

Monitored Anesthesia Care Using Target-Controlled Infusion with Propofol and Remifentanyl in a Patient with Subglottic Stenosis

Jung Jo Choi, Kyung Cheon Lee, Hong Soon Kim, Hee Yeon Park and Youn Yi Jo

Department of Anesthesiology and Pain Medicine, Gachon University Gil Medical Center, Incheon, Korea

Abstract

Symptomatic airway stenosis requires repeated interventions, such as, dilatation, laser resection, stent implantation, or surgery, and the anesthetic management of upper airway stenosis is complicated due to the risk of respiratory problems while facilitating optimal surgical conditions. The authors described a case of successful monitored anesthetic care with target-controlled propofol and remifentanyl infusion during prolonged laser ablation in a patient who developed upper airway stenosis after endotracheal intubation.

Keywords: Airway stenosis; Monitored anesthetic care; Propofol; Remifentanyl

Introduction

Acquired subglottic stenosis may be caused by prolonged endotracheal intubation and mechanical ventilation, and symptomatic airway stenosis requires repeated interventions, such as, dilatation, laser resection, stent implantation, or surgery. Anesthetic management for airway intervention in patients with upper airway stenosis is complicated by the challenge of maintaining the airway during anesthesia and providing optimal surgical conditions. Propofol is the most commonly used sedative during monitored anesthetic care (MAC) because of its rapid onset, easy titration, and short duration [1]. Remifentanyl, an ultra-short acting opioid, has been recently reported to be a suitable adjuvant for MAC with propofol [2]. Although many reports have described the anesthetic management of intrinsic upper central airway obstruction [3], no report has described the use of MAC based on a combination of propofol and remifentanyl. Here, we describe a case of successful MAC based on the target-controlled infusion (TCI) of propofol and remifentanyl during laser ablation in a patient that developed upper airway stenosis after prolonged endotracheal intubation.

Case Report

A 17-year-old male (height, 170 cm; weight, 60 kg) presented at the operation theatre with noisy, difficult breathing. He had a history of endotracheal intubation due to decreased mental ability caused by rupture of an arterio-venous malformation 28 days previously. He was referred to an intensive care unit with intubated state after external ventricular drainage at right Kocher's point and embolization of the arterio-venous malformation. Endotracheal intubation was initiated with a single lumen internal diameter (ID) 7.5 mm tube (high volume low pressure tube, Mallinckrodt Medical, Athlone, Ireland) fixed 23 cm from the level of the incisors with a cuff inflated with air to minimal volume to prevent a circle leak and maintained for 9 days. On extubation day 7, he suffered from sudden onset dyspnea with stridor. Arterial blood gas analysis (ABGA) revealed pH 7.096, PaCO₂ 98.6 mmHg, PaO₂ 47.3, mmHg, SaO₂ 64.1% (facial mask O₂ 10 L/min), and facial and neck edema rapidly developed. He was re-intubated with an ID 7.0 mm tube. Computed tomography (CT) and neck plain X-ray demonstrated extensive emphysema in the neck and upper thorax with subglottic stenosis (Figure 1). Four days after re-intubation, he self-extubated. Flexible bronchoscopy then demonstrated longitudinal endotracheal narrowing and ulceration from underneath the vocal cord to 10 cm higher portion of carina with normal vocal cord movement.

Tracheal narrowing was not measured due to lack of cooperation.

He was not pre-medicated, and upon arrival at the operating theatre, standard monitoring devices were applied in a semi-sitting position. Vital signs were 130/70 mmHg, 90 beats/min, and SaO₂ revealed 95% with a Glasgow coma scale (GCS) score of 10 (eye response 4, verbal response 1, motor response 5) before sedation. Sedation was induced and maintained with propofol (target blood concentration 3-3.5 µg/ml) and remifentanyl (target blood concentration 2.5-3.5 ng/ml) using a TCI device (Orchestra; Fresenius Kabi, Bad Homburg, Germany). The effect site concentrations for the propofol was calculated as Schnider's pharmacokinetic model and for the remifentanyl was calculated as Minto's pharmacokinetic models, as previously programmed in the TCI device respectively. Propofol adjusted to maintain an effect-site concentration of 1.5-2 µg/mL and remifentanyl to an effect-site concentration of 1-2 ng/mL to reducing airway reaction to rigid bronchoscopy without topical anesthetics and instrument handling and to maintain hemodynamic stability in the supine position. The

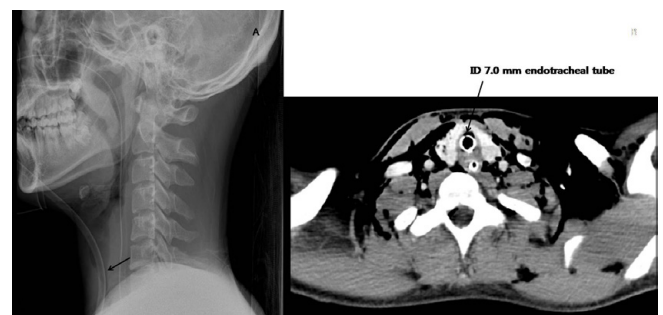


Figure 1: Plain X-ray and computed tomography revealed subcutaneous emphysema with subglottic stenosis.

***Corresponding author:** Youn Yi Jo, Department of Anesthesiology and Pain Medicine, Gachon University of Medicine and Science Gil Medical Center, 1198 Guwol-dong, Namdong-gu, Incheon 405-760, Korea, Tel: 82-32-460-3636; Fax: 82-32-469-6319; E-mail: endless37@gilhospital.com

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cross sectional area of the subglottis was Myer-Cotton Grade III [4]. He was kept on spontaneous respiration and O₂ was applied at 3 L/min via a nasal cannula. His vital signs were 97/59-134/78 mmHg and 76-90 beats/min, and SaO₂ was 92-100%. After confirming a stenotic lesion by rigid bronchoscopy, neodymium:yttrium-aluminum-garnet (Nd:YAG) laser ablation and electrocautery were performed to remove granulation tissue and achieve hemostasis. During the laser ablation, O₂ supply via the nasal cannula was stopped and two desaturation events of up to 84% for 10-30 sec occurred. To recover SpO₂, assisted manual ventilation via an ID 6 mm endotracheal tube was performed for about 30-60 sec after stopping the procedure. Total amounts of infused propofol and remifentanyl were 320 mg and 313 µg, respectively, during the 85-minute procedure. The patient achieved an uneventful recovery in the post-anesthetic care unit with clear breathing sounds. The patient underwent tracheostomy two weeks later due to restenosis

Discussion

We describe the anesthetic management of a patient that underwent prolonged laser ablation therapy and electrocautery for intrinsic upper central airway stenosis under MAC based on TCI of propofol and remifentanyl.

Despite the use of a high volume/low pressure cuff, post-intubation stenosis is still considered a major iatrogenic complication after tracheal intubation, and has been reported to occur in up to 11% of critically ill patients [5]. When the cuff pressure exceeds the mucosal capillary pressure of the upper airway, mucosa and underlying cartilages develop ischemia and ulceration, which is followed by fibrotic healing, the leading cause of tracheal stenosis [6]. The underlying conditions responsible for post-intubation upper airway stenosis are intubation duration, cuff pressure, and tube size.

Anesthesia for airway surgeries can be technically challenging. For surgeons, it should provide a clear, immobile field with sufficient access. A deeper level of anesthesia to control airway reflexes and hemodynamic fluctuations during the procedure, while ensuring ventilation and oxygenation were needed. During short procedures, subglottic jet ventilation or apneic anesthesia with intermittent ventilation is appropriate. However, in our case, the surgical procedure took about 85 min, which was too long for jet ventilation or apneic anesthesia. Conventional controlled mechanical ventilation via a small endotracheal tube can secure adequate airway protection, but surgical field and instrument handling limitations are problematic. Furthermore, airway fires during electrocautery and laser ablation and environmental contamination by volatile anesthetic agents are considerations. Thus, we chose slow, incrementally stepped intravenous anesthesia with TCI based on propofol and remifentanyl under spontaneous respiration rather than under gaseous induction.

Propofol is preferred for MAC because it is easily titrated to desired sedation levels and is associated with less postoperative confusion and more rapid cognitive function recovery [1]. Remifentanyl provides optimal analgesia with a smooth hemodynamic profile [7], and metabolizes rapidly due to its tissue and blood-nonspecific hydrolysis, which reduces respiratory depression postoperatively regardless of infusion duration [2]. However, respiratory depression caused by

propofol and remifentanyl sometimes lead to oxygen desaturation during procedures [2]. Nevertheless, this can be easily managed by reducing the anesthetic agent maintenance dose; furthermore, smooth and incremental sedation provides minimal respiratory depression and good control of airway reflexes. In the described case, the patient experienced desaturation events, but they resulted from the surgical procedure after dilation of the central airway for hemostasis, and not from respiratory suppression by anesthetic agents. A multidisciplinary approach is required to ensure safe sedation and analgesia during airway procedures and discussion between anesthesiologist and surgeon is essential to determine the proper anesthetic technique.

Summarizing, MAC based on propofol and remifentanyl has the advantages of reducing the risks of airway fire and of environmental contamination by volatile agents and offers good visualization of the operative field with minimal respiratory depression.

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