Journal of Clinical Anesthesia (2016) **28**, 19–25

Journal of Clinical Anesthesia

Original Contribution

Comparison of emergence after deep extubation using desflurane or desflurane with remifentanil in patients undergoing general anesthesia: a randomized trial☆

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Received 2 December 2014; revised 21 April 2015; accepted 10 August 2015

Keywords:
Anesthetics volatile;
Desflurane;
Complications;
Tracheal extubation;
Remifentanil;
Recovery

Abstract

Study objective: To compare recovery times and respiratory complications during emergence after deep extubation using either desflurane alone or a lower concentration of desflurane with remifentanil.

Design: Prospective randomized double-blind clinical trial.

Setting: Intraoperative.

Patients: A total of 62 patients between the ages of 20 and 60 years with American Society of Anesthesiologists class I or II and who underwent low- to intermediate-risk surgery of 2- to 4-hour duration were enrolled.

Interventions: Randomly assigned either 1.5 minimum alveolar concentration desflurane (group D; n = 31) or 1.0 minimum alveolar concentration of desflurane and 1.0 ng/mL effect-site concentration of remifentanil (group DR; n = 31).

Measurements: Recovery times, from the time of extubation to the time when the patients could breathe without assistance, were awake enough to maintain the airway independently, and exited the recovery room, as well as respiratory complications were compared between the groups.

☆ Disclosures: None. Conflicts of interest: None. Presentation: None.

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http://dx.doi.org/10.1016/j.jclinane.2015.08.013

Main Results: Recovery times were significantly reduced in the group DR ($P < .001$). The incidence of respiratory complications was also lower in group DR than in group D (48% vs 3.8%; $P < .001$).
Conclusions: The combined use of remifentanil while lowering the concentration of desflurane improves recovery profiles during emergence after deep extubation.

1. Introduction

In patients who have undergone general anesthesia with tracheal intubation, the extubation period is a critical time when many physiological changes take place. During this period, emergence phenomena may occur, which can result in respiratory complications and hemodynamic changes. Furthermore, these phenomena can lead to elevated intraocular and intracranial pressure, which are risk factors for postoperative complications [1]. For these reasons, many studies have explored various methods to minimize emergence-related hazards. These include extubation under deep anesthesia; deep extubation; and administration of local anesthetics, vasodilators, and short-acting opioids [2]. Although it has been well established that deep extubation can minimize many emergence phenomena, many anesthesiologists do not favor the procedure because of a concomitant delayed recovery time, as well as an increased risk of complications such as laryngospasm, airway obstruction, and aspiration [3].

Desflurane, a commonly used volatile anesthetic, has low blood gas solubility. This facilitates a faster recovery than that seen when using other volatile anesthetics. Consequently, a patient may reach a state of light anesthesia too soon during the emergence period, which, in turn, may result in cardiopulmonary instability. It follows that maintaining a stable alveolar concentration of volatile anesthetics is important when performing deep extubation.

Remifentanil is an ultra-short-acting opioid, which is known to reduce coughing, nonpurposeful movement, and tachycardia, when continuously used in low dosage during the emergence phase. However, the drug does not compromise recovery from anesthesia [4]. Moreover, remifentanil can reduce the concentration of volatile anesthetics required for stable extubation.

Reports have been published regarding the effects of continuous infusion or bolus injection of remifentanil combined with desflurane in the emergence state during awake extubation. However, these studies have not investigated the effects of continuous remifentanil infusion combined with desflurane on the emergence state during deep extubation. We hypothesized that the use of remifentanil combined with a lower desflurane concentration would minimize recovery times and respiratory complications during deep extubation.

2. Materials and methods

2.1. Patients

The protocols used in this study were approved by the Institutional Review Board of Chung-Ang University Hospital, Seoul, Korea (2013.07.05), and were registered in the Clinical Trials database (NCT01924871). The study was conducted in accordance with the principles laid out in the Declaration of Helsinki, 2000, and written informed consent was obtained from all participants before inclusion in the trial.

Patients between the ages of 20 and 60 years, with American Society of Anesthesiologists class I or II, and who were to undergo elective surgery under general anesthesia were assessed for study eligibility. To minimize the confounding effect of the surgery itself, patients were selected only when they were to undergo low- to intermediate-risk surgery of 2- to 4-hour duration and did not require patient-controlled analgesia. Hence, cases of excision and biopsy, tympanomastoidectomy, orbiotomy, and arthroscopic surgery were selected.

Subjects were excluded when they had a history of neurologic or cardiopulmonary disease, were on medication associated with these diseases, had signs of a difficult airway (ie, Mallampati score of class III or IV) [5,6], were obese (body mass index ≥ 35 kg/m), or showed risk factors for perioperative aspiration. The decision to either enroll or exclude patients was made by an anesthesiologist who did not participate in the study and data collection.

2.2. Study design and randomization

This was a randomized double-blind study. Sixty-two subjects were randomly allocated to either the desflurane group (group D, n = 31) or the desflurane and remifentanil group (group DR, n = 31). Randomization was based on a computer-generated random table.

The group assignments were kept in a set of sealed envelopes, each bearing only the case number on the outside. Twenty minutes before the end of surgery, when the intervention for the study began, the appropriate envelope was opened by an anesthesiologist to reveal the group assignment.

All parties involved, including the patients, the surgeons, the anesthesiologists (with the exception of those opening the envelope adjusting the anesthetic agents administered), and the investigator collecting the data were unaware of the subjects' group assignment.

2.3. General anesthesia

All patients entered the operating room without premedication. Noninvasive arterial blood pressure, electrocardiography, and pulse oximetry were continuously monitored. After intravenous administration of lidocaine (40 mg) to