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Original Contribution

Effects of fentanyl administration before induction of anesthesia and placement of the Laryngeal Mask Airway: a randomized, placebo-controlled trial☆,☆☆

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Abstract

Study Objective: To assess the effects of fentanyl administered before induction of anesthesia on movement and airway responses during desflurane anesthesia *via* the Laryngeal Mask Airway (LMA).

Design: Randomized, double-blinded, controlled trial.

Study Setting: Tertiary-care academic center.

Patients: 100 adult, ASA physical status 1, 2, and 3 patients undergoing ambulatory surgery.

Interventions: Patients were administered fentanyl 1 μg/kg (n=51) or saline (n=49) 3 to 5 minutes before induction with propofol 2-2.5 mg/kg intravenously (IV), followed by LMA placement. Anesthesia was maintained with desflurane titrated to a bispectral index (BIS) of 50-60 and 50% nitrous oxide in oxygen, and fentanyl 25 μg boluses were titrated to respiratory rate.

Measurements: Apnea occurrence and duration of manual ventilation, as well as frequency and severity of movement, coughing, breath holding, and laryngospasm were recorded.

Main Results: Two patients in each group were excluded from analysis. The fentanyl pretreatment group had a higher frequency of apnea (94% vs 64%; $P=0.0003$) and longer duration of manual ventilation (3 [interquartile range (IQR), 1.5-5] min vs 1 [0-1.5] min; $P<0.0001$) at induction. In contrast, the fentanyl pretreatment group had a lower frequency of movements (16% vs 51%; $P=0.0001$). The rates of intraoperative breath holding (6.1% vs 8.5%) and laryngospasm (2% vs 4.3%) in the two groups were similar. All subjects experiencing laryngospasm were smokers. Adjusting for smoking status did not affect the differences noted in apnea, duration of manual ventilation, or

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movement between groups; however, coughing occurrence was statistically higher in the placebo group (P=0.043).
Conclusions: Preinduction fentanyl increased the frequency of apnea at induction and duration of manual ventilation, but reduced the frequency of movements. In addition, it reduced intraoperative coughing in smokers.

1. Introduction

Supralaryngeal devices such as the Laryngeal Mask Airway (LMA) are popular in ambulatory anesthesia practice because they avoid the need for neuromuscular blockade and facilitate rapid emergence from anesthesia and transfer out of the operating room (OR) [1-3]. Similarly, desflurane allows rapid emergence from anesthesia [4-7]. Desflurane is sometimes avoided with use of the LMA due to concerns of increased airway irritation and respiratory complications, such as coughing, breath holding, and laryngospasm [8,9]. The use of fentanyl may reduce airway responses during desflurane anesthesia [10-13], and reduce propofol dose and propofol-induced movements [14,15]. However, this hypothesis has not been evaluated in a randomized, double-blind, controlled study. In addition, administration of fentanyl prior to induction of anesthesia may induce apnea and increase the need for manual ventilation, which may negate some of the benefits of the LMA [16].

We hypothesized that administration of fentanyl before induction of anesthesia would result in higher frequency of apnea and need for manual ventilation. Secondary evaluations included assessments of movement and airway responses during desflurane anesthesia through an LMA.

2. Materials and methods

After approval from the Institutional Review Board at the University of Texas Southwestern Medical Center at Dallas, Texas, USA and written, informed consent, 100 adult, ASA physical status 1, 2, and 3 subjects, 18-64 years of age, scheduled for ambulatory surgery with an expected duration of less than 2 hours, were enrolled in this study. The trial was registered with the United States National Clinical Trials Registry (registration no. NCT01277861). Participants were excluded from the study if they required tracheal intubation for the surgical procedure, had a body mass index (BMI) > 40 kg/m^2, were pregnant, had a history of significant gastroesophageal reflux, hiatal hernia, significant cardiovascular, pulmonary (eg, reactive airway disease), hepatic, renal, neurologic, metabolic, and endocrine disease, or had a history of alcohol and drug abuse.

Subjects were randomly assigned, according to a computer-generated randomization schedule, to receive either fentanyl 1 μg/kg (constituted to 10 mL with saline) or 10 mL saline before induction of anesthesia. Group allocation was concealed in sealed opaque envelopes and opened just prior to induction of anesthesia by a person who prepared the study drugs and was not involved in the study.

After premedication with midazolam 2 mg, subjects were transferred to the OR. On arrival at the OR, subjects received the study drug during preoxygenation with 100% oxygen and placement of standard monitors and the bispectral index (BIS) monitor. Induction of anesthesia was performed 3-5 minutes after administration of the study drug with propofol 2-2.5 mg/kg after lidocaine 20-30 mg intravenously (IV). After loss-of-eyelash reflex, an appropriate size LMA (Classic LMA; LMA North America, San Diego, CA, USA) was placed. If necessary, manual ventilation was performed to maintain end-tidal carbon dioxide ($ETCO_2$) concentrations at 40-45 mmHg with oxygen/nitrous oxide (O_2/N_2O) 50% and desflurane at 3% initial dialed concentration.

A standardized maintenance anesthetic technique was utilized for all subjects. Anesthesia was maintained with desflurane titrated to achieve a BIS value of 50-60, along with 50% N_2O and O_2. Once spontaneous breathing resumed, 25 μg boluses of fentanyl were administered to achieve a respiratory rate (RR) of 10-15 breaths/min. Additional doses of propofol were allowed, if deemed necessary by the anesthesiologist. The attending anesthesiologists/surgeon determined whether to administer local/regional anesthesia as well as ketorolac 30 mg IV or hydromorphone up to 2 mg IV at the end of surgery. All subjects received antiemetic prophylaxis with dexamethasone 4 mg IV after induction of anesthesia and ondansetron 4 mg IV approximately 20 to 30 minutes before the end of surgery. Desflurane and N_2O were simultaneously discontinued after closure of the surgical wound. The LMA was removed after subjects responded to verbal command.

A blinded observer recorded patient demographics (age, weight, height), history of smoking, total doses of propofol, fentanyl, and other drugs administered, duration of anesthesia, and time from discontinuation of desflurane until patient's response to verbal command. In addition, heart rate (HR), mean arterial blood pressure (MAP), RR, oxygen saturation (SpO_2), $ETCO_2$, and end-tidal desflurane concentration were recorded every 15 minutes.

Data recorded from the start of induction of anesthesia until removal of the LMA included occurrence of apnea (no breathing for at least 30 sec) and duration of manual ventilation, as well as occurrence and severity of movements (graded as 0 = no movement, 1 [mild] = isolated limb flexion, 2 [moderate] = limb flexion and extension occurring less than three times, and 3 [severe] = limb flexion and extension