body removal during rigid bronchoscopy.

1. Introduction

Removal of an aspirated foreign body in a child is an anesthetic challenge. Although rigid bronchoscopy during general anesthesia is the mainstay therapeutic option for removal of airway foreign bodies, it is often difficult to maintain adequate ventilation and oxygenation.

Total intravenous anesthesia (TIVA) with a remifentanil-propofol mixture provides safe and effective sedation and rapid recovery for pediatric flexible fiberoptic bronchoscopy [1,2]. As rigid bronchoscopy results in greater airway stimulation and often takes more time than flexible bronchoscopy, the procedure requires a deeper level of anesthesia. Rigid bronchoscopy causes a similar hemodynamic response to that of laryngoscopy and tracheal intubation, with the stimulations being greater and the duration longer [3]. In previous studies, TIVA with 0.1 μg/kg/min remifentanil and propofol infusions was associated with a high incidence of breath-holding, desaturation (SpO_2), and excitement, possibly related to insufficient doses of remifentanil [4,5].

☆ Supported by Ondokuz Mayis University Research Funding.
* Correspondence: Sibel Baris, MD, Associate Professor, Department of Anesthesiology, Ondokuz Mayis University, Medical Faculty, 55139, Atakum, Samsun, Turkey.
E-mail address: sbaris@omu.edu.tr (S. Baris).

0952-8180/$ – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jclinane.2012.10.008

This prospective, randomized clinical trial was performed to assess the effect of a 0.2 μg/kg/min remifentanil-propofol infusion on hemodynamic stability and recovery characteristics during rigid bronchoscopy, and to compare it with a 0.1 μg/kg/min remifentanil-propofol infusion in children undergoing foreign body removal.

2. Materials and methods

After obtaining Ondokuz Mayis University Ethical Committee approval and parents' informed consent, 70 ASA physical status 1 and 2 children, aged 3 to 12 years, undergoing rigid bronchoscopy for foreign body removal during general anesthesia were enrolled in this randomized, double-blinded study. This study was conducted between May 2009 and May 2010. Exclusion criteria included children with renal, cardiac, endocrine, or hepatic diseases and SpO_2 < 95% while breathing room air. No sedative premedication was given. After placement of an intravenous (IV) cannula, children received 5% dextrose in 0.33 normal saline at a rate of 4 mL/kg/hr. In the operating room (OR), all children were monitored continuously for heart rate (HR), electrocardiography (ECG), respiratory rate (RR), SpO_2, end-tidal carbon dioxide ($ETCO_2$), noninvasive blood pressures (BPs), and axillary body temperature.

Children were randomly allocated to each group sequentially. Children received a remifentanil infusion of either 0.1 μg/kg/min (Group R1, n=35) or 0.2 μg/kg/min (Group R2, n=35). Ten minutes after the start of the remifentanil infusion, anesthesia was induced with 3 mg/kg of propofol and 0.02 mg/kg of atropine. In Group R1, anesthesia was maintained with 0.1 μg/kg/min of remifentanil and 100–250 μg/kg/min of propofol; in Group R2, it was maintained with 0.2 μg/kg/min of remifentanil and 100–250 μg/kg/min of propofol. The propofol infusion was commenced immediately after induction with the lowest dose, then adjusted to maintain systolic blood pressure (SBP) within ± 20% of the baseline value.

Neuromuscular function was monitored by acceleromyography of the abductor pollicis with a train-of-four (TOF) Watch SX® monitor (Organon, Dublin, Ireland). After the skin was cleaned, two pediatric surface electrodes were placed over the ulnar nerve on the volar side of the wrist, and the transducer was affixed to the ulnar side of the thumb. A temperature sensor was attached to the palmar side of the hand. Temperature of the arm was maintained at > 33° C using a warming blanket covering the body when necessary. After induction of anesthesia and loss of consciousness, calibration and baseline responses were obtained. Supramaximal TOF stimuli were applied every 15 seconds and acceleration of the thumb was recorded. After baseline measurements were obtained, 0.2 mg/kg of mivacurium was given intravenously. Patients were ventilated via facemask with 100% O_2. After a TOF level less than 10% was achieved, the rigid bronchoscope was inserted by a pediatric surgeon. Ventilation was maintained with 100% O_2 via a "T" piece connected to the side arm of the bronchoscope.

Onset time [from injection of mivacurium to 90% first twitch (T1) depression], clinical duration (time from mivacurium injection to recovery of T1 to 25%), and recovery index (time to recovery of T1 from 25% to 75%) were recorded. Additional mivacurium doses (0.1 mg/kg) were given if TOF > 25% or movement of the extremities and/or gagging occurred.

Heart rate, SBP, diastolic (DBP), and mean arterial (MAP) pressures, and SpO_2 were recorded before (baseline) and after induction, and 1, 3, 5, 10, 15, 20, 25, and 30 minutes after insertion of the rigid bronchoscope into the trachea. If HR decreased below 70 bpm, atropine 0.02 mg/kg was given. Arterial desaturation was defined as a SpO_2 < 90%. If oxygen desaturation (SpO_2 < 95%) was encountered, the bronchoscope was removed above the carina and the patient was ventilated to restore normoxemia.

After removal of rigid bronchoscope at the end of the procedure, propofol and remifentanil infusions were terminated. Duration of anesthesia (time from start of the remifentanil infusion to termination of the propofol-remifentanil infusion) and duration of bronchoscopy (ie time from insertion into and withdrawal of the bronchoscope from the trachea) were noted. Emergence from anesthesia was evaluated with time to spontaneous eye opening (ie, time from discontinuation of the propofol-remifentanil infusion to spontaneous eye opening). Complications (coughing, bronchospasm, laryngospasm, stridor, vomiting, airway trauma) and time to achieve a modified Aldrete score ≥ 9 were recorded.

2.1. Statistics

SPSS software (version 15.0; SPSS, Chicago, IL, USA) was used for statistical analysis. Age, weight, HR, BPs, RR, and SpO_2 values between groups at baseline were compared using an unpaired, two tailed Student's t-test. Within-group HR and BP values during the study period were compared using a repeated-measures general linear model. Duration of anesthesia and bronchoscopy, emergence time, time to achieve a modified Aldrete score ≥ 9, onset time, clinical duration, recovery index, and propofol and mivacurium consumption between groups were compared using an independent samples t-test. Differences in categorical variables between the groups were analyzed with *chi-square* test. A *P*-value < 0.05 was considered statistically significant. Values are expressed as means ± SD.

3. Results

There was no significant difference between groups in age, gender, weight, ASA physical status, or duration of bronchoscopy and anesthesia ($P > 0.05$; Table 1).

Heart rate, SBP, DBP, and MAP significantly increased one minte after insertion of the bronchoscope in Group R1 ($P < 0.01$); however, no significant changes were observed in Group R2. Thereafter, there was no difference between groups throughout the procedure (Figs. 1, 2).

Onset time, clinical duration, and recovery index of mivacurium are shown in Table 2. Propofol and mivacurium consumption are shown in Table 3. Propofol consumption was significantly higher in Group R1 than Group R2 ($P < 0.01$).

Emergence time was 8.6 ± 1.3 minutes in Group R1 and 6.3 ± 1.1 minutes in Group R2 ($P < 0.05$). Time to recovery to an Aldrete score of 9 was greater in Group R1 (19.8 ± 3.0 min) than Group R2 (16.1 ± 3.0 min; $P < 0.01$). Thirty-four children (97.1%) in Group R1 and 30 children (85.7%) in Group R2 coughed after bronchoscopy ($P > 0.05$). Laryngospasm, stridor, or chest wall rigidity were not observed in any child. Desaturation was observed in 17 Group R1 children (48.5%) and 12 Group R2 children (34.2%; $P > 0.05$) during the procedure.

4. Discussion

Total intravenous anesthesia with propofol and a 0.2 μg/kg/min remifentanil combination resulted in hemodynamic stability and faster awakening in children undergoing tracheobroncial foreign body removal with rigid bronchoscopy.

Table 1
Demographic values and duration of bronchoscopy and anesthesia

	Group R1 (n = 35)	Group R2 (n = 35)
Age (yrs)	3.4 ± 1.7	4.5 ± 2.8
Gender (F/M)	18/17	15/20
Weight (kg)	13.9 ± 4.7	16.3 ± 1.8
ASA physical status (1/2)	29/6	30/5
Bronchoscopy duration (min)	11.8 ± 5.6	12.0 ± 5.7
Anesthesia duration (min)	21.8 ± 5.6	22.0 ± 5.7

Data are means ± SD. $P > 0.05$.
Group R1 received a 0.1 μg/kg/min remifentanil infusion; Group R2 received a 0.2 μg/kg/min remifentanil infusion.