

Postoperative residual curarization after sugammadex reversal following a prolonged rocuronium infusion

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A 48-year-old male patient underwent robot-assisted radical cystectomy and neobladder formation under general anesthesia. He received a continuous infusion of rocuronium bromide to induce profound neuromuscular blockade during the operation. Sugammadex was injected for the reversal of neuromuscular blockade but the patient developed respiratory arrest in 30 minutes

in ICU. He was reintubated and injected additional sugammadex. After improvement he was extubated, moved to the general ward the following day and was discharged without any further complications. (Rawal Med J 201;41:511-513)

Key words: Neuromuscular blockade, rocuronium, sugammadex.

INTRODUCTION

Robotic-assisted laparoscopic radical cystectomy (RARC) has become a surgical option for patients with bladder cancer as it maintains functional and oncological results while providing additional benefits, including decreased blood loss and early return of bowel functions. Due to its nature as a minimally invasive surgery, it helps rapid patient recovery.¹ Robotic-assisted urologic surgery is associated with postoperative increases in morbidity and mortality owing to the risk of residual neuromuscular curarization and subsequent complications due to prolonged anesthesia and the use of muscle relaxants.^{2,3} A case of postoperative residual curarization (PORC) that occurred following reversal of muscle blockade with sugammadex in a patient who underwent prolonged RARC with rocuronium infusion under general anesthesia is described here. The patient gave written informed consent before the publication of this case.

CASE PRESENTATION

A 48-year-old male patient with a height of 161 cm and a weight of 81 kg was diagnosed with bladder cancer and was taken to the operating room to undergo robot-assisted radical cystectomy and neobladder formation using the da Vinci system (Intuitive Surgical Inc., Sunnyvale, CA, USA) under general anesthesia. The patient had no

abnormal medical history or family history and also had no hypersensitivity to drugs or food or atopy. Preoperative blood tests, biochemical tests, urinalysis, ECG and plain chest x-ray revealed no abnormal findings. As a premedication, he received an intramuscular injection of glycopyrrolate 0.2 mg 30 minutes prior to arrival in the operating room.

In the operating room, he was monitored using a bispectral index (BIS) (Model A2000, Aspect Medical Systems, Inc., Natick, MA, USA). The patient's vital signs before surgery were: BP of 130/80 mmHg, heart rate (HR) of 90 beats/min, and SpO₂ of 98%. Anesthesia was induced with lidocaine 40 mg and propofol 150 mg while providing 100% oxygen, and after confirming loss of consciousness, rocuronium 50 mg was intravenously infused. Anesthesia was maintained with continuous infusion of O₂ (1.5 L/min), air (1.5 L/min), 5% vol% desflurane and remifentanyl (0.1 µg/kg/min), and rocuronium (810 µg/kg/min). Neuromuscular monitoring was done using TOF-Watch SX (Organon Ltd., Drynam Road, Swords, Co. Dublin, Ireland).

The total duration of anesthesia was 12 hours. The patient's core temperature was 36.7 degrees, and the total rocuronium dose was 830 mg. At the reappearance of one train-of-four (TOF) count, 400 mg (4.93 mg/kg) of sugammadex was administered. Extubation was performed 5 minutes later, after confirming a train-of-four ratio (TOFR) > 0.9 and

verifying that the patient was able to respond well to verbal commands. He was subsequently transferred to ICU.

Ten minutes after the patient was admitted to the ICU (30 min after the administration of sugammadex), he experienced bradypnea. This was immediately followed by respiratory arrest. The patient was determined to be experiencing rocuronium-induced recurarization, so we immediately performed intubation and infused an additional 200 mg of sugammadex. He recovered spontaneous breathing 2 minutes later, but we decided to perform further monitoring for respiratory failure. Six hours later, after confirming that the patient was able to answer verbal commands, we performed extubation. He was moved to the general ward the following day and was discharged without any further complications.

DISCUSSION

This patient had been infused with a total of 830 mg of rocuronium due to long surgery. We administered 400 mg (4.93 mg/kg) of sugammadex for reversal of muscular blockade, and the patient showed normal reversal of muscular blockade, but PORC occurred 30 minutes later in the ICU. PORC is said to exist when neuromuscular blockade by nondepolarizing neuromuscular blocking agents administered during surgery persists after the surgery, resulting in inadequate neuromuscular function.³ Although it is difficult to clearly determine PORC-associated mortality and morbidity, undetected PORC may be a critical risk factor for postoperative complications, such as hypoxia, airway obstruction, respiratory failure, and aspiration of saliva, blood, or gastric contents.⁴

Residual curarization or neuromuscular blockade can be defined as insufficient neuromuscular recovery measured by objective neuromuscular monitoring, and a TOFR of less than 0.9 is considered inadequate recovery.⁵ RARC is a minimally invasive surgery that has become increasingly popular to reduce perioperative morbidity and mortality.⁶ Neuromuscular blocking agents are especially important in robot-assisted surgeries. Once the robot is docked, surgical instruments are firmly attached to the patient

through the trocar insertion sites. It is highly important that the patient remain completely immobilized until the robot is undocked because movement may incur injury to vascular and visceral structures.⁷ Furthermore, deep neuromuscular block improves surgical access and the visual field.

Continuous infusion of rocuronium induces a consistent degree of muscle blockade with a stable drug concentration, and is currently a method in relatively common method.⁸ In the present case, we maintained deep neuromuscular block through infusion of rocuronium instead of bolus, in consideration of the long length of the operation.

Continuous infusion of a muscle blocker may increase the risk of PORC, as it has been reported that the incidence of residual curarization in the recovery room was higher in patients who were administered neuromuscular blocking agents via continuous infusion than in those who were administered the agents via a bolus.⁹

Anticholinesterase has been used universally as an antagonist for neuromuscular block with nondepolarizing muscle blockers, but even a high dose of anticholinesterase cannot completely reverse a deep neuromuscular block. Furthermore, even if an intermediate-acting nondepolarizing neuromuscular block is used, the possibility of residual curarization cannot be completely eliminated.⁵

Another method of reversing neuromuscular blockade involves the injection of sugammadex, which selectively binds neuromuscular relaxants. Sugammadex is the first selective relaxant binding agent, is unrelated to acetylcholinesterase, and does not require anticholinergic agents, preventing related complications and producing effective reversal of neuromuscular blockade regardless of depth.¹⁰ In order to reverse a deep neuromuscular block, 4 mg/kg of sugammadex is generally required.¹⁵ In the present study, 400 mg (4.93 mg/kg) of sugammadex was administered while monitoring the TOFR, but respiratory failure occurred 30 minutes later.

Theoretically, an underdosing of sugammadex can lead to the reappearance of neuromuscular block following a successful reversal.¹¹ The author believes that this is because the number of

sugammadex molecules are not enough to bind with most of the rocuronium molecules in the body. An inadequate dose of sugammadex binds with rocuronium molecules in nearby areas, such as the intravascular space and neuromuscular junction, which leads to a reduced concentration of free rocuronium. When rocuronium migrates from the peripheral compartment to the intravascular space, additional rocuronium molecules that migrated to the intravascular space are not bound by sugammadex, causing curarization.¹² In the present case, the exact cause of curarization despite the fact that we used the recommended dose of sugammadex (greater than 4 mg/kg) is unknown, but we could predict that the accumulation of rocuronium during a prolonged operation might have been the cause. When a high dose is used, there still is a possibility of residual curarization in the recovery room even after 2 hours, so it is necessary to keep adequate neuromuscular monitoring and to use sufficient doses of antagonists prior to extubation.

PORC is a complication of anesthesia that may lead to serious results, but it can be prevented with careful management of anesthesia. Hence, if neuromuscular blocking agents are continuously infused during a prolonged robotic surgery, temperature management, checking TOF count (at least higher than 2) prior to administration of sugammadex and continuous neuromuscular monitoring during recovery period could reduce the risk of PORC.

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