Case Report

Transient hypoxemia after endotracheal tube extubation in a patient who received reversal of muscle relaxation using sugammadex after general anesthesia: A case report

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ABSTRACT

Post-operative respiratory depression is common in patients recovering from anesthesia and can result in fatal cardiopulmonary collapse, anoxic brain injury, and mortality. We report a case of a 54-year-old morbidly obese female patient who developed transient hypoxemia after general anesthesia. The patient with obstructive sleep apnea (OSA) underwent breast excision surgery. At the end of the surgery, her muscle function was fully restored using sugammadex. However, the patient developed transient hypoxemia in the post-anesthesia care unit. The clinician should keep in mind that OSA patients are likely to develop hypoxemia due to the residual sedative effects and airway obstruction despite the recovery of muscle function after anesthesia.

Key words: Airway extubation, Obstructive, Respiratory insufficiency, Sleep apnea, Sugammadex

Maintaining the patient's airway after general anesthesia is the primary task of anesthesiologists [1]. To maintain the patient's safe airway, it is essential to reverse the effect of the neuromuscular blocking agent used during surgery before the extubation of the endotracheal tube [2,3]. However, recovery of muscle function does not guarantee the maintenance of the patient's airway after anesthesia [4]. There have been many studies of post-operative critical events associated with obstructive sleep apnea (OSA), but few reports have described respiratory failure after complete muscle recovery in obese patients [5].

We report a case of a patient who developed transient hypoxemia after general anesthesia, although her muscle function was restored by using sugammadex before extubation of the endotracheal tube. Therefore, we would like to remind the anesthesiologists about the additional considerations required for post-operative safe airway management beyond muscle recovery.

CASE REPORT

A 54-year-old morbidly obese female patient with a height of 164 cm, a weight of 96 kg, and a body mass index of 35.7 visited our clinic to remove a breast mass diagnosed 2 years ago. The mass was located in the lower medial quadrant of the left breast and was 4.0 × 5.0 cm in size. She had a history of a cesarean section 25 years ago and was being treated orally for hypertension for 6 years and diabetes for 4 years. Although she had a history of heavy snoring, she did not receive any treatment and was diagnosed with OSA on polysomnography performed by the neurologist before surgery. A chest radiograph showed no specific findings other than cardiomegaly. In the pulmonary function test, her forced expiratory volume (FEV) in 1 s is 2.90 L, forced vital capacity (FVC) is 2.35 L, and FEV1/FVC is 77%; thus, showing no specific findings.

After admission to the operating room (OR), vital signs before induction of anesthesia were as follows: Blood pressure (BP) of 108/63 mmHg, heart rate (HR) of 67 beats/min, and peripheral pulse oximetry (SpO_2) of 96%. A bispectral index (BIS) sensor (BIS Quatro™ Sensor; Covidien, Mansfield, MA, USA) was attached to the patient's forehead to monitor the depth of anesthesia. Anesthesia was induced with 1.5 mg/kg of propofol, 0.02 mg/kg of midazolam, 1 μg/kg of remifentanil, and 70 mg of rocuronium. Anesthesia was maintained with desflurane 5–6% and remifentanil continuous infusion (0.1–0.25 μg/kg/min). The degree of neuromuscular blockade during surgery was evaluated using train-of-four (TOF) stimulation of the ulnar nerve. Mechanical ventilation was initiated with an inhalation oxygen fraction (FIO_2) of 0.5, a tidal volume of 7 mL/kg, a respiratory rate (RR) of 17 breaths/min, and a positive end-tidal pressure of

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7 cmH_2O. To maintain the end-tidal carbon dioxide pressure of 35 sure of, the RR was adjusted appropriately. During surgery, the patient's BP was maintained at 85–110/55–80 mmHg, HR at 54–89/min, and SpO_2 at 96–100%.

The operation was terminated 135 min after the start of anesthesia. For the emergence of the patient, mechanical ventilation was stopped and 100% oxygen was administered, followed by manual ventilation. Then, 200 mg of sugammadex was administered to completely reverse muscle relaxation, and after 3 min, a TOF ratio >0.9 was confirmed. At that time, the patient's BIS was 72, and although her eyes were not open, extubation was performed because the patient became very agitated. After extubation, manual ventilation with a facial mask was applied for 5 min, and the patient's SpO_2 showed a value of 98%. The patient recovered consciousness to the extent of nodding her head when asked, and she was transferred to the post-anesthesia care unit (PACU).

After entering the PACU, 100% oxygen 5L/min was administered to the patient through a facial mask. The patient's BP was 108/65 mmHg, HR was 94/min, and the SpO_2 was 96%. However, the patient's SpO_2 gradually decreased to 84% 10 min after entering the PACU. The patient had poor spontaneous breathing and she seemed very sedated and did not respond appropriately to the doctor's verbal commands. The patient's SpO_2 was further reduced to 64% while checking her consciousness and respiration. The anesthesiologist performed a chin-lifting maneuver for breathing assistance, but the patient still did not perform spontaneous breathing properly. The oropharyngeal airway was placed in the mouth and manual ventilation with a bag-valve-mask device was attempted. However, adequate respiratory ventilation of the patient was not achieved. Considering the applicability of reintubation and mechanical ventilation, the patient was moved back to the OR. After re-entry to the OR, the patient was placed in an upright position and a supraglottic airway (SGA) was inserted. After that, manual ventilation was continuously applied to assist the patient's breathing. After applying the SGA, we were able to ventilate the patient appropriately through manual ventilation. After 5 min of manual ventilation, the patient's SpO_2 was increased to 96%. When oxygen was administered with FiO_2 0.6, the SpO_2 increased to 99%, and spontaneous respiration and consciousness of the patient were fully restored after 10 min. After this, the SpO_2 was well maintained only by spontaneous breathing without the aid of manual ventilation (Fig. 1).

After removal of the SGA, the patient was moved back to the PACU, and vital signs observed for 30 min showed no specific findings. The patient was transferred to the ward while applying 2 L/min of oxygen with a nasal cannula. After 7 days, the patient was discharged without any complications.

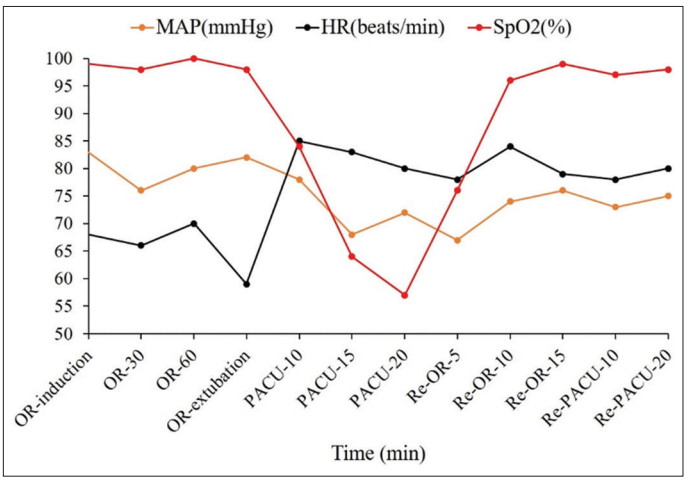

Figure 1: Time course of symptoms of hypoxemia after the operation. OR: Operation room, PACU: Post-anesthesia care unit, Re-OR: Re-entry from the PACU to the operation room, Re-PACU: Retransfer to the PACU after recovery of spontaneous breathing in the operating room, MAP: Mean arterial pressure (mmHg), HR: Heart rate (beats/min), SpO2: Peripheral oxygen saturation (%)

DISCUSSION

Post-operative acute respiratory failure can lead to major complications of general anesthesia and can significantly affect patient mortality and morbidity [1].

Sugammadex is a selective antagonist of rocuronium, a neuromuscular blocker, and it almost completely restores the patient's muscle function within a short time after injection. The use of sugammadex accelerates the reversal and recovery of muscle strength after surgery compared with neostigmine [3]. However, restoration of muscle function does not promise adequate respiratory function in patients after surgery [4]. In this case, after the use of sugammadex, the TOF ratio in the patient measured before extubation was higher than 0.9. Therefore, it can be determined that the patient's muscle function had been restored. Nevertheless, in the PACU, it is presumed that the patient developed hypoxemia due to residual sedative effects and airway obstruction caused by the pre-existing OSA.

Post-operative respiratory suppression in patients can be affected by a variety of factors. These factors include not only the post-operative residual neuromuscular blockade, but also the residual effects of sedatives, inhalation anesthetics, narcotics, improper posture, and patient airway abnormalities [6]. In addition, the incidence of these complications may increase after anesthesia in patients with risk factors, such as advanced age, greater medical comorbidities, longer operations, and patients undergoing thoracic procedures [7]. Even with desflurane or sevoflurane, which induces rapid awakening, the recovery of muscle function by the use of sugammadex may be faster than the recovery of consciousness due to the elimination of the inhaled anesthetic [8]. In such patients, it is necessary to consider the effect of residual sedatives or inhaled anesthetic on respiration after extubation.

Obese patients are at an increased risk of developing hypoxemia during the perioperative period. This is because desaturation occurs rapidly during apnea due to increased oxygen consumption and decreased functional residual capacity [9]. In these obese patients, the application of non-invasive ventilation (NIV) and head-up or beach-chair positioning may improve the safe apnea time before severe hypoxemia develops [10]. In particular, NIV

can improve gas exchange and reduce the inspiratory effort through positive pressure; thus, it can be considered as a general preventive strategy for OSA patients. However, it is sometimes difficult to apply NIV continuously due to frequent leaks around the mask. High-flow nasal cannula (HFNC) oxygenation therapy, which has shown good results in recent years, provides good comfort through the heated and humidified gas flow delivered through nasal prongs [11]. It maintains a high FiO_2 and creates a low level of positive pressure in the upper airway due to the high gas flow to wash out the dead space of the upper airway. Thus, HFNC may be an alternative treatment for hypercapnic respiratory failure, and its use during the perioperative period in obese patients may be beneficial.

In this patient, assisted ventilation could be performed by applying an SGA without additional administration of muscle relaxants. According to the difficult airway algorithm, the application of an SGA in emergency situations can help patients if adequate ventilation is not achieved with the face mask [12]. Therefore, anesthesiologists should be familiar with difficult airway management algorithms and learn how to use various instruments, including SGA, to prevent airway-related complications.

CONCLUSION

Recovery of muscle function following the use of sugammadex in obese patients with OSA does not guarantee adequate respiratory function after extubation. In particular, it should be kept in mind that patients with OSA have a high possibility of developing hypoxemia due to the residual sedative effect and airway obstruction despite the recovery of muscle function.

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