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Original Contribution

Optimal dose of succinylcholine for tracheal intubation in patients during inhalation induction with sevoflurane: a randomized controlled trial☆,☆☆

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Abstract

Study Objective: To determine the dose of succinylcholine during inhalation induction of a patient.

Designed: Prospective, double-blind, randomized study.

Setting: Operating room of a university hospital.

Patients: 180 adult, ASA physical status 1 and 2 patients with a suspected difficult airway, who were scheduled for surgery.

Interventions: Nonpremedicated patients were anesthetized with inhalation of 8% sevoflurane, followed by succinylcholine. Group 1 received intravenous (IV) succinylcholine 0.3 mg/kg, Group 2 had IV succinylcholine 0.6 mg/kg, and Group 3 was given IV succinylcholine 1.0 mg/kg. Direct laryngoscopy and tracheal intubation were performed after onset of succinylcholine.

Measurements: Intubation conditions were scored as excellent, good, or poor. The recovery time of spontaneous respiration, end-tidal carbon dioxide partial pressure ($P_{ET}CO_2$), and pulse oxygen saturation (SpO_2) were recorded.

Main Results: Acceptable conditions (excellent and good) for intubation were rated in 80% of Group 1 patients (0.3 mg/kg succhinylcholine), 91.7% of Group 2 patients (0.6 mg/kg), and 93.3% of Group 3 patients (1.0 mg/kg), respectively. Intubation scores were similar in Groups 2 and 3, and were significantly higher than in Group 1 patients (0.3 mg; $P < 0.01$). Time to recovery of spontaneous respiration in Group 3 was significantly prolonged compared with Groups 1 and 2 (238 ± 59 sec vs 132 ± 43 sec, $P < 0.001$; 238 ± 59 sec vs 151 ± 47 sec, $P < 0.001$, respectively). SpO_2 in Group 3 did not differ significantly from Group 1 and 2 values. However, $P_{ET}CO_2$ in Group 3 was significantly higher than in Groups 1 or 2.

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Conclusions: Succinylcholine at a dose of 0.6 mg/kg IV provided intubation conditions similar to succinylcholine at 1.0 mg/kg IV, and recovery of spontaneous respiration following a 0.6 mg/kg dose of succinylcholine was significantly shorter.

1. Introduction

Succinylcholine at a dose of 1.0 mg/kg allows rapid-sequence tracheal intubation to proceed in a timely manner [1], and has been regarded as the appropriate "intubating dose" [2]. However, recovery of respiratory muscle function following this dose is not fast enough to prevent critical oxyhemoglobin desaturation if ventilation is not assisted [3], and dangerous oxyhemoglobin desaturation levels may occur before recovery of spontaneous ventilation if intubation has failed or ventilation cannot be assisted [4,5]. Lower doses of succinylcholine are recommended to prevent oxyhemoglobin desaturation from apnea of sufficient duration [6–8].

Intravenous (IV) administration of anesthetic drugs such as propofol, thiopental sodium, and etomidate are often employed for induction of general anesthesia. Sevoflurane has a low blood-gas distribution coefficient and a rapid anesthesia induction without stimulation of the respiratory tract [9]. Although sevoflurane may be used by itself, its combination with succinylcholine helps produce more effective anesthesia in patients with a suspected difficult airway. However, in the combination of sevoflurane and succinylcholine, an ideal dose of succinylcholine that produces optimal intubation conditions, allows tracheal intubation while maintaining shorter time to recovery of spontaneous respiration, and avoids critical oxyhemoglobin desaturation in patients at risk of intubation failure, has not been explored.

The present study was designed to examine prospectively the dose of succinylcholine to be used in combination with sevoflurane during inhalation induction of patients with a suspected difficult airway.

2. Materials and methods

2.1. Subjects

After study approval of the Ethics Committee of Sichuan University, 256 patients were assessed for eligibility. Of this number, 76 patients were excluded from the study: 47 did not meet the study criteria and 29 declined to participate. After written, informed consent, 180 adult, ASA physical status 1 and 2 patients, aged 18–50 years, with a body mass index less than 30 kg/m^2, undergoing elective surgical procedures, were enrolled in this study. None of the patients had a neuromuscular disorder, nor did any patient receive medication with potential effects on neuromuscular transmission.

Exclusion criteria included the difficult airway, disturbance of water-electrolyte and acid–base balance, administration of a sedative or analgesic 24 hours before surgery, obesity with sleep apnea, and allergy to any of the study drugs.

Patients were randomized to three groups of 60 patients each, with a table of random numbers. Succinylcholine doses of 0.3 mg/kg, 0.6 mg/kg, and 1.0 mg/kg were administered depending on actual body weight.

2.2. Protocol

No premedication was administered to any patient before surgery; anesthesia was induced through inhalation of sevoflurane. According to the weight and the group allocation of each patient, succinylcholine was prepared by the same physician who did not participate in the subsequent study. Each syringe was labelled with the patient's name only, not the succinylcholine dose to be given. After three minutes of administration of pure oxygen (10 L/min) with a tight fitting mask, a concentration of 8% of sevoflurane was begun and patients were advised to breathe deeply.

Loss of consciousness (LOC) was defined as an Observer's Assessment of Alertness/Sedation score [10] of less than 2 [loss of responsiveness to voice command (open eyes) with light tapping on the shoulder or mild shaking] [11]. After LOC, positive airway pressure was applied via a tight fitting mask for 60 seconds, and IV succinylcholine was administered. After succinylcholine onset, tracheal intubation was successfully completed within 60 seconds in each patient. An endotracheal tube (ETT) with an internal diameter of 7.5 mm for men and 7.0 mm for women was used. After tracheal intubation, a gas concentration monitor was connected to the ETT. Ventilation was not mechanically controlled until the obviously recognizable end-tidal CO_2 waveforms appeared on the monitor. Depth of anesthesia was adjusted and ventilation was controlled mechanically on recovery of spontaneous respiration.

2.3. Measurements

Electrocardiogram (ECG), pulse oxygen saturation (SpO_2), mean arterial pressure (MAP), heart rate (HR), partial pressure of end-tidal carbon dioxide ($P_{ET}CO_2$), end-tidal sevoflurane concentration ($C_{ET}SEV$), and bispectral index (BIS) were monitored using an S/5 TM monitor (GE Healthcare, Wauwatosa, WI, USA).