Case Report

General Anesthesia in Patients Receiving Home Oxygen Therapy

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General anesthesia in patients receiving Home Oxygen Therapy (HOT) is challenging. We safely managed a patient receiving long-term HOT under general anesthesia with a novel anesthetic, remimazolam, for colostomy.

Written informed consent was obtained from the patient. A 77-year-old man (height: 160 cm, weight: 55 kg) was scheduled to undergo colostomy due to sigmoid colon obstruction caused by a recurrent tumor. For the past ten years, the patient had been receiving HOT for diffuse bronchitis. Two years prior, he was diagnosed with sigmoid colon cancer and underwent endoscopic resection. Although he required additional surgical procedures, general anesthesia was contraindicated due to poor respiratory function; thus, he could not undergo surgery. The patient was then referred to our hospital because of recurrence of sigmoid colon cancer.

Preoperative respiratory function tests showed mixed impairment with a percent vital capacity of 57%, percent forced expiratory volume in one second of 42%, PaO_2 of 166 mmHg, $PaCO_2$ of 77 mmHg, pH of 7.36, and base excess of 15 mmol/L with oxygen inhalation at 3 L/minute. Based on these findings, the patient was diagnosed with severe chronic obstructive pulmonary disease (COPD) [1].

In patients receiving HOT for severe COPD, it is recommended to avoid administering general anesthesia as much as possible and to use regional anesthesia [2]. However, this patient was scheduled to undergo colostomy of the transverse colon. Spinal anesthesia in the upper abdomen was expected to affect his respiratory function. Therefore, we decided to administer general anesthesia for the management of this patient.

We planned to use a novel intravenous anesthetic agent, remimazolam, as the general anesthetic [3]. Remimazolam is an ultra-short-acting benzodiazepine sedative. In addition, it can be antagonized by flumazenil, which ensures that the effect of the anesthetic disappears. In this case, we planned to administer general anesthesia mainly with remimazolam because it is desirable to have as little residual effect of the anesthetic as possible after awakening.

After the patient entered the operating room, standard monitoring was initiated. A catheter was inserted into the left radial artery, and arterial blood pressure was then continuously monitored. Blood gas analysis with oxygen inhalation at 3 L/min revealed a PO_2 of 209 mmHg and PCO_2 of 60 mmHg. Remimazolam was administered at 6 mg/kg/min, and the patient lost consciousness 1 min after the initiation of infusion. Subsequently, the dose of remimazolam was reduced to 1 mg/kg/min, and remifentanil was initiated at 0.2 μg/kg/min. After neuromuscular monitoring of the left ulnar nerve was commenced using a train-of-four (TOF) stimulus, 50 mg of rocuronium was administered, and the patient was intubated after the TOF was confirmed to be zero. Artificial respiration was set in a pressure-controlled mode (maximum airway pressure: 20 mmHg) with an inhaled oxygen concentration of 60%. After intubation, a subcostal transversus abdominis plane block (0.25% levobupivacaine, 20 mL × 2) was performed. Intraoperatively, remifentanil was administered at 0.1 μg/kg/min, and the infusion rate of remimazolam (0.6-0.8 mg/kg/min) was adjusted using a bispectral index monitor. After laparoscopic observation in the abdominal cavity, a small incision was made on the left cephalic side of the umbilicus, and colostomy was performed in the transverse colon. Before completion of the surgery, 1000 mg of

acetaminophen was administered intravenously. The operation time was 69 min.

After completion of the surgery, remimazolam and remifentanil administration were discontinued. As the TOF count was 2 on neuromuscular monitoring, 100 mg of sugammadex was administered. Five minutes after the discontinuation of remimazolam administration, the patient opened his eyes to call. The patient was extubated after TOF recovery to 100%, and an injection of 0.2 mg of flumazenil was administered to boost recovery.

After extubation, blood gas analysis showed a PaO_2 of 103 mmHg and $PaCO_2$ of 77 mmHg with oxygen inhalation at 3 L/min. The respiratory condition did not change compared to that before the surgery. After the surgery, he was observed in the intensive care unit for one day. Acetaminophen (1000 mg) was administered every 6 h, the numeric rating scale score was less than 3, and no additional analgesics were required.

General anesthesia for patients receiving HOT for severe COPD is associated with a high risk of postoperative respiratory complications, and management with regional anesthesia is recommended [2]. However, in this case, we safely administered general anesthesia using remimazolam, a new, ultra-short-acting benzodiazepine intravenous anesthetic that was approved in Japan in 2020 [3]. Its context-sensitive half-time is 7.5 min, which is equivalent to that of propofol [4]. Moreover, the advantage is that it can be antagonized by flumazenil. In this case, we were concerned about the development of respiratory complications after awakening; however, we managed the anesthesia safely by antagonizing the hypnotic effect of remimazolam using flumazenil.

Opioids are useful in suppressing the cough reflex during tracheal intubation and pain control during surgery, but prolonged action after surgery may cause respiratory depression. In this case, we used remifentanil, an ultra-short-acting opioid. Postoperative pain was controlled by a transversus abdominis plane block and acetaminophen without the use of opioids.

As muscle relaxants, rocuronium was administered under neuromuscular monitoring and antagonized with sugammadex after the surgery. Sugammadex antagonizes the effect of rocuronium more rapidly than that by conventional cholinesterase inhibitors. It may also be useful because it does not increase airway secretions caused by cholinesterase inhibitors.

Thus, the combination of remifentanil, rocuronium, and sugammadex has made general anesthesia management safer in recent years. Furthermore, the use of remimazolam and flumazenil allows for complete recovery from the hypnotic state, making general anesthesia safe, even in patients with severe respiratory complications.

Declaration of Competing Interest

The authors declared no conflict of interest.

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